Conditions of Fertility Decline in Developing Countries, 1965-75

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This paper is a macro-analysis of the correlates of fertility decline in developing countries for the period 1965–75, during which there was substantial fertility decline in Asia, quite a bit in the Americas, some in North Africa, and almost none in black Africa. The analysis focuses on how much of the fertility decline is associated with such socioeconomic variables as health, education, economic status, and urbanization, or with "modernization" as a whole, and how much with population policies and programs, primarily family planning programs, designed to reduce rates of growth.

The data are examined in a variety of ways: simple correlations among the variables; multiple regression analyses using both 1970 values of socioeconomic variables and, for the alternative lag theory, 1960 values; change in the socioeconomic variables over time; a special form of regression analysis called path analysis in which program effort is considered to be partly a function of socioeconomic level; a relatively new type of analysis called exploratory data analysis; relation of socioeconomic level and program efforts to both absolute and percentage declines in fertility; and cross-tabulations of program effort with an index of socioeconomic variables.

Such data and analyses show that the level of "modernization" as reflected by seven socioeconomic factors has a substantial relationship to fertility decline but also that family planning programs have a significant, independent effect over and above the effect of socioeconomic factors. The key finding probably is that the two—social setting and program effort—go together most effectively. Countries that rank well on socioeconomic variables *and also* make substantial program effort have on average much more fertility decline than do countries that have one or the other, and far more than those with neither. Finally, the relationship between predicted and observed CBR decline for the 94 developing countries over this period is illustrated for different combinations of factors; and an attempt is made to estimate the quantitative impact of the major conditions upon the intermediate variables traditionally assumed to account for CBR changes.

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Conditions of Fertility Decline in Developing Countries, 1965-75

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This paper analyzes conditions associated with fertility decline in developing countries in the recent past, thus addressing a major issue of contemporary population policy that remains controversial within the scientific community.

Did fertility decline in developing countries from 1965 to 1975? Clearly yes in a number of Asian and Latin American countries; clearly no in most of Africa; still uncertain for several countries. In the nature of the case, the facts are by no means fully determined, but there are various indications of fertility decline, as detailed below; for our purposes we assume that they are by and large valid. If fertility has declined, why? That is a consequential issue for population policy, since it is caught up in the current international dispute over the relative contributions of "development" and "family planning" in affecting fertility rates, and, importantly, the views of planners influence the allocation of priorities and resources to reduce rates of population growth in order to achieve development.

In this paper, we analyze a range of possible influences on fertility, by country, in order to discern their relative impact. If the several factors are studied simultaneously, what do they show about the conditions of fertility decline? As with any analysis of such social complexity, there are pitfalls everywhere: in quality of data, in adequacy of statistical technique, in validity of interpretation. We shall try to identify such problems as we nevertheless proceed—"nevertheless," because of the importance of the matter for both scientific and policy purposes. In short, what conditions were associated with different magnitudes of fertility decline in developing countries over the decade 1965 to 1975?

Viewed from a broad perspective, fertility can be considered a function of both demand and supply factors: demand factors that affect the level of interest in or motivation for fertility control and supply factors that affect the availability of information and services for fertility control. Both are continua: that is, the demand for fertility control can range from absolute to nil and the supply of fertility control means can range from very high to zero—and in the real world, both do so range. By and large, the two sets of factors go together in the current era: for example, high demand and high supply in the well-off, industrialized countries; low demand and low supply in poor, agricultural countries. However, given the complexity of this fundamental aspect of human behavior and the recent introduction of policies to influence population growth in the developing countries, there are many countries in which demand and supply levels do not correspond.

Within the demographic community, it is accepted that very high demand for fertility control can result in very low fertility even in the absence of much modern supply; at any rate, there are several historical cases to that effect.[1] But it is probably also acknowledged that strong supply of modern means of fertility control (especially if sterilization and abortion are included) can affect the magnitude and the pace of fertility control under certain conditions of demand; and similarly, there are contemporary cases to that effect.[2] Demand and supply factors are interwoven in a complex matrix of influences upon fertility behavior such that it is extremely difficult, and at this stage perhaps technically impossible, to disentangle their effects upon fertility rates with a substantial degree of precision and validity. But there have been attempts to do so, and this paper can be considered another attempt in that direction: a systematic effort to measure the relative impact of both demand and supply factors on fertility change in the indicated period across virtually the entire range of developing countries.

Before proceeding, we wish to clear away some semantic underbrush, or try to. We use the terms "demand" and "supply" as convenient shorthand terms that have appropriate echoes on both policy and scientific grounds. As for policy, "demand" represents the effect of development and its component elements upon fertility; "supply" represents the effect of family planning programs. Thus the terms tap into a major current debate within the field, particularly post-Bucharest (where a major slogan was, "Development is the best contraceptive"). As for science, "demand" represents the basic determinants of fertility—the fundamental socioeconomic, cultural, social-structural factors that give rise to interest or motivation to limit family size; "supply" represents one of the proximate determinants or intermediate factors—a necessary mechanism or instrument through which demand gets expressed in actual behavior. (In our case, the term includes not only supply of services and means for fertility control but also supply of associated information covering its legitimacy, benefits, and use.) In this context, supply differences may or may not make an impact upon fertility decline beyond levels or changes in demand; that is an empirical question we address here. Any such impact is independent of the socioeconomic setting in that sense, though not in the sense that supply itself always oper-

ates within a social setting that conditions its prospects and its own viability.

In short, as has recently been said:

> Studies of the causes of fertility levels and their changes often seek directly to measure the impact of socioeconomic factors on fertility. Such a procedure may be useful for some purposes, but substantial insights can be gained if in addition the specific mechanisms through which the socioeconomic factors operate are identified.[3]

That is the effort undertaken here, centered specifically upon certain socioeconomic factors on the one hand (demand) and family planning program effort on the other (supply).

The paper is organized into the following sections: (1) review of recent scientific literature on the question; (2) presentation of the measures and data used in the study; (3) statistical analyses of relationships between CBR declines and the indicated demand and supply variables, singly and in various combinations, on a base of 94 developing countries with a 1975 population of 2.8 billion, or 98 percent of the total population in developing countries; (4) reanalysis by cross-tabulation of demand and supply factors as related to CBR decline for the individual countries; and (5) conclusions.

The Literature

Heightened interest in population problems has stimulated a marked increase in fertility studies in recent years. We review here only those macro-studies that, like ours, focus on the correlates or determinants of fertility, that include multiple correlating or determining factors, that deal with countries as units, and that make intercountry analyses. Even so, the literature is substantial: we include 24 English-language publications of some quality in the past 15 years. In addition, the historical literature contains a number of similar studies, and this genre can be considered to be among the traditional modes of demographic research.

The 24 studies, summarized in Appendix A, are of varying character. But the salient points appear to be these:

Countries. Of the 24 studies, 18 include both developed and developing countries; only 6 are limited to developing countries. The mean and median number of countries included per study are both about 50.

Fertility Measures. Fifteen studies use the crude birth rate (CBR); 7, the fertility rate in some form; 4, the gross reproduction rate; 4, acceptor data; 2, the child-woman ratio; 1, change in birth rates; and 1, births prevented. Some studies, of course, use more than one such measure.

Demand Factors. These cover a wide range of variables—a total of 44 identifiable factors (and another 30–35 if every variation is counted separately by, for example, counting 3 different measures of educational attainment as 3 instead of 1). Here is the list of the identifiable factors by frequency of use in the 24 studies:

19 income per capita
14 literacy
13 infant mortality rate; agricultural and nonagricultural labor force
12 newspaper circulation
10 education; urbanization
8 population density
7 life expectancy
6 energy consumption
4 religion; radios; hospital beds
3 female labor force; income distribution; index of overall development; marriage rates by age; telephones
2 caloric/protein consumption; political system; social security; linguistic homogeneity; crude death rate; racial composition; medical personnel
1 dependency ratio; inside water supply; mail; male/female ratio; cinema attendance; child labor; family structure; modernized attitudes; strength of labor movement; administrative efficiency; social mobility; strength of traditional elite; nationalism; government's commitment to economic development; economic structure; social tension; achievement motivation; class structure; income from agriculture

As acknowledged in several of the studies, this list should be considered a compromise between what the researchers may have wanted and what they found available in acceptable data for a suitable number of countries. In any case, it reflects the current perceptions of what is important by way of demand factors.

Supply Factors. Only four[4] of the studies include supply considerations in their analyses (all four, incidentally, done with the participation of donor agencies directly concerned with policy issues). The others, of a more traditional academic character, presumably did not consider the conditions of supply sufficiently important to include as a possible determinant of fertility, even though the supply differentials are large across the developed and developing countries—surely as large as the socioeconomic factors traditionally included. This point appears to have been neglected if not forgotten, although the field was reminded to the contrary by one eminent demographer some years ago:

> An illustration is the rather common view that the rate of population growth declines as the standard of living rises. From this the deduction is sometimes made that birth control plays no role. Actually, the generalization is not true in all cases, but the main point is that the only way that a rise in the standard of living can reduce the growth rate is by increasing the death rate, lessening the net immigration, or reducing the birth rate. Since it usually does not cause the first two eventualities but rather the opposite, its normal channel for reducing population growth is through lowering fertility. But a rising level of living lowers the birth rate by the instrumentality of birth control. Therefore, to speak of a rise in the standard of living as accomplishing its effect on population growth *without the use of birth control* is to speak in erroneous terms" (emphasis in original).[5]

TABLE 1 Threshold values for fertility decline that are roughly similar in three studies

Factor	*Threshold value*		
	United Nations	*Kirk*	*Srikantan*
Income per capita	US $230–339		US $704–1,056
Energy consumption per capita	360–1,012 kg.		687–2,998 kg.
Population in cities of 20,000 +	16–33 percent	16–47 percent	18–63 percent
Nonagricultural labor force	45–61 percent	58–63 percent	47–74 percent
Life expectancy	62–63 years	59–67 years	64–69 years
Female marriage before age 20	11–15 percent		11–22 percent
Female literacy	62–75 percent	74–85 percent	55–70 percent
Hospital beds per 1,000 population	5–6	4–5	3–5
Newspaper circulation per 1,000 population	80–89	63–109	68–122
Radio receivers per 1,000 population	87–88		41–279

NOTE: The included countries, the definitions of "threshold," and the specification of measures can be found in the cited studies. The following factors are also included in only one of the studies: infant mortality, movie attendance, number of telephones, school enrollment, and number of medical personnel (physicians, nurses, midwives). The threshold values are the minimum values for countries of low fertility and maximum value for those of high fertility. The United Nations figures exclude the top 10 percent of the high-fertility countries and the bottom 10 percent of the low-fertility countries for each indicator. SOURCES: United Nations, Department of Economic and Social Affairs, *Population Bulletin, no. 7-1963, with special reference to conditions and trends of fertility in the world* (United Nations, 1965); Dudley Kirk, "A new demographic transition?" in *Rapid Population Growth: Consequences and Policy Implications* (published for the National Academy of Sciences by the Johns Hopkins University Press, 1971) pp. 138–145; K. S. Srikantan, *The Family Planning Program in the Socioeconomic Context* (New York: The Population Council, 1977).

Only recently another demographer wrote that the three "preconditions for sustained decline in marital fertility" are perceived legitimacy of fertility control, perceived advantage, and the availability of "effective techniques of fertility reduction."[6]

Modes of Analysis. They are mainly of two kinds: multiple and partial regression analysis (with various technical refinements) in 17 studies and correlational analysis (usually simple correlations) in 11 studies. Beyond them, cross-tabulations were used in 5 studies, factor analysis and path analysis in 2 studies, and correspondence analysis, cluster analysis and histogram analysis in 1 each.

Findings. These vary widely, and even more so when all the usual scholarly qualifications as to data, measures, samples, and so on, are taken into account. This is not the place for a detailed summary[7] but a few points deserve mention:

1. On the whole the studies find the expected associations between fertility and education, literacy, urbanization, infant mortality rate, female and agricultural labor force, and the generalized factor of "modernization" or "development," but some disputes remain with regard to such economic measures as per capita income,[8] income distribution, and social security.

2. Various studies claim that the demand variables explain 45–90 percent of the variance in fertility across developed and developing countries at a given point in time, but:

3. Much less explanatory value is found *within* developing countries as a category. In other words, the wider the range of socioeconomic conditions, the greater the explanatory power of such demographic variables. Explanatory correlations are harder to come by within more homogeneous categories.

4. Only three studies (United Nations, Kirk, and Srikantan)[9] venture to suggest quantitative "threshold" values that trigger fertility declines. The thresholds are not defined identically; the sampled countries and time periods are different; and the threshold factors are not the same ones or measured in the same way. Still there are some rough similarities, as shown in Table 1, which lists those factors approximately similar in more than one study. In that array of ten factors, there is reasonable agreement on all but three (income per capita, energy consumption per capita, and radio distribution). For the other seven, the approximate thresholds for fertility decline, rounded off and averaged, appear to be:

Variable	*Threshold range*
Population in cities of 20,000+	16–50 percent
Nonagricultural labor force	50–65 percent
Life expectancy	60–70 years
Female marriage before age 20	10–20 percent
Female literacy	60–75 percent
Hospital beds per 1,000 population	5
Newspaper circulation per 1,000 population	70–100

TABLE 2 Fertility declines producible by specified changes in variables, as found in three studies

Study	*This change in determinants . . .*	*. . . makes for this change in fertility*
Gregory et al.	In developing countries, "a one percent reduction in the illiteracy rate	tends to reduce the birth rate by .19 percent" (pp. 237–238).
	In developed countries, a one percent reduction in the illiteracy rate	"generates a .22 percent reduction in the birth rate" (p. 238).
	In developed countries, "a one percent increase in the female participation rate" in the labor force	"generates a .14 percent reduction in the birth rate" (p. 238).
	In both sets of countries "a reduction in the rate of infant mortality weighted by the rural ratio of one percent	will cause a .19 percent reduction in the birth rate" (p. 238).
World Bank Appendix A	"Each additional percentage point of total income received by the poorest 40 percent	reduces the fertility index by 2.9 points" (pp. 147–148).
	"Each additional year of life expectancy at birth	reduces the fertility index by 1.86 points" (p. 148).
Beaver	A decline in the crude death rate of about 5 points over ten years	"would suggest a corresponding temporary increase of 2.7 in the CBR" (p. 128).
	"An improvement of forty years in e_0" [expectation of life at birth]	". . . would imply a decline of 21.9 [points] in the CBR" (p. 129).
	"A 20 percentage point increase in urban population	would lower the CBR 1.24 points" (p. 133).

SOURCES: Paul Gregory, John Campbell, and Benjamin Cheng, "Differences in fertility determinants: Developed and developing countries," *Journal of Development Studies* 9 (1972): 233–241; World Bank, *Population Policies and Economic Development*, a World Bank Staff Report, coordinating author, Timothy King (Johns Hopkins University Press, 1974); Steven E. Beaver, *Demographic Transition Theory Reinterpreted: An Application to Recent Natality Trends in Latin America* (Lexington Books, 1975).

At the same time, it is necessary to stress that different definitions and measures are used in these few studies and that the studies themselves warn about the tentative nature of their conclusions: Kirk, for example, wrote that "Efforts to identify 'thresholds' for the initiation of fertility reduction are at a preliminary stage and their predictive capacity . . . remains to be tested,"[10] and the United Nations study approached the concept of "the threshold hypothesis" carefully indeed ". . . assuming it to have some validity, although admittedly the degree of its validity is questionable. . . ."[11]

5. Another three studies—Gregory et al., World Bank, and Beaver[12]—contain explicit quantitative values of the fertility decline that would be produced by a specified change in the independent variables (Table 2), but unfortunately there is no certain common estimate for comparison. For example, if the fertility index of the World Bank study (roughly equivalent to the general fertility rate) is transformed into an approximate CBR by dividing by 5, then the comparative figure for an increase of 40 years in life expectancy becomes 14.9 points off the CBR, as against 21.9 in Beaver—hardly a close similarity.

6. The only four studies that take supply factors into account find that they have some independent explanatory power.

7. While several studies suggest policy implications, of the increase-education or lower-mortality type (i.e., based on the logic of finding a determinant and then realizing it), hardly any address the resource allocation or practicability issues involved in realistic policy decisions made to reduce fertility.

This then is a background in the scientific literature. Compared with that array our study includes: (1) a relatively *large number* of countries, (2) only *developing* countries, (3) fertility *change over time,* (4) a small number of the presumably *more important demand factors* (selected after analysis of a much larger set), also summarized into an index of developmental status, (5) *supply measures* as well as demand, and (6) the *most-utilized modes of analysis* plus a few innovations thereon.

The Measures and the Data

This study includes 94 developing countries: all those with populations of one million or more as of 1975, minus South Africa and Rhodesia as special cases and plus Barbados, Fiji, and Mauritius. (The latter three are included because the Population Council's data bank included them at the time of this analysis. They are so small as to be insignificant in any data weighted by population size; they have similar classifications by social setting and program effort and do not affect the average for such countries. In short, this inclusion does not affect the conclusions of this study to any

appreciable extent.) While much has been and can be learned about fertility determinants in other ways—for example, from intracountry studies utilizing survey data or registration data for regions or districts, or from in-depth microstudies of individual families—we deal with countries as units since they are the effective policy entities for the interplay of fertility determinants and attempted interventions.

In order to proceed with our analysis, we need three sets of data: (1) measures of fertility change, (2) measures of demand, and (3) measures of supply. As everyone knows who has ever tried, it is not possible at the present time to construct a completely satisfactory set of data for such measures: numbers are often incomplete, inappropriate, suspect, or missing altogether. We have made a diligent effort to construct a good set of data but in the end all we can claim is that they are, so far as we know, only the best available data (and despite the unfortunate acronym produced by that phrase!). Despite their deficiencies, in our judgment they are generally correct in order of magnitude; they do differentiate in a broad qualitative way, if not always in precise exactitude; and they are serviceable for our purpose. With that caveat, we now describe the nature and source of our data.

Measures of Fertility Change

The measures are crude birth rates (CBRs) for 1965 and 1975 taken mainly from United Nations sources and from vital statistics for individual countries,[13] and total fertility rates (TFRs).[14] For the period 1965–75 the total fertility rate declined slightly more than did the crude birth rate, an average of 1 or 2 percentage points per country. This indicates that, over the 10-year span, changes in the age composition affected fertility rates only slightly, and in such a way that changes in crude birth rates understate fertility decline slightly in comparison with the more technical and professionally preferred measure. Moreover, the two rates are so closely correlated ($R = 0.97$) as to be virtually identical for practical purposes, and certainly for ours (Figure 1). (To be sure, there are exceptions to this generalization, principally countries with rapidly declining fertility in which the changing age structure tended to increase the number of births, and hence, total fertility rates declined somewhat more than crude birth rates.)

We use the crude birth rate in the tables that follow both because of its greater familiarity to the general reader and because of its availability. Because the crude birth rate, while reasonably available, is flawed by the normal technical difficulties of data collection in developing countries, reported CBR declines of less than 5 percent should be taken to indicate essentially no change, and declines of 5 to 10 percent merely suggest change.

The CBRs for 1965 and 1975 and the percentage decline from the earlier to the later year comprise our measure of fertility change for the 94 developing countries in this study (see Table 3). Overall, the CBR decline from 1965–75 in this sector of nearly 3 billion population was about 13 percent or 5.5 points—from a CBR of 41 to 35.5. However, that decline was unevenly distributed among countries of different size (Table 4). The largest countries, with 35 million population or more—over 75 percent of the developing world—had the greatest declines in that decade, and crude birth rates appeared to be falling appreciably in most of them.[15] Among the smaller countries, the CBR declines were smaller and occurred in relatively fewer countries.

Components of Fertility Change

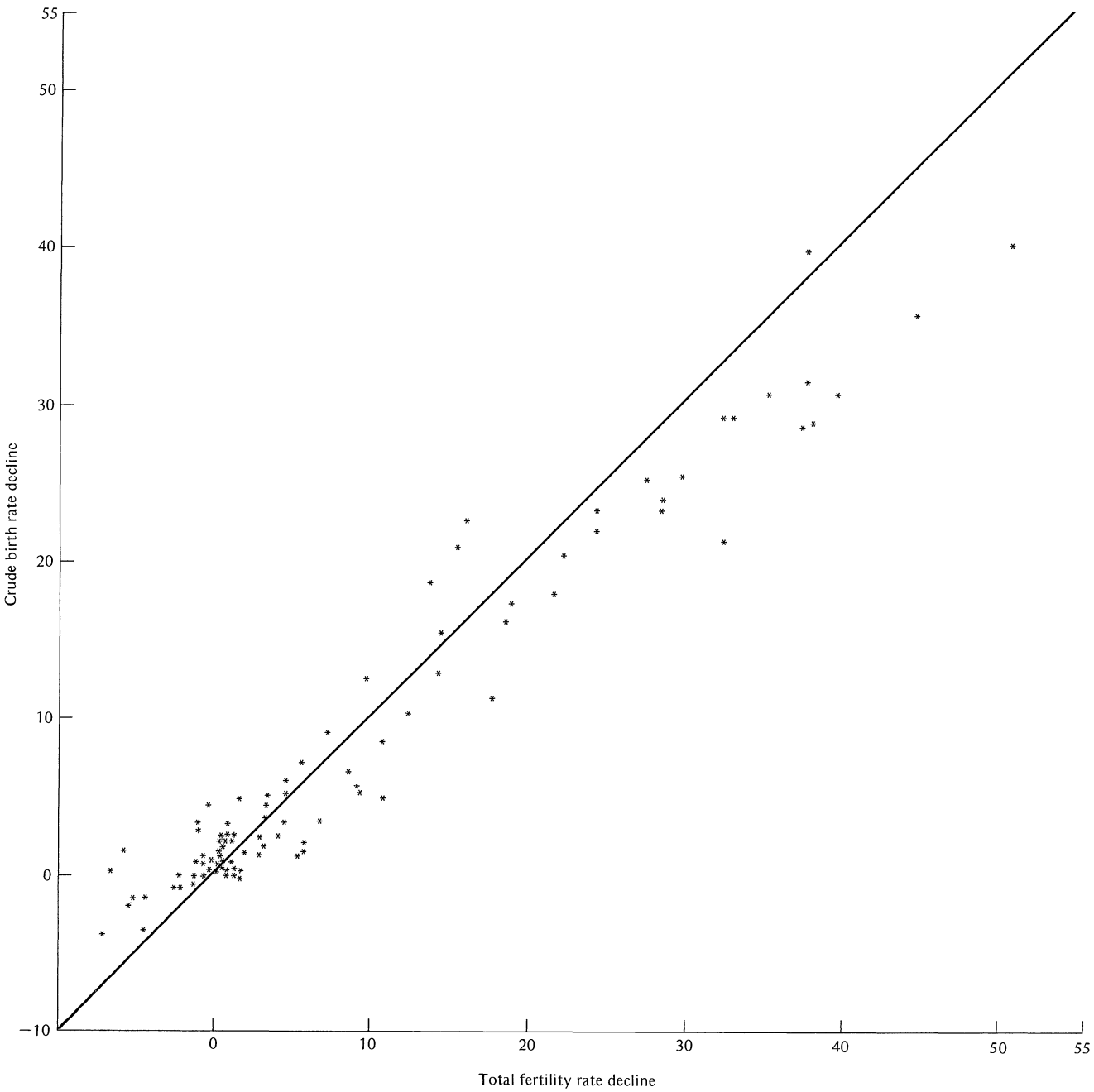
Changes in crude birth rates can be decomposed into three components: change brought about by the age structure, by marriage patterns (mainly age at marriage), and by marital fertility (using a broad definition of marriage and marital fertility in order to allow for consensual unions in Latin America).

Age Structure. High fertility countries tend to have relatively stable age structures; but when fertility begins to decline, the proportions in the youngest age groups decline. This leads to a slightly higher proportion in the reproductive ages, which tends to increase the crude birth rate. The examples given in Table 5 indicate that, for most of the countries listed, changes in age structure tended to increase the crude birth rate or to decrease the amount of decline in the crude birth rate (contributing perhaps −5–10 percent of the change). That this is also true for countries without currently available data is uncertain.

Marriage Patterns. Changing marriage patterns have been an important component of the recent fertility decline in many developing countries. Data on this factor in Table 5 are limited to Asia and to one country in Africa because of the problems of defining and getting data on marriages in Latin America (where common law marriages are numerous) and because few countries in Africa have had significant fertility decline. All of the countries listed in the table had fertility declines of more than 10 percent, and seven of them had declines of more than 20 percent. Rising age at marriage accounted for about one-fourth of the change in three countries, for about one-half the change in three, and for less than one-quarter and for more than one-half in two each. Thus it is clear from these data that rising age at marriage has been a very important factor in fertility decline in many developing countries in recent years; and, as an order of magnitude, changing marriage patterns account for perhaps 35 to 40 percent of the total, but with great variation from country to country.

As illustrative of rapid change in age at marriage consider Tunisia. The proportions of females unmarried in the 15–19 age group were 58, 81, and 95 percent for 1956, 1966, and 1975, respectively. Comparable figures for the 20–24 age group were 20, 27, and 52 percent. Duza and Baldwin cite six factors that account for these rapid changes: sex-ratio imbalance in the usual marriage ages, socioeconomic factors, change in marital values and orientation, legislation of minimum age at marriage, banning of polygyny, and the role played by a committed leadership, especially by President Bourguiba, in improving the status of women.[16] Their analysis indicates that the two major determinants of rising

FIGURE 1 Percent 1965–75 crude birth rate declines, by decline in total fertility rate: 94 developing countries



age at marriage were increases in education and employment of women. They also note that increased economic difficulties in Tunisia (as well as Sri Lanka, and particularly Malaysia), plus a drive to improve socioeconomic status, also appear to have contributed to the rising age at marriage.

In Malaysia, where age at marriage has also risen quite rapidly, the analysis is complicated by ethnic differences in marriage patterns. The Chinese have always had a higher age at marriage than the Malays and Indians. Caldwell[17] has noted that a "marriage squeeze" due to shortage of males in the culturally appropriate ages contributed to the rise in female age at marriage in the 1950s, as did increasing urbanization and education. Malays marry much earlier than do Chinese, but are also much more likely to divorce and remarry. Differentials in age at marriage are found both for the Chinese and the Malays by rural/urban residence and by level of education. These education and rural/urban differentials explain part of the ethnic differentials, since Malays are mostly rural and have the lowest levels of education and Chinese are mostly urban and have the highest education. But racial differences remain after standardizing for these factors.[18]

TABLE 3 1965 and 1975 crude birth rates, 1965–75 crude birth rate declines, and 1975 population: 94 developing countries

Country	Crude birth rate 1965	Crude birth rate 1975	1965–75 crude birth rate decline (in percents)	1975 population (in thousands)
Afghanistan	49	49	—2	19,280
Algeria	50	48	4	16,792
Angola	49	47	4	6,353
Bangladesh	50	49	2	73,746
Barbados	27	19	31	245
Bhutan	45	43	3	1,173
Bolivia	44	44	1	5,410
Brazil	42	38	10	109,730
Burma	41	40	3	31,240
Burundi	48	48	1	3,765
Cameroon	42	41	3	6,398
Cen. African Rep.	45	43	5	1,790
Chad	45	44	2	4,023
Chile	33	23	29	10,253
China	34	26	24	822,605
Colombia	44	33	25	25,890
Congo	44	45	—2	1,345
Costa Rica	41	29	29	1,994
Cuba	34	21	40	9,481
Dahomey/Benin	51	49	3	3,074
Dominican Rep.	47	38	21	5,118
Ecuador	45	45	0	7,090
Egypt	42	35	17	37,543
El Salvador	46	40	13	4,108
Ethiopia	50	49	2	27,975
Fiji	36	28	22	577
Ghana	50	49	2	9,873
Guatemala	45	43	4	6,129
Guinea	47	46	2	4,416
Haiti	45	45	0	4,552
Honduras	51	48	7	3,037
Hong Kong	28	18	36	4,225
India	43	36	16	613,217
Indonesia	46	40	13	136,044
Iran	46	45	2	32,923
Iraq	48	48	0	11,067
Ivory Coast	46	45	1	4,885
Jamaica	38	30	21	2,029
Jordan	48	47	1	2,688
Kenya	50	50	0	13,251
Khmer/Kampuchea	47	47	2	8,110
Korea, North	39	37	5	15,852
Korea, South	35	24	32	33,949
Kuwait	46	44	5	1,085
Laos	44	42	5	3,303
Lebanon	41	40	2	2,869
Lesotho	38	40	—4	1,148
Liberia	50	50	0	1,708
Libyan Arab Rep.	47	47	—1	2,255
Madagascar	50	50	0	8,020
Malawi	49	47	5	4,916
Malaysia	42	31	26	12,093
Mali	50	50	—1	5,697
Mauritania	45	45	0	1,283
Mauritius	36	26	29	899
Mexico	44	40	9	59,204
Mongolia	42	38	9	1,446
Morocco	49	48	2	17,504
Mozambique	43	43	2	9,239
Nepal	45	45	—1	12,572
Nicaragua	49	46	7	2,318
Niger	52	52	1	4,592
Nigeria	50	49	1	62,925
Pakistan	48	47	1	70,560
Panama	40	31	22	1,678
Papua New Guinea	43	41	5	2,716
Paraguay	42	39	6	2,647
Peru	43	42	2	15,326
Philippines	44	36	19	44,437
Rwanda	51	51	0	4,200
Saudi Arabia	50	50	0	8,966
Senegal	48	47	0	4,418
Sierra Leone	45	45	0	2,983
Singapore	29	18	40	2,248
Somalia	48	48	0	3,170
Sri Lanka	33	27	18	13,986
Sudan	49	49	0	18,268
Syrian Arab Rep.	48	46	4	7,259
Taiwan	33	23	30	16,198
Tanzania	51	48	5	15,438
Thailand	44	34	23	42,093
Togo	51	50	2	2,248
Trinidad and Tobago	33	23	29	1,009
Tunisia	45	34	24	5,747
Turkey	41	34	16	39,882
Uganda	46	47	—4	11,353
Upper Volta	50	49	1	6,032
Venezuela	42	37	11	12,213
Vietnam, North	42	32	23	23,798
Vietnam, South	42	41	0	19,653
Yemen	51	50	1	6,668
Yemen, P.D.R. of	50	49	3	1,660
Zaire	47	44	6	24,485
Zambia	50	50	—2	5,022
Total				2,794,678
Total weighted by Unity[a]	44	41	9	
Total weighted by Population[b]	41	36	13	

[a] Each country is given a weight of one.
[b] Each country is weighted by the population of that country.

As these examples indicate, the causes of changes in marriage patterns are complex. Changes in socioeconomic status almost certainly play an important part. However, age at marriage has changed more rapidly in a number of countries than have the presumed explanatory socioeconomic variables such as education, nonagricultural employment, husband's occupation, rural or urban residence, and income. The rapidity of change in marital patterns, as well as the factors mentioned in the Duza-Baldwin analysis referred to above, suggests that other factors are at work as well. It is possible that adoption of the concept of planning one's family contributes to the rise in age at marriage, in consonance with Knodel's analysis that

> the spread of family limitation behaviour itself can serve as a catalyst to change fertility desires, especially within a context of general socio-cultural and economic change. Once the possibility of limiting family size is fully realized, and as other couples practising family limitation and experiencing benefits of reduced family size become available as examples for younger couples to follow, the possibility of having even fewer children can appear much more realistic than before. . . . The important point is that family limitation behaviour may well influence fertility attitudes rather than just vice versa, and that this is consistent with a view of family limitation as innovative behaviour during the initial stages of the fertility transition.[19]

Nuptiality, or changing age at marriage and proportion married, is considered an intermediate variable rather than

TABLE 4 1965–75 crude birth rate declines (in percents) by population size: 93 developing countries

35 million or more		*15–35 million*		*5–15 million*		*.5–5 million*	
Country	*Decline*	*Country*	*Decline*	*Country*	*Decline*	*Country*	*Decline*
Bangladesh	2	Afghanistan	—2	Angola	4	Bhutan	3
Brazil	10	Algeria	4	Bolivia	1	Burundi	1
China	24	Burma	3	Cameroon	3	Cen. African Rep.	5
Egypt	17	Colombia	25	Chile	29	Chad	2
India	16	Ethiopia	2	Cuba	40	Congo	—2
Indonesia	13	Iran	2	Dominican Rep.	21	Costa Rica	29
Korea, South	32	Korea, North	5	Ecuador	0	Dahomey	3
Mexico	9	Morocco	2	Ghana	2	El Salvador	13
Nigeria	1	Peru	2	Guatemala	4	Fiji	22
Pakistan	1	Sudan	0	Iraq	0	Guinea	2
Philippines	19	Taiwan	30	Ivory Coast	1	Haiti	0
Thailand	23	Tanzania	5	Kenya	0	Honduras	7
Turkey	16	Vietnam, North	23	Khmer/Kampuchea	2	Hong Kong	36
		Vietnam, South	0	Madagascar	0	Jamaica	21
		Zaire	6	Malawi	5	Jordan	1
				Malaysia	26	Kuwait	5
				Mali	—1	Laos	5
				Mozambique	2	Lebanon	2
				Nepal	—1	Lesotho	—4
				Saudi Arabia	0	Liberia	0
				Senegal	0	Libyan Arab Rep.	—1
				Sri Lanka	18	Mauritania	0
				Syrian Arab Rep.	4	Mauritius	29
				Tunisia	24	Mongolia	9
				Uganda	—4	Nicaragua	7
				Upper Volta	1	Niger	1
				Venezuela	11	Panama	22
				Yemen	1	Papua New Guinea	5
				Zambia	—2	Paraguay	6
						Rwanda	0
						Sierra Leone	0
						Singapore	40
						Somalia	0
						Togo	2
						Trinidad and Tobago	29
						Yemen, P.D.R. of	3
Total weighted by							
Unity[a]	14		7		7		9
Population[b]	16		7		6		6

NOTE: Barbados is not included in this table because its population size is less than .5 million.
[a] Each country is given a weight of one.
[b] Changes in CBRs are weighted by the population of each country.

an explanatory variable. As we have indicated, the determinants of marriage patterns are not well known, and analysts have not yet found a satisfactory way of treating cultural determinants and, in particular, change in social norms relating to age at marriage. Nuptiality changes in themselves are partly attributable to the socioeconomic factors under consideration, to which we will turn in the next section.

Marital Fertility. Substantial declines in fertility are typically associated with declines in marital fertility. The demographic transition theory focuses on the shift from a large to a small number of children, and Coale describes this process as "the universality of the major decline in marital fertility in highly modernized societies."[20] Demeny writes that "Any reasonable description of fertility transition contains the idea that marital fertility is 'high' before transition, but 'low' after transition."[21] Ryder, writing of the Western transition toward low fertility, observes that "The primary demographic source of the fall in fertility was a decline in the mean completed parity of married women from the neighborhood of seven to a level below three."[22] Similarly, a study of demographic trends in Europe notes that the "decline in the average family size expected has been largely brought about by the virtual elimination of women expecting families of four or more children, and to the growing predominance of one- or two-child families."[23] Most studies of fertility trends and differentials are concerned with the average number of children born to married women.

Table 5 shows that for most countries marital fertility declines accounted for most of the crude birth rate decline; this is particularly true of countries having CBR declines of 20 percent or more. Indeed, if there are surprises in the figures shown in Table 5, they come from the extent to which changes in age structure and marital patterns influence fertility declines. These data suggest that a number of developing countries are well into the demographic transition and that the average number of children per married couple is decreasing.

Measures of Demand

Precisely what demand factors produce motivation for family limitation or account for fertility decline at different historical periods, in different societies, and in what magni-

TABLE 5 Components of crude birth rate declines: Selected developing countries, selected years, 1957–75

Country and years	Crude birth rate: Beginning of period	Crude birth rate: End of period	Crude birth rate: Amount change	Crude birth rate: Percent change	Absolute change due to: Age structure	Absolute change due to: Marriage pattern	Absolute change due to: Marital fertility	Percent of decline due to: Age structure	Percent of decline due to: Marriage pattern	Percent of decline due to: Marital fertilty
Fiji, 1965/66–1974/75[a]	35.7	28.0	— 7.7	—22	1.6	— 2.2	— 7.1	—21	29	93
Hong Kong, 1961–71	35.5	19.7	—15.8	—45	—4.2	— 3.8	— 7.9	26	24	50
Korea, South, 1966–74	35.1	25.4	— 9.7	—28	0.0	— 0.9	— 8.8	0	9	91
Malaysia (West), 1960–69[b]	42.9	34.6	— 8.3	—19	—0.4	— 5.6	— 2.3	5	67	28
Mauritius, 1962–72	38.0	24.4	—13.6	—36	3.4	— 7.2	— 9.9	—25	53	72
Singapore, 1957–70[c]	42.7	22.1	—20.6	—48	2.6	—10.9	—12.3	—13	53	60
Sri Lanka, 1963–71[d]	34.4	29.9	— 4.5	—13	1.9	— 4.0	— 2.4	—42	89	53
Taiwan, 1965–75[e]	32.1	23.0	— 9.1	—28	3.8	— 4.5	— 8.4	—42	49	93
Thailand, 1964/65–1974/75[f]	42.2	37.0	— 5.2	—12	1.2	— 1.0	— 5.4	—22	19	103
Turkey, 1960–75[g]	45	32	—13	—29	— 1	— 3	— 9	8	23	69

NOTE: The crude birth rates shown in this table differ slightly in some instances from those shown in Table 3. We have not adjusted these figures because to do so would require an arbitrary adjustment of one or more of the components.

[a] There is evidence in the Fiji Fertility Survey, 1974, of the World Fertility Survey that birth registration has deterioriated for the Fijian population. For the purpose of this analysis, the age-specific fertility rates from 1965 and 1975 registration data were used with the 1966 and 1974 age structures and percent currently married, as given by the 1966 census and Fiji Fertility Survey, 1974. Therefore, marital fertility decline may be overestimated. The age-specific marital fertility rates were then adjusted to yield the CBRs given for 1965 and 1975.

[b] From Lee-Jay Cho and Robert D. Retherford, "Comparative analysis of recent fertility trends in East Asia," *International Population Conference, Liege, 1973*, vol. 2 (Liege: IUSSP, 1973) p. 167.

[c] Singapore calculations are based on data from Chen-Tung Chang, *Fertility Transition in Singapore* (Singapore University Press, 1974).

[d] Sri Lanka calculations are based on data from *Population of Sri Lanka*, ESCAP Country Monograph Series No. 4, 1976.

[e] Taiwan figures are based on data supplied by Ronald Freedman, University of Michigan.

[f] The 1964/65 age-structure and age-specific fertility rates were taken from the 1964/65 survey, which excluded Bangkok-Thonburi. The percents currently married in 1965 were interpolated from the 1960 and 1970 censuses.

[g] Ferhunde Ozbay, Frederic Shorter, and Samira Yener, "Accounting for the trend of fertility in Turkey," paper presented at UN/UNFPA Expert Group Meeting on Demographic Transition and Socioeconomic Development, Istanbul, 27 April–4 May 1977. The Kitagawa method was not used here.

tudes is uncertain. The one certainty is that numerous factors —social, economic, cultural, familial, religious, psychological, personal—have been discerned or proposed in the literature as having such an effect. These include education, mortality prospects especially for children, industrialization, urbanization and density, income and income distribution, status of women, nuptiality and age at marriage, religious and ethnic affiliation, "modernization," Westernization, nuclear family structure, old-age security, perception of familial advantages, perception of the costs and benefits of children, and reversal of intergenerational wealth flow from children-to-parents to parents-to-children.[24]

Again there are the twofold problems of data: what one might want is unavailable (e.g., on intergenerational wealth flows) and what is available is sometimes flawed. In what follows we mainly consider the major socioeconomic variables typically included in such studies summarized in a social setting index, plus a few additional qualitative factors of special interest.

With regard to social setting, we consider that as the values of the various socioeconomic variables increase (or improve) and as "modernization" advances, a larger proportion of couples want fewer children than was heretofore the case—with the desired number approaching the replacement level in highly modern countries (or societies or groups). That process results in growing motivation for planned control of family size, for "demand" for family planning information and services, and for actual practice of some form of family limitation.

We hypothesize that there are five categories of variables that lead toward demand for smaller families: namely, health, education, economic status, urbanization, and status of women. Working from this hypothesis, we initially put together a "data bank" of about 50 variables with presumed relevance as of 1970, the midpoint of our study period and thus reflecting order of magnitude for 1965–75, given the slowness with which such large matters change. We also examined the values for these variables for earlier periods, principally 1960, plus changes over time and male/female differences. Counting these derived measures, we examined well over 100 variables, the most important of which are listed below:

Education
Primary school enrollment: total, male, female
Secondary school enrollment: total, male, female
Primary and secondary school enrollment: total, male, female
Post-secondary school enrollment ratios: total, male, female
Vocational school enrollment

Health
Life expectancy at birth: total, male, female
Infant mortality rate
Physicians per 1,000 population
Hospital beds per 1,000 population
Crude death rate per 1,000 population
Calories consumed per person per day
Protein consumed per person per day

Economic status
Gross national product (GNP) per capita
Annual percentage growth in GNP per capita
Energy consumption per capita
Arable land per capita
Gini index of income distribution
Percentage of males aged 15–64 in agricultural labor force
Percentage of females aged 15–64 in agricultural labor force
Percentage of males aged 15–64 in nonagricultural labor force
Percentage of females aged 15–64 in nonagricultural labor force
Percentage economically active employed in specified industries
Savings as percentage of national income
Percentage dwellings with piped water
Percentage dwellings with electricity

Urbanization
Percentage of population urban, by local definition
Percentage living in cities of 100,000+

Status of women
Legal age of marriage
Percentage of females aged 15–19 never married
Percentage of females aged 20–24 never married
Some other indexes, as listed above, applied to women

After considerable preliminary analysis to eliminate redundancies and to identify major as against minor factors, and with consideration of the predominant scientific consensus on such a list, we retained the two variables in education, health, and economic status categories having the highest zero-order correlation with CBR decline, plus one with regard to urbanization. (We were not able to find satisfactory indexes of the status of women and therefore that is not included in the primary analysis of socioeconomic variables; it is dealt with separately in Appendix B.) We thus settled upon seven variables as simultaneously satisfying the two criteria of substantial relevance and substantial availability:

Education
Adult literacy (ages 15 and over)
Primary and secondary school enrollment as a percentage of the 5–19 age group

Health
Life expectancy at birth
Infant mortality rate[25]

Economy
Percentage of adult males in nonagricultural labor force
GNP per capita

Urbanization
Percentage of population living in cities of 100,000+

These seven variables serve as our major measure of social setting as it presumably affects motivation for fertility control (Table 6). (Note that in this definition and selection, their association with CBR decline is being maximized.) Since all of them are considered a part of the general socioeconomic movement called development or modernization, it is only natural that they tend to hang together, or, to use the technical term, that they are characterized by multicollinearity, as shown in this table of intercorrelations:

Variable	*Correlation*						
	1	*2*	*3*	*4*	*5*	*6*	*7*
1. Adult literacy	1.00						
2. Primary and secondary school enrollment	.80	1.00					
3. Life expectancy	.87	.76	1.00				
4. Infant mortality rate	—.78	—.71	—.86	1.00			
5. Males aged 15–64 in nonagricultural labor force	.65	.73	.80	—.73	1.00		
6. GNP per capita	.23	.38	.40	—.37	.62	1.00	
7. Population in cities of 100,000+	.45	.58	.58	—.54	.78	.57	1.00

On average these factors correlate substantially with one another across the range of developing countries studied.

We do not mean to claim that these socioeconomic factors, or others like them, are necessarily *the* ones, and certainly not the *only* ones, that affect the demand for fertility control. There now appears to be some debate in the field as to whether such factors are only the surface and readily identifiable manifestations of some deeper or underlying structure of the decision process, which involves such factors as the perceived benefits and costs of children, the perceived legitimacy of fertility control, the intergenerational transfer of wealth, and the appreciation of negative externalities within the community (costs produced by individuals but borne by the community). It remains for the field to operationalize such concepts. At present, the "deeper structures" often get expressed in such measurable qualities as education, health, standard of living, urbanization, or the catch-alls of "development" or "modernization"; and, as we have seen, the literature is full of just such measures. In any case, there are plausible reasons why such factors do affect fertility decisions—for example, education, by increasing the economic value of children, heightening aspirations for children, inculcating modern attitudes in place of traditional ones, and making the future real; health, by reducing the number of children needed for a given number of survivors; economic modernization and urbanization, by changing the cost-benefit ratio of children, changing the status of women and traditional sex roles, and providing alternatives to early marriage, breaking down the traditional kinship networks and promoting the nuclear family.[26] Whether these factors are really determinants of fertility or only structural manifestations of some underlying theme or thesis we leave to current dispute and subsequent settlement. Their general association with fertility, however, despite contrary cases, is accepted in the demographic fraternity, whether as genuine

TABLE 6 Socioeconomic measures: 94 developing countries, circa 1970

Country	*Percent adults literate*	*Percent aged 5–19 enrolled in primary and secondary school*	*Life expectancy (in years)*	*Infant mortality rate*	*Percent males aged 15–64 in nonagricultural labor force*	*GNP per capita (in 1974 US$)*	*Percent population in cities of 100,000+*
Afghanistan	8	14	39	190	18	102	8
Algeria	26	45	52	145	33	655	16
Angola	13	40	37	192	31	511	8
Bangladesh	22	33	40	140	14	119	3
Barbados	99	75	68	42	68	1,137	0
Bhutan	u	6	42	159	7	80	0
Bolivia	40	56	46	161	33	248	17
Brazil	66	58	61	109	41	680	30
Burma	60	59	49	139	30	95	18
Burundi	10	17	39	161	17	90	0
Cameroon	13	59	41	110	22	292	8
Cen. African Rep.	8	40	40	163	13	220	11
Chad	8	16	38	129	11	118	4
Chile	88	83	62	79	57	811	41
China	u	u	60	u	34	170	11
Colombia	81	63	60	76	44	432	38
Congo	20	97	42	148	48	383	30
Costa Rica	88	75	67	70	45	713	23
Cuba	94	76	69	39	53	450	32
Dahomey/Benin	20	23	40	149	21	128	8
Dominican Rep.	67	67	57	99	29	488	21
Ecuador	70	65	58	91	38	415	21
Egypt	35	52	51	120	38	266	27
El Salvador	57	59	56	67	30	379	10
Ethiopia	7	12	38	162	16	93	4
Fiji	79	63	69	22	43	682	0
Ghana	30	43	43	122	33	427	15
Guatemala	46	38	52	83	28	490	13
Guinea	8	24	40	216	19	113	7
Haiti	23	22	49	130	14	151	12
Honduras	52	51	51	135	23	324	13
Hong Kong	77	78	69	20	83	1,379	93
India	33	40	48	130	32	140	11
Indonesia	57	43	46	140	29	146	11
Iran	37	54	50	140	43	882	23
Iraq	42	47	51	104	46	756	33
Ivory Coast	20	44	42	154	16	432	14
Jamaica	82	66	69	32	49	982	28
Jordan	62	55	52	36	55	442	29
Kenya	35	42	49	126	21	178	7
Khmer/Kampuchea	41	18	45	159	23	120	8
Korea, North	90	u	59	144	47	u	18
Korea, South	88	76	59	60	45	344	38
Kuwait	55	77	66	41	87	6,737	85
Laos	15	28	40	137	22	130	6
Lebanon	64	71	62	65	64	700	52
Lesotho	59	64	45	111	12	113	0
Liberia	21	29	42	148	28	370	0
Libyan Arab Rep.	27	73	52	121	57	4,430	24
Madagascar	39	48	42	102	13	188	5

cause or as causal surrogate. Moreover, these are the kinds of socioeconomic factors that are put forward as policy instruments in this field—prominently, for example, in the World Population Plan of Action—in connection with the development-*and*-family-planning or development-*versus*-family-planning debate. So we proceed on this basis without undue apology on the one hand or undue naivete on the other.

After considerable analysis we have concluded that for our purposes—that is, to distinguish among countries by their motivational readiness for fertility control—the use of additional socioeconomic variables does not increase correlations. Indeed, as we shall see, even fewer than these seven would yield essentially the same correlations with fertility decline. In short, without claiming that we have selected the single best set of socioeconomic factors for such an analysis, we do believe that we have a highly representative set of the major factors at work, which at the least reflect "deeper structures" if they are not instrumental in their own right, and that in multiple and cross-tabular analyses they yield essentially the same results as any equally qualified set.

In our correlational analyses we use the numerical values given in Tables 3 and 6. In our descriptive cross-tabulation we use an index constructed from the numerical values by ranking the countries on each of those variables from high to low (94 to 1), dividing each rank by the number of coun-

TABLE 6 Socioeconomic measures: 94 developing countries, circa 1970 (continued)

Country	*Percent adults literate*	*Percent aged 5–19 enrolled in primary and secondary school*	*Life expectancy (in years)*	*Infant mortality rate*	*Percent males aged 15–64 in nonagricultural labor force*	*GNP per capita (in 1974 US$)*	*Percent population in cities of 100,000+*
Malawi	22	23	40	119	13	100	3
Malaysia	58	62	58	41	42	555	12
Mali	10	16	38	190	10	84	4
Mauritania	11	10	40	137	12	264	0
Mauritius	61	61	64	57	58	444	17
Mexico	74	69	62	68	42	996	37
Mongolia	54	78	59	86	37	380	22
Morocco	21	32	52	133	35	378	25
Mozambique	10	28	42	140	33	417	4
Nepal	13	19	42	200	8	102	3
Nicaragua	58	53	52	45	34	581	21
Niger	5	8	39	148	7	140	4
Nigeria	25	21	40	157	31	219	11
Pakistan	22	27	49	136	37	131	15
Panama	78	77	66	58	41	929	24
Papua New Guinea	32	41	46	134	18	393	0
Paraguay	80	66	61	67	34	442	20
Peru	72	75	55	135	41	659	25
Philippines	83	87	57	82	33	289	17
Rwanda	10	42	41	133	10	97	0
Saudi Arabia	15	23	44	157	31	1,719	11
Senegal	6	27	40	156	24	308	18
Sierra Leone	10	23	42	183	30	192	7
Singapore	69	77	69	21	81	1,635	86
Somalia	5	6	40	190	17	92	7
Sri Lanka	78	73	67	50	41	129	7
Sudan	20	21	47	145	17	139	5
Syrian Arab Rep.	40	66	53	125	43	433	31
Taiwan	81	78	68	19	65	623	37
Tanzania	28	22	43	167	17	156	3
Thailand	79	58	57	80	21	269	7
Togo	16	43	40	163	18	231	10
Trinidad and Tobago	92	81	69	34	69	1,499	0
Tunisia	30	65	53	135	39	484	19
Turkey	51	69	56	145	38	612	19
Uganda	31	29	49	160	16	267	4
Upper Volta	8	7	37	181	11	101	0
Venezuela	77	75	64	49	57	1,837	41
Vietnam, North	u	u	47	132	23	110	9
Vietnam, South	77	69	40	180	23	187	16
Yemen	10	6	44	160	19	u	2
Yemen, P.D.R. of	27	42	44	160	32	100	14
Zaire	35	68	43	115	30	134	18
Zambia	47	51	44	159	24	519	21
Mean	43	48	50	118	33	534	17
Standard deviation	28	24	10	49	18	863	17

u = unavailable.

tries for which we had values, summing those ranks, dividing the sum by the number of variables for which a given country had numerical values, and multiplying the result by 100. Since no "natural" breaking points emerged, we divided the countries into four equal groups on what we term the "social setting" index—"high," "upper middle," "lower middle," and "low"—as shown in Table 7. (Appendix C describes a previous classification utilizing a different procedure but producing essentially similar results.) While we do not claim precise discrimination point by point and the boundaries may tend to be fuzzy, we do think that this index differentiates broadly among developing countries by their 1970 level of development or modernization.

Measures of Supply

There is no single accepted index of the accessibility, at some adequate level of quality service, of modern means of fertility control (pill, IUD, condom, sterilization, abortion) that is available for a range of countries. As in the case of demand factors, in principle there are several ways to measure the concept of supply. It is difficult to settle upon an "ideal" measure, but it is useful, at least illustratively, to consider alternatives that, while not now available, may become so in the future. For example, consider this designation: how many people in the community have available to them the specified means of fertility control (or some locally

TABLE 7 Rank by social setting index: 94 developing countries

High		*Upper middle*		*Lower middle*		*Low*	
Country	*Rank*	*Country*	*Rank*	*Country*	*Rank*	*Country*	*Rank*
Hong Kong	95	Korea, North	72	Burma	48	Togo	29
Singapore	93	Philippines	71	Bolivia	46	Laos	28
Taiwan	91	Mongolia	71	Vietnam, South	46	Sudan	28
Venezuela	91	Malaysia	71	Indonesia	45	Sierra Leone	27
Kuwait	90	Ecuador	70	India	44	Tanzania	26
Chile	89	Iraq	70	Saudi Arabia	43	Dahomey	25
Cuba	89	Nicaragua	68	Pakistan	43	Malawi	24
Jamaica	87	Syrian Arab Rep.	68	Kenya	41	Cen. African Rep.	24
Lebanon	85	Dominican Rep.	68	Cameroon	41	Bangladesh	24
Costa Rica	84	Sri Lanka	67	Lesotho	39	Rwanda	21
Trinidad		Turkey	64	Madagascar	38	Mauritania	19
and Tobago	84	Iran	62	Papua New Guinea	38	Yemen	18
Panama	84	Tunisia	62	Ivory Coast	38	Chad	18
Mexico	83	El Salvador	60	Vietnam, North	37	Guinea	17
Korea, South	81	Congo	59	Haiti	35	Afghanistan	15
Barbados	81	Egypt	58	Mozambique	35	Nepal	14
Colombia	77	Thailand	57	Senegal	32	Niger	13
Mauritius	75	Guatemala	55	Yemen, P.D.R. of	32	Somalia	12
Jordan	75	China	55	Angola	32	Burundi	11
Brazil	74	Algeria	54	Uganda	32	Ethiopia	10
Paraguay	74	Morocco	53	Khmer/Kampuchea	31	Bhutan	10
Fiji	74	Zaire	51	Nigeria	31	Mali	9
Peru	73	Honduras	51	Liberia	31	Upper Volta	6
Libyan Arab Rep.	73	Zambia	50				
		Ghana	50				

approved selection thereof) at a specified level of quality service, at affordable cost, and within, say, 30 minutes travel time? In the industrialized countries that figure is probably around 80–90 percent; surely in some developing countries it is well under 10 percent (i.e., it is limited to some well-off urban dwellers).[27] Such a measure, while useful, requires data that are not presently available across the range of developing countries; thus we turn to another index of supply.

In view of concern with the impact of family planning programs, and in the absence of better data, we utilize as our major measure an index of program effort. By family planning programs we mean organized efforts, typically governmental, to extend the effective practice of modern fertility control without direct or major efforts to affect socioeconomic determinants or the structure of demand. Such programs range from vigorous and continuous efforts under skilled management to weak and spotty performance under indifferent administration, on down to no effort at all. It is a commonplace in the field that family planning programs vary widely in the effort with which they are pursued, from a paper policy with no actual implementation in some cases all the way to a highly efficient working organization in others. Our measure seeks to discern the will, energy, and capability of programmatic effort in order to distinguish among strong, moderate, and weak programs.

The measure was derived from the following 15 "programmatic criteria" ("procedures and supportive measures"), originally developed by Lapham and Mauldin,[28] intended to estimate family planning effort:

Fertility reduction included in official planning policy

Favorable public statements by political leaders

Contraception readily and easily available, publicly and commercially throughout the country

Customs and legal regulations allow importation of contraceptives not manufactured locally

Vigorous effort to provide family planning services to all MWRA (married women of reproductive age)

Adequate family planning administration structure

Training facilities available and utilized

Full-time home-visiting field workers

Postpartum information, education, and service program

Abortion services openly and legally available to all

Voluntary sterilization services (male and female) openly and legally available to all

Use of mass media on a substantial basis

Government provides substantial part of family planning budget from its own resources

Record keeping systems for clients at clinic level and for program service statistics

Serious and continuous evaluation effort

For each country, each criterion was scored yes—2 points; qualified yes—1 point; partially or no—0 points. These ratings produced country scores ranging from 0 to 30, which are used in our correlational analysis. In our cross-tabulational analysis we use a fourfold classification of program effort: Strong—20 points or more; Moderate—10–19 points; Weak—0–9 points; and None. Using this index the 94[29] countries are grouped as shown in Table 8.

The broad character of the classification is indicated by the following descriptions of prototypic programs:[30]

Strong: Programs with full political backing and energetic professional leadership as in South Korea, Taiwan, and reportedly North Vietnam and China (with its own brand of organized inducements); and programs in such relatively small and highly infrastuctured societies as Singapore, Hong Kong, or Mauritius (where two programs were officially undertaken, one for the Catholic community).

TABLE 8 Program effort classification: 94 developing countries

Strong (20+)		*Moderate (10–19)*		*Weak (0–9)*		*No program (0)*	
Country	*Score*	*Country*	*Score*	*Country*	*Score*	*Country*	*Score*
Singapore	26	Panama	19	Guatemala	9	Angola	0
China	25	India	19	Egypt	8	Burundi	0
Korea, South	24	Malaysia	18	Pakistan	8	Cen. African Rep.	0
Taiwan	24	Chile	16	Honduras	7	Chad	0
Jamaica	23	Colombia	16	Venezuela	7	Congo	0
Hong Kong	23	Philippines	16	Kenya	6	Ethiopia	0
Fiji	22	Cuba	15	Ecuador	6	Guinea	0
Barbados	21	Trinidad and Tobago	15	Nepal	6	Ivory Coast	0
Costa Rica	21	Dominican Rep.	14	Turkey	6	Lesotho	0
Mauritius	20	Indonesia	14	Morocco	4	Libyan Arab Rep.	0
Vietnam, North	20	Iran	14	Mexico	4	Madagascar	0
		El Salvador	13	Algeria	3	Malawi	0
		Tunisia	12	Dahomey/Benin	3	Mauritania	0
		Sri Lanka	12	Ghana	3	Mozambique	0
		Thailand	11	Liberia	3	Niger	0
				Sudan	3	Rwanda	0
				Tanzania	3	Senegal	0
				Zaire	3	Sierra Leone	0
				Haiti	3	Somalia	0
				Paraguay	3	Togo	0
				Afghanistan	3	Cameroon	0
				Bangladesh	3	Upper Volta	0
				Nigeria	2	Zambia	0
				Bolivia	0	Peru	0
				Brazil	0	Bhutan	0
				Iraq	0	Burma	0
				Mali	0	Jordan	0
				Nicaragua	0	Khmer/Kampuchea	0
				Papua New Guinea	0	Korea, North	0
				Uganda	0	Kuwait	0
						Laos	0
						Lebanon	0
						Mongolia	0
						Saudi Arabia	0
						Syrian Arab Rep.	0
						Vietman, South	0
						Yemen	0
						Yemen, P.D.R. of	0

Moderate: Programs with strong commitment and effort but confronted with overwhelming administrative and logistic difficulties, such as in India after the 1965 reorganization (before that it would have been classified as weak); programs that began slowly but had built up to considerable strength about midway in this period, as in Indonesia, the Philippines, or Thailand (which with a full decade of such effort would qualify as strong); programs that were pursued strongly in some parts of the country, typically the cities and towns, but less so elsewhere, as in Chile, Colombia, Iran, or Tunisia; and programs in smaller countries, in which they could be pursued moderately well through the existing health network and/or assigned to private agencies with government support, such as El Salvador, Trinidad and Tobago, or the Dominican Republic.

Weak: Programs with supporting formal policy but sparse implementation across the country as a whole, as in Egypt, Turkey, Pakistan, Bangladesh, Kenya, or Morocco; programs that became energized too late for impact on the period under review, as in Mexico; programs with less than full policy support and subsequent formal assignment to an understaffed existing bureaucracy or private agency, as in Venezuela, Honduras, Afghanistan, or Nigeria; and programs with both weak policy support and weak implementation, as in Algeria, Sudan, Tanzania, Haiti, or Uganda.

This measure of program effort may be a rough and approximate one, but we are satisfied on the basis of close and long observation that it correctly distinguishes stronger from weaker programs. With other measures of program effort, a few individual countries might be moved to an adjacent category, but it is highly unlikely that the overall distribution or analysis would be significantly affected. In any case, as will be seen later, the key empirical discrimination is between strong/moderate on the one hand and weak/none on the other, so the issue of borderline classification is narrower and less critical than it might appear here; and as will also be seen later, a classification by program duration alone yields essentially the same results.

We have now set forth the central measures on which this study proceeds: 1965–75 CBR declines, seven socioeconomic factors of a demand character, and program effort on the supply side. In the remainder of the paper, we utilize these measures to analyze the effect of the demand and the supply variables upon the specified declines. We do this first through correlational/regression analysis and then through cross-tabulational specification by individual countries.

Correlation and Regression Analysis[31]

DEMAND FACTORS

On the hypothesis that modernization leads to fertility reduction, we first examine the relationship of the 1965–75 decline in the crude birth rate to the socioeconomic demand factors, singly and together. First, the simple correlations:

Variable	Correlation coefficient with 1965–75 CBR decline
Life expectancy	.76
Infant mortality rate	—.71
Adult literacy	.70
Males in nonagricultural labor force	.61
Primary and secondary school enrollment	.60
Population in cities of 100,000+	.42
GNP per capita	.13

Among the traditional demand factors associated with fertility, in these data the health and literacy variables are most closely associated with fertility decline, with education and nonagricultural labor force not far behind, then urbanization, and the direct income measure clearly last.

But as we have noted, there is a considerable amount of intercorrelation among these factors, so we next analyze the combined effect of various sets of demand factors, by means of multiple correlations (R^2's) (see Table 9). For all seven factors, the R^2 is 0.66, or an "explanation" of about two-thirds of the observed decline. Actually, as indicated in the following data, that level of association is essentially reached with fewer of the demand variables (see regressions 1–6, Table 9); moreover, that level is about the plateau that would be reached by the addition of further demand factors from the original list, in view of the multicollinearity in the real world:

Variable	R^2's with 1965–75 CBR decline
Life expectancy	.58
That plus infant mortality rate	.59
Those plus adult literacy	.61
Those plus males in nonagricultural labor force	.61
Those plus primary and secondary school enrollment	.62
Those plus urbanization (population in cities of 100,000+)[32]	.62
Those plus GNP per capita, i.e., all 7 variables	.66

Or, to look at the same matter in another way, of the 35 separate combinations of four factors in our array, 28 have multiple R^2's between .58 and .64, 32 between .54 and .64, and all 35 between .52 and .66. Similarly, two factors (life expectancy, males in nonagricultural labor force) produce an R^2 of .58, and three factors (those plus GNP) an R^2 of .64. By such measures urbanization contributes nothing to the R^2 value, and literacy and enrollment not much (.016 each).

TABLE 9 1970 socioeconomic (demand) and program (supply) variables as predictors of crude birth rate declines: 94 developing countries, 1965–75

	Multiple regression											
Item	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Multiple R	.81	.76	.80	.80	.81	.81	.91	.91	.91	.91	.91	.91
Multiple R^2	.66	.58	.64	.64	.66	.66	.83	.83	.83	.83	.83	.83
Socioeconomic (demand) variable	*Beta coefficients*											
Adults literate	.08				.04	.08	.04				.06	.03
Primary and secondary school enrollment	—.06					—.06	.04					.05
Life expectancy	.52	.77	.69	.57	.53	.52	.11	.20	.21	.16	.11	.11
Infant mortality rate	—.13			—.14	—.13	—.13	—.06			—.06	—.06	—.05
Percent males aged 15–64 in nonagricultural labor force	.28	—.01	.24	.24	.26	.28	.11	.09	.16	.14	.16	.14
GNP per capita	—.28		—.29	—.29	—.28	—.28	—.10		—.10	—.09	—.09	—.09
Percent population in cities of 100,000+	.00						.04					
Program (supply) variable							.65	.70	.66	.66	.64	.65
Number of cases	89	94	92	91	89	89	89	94	92	91	89	89
Degrees of freedom	81	91	88	86	83	82	80	90	87	85	82	81
F-statistics	22.6	63.2	52.1	38.3	32.3	26.7	49.2	142.8	106.4	83.3	66.6	56.6
Significance level: P = <	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01

NOTE: The figures shown for regression number 3, for example, indicate that three independent variables were used in the multiple correlation analysis. The multiple R was .80, and the multiple R^2 was .64. Beta values are given for the variables life expectancy, percent males aged 15–64 in nonagricultural labor force, and GNP per capita, thus indicating that those were the three variables used in computing the multiple correlation. The number of countries (cases) included in the analysis and three technical statistics relating to the significance of the regression are shown at the bottom of the table.

In short, these demand factors have a substantial association with CBR decline over the time span of a decade; they are themselves so interrelated (and thus reflective of the underlying general factor of modernization) that only a few of them (and virtually regardless of which ones) produce close to the maximum correlation; and as more and more socioeconomic factors are added to the multiple correlations (within our seven) they do not substantially increase its magnitude.

Demand Factors plus Supply

That leads, then, to a consideration of what, if anything, is added by the supply factor of program effort. That is, we investigate the extended hypothesis that modernization combined with program effort leads to an increased reduction in fertility.

We note that just as the demand factors correlate with one another, so program effort correlates with them as well:

Variable	*Correlation coefficient with program effort*
Life expectancy	.70
Infant mortality rate	−.65
Adult literacy	.64
Males in nonagricultural labor force	.52
Primary and secondary school enrollment	.52
Population in cities of 100,000+	.32
GNP per capita	.07

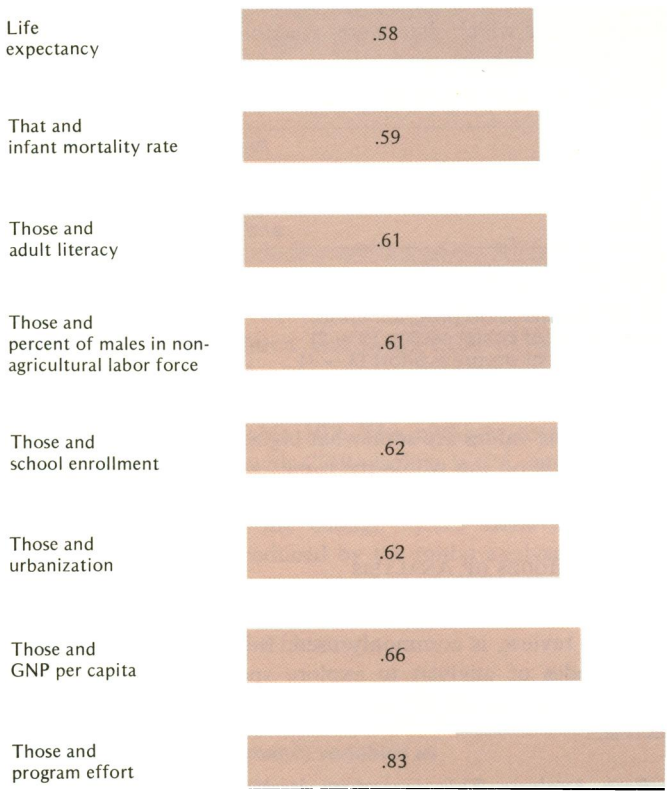
These correlations are not as high as the intercorrelation among the demand factors but still they are substantial. So program effort, as measured, hangs together with the demand factors in the historical process of modernization, though not as closely as the socioeconomic factors do among themselves. But when it comes to the simple correlation of program effort with the 1965–75 CBR decline, where the demand factors range from .76 to .13, the figure for program effort is .89. And the multiple correlation (R^2) with CBR decline for all seven demand factors plus program effort is .83 (see regression number 7, Table 9) as compared with .66 for the demand factors alone.[33]

Thus it is clear that program effort adds substantially to the multiple R^2 of such factors, and in effect breaks through the plateau of small increments among these factors, presumably as "another kind" of influence (Figure 2).[34] Another demand factor that similarly extended the correlation would surely be considered a major influence on CBR decline.

Continuing the parallel analysis with the socioeconomic factors as above, we find that the Beta values are extremely high for program effort in combination with demand factors: .65–.70 for program effort as against .20 or less for each of the socioeconomic factors. And if they are combined into a single factor of "modernization," the corresponding Betas are still striking: .75 for program effort as against .22 for social setting.

In summarizing the effect of the different factors on CBR decline we get the following R^2 values (with the seven socioeconomic variables included as the original values):

FIGURE 2 Multiple correlations (R^2's) of demand (socioeconomic) and supply (program) variables with 1965–75 crude birth rate declines



Item	R^2
Socioeconomic factors	.66
Program effort	.78
Socioeconomic factors and program effort	.83

And when the appropriate subtractions are made from the total R^2 value, it is apparent that most of the association derives from the combination and only a small proportion from the net effect of a single factor—that is, by subtracting .66 from .83 for the net effect of program effort (.17) or by subtracting .78 from .83 for the net effect of socioeconomic factors (.05). This general picture is further elucidated using rank order on socioeconomic factors rather than the individual values of each variable. The R^2 of rank order on socioeconomic variables plus program effort with CBR declines is .82. The Beta coefficient for socioeconomic factors is .23 and for program effort, .75. Each contributes to the overall result, but in different degree; and the relative contributions to the discerned association are consistent throughout.

If we start with the R^2 for the seven socioeconomic variables and CBR decline, in the traditional way, we then add about 25 percent to explained variance when we add program effort (i.e., from .66 to .83). The analysis indicates that both social setting ("modernization") and program effort make a difference and that program effort adds substantially to fertility decline when combined with the social variables.

A replication of the regression analysis of similar character reported in an earlier study,[35] based on the same general concepts but utilizing data for fewer countries (3 social setting indicators and 29 countries in the earlier study, compared with 7 social setting indicators and 89 countries in this study for which data were available on all seven socioeconomic variables) and dealing with a different period (1960–73), provides an interesting comparison:

Variable	Percent of CBR decline associated with variable	
	Freedman and Berelson	This study
1. Social setting alone	51.3	66.1
2. Program effort alone	60.7	78.5
3. Social setting and program effort	68.1	83.1
4. Net effect of social setting (3 — 2)	7.4	4.6
5. Net effect of program effort (3 — 1)	16.8	17.0
6. Joint effect (3 — [5 + 4])	43.9	61.5

Although the values are somewhat higher in the present case, the pattern is on the whole the same: substantial joint effect and similar contributions from the component elements.

Further Modes of Analysis

The above type of correlational analysis, as shown in the literature review, is commonly used. In addition, we utilized other modes of analysis to explore specific aspects of the intricate relationships among demand, supply, and fertility decline.

Path Analysis. This procedure, itself a type of regression analysis, allows us to explore the consequential question: To what extent is program effort itself a function of modernization, of the socioeconomic factors used in the analysis? Program effort is significantly affected by socioeconomic development; the seven demand variables produce a multiple R^2 of .60 with program effort as the dependent variable. Thus, 60 percent of the variance in program effort is "explained" by socioeconomic factors, with 40 percent left to be accounted for by other considerations.

A convenient way of showing the interrelationship among the socioeconomic factors, program effort, and CBR decline is path analysis. In the following model we assume that both social setting and program effort exert a direct impact on fertility decline and that the socioeconomic factors themselves influence program effort.

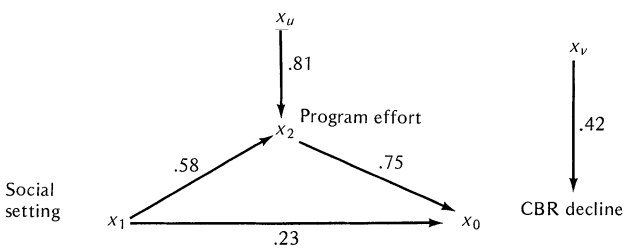
Path analysis is a statistical model in which "each dependent variable must be regarded explicitly as *completely* determined by some combination of variables in the system. In problems where complete determination by measured variables does not hold, a residual variable uncorrelated with other determining variables must be introduced."[36] A path coefficient is the Beta coefficient in a regression analysis and "gives the expected effect of a change in one standard deviation in the explanatory variable (holding other variables constant); this expected change is expressed in terms of the standard deviation of the predicted variable."[37]

In order to use path analysis we must select a given variable or combine the socioeconomic variables into a single variable—in this case our index of social setting. For convenience we label CBR decline as variable 0, social setting as variable 1, and program effort as variable 2. The correlations and path coefficient values for these variables are:

Variables	Correlation coefficient	Path coefficient
01 Crude birth rate decline and social setting	.67	.23
02 Crude birth rate decline and program effort	.89	.75
21 Program effort and social setting	.58	.58

It should be noted that the R^2 between the socioeconomic variables and CBR decline decreases from .66 to .44 when the seven factors are collapsed into a single variable.[38]

In the graphic presentation of path analysis below, the arrows indicate the assumed direction of effect, with the vertical arrows indicating unexplained or residual effects.



According to this model, program effort has more *direct* effect on CBR decline (.75) than do the socioeconomic variables (.23). But this understates the total effect of the socioeconomic variables inasmuch as they also operate through program effort. Their indirect effect is estimated by multiplying the path value from demand to program effort, expressed as p_{21} (with a value of .58) by p_{02} (with a value of .75), or .44. Thus, the combined direct and indirect effect of the demand variables is .23 + .44, or .67. The diagram shows the direct effect of program effort (.75), but its total effect is given by the correlation coefficient of program effort and CBR decline, .89; thus, the joint and indirect effect of program effort is .14 (.89 — .75). Again, both factors are important, but in this analysis two-thirds of the total effect of social setting is filtered through program effort, and the total effect of program effort is more than that of social setting in a ratio of 89:67, or 4:3.[39] It is worth noting that the path coefficients of unexplained variance are significant, .42 for CBR decline and .81 for program effort. Thus a considerable part of program effort is not associated with socioeconomic status, important though those variables are.

Interaction Effects. To the best of our knowledge, there is no wholly satisfactory way of disentangling the interaction effects of socioeconomic variables and program effort on fertility decline, although we sought to estimate separate effects by using various methods.

Another approach is to estimate the interrelationship between 1960 socioeconomic values and the 1955–65 CBR decline, and to use the Beta coefficients generated by that analysis to predict the effect of 1970 values on the 1965–75

CBR decline. (For data on socioeconomic variables in 1960, see Appendix D.) The R^2 between the seven variables, using 1960 values, and the 1955–65 CBR decline is 0.57, but this association is based on only 38 cases because of lack of data. (We can increase the number of cases by dropping variables with the smallest number of countries with available data, but at the expense of the R^2 value.) Using the Beta values generated with this analysis, and substituting 1970 values, the R^2 between socioeconomic variables and the 1965–75 CBR decline is 0.53 for the same 38 countries. If the analysis is extended to all countries for which data are available in 1970, the number of cases is increased to 89, and the R^2 decreases to 0.47. The addition of program effort raises these last two R^2's to .78 in each case. Thus, this approach suggests that socioeconomic variables were somewhat less closely associated with fertility declines before family planning programs were organized than was the case after they were organized. We interpret these findings as another indication of the importance of the interrelationship between program effort and socioeconomic setting.

Change Analysis. On the hypothesis that it is the change in the socioeconomic variables over time that makes for fertility reduction rather than their state at a given time (in our case, the mid-point of the period, circa 1970), we undertook analysis of changes[40] of the following character:

Literacy: percentage increase 1960–70

Education: proportionate increase in the percentage enrolled in primary and secondary schools 1960–70

Life expectancy at birth: percentage increase 1960–70

Infant mortality: percentage decline 1960–70

Nonagricultural labor force: percentage increase for males aged 15–64 1960–70

GNP per capita: annual percentage increase in GNP per capita 1965–70

Urbanization: proportionate increase in percentage of population living in cities of 100,000+ 1960–70

These data are unfortunately not complete. We have data for as few as 57 countries (for the 1960–70 percentage decline in infant mortality) to all 94 countries (for percentage change in life expectancy and males aged 15–64 employed in the nonagricultural labor force). (For data, see Appendix E.) But for only 35 countries are there data for all seven of the variables (see Table 10). The multiple correlation for those seven changes with CBR decline is .74, and the R^2 is .55; if program effort is added, the multiple R^2 becomes .84. As is readily noted, the change values alone are slightly smaller than those produced by the initial analyses in which the same factors were measured circa 1970, but of course there is some selectivity in the countries for which values are available for all the factors.

TABLE 10 Program (supply) variable and change in socioeconomic (demand) variables as predictors of crude birth rate declines: 94 developing countries, 1965–75

	Multiple regression					
Item	*1*	*2*	*3*	*4*	*5*	*6*
Multiple R	.74	.92	.69	.53	.66	.30
Multiple R^2	.55	.84	.48	.29	.44	.09
Socioeconomic (demand) variable	*Beta coefficients*					
Proportion increase in adults literate	.20	.18			.33	
Proportion increase in primary and secondary enrollment	—.01	—.00	—.03	—.05	.02	.10
Percent change in life expectancy	—.32	—.17	—.44	—.33	—.32	—.28
Percent decline in infant mortality rate	.39	.13	.32			
Increase in percent males aged 15–64 in nonagricultural labor force	—.09	—.11	.02	—.01	—.13	.05
Annual percent increase in GNP per capita, 1965–70	.16	—.09	.16	.30	.23	
Proportion increase in population in cities of 100,000+	.04	.08	.15	.22	.07	
Program (supply) variable		.71				
Number of cases	35	35	46	69	52	86
Degrees of freedom	27	26	39	63	45	82
F-statistics	4.736	17.231	5.884	5.037	5.900	2.783
Significance level: P = <	.05	.01	.05	.05	.05	N.S.

If we use change in six factors (omitting literacy), the number of cases increases from 35 to 46 but with a loss in the association (multiple R^2 of .48); with five factors (also omitting infant mortality), the number of cases is increased to 69, but the multiple R^2 drops to .29; with only three or four change measures, the number of cases can be increased to 85–91, but the multiple R^2's decrease to values of .09–.41, far below the corresponding R^2's for the measures as of 1970.

In general, the countries with better statistical systems and available data tend to be countries that are relatively more advanced than the others in the developing category. (For example, the unweighted average CBR decline for the 35 countries is 16 percent as against about 11 percent for the others.) The two factors with the smallest number of cases are change in infant mortality and change in percentage literate, and both have a moderately high correlation with fertility decline. Overall, this analysis suggests that changes in the social factors have almost as much explanatory power as do the 1970 levels, but lack of data prevents a definitive analysis.

Lag Analysis. It is often put forward that whereas socioeconomic factors are prime determinants of the level of fertility, there is a lag of some years between achievement of a given level of socioeconomic status and the reduction of fertility to a corresponding level. The period of that lag is usually unspecified. For our purposes, we also analyzed the relationship between socioeconomic variables in 1960 and the 1965–75 CBR decline.

The R^2 between the seven socioeconomic variables with 1960 values and 1965–75 CBR decline is .72, slightly higher than with 1970 values (.70 for the same 48 countries, .66 for the 89 countries for which 1970 data are available). Infant mortality rates are less available than the other variables for 1960, and if that variable is dropped from the analysis the number of cases increases to 66, but with a slight decrease in the degree of association with CBR decline, to an R^2 of .69. (The association is trivially increased to .70 by using the logarithm of GNP per capita rather than absolute values, and with no loss in the number of cases.) The comparable figures with 1970 values are .70 and .64, for the same 66 countries and for all countries, respectively. If program effort is added to the six socioeconomic variables (omitting infant mortality), the R^2 with the 1965–75 CBR decline is .87. The comparable R^2 using 1970 data, and restricting the analysis to the same countries for which data were available in 1960, is .86 (and .82 for the 89 countries for which data are available in 1970).

The R^2's obtained using 1960 and 1970 values of socioeconomic factors as dependent variables and CBR declines as the dependent variable are almost identical. Thus, this analysis does not provide a basis for choosing between the two theories or hypotheses (lag as against current development). On empirical grounds we have chosen to use 1970 values inasmuch as data are available for a much larger number of countries than for 1960.

Absolute CBR Decline. Some analysts think that percentage CBR declines are less pertinent to both scientific and policy considerations than absolute declines in CBR; they say, for example, that a 10 percent decline in a CBR of 45—4.5 points—is more pertinent than a 10 percent decline in a CBR of 25—2.5 points. Clearly there is a "floor effect" in that wherever CBRs have declined to a low level, further decline is less likely. At the same time, we know that initial fertility declines may be slower and more difficult to achieve than is the case once fertility has dropped, say, into the mid-30s.

Analyses based on the absolute differences between 1965 and 1975 CBRs show about the same relationships as have been presented for percentage declines in CBRs, but with R^2 values being somewhat lower. For example, using 1960 data, the R^2 with the seven socioeconomic variables and absolute change in the 1965–75 CBR is .64 as compared with .72 for the same countries and time period using the percentage decline for 1965–75. If program effort is added to the former multiple correlation, the R^2 becomes .81 as compared with .86 for the latter, a rather small difference. Comparable figures using 1970 socioeconomic values are .61 for absolute CBR decline and .66 for percentage CBR decline and, with the addition of program effort, are .79 and .83, respectively. Thus, the pattern of relationships is quite similar whether the analysis is based on percentage or on absolute CBR declines from 1965 to 1975. Although the R^2s are lower for the latter as compared with the former, the differences are not large.

Correspondence Analysis. We have been impressed with the work of McGranahan and colleagues at the United Nations Research Institute for Social Development (UNRISD)[41] in generalizing the interrelationship of selected socioeconomic variables in the form of a series of "correspondence points." At our request they developed correspondence points for a variety of available factors, including levels of crude birth rates and infant mortality rates, as shown in Table 11.

We appreciate that there is a conceptual problem in using levels of independent variables to explain changes in fertility. But if the model is perfectly general, cross-sectional data for a number of different countries can be viewed as a proxy for a time series for an average country. This correspondence table provides a revealing description of what goes along with what in the process of development, and at what quantitative values, without reference to "cause," only to association. Thus a country with a crude birth rate of 48.5 (first column, Table 11) would be expected to have an infant mortality rate of 161.7, a life expectancy of 41.3 years, more than 90 percent of males in the agricultural labor force, GNP per capita of US$72, and so on. With a crude birth rate of 35 (column 7), the infant mortality rate would be expected to have fallen to 64, life expectancy would have risen to 62.4, well below half of employed males would be working in agriculture, and the GNP per capita would be $465. There is, to be sure, considerable variation in the relationship between any two or more variables for a given country, but the UNRISD analyses for 1960 and 1970 provide an interesting, and we think useful, analysis of the relationship among a number of variables—and, in a general sense, is consistent with our results.

TABLE 11 Index of correspondence among development indicators

Indicators	Index range										
	0	*10*	*20*	*30*	*40*	*50*	*60*	*70*	*80*	*90*	*100*
Crude birth rate	48.50	46.75	44.87	44.79	43.67	40.23	35.04	27.25	20.88	17.15	16.50
Infant mortality rate	161.70	148.60	135.67	125.87	106.84	86.32	64.35	45.47	32.48	21.52	13.86
Life expectancy	41.34	44.10	47.05	48.77	52.48	57.79	62.41	66.87	69.44	71.49	72.94
Animal protein consumption per capita per day	9.68	11.27	11.59	12.41	14.04	18.07	24.01	35.98	45.98	53.36	63.16
Percent literate, ages 15+	23.65	32.31	37.07	39.87	47.75	60.07	72.14	85.04	92.76	97.78	101.11
Percent aged 5–19 enrolled in primary and secondary school	23.50	26.80	31.08	35.67	43.76	50.69	56.49	63.27	69.33	75.15	80.68
Percent of dwellings with electricity	23.18	27.43	33.37	37.20	38.24	46.66	58.61	78.25	93.83	98.92	99.78
Newspaper circulation per 1,000 population	4.79	7.35	11.41	17.61	32.41	55.09	83.69	133.10	208.89	290.55	356.82
Telephones per 100,000 population	136.50	205.82	348.34	607.26	1,088.23	2,011.51	3,768.04	6,768.05	12,193.11	22,482.20	41,192.50
Automobiles per 1,000 population	1.88	3.21	4.81	7.05	8.58	13.22	23.07	46.12	92.52	166.79	299.65
Males in agriculture as percent of total male labor force	91.37	81.85	71.04	64.02	57.22	52.16	42.28	29.68	20.96	13.85	8.29
Steel consumption per capita (kg.)	3.68	5.66	8.63	14.85	26.67	43.56	73.67	143.68	275.05	442.57	571.69
Energy consumption per capita (kg.)	37.15	73.22	118.58	201.02	351.72	524.39	871.88	1,600.78	2,837.27	4,389.17	6,608.19
Percent GDP from manufacturing	9.79	10.16	10.46	11.62	14.47	17.92	19.49	22.22	27.18	30.54	33.26
GNP per capita (US $)	72.00	90.29	117.95	163.10	230.46	304.09	464.77	727.58	1,081.07	1,675.49	2,500.47
Crude birth rate	48.50	46.75	44.87	44.79	43.67	40.23	35.04	27.25	20.88	17.15	16.50

SOURCE: United Nations Research Institute for Social Development.

Special thanks are due D. V. McGranahan and his colleagues at the UnitedNations Research Institute for Social Development for preparing this table.

Moreover, if the "threshold" range for fertility reduction is defined as between the 50 and 70 correspondence lines, representing CBRs of approximately 40 and 27, then there is considerable agreement between this analysis and that summarized from the literature and supporting text for similar factors:

Variable	From summary	From correspondence analysis (CBRs 40 and 27)
Nonagricultural labor force	50–65 percent	48–70 percent
Life expectancy	65 years	58–67 years
Female literacy	65–75 percent	60–85 percent (adult literacy)
Newspaper circulation	70–100	55–133

There are additional overlaps with single studies, for example, infant mortality of 44–78 in the UN analysis and 45–86 in the UNRISD analysis.

Cross-Tabulational Analysis

Let us now look at the relationship between social setting, program effort, and fertility decline within individual countries, with particular reference to the place of family planning programs in fertility decline relative to the social context within which they operate.

Social Setting and Program Effort

We begin with a cross-tabulation of the demand and supply factors as expressed by the indexes of social setting and of program effort previously described (Table 12). Through the number of entries within cells, the tabulation indicates the moderately strong relationship between social setting and program effort, as noted in the correlational analysis. As has been suggested on several occasions,[42] and as we noted in the path analysis above, the social setting as

TABLE 12 1965–75 crude birth rate declines (in percents), by social setting and program effort: 94 developing countries

Social setting	Program effort: Strong (20+) Country	Decline	Moderate (10–19) Country	Decline	Weak (0–9) Country	Decline	None Country	Decline	Total
High	Singapore	40	Cuba	40	Venezuela	11	Korea, North	5	
	Hong Kong	36	Chile	29	Brazil	10	Kuwait	5	
	Korea, South	32	Trinidad and Tobago	29	Mexico	9	Peru	2	
	Barbados	31	Colombia	25	Paraguay	6	Lebanon	2	
	Taiwan	30	Panama	22			Jordan	1	
	Mauritius	29					Libya	—1	
	Costa Rica	29							
	Fiji	22							
	Jamaica	21							
	Mean	**30**	Mean	**29**	Mean	**9**	Mean	**3**	**19**
	Median	30	Median	29	Median	9.5	Median	2	22
Upper middle	China	24	Malaysia	26	Egypt	17	Mongolia	9	
			Tunisia	24	Turkey	16	Syria	4	
			Thailand	23	Honduras	7	Zambia	—2	
			Dominican Republic	21	Nicaragua	7	Congo	—2	
			Philippines	19	Zaire	6			
			Sri Lanka	18	Algeria	4			
			El Salvador	13	Guatemala	4			
			Iran	2	Morocco	2			
					Ghana	2			
					Ecuador	0			
					Iraq	0			
	Mean	**24**	Mean	**18**	Mean	**6**	Mean	**2**	**10**
	Median	24	Median	20	Median	4	Median	1	7
Lower middle	Vietnam, North	23	India	16	Papua New Guinea	5	Angola	4	
			Indonesia	13	Pakistan	1	Cameroon	3	
					Bolivia	1	Burma	3	
					Nigeria	1	Yemen, P.D.R. of	3	
					Kenya	0	Mozambique	2	
					Liberia	0	Khmer/ Kampuchea	2	
					Haiti	0	Ivory Coast	1	
					Uganda	—4	Senegal	0	
							Saudi Arabia	0	
							Vietnam, South	0	
							Madagascar	0	
							Lesotho	—4	
	Mean	**23**	Mean	**14**	Mean	**1**	Mean	**1**	**3**
	Median	23	Median	14.5	Median	0.5	Median	1.5	1
Low					Tanzania	5	Laos	5	
					Dahomey	3	Central African Republic	5	
					Bangladesh	2	Malawi	5	
					Sudan	0	Bhutan	3	
					Nepal	—1	Ethiopia	2	
					Mali	—1	Guinea	2	
					Afghanistan	—2	Chad	2	
							Togo	2	
							Upper Volta	1	
							Yemen	1	
							Niger	1	
							Burundi	1	
							Sierra Leone	0	
							Mauritania	0	
							Rwanda	0	
							Somalia	0	
					Mean	**1**	Mean	**2**	**2**
					Median	0	Median	1.5	1
Mean		**29**		**21**		**4**		**2**	**9**
Median		29		22		2		2	3

defined has not only a direct effect on fertility reduction in increasing motivation for family limitation but also an indirect effect in facilitating the implementation of family planning programs themselves (through better-trained people, facilitating infrastructures, administrative efficiencies, organizational skills, logistic and evaluational capabilities, etc.).[43]

The salient findings of Table 12 are summarized as follows:

1. The relationships of demand and supply to CBR declines are immediately apparent in the marginal figures, with a rather steady progression by demand (social setting) and a sharp break (between moderate and weak) on the supply side (program effort). By this initial measure, both sets of factors matter. Either index alone differentiates fertility decline on these four-point classifications but program effort does so more than social setting (by a factor of 15 as against 10, in the marginals). There is a strong progression from the upper left cell to the lower right, with about 15–20 times as much fertility decline in the former as in the latter, with other values ranging regularly in between.

2. The single cells at upper left and lower right set the upper and lower limits of fertility reduction for developing countries in this period. The upper limit, by category,[44] is about 30 percent, or 10 points, off the CBR. In this analysis the upper left countries had the dual advantages of fast modernization and strong family planning programs. In sharp contrast, the countries in the lower-right cell, with virtually no fertility reduction, had almost no advantages in this respect: little or slow modernization, weak or no family planning efforts.

3. On the whole the intermediate cells reflect the same situation: the layer of countries with a CBR reduction in the 15–30 percent range on average, represented by such countries as Colombia, Chile, Philippines, China, Thailand, Malaysia, and Sri Lanka, is marked by substantial modernization and for the most part moderate family planning programs. And the other cells toward the lower right essentially resemble those in the corner cell: low social setting, weak or no program effort—and, on the whole, small fertility reductions.

4. The only countries with lower middle or low social setting and a fertility reduction above 10 percent, or about 5 points off the CBR, are those with strong or moderate program effort—North Vietnam, India, and Indonesia. Their counterparts, with high or upper middle social setting but with weak or no program effort, had on the average only about one-third as much fertility reduction in this period. This suggests that such countries as Mexico, Venezuela, Brazil, Peru, Zaire, and Ghana could have reduced fertility more sharply with a substantial program effort.

5. The major deviants or "outliers" in this array are three: Iran has "too little" fertility reduction for its location in the tabulation, Turkey and Egypt perhaps "too much." In Iran the actual implementation of the program, as against the policy intent, may be overrated in our index; in Turkey and Egypt the critical factors may be the fast modernization of the former and the unsettled, war-related situation of the latter.

This analysis indicates that the two indexes—social setting and program effort—organize the observed declines quite well.

Qualitative Factors

In addition to the socioeconomic factors we have identified, there are others of a demand character that are often asserted to be associated with fertility behavior, which we briefly note here. They are the ethnic status of a society, island or quasi-island character, and the pace of social change. In order to explore these associations we analyzed the CBR decline in the 94 countries for these factors (see Table 13).

Ethnic Status. Three religious or cultural traditions are associated with higher fertility: Catholic on doctrinal grounds; Muslim through subordination of women in cultural traditions; and black African because of traditional status within the society. Chinese and Chinese-related ethnic groups are associated with lower fertility through pragmatic response to changing conditions.[45]

Island Status. Although often considered as unserious, the notion dies hard that island residence affects fertility[46]—or more precisely, that a community situated and required to live within a restricted space tends to exert a special control over fertility, through the psychology of "being on our own" or "being pushed into the sea" or "having nowhere to go." That response, however, may come not from island residence as such but from the population density associated therewith, for islands are on average relatively densely populated.

Social Change. According to Irene Taeuber, "precipitant social change, disrupted traditions, and cultural shock are more conducive to family restriction than social adjustments that preserve continuities."[47] In the absence of objective indicators of the pace of social change, we identified such countries only on the basis of common knowledge—swift modernization (e.g., Singapore, South Korea, Taiwan), rapid increase of per capita income (e.g., Brazil, Mexico, Venezuela, Jamaica), revolutionary political and social change (e.g., China, Cuba), stress of war (e.g., the Vietnams, Egypt).

In these cases, within the four social-setting categories, there is an additional differentiation by these factors (Table 14): by ethnic status, in which Muslim and black African average declines are uniformly low, Catholic averages are intermediate, and Chinese and other averages are equivalently high; by island and quasi-island status and by density, (which are closely related) with a clear differentiation except at the bottom of the social scale, so perhaps "the psychology of being crowded in" does break through into conscious control of fertility; and by social change, where a fast pace is associated with fertility decline. Moreover, such influences may be shining through Table 12 as well: of the 23 countries in the four upper-left cells, 18 are islands or quasi-islands, 15 experienced fast social change in this decade, and only 1 was Muslim or black African (and it, Iran, was far out of line); of the 43 countries in the lower-right cells, 35 were Muslim or black African, only 4 were islands or quasi-islands, and only 4 experienced fast social change.

TABLE 13 1965–75 crude birth rate decline, ethnic status, island status, density, and pace of social change: 94 developing countries

Country	*1965–75 crude birth rate decline (in percents)*	*Ethnic status*	*Island and quasi-island status*	*1970 population density per sq. km.*	*Pace of social change*[a]
Afghanistan	—2	Muslim	Other	26	
Algeria	4	Muslim	Other	6	
Angola	4	Bl Afr	Other	5	
Bangladesh	2	Muslim	Other	474	
Barbados	31	Other	Island	556	Fast
Bhutan	3	Other	Other	22	
Bolivia	1	Cath	Other	4	
Brazil	10	Cath	Other	11	Fast
Burma	3	Other	Other	41	
Burundi	1	Bl Afr	Other	120	
Cameroon	3	Bl Afr	Other	12	
Cen. African Rep.	5	Bl Afr	Other	3	
Chad	2	Bl Afr	Other	3	
Chile	29	Cath	Quasi	12	Fast
China	24	Chin	Other	79	Fast
Colombia	25	Cath	Other	19	
Congo	—2	Bl Afr	Other	3	
Costa Rica	29	Cath	Quasi	34	
Cuba	40	Other	Island	75	Fast
Dahomey/Benin	3	Bl Afr	Other	24	
Dominican Republic	21	Cath	Quasi	89	
Ecuador	0	Cath	Other	21	
Egypt	17	Muslim	Other	33	Fast
El Salvador	13	Cath	Quasi	164	
Ethiopia	2	Bl Afr	Other	20	
Fiji	22	Other	Island	58	Fast
Ghana	2	Bl Afr	Other	36	
Guatemala	4	Cath	Quasi	49	
Guinea	2	Bl Afr	Other	16	
Haiti	0	Cath	Quasi	153	
Honduras	7	Cath	Quasi	23	
Hong Kong	36	Chin	Island	3,827	Fast
India	16	Other	Other	166	
Indonesia	13	Muslim	Island	63	Fast
Iran	2	Muslim	Other	17	
Iraq	0	Muslim	Other	22	
Ivory Coast	1	Bl Afr	Other	13	
Jamaica	21	Other	Island	172	Fast
Jordan	1	Muslim	Other	23	
Kenya	0	Bl Afr	Other	19	
Khmer/Kampuchea	2	Chin	Other	39	
Korea, North	5	Chin	Quasi	115	
Korea, South	32	Chin	Quasi	312	Fast
Kuwait	5	Muslim	Other	48	
Laos	5	Chin	Other	13	Fast
Lebanon	2	Muslim	Other	237	
Lesotho	—4	Bl Afr	Other	34	
Liberia	0	Bl Afr	Other	14	
Libyan Arab Rep.	—1	Muslim	Other	1	
Madagascar	0	Bl Afr	Island	12	
Malawi	5	Bl Afr	Other	37	
Malaysia	26	Chin	Quasi	31	
Mali	—1	Bl Afr	Other	4	
Mauritania	0	Bl Afr	Other	1	
Mauritius	29	Cath	Island	443	Fast
Mexico	9	Cath	Other	26	Fast
Mongolia	9	Chin	Other	1	
Morocco	2	Muslim	Other	34	
Mozambique	2	Bl Afr	Other	11	
Nepal	—1	Other	Other	80	
Nicaragua	7	Cath	Quasi	15	
Niger	1	Bl Afr	Other	3	
Nigeria	1	Bl Afr	Other	60	
Pakistan	1	Muslim	Other	75	
Panama	22	Cath	Quasi	19	Fast
Papua New Guinea	5	Other	Island	5	
Paraguay	6	Cath	Other	6	
Peru	2	Cath	Other	10	
Philippines	19	Cath	Island	125	Fast
Rwanda	0	Bl Afr	Other	140	

TABLE 13 1965–75 crude birth rate decline, ethnic status, island status, density, and pace of social change: 94 developing countries (continued)

Country	1965–75 crude birth rate decline (in percents)	Ethnic status	Island and quasi-island status	1970 population density per sq. km.	Pace of social change[a]
Saudi Arabia	0	Muslim	Other	4	
Senegal	0	Bl Afr	Other	20	
Sierra Leone	0	Bl Afr	Other	37	
Singapore	40	Chin	Island	3,577	Fast
Somalia	0	Bl Afr	Other	4	
Sri Lanka	18	Other	Island	191	
Sudan	0	Bl Afr	Other	6	
Syrian Arab Rep.	4	Muslim	Other	34	
Taiwan	30	Chin	Island	406	Fast
Tanzania	5	Bl Afr	Other	14	Fast
Thailand	23	Chin	Other	70	Fast
Togo	2	Bl Afr	Other	35	
Trinidad and Tobago	29	Other	Island	186	Fast
Tunisia	24	Muslim	Other	31	
Turkey	16	Muslim	Other	45	Fast
Uganda	—4	Bl Afr	Other	42	
Upper Volta	1	Bl Afr	Other	20	
Venezuela	11	Cath	Other	12	Fast
Vietnam, North	23	Chin	Quasi	133	Fast
Vietnam, South	0	Chin	Quasi	103	Fast
Yemen	1	Muslim	Other	30	
Yemen, P.D.R. of	3	Muslim	Other	5	
Zaire	6	Bl Afr	Other	9	
Zambia	—2	Bl Afr	Other	6	

Bl Afr = Black African.
Cath = Catholic.
Chin = Chinese and Chinese-related.
[a] Blanks indicate pace of change was "not fast."

TABLE 14 Mean 1965–75 crude birth rate declines (in percents) by ethnic status, island status, density, and pace of social change, by social setting: 94 developing countries

Status	Social setting: High	Upper middle	Lower middle	Low
Ethnic				
African		2 (4)	0 (12)	2 (15)
Muslim	2 (4)	9 (8)	4 (4)	0 (4)
Catholic	16 (9)	10 (7)	1 (2)	
Chinese	29 (5)	21 (4)	8 (3)	5 (1)
Other	29 (6)	18 (1)	8 (3)	1 (2)
Island				
Island	31 (9)	17 (2)	9 (2)	
Quasi island	23 (5)	13 (6)	8 (3)	
Other	7 (10)	4 (15)	2 (18)	2 (24)
Density				
High	26 (10)	17 (3)	10 (4)	1 (3)
Medium	21 (5)	15 (11)	2 (7)	1 (6)
Low	12 (9)	3 (10)	2 (12)	2 (14)
Pace of social change				
Fast	26 (15)	20 (5)	12 (3)	5 (2)
Not fast	8 (9)	8 (19)	2 (20)	1 (21)

NOTE: Number of countries is shown in parentheses.

Duration and Type of Program Effort

Our classification of program effort is meant as an average estimate over the duration of the family planning program, within the indicated period. But given the sharp increase in such policies in recent years, the programs analyzed are of varying durations: some were in operation throughout the decade, some for half the time, some only for a year or two. Let us see how that consideration can be taken into account.

A clear correlation between policy duration and program effort is indicated by the tabulation below, which shows the number of countries in each category of program effort by the year in which their policy was established (38 countries had no family planning policy by 1974).[48] The table suggests that it takes five years or more to develop a moderate or strong effort:

Program effort	Number of countries: 1965 or earlier	1966–68	1969–72	1973–74	Mean number of years since policy established to 1975
Strong	8	3	0	0	11.5
Moderate	4	9	2	0	8.3
Weak	5	8	13	4	5.5
Total	17	20	15	4	

A cross-tabulation of duration of family planning policy and CBR decline confirms that it takes at least five years before a program is effective enough to substantially influence the birth rate, as is demonstrated by the data in Table 15.

Because the dates that policies were established may simply reflect differences in social setting, we cross-tabulated social setting and program duration to show mean percentage of CBR declines (with number of countries shown in parentheses, and data grouped for roughly equivalent numbers by column):

Social setting	Mean 1965–75 CBR decline (in percents) and year program established: 1965 or earlier	1966–68	1969–72	1973 or later, and no program
High	30 (8)	27 (6)	14 (2)	4 (8)
Upper middle	20 (5)	11 (9)	6 (5)	3 (5)
Lower middle	13 (3)	5 (4)	–1 (3)	1 (13)
Low	2 (1)	–1 (1)	1 (5)	2 (16)

TABLE 15 1965–75 mean crude birth rate declines and range of declines by year policy was established: 94 developing countries

Year policy established	Country	Mean 1965–75 CBR decline (in percents)	Range of CBR declines (in percents)
1965 or earlier	Hong Kong, Singapore, Taiwan, South Korea, Fiji, China, North Vietnam, Cuba, Tunisia, India, Pakistan/ Bangladesh, Venezuela, Mauritius, Sri Lanka, Turkey, Morocco, Egypt	24.1	1–40
1966–67	Jamaica, Chile, Malaysia, Honduras, Kenya, Nepal, Barbados, Trinidad and Tobago, Colombia, Thailand, Iran, Nicaragua	16.7	—1–31
1968–69	Costa Rica, Panama, Dominican Republic, Ecuador, El Salvador, Guatemala, Indonesia, Ghana, Bolivia, Papua New Guinea	11.1	0–29
1970–71	Philippines, Algeria, South Vietnam, Tanzania, Nigeria, Sudan, Haiti, Afghanistan	3.4	0–19
1972–73	Mexico, Paraguay, Iraq, Zaire, Dahomey/ Benin, Liberia, Jordan, Laos, Mali, Uganda, Khmer, P.D.R. of Yemen	2.5	—4– 9
1974 or later, or no policy	Remaining 32 countries	1.9	—4–10

Within our four categories of social setting, the association with policy (program) duration consistently shows through —and again quite strikingly so given the small numbers involved. Not only did countries in the two higher social setting categories adopt such policies (programs) earlier—58 percent by 1968 as against 20 percent for those in two lower social setting categories—but CBR declines are larger with longer program duration, except in countries with low social setting (see Appendix F).

Next we examine the relationship between program duration and our measure of program effort, in a tabulation similar to the previous one:

Program effort	Mean 1965–75 CBR decline (in percents) and year program established: 1965 or earlier	1966–68	1969–72	1973 or later, and no program
Strong	29 (8)	27 (3)		
Moderate	24 (4)	20 (9)	20 (2)	
Weak	10 (5)	3 (8)	1 (13)	6 (4)
None				2 (38)

Here again the findings are striking: duration consistently matters; there are only two strong or moderate programs established as late as 1969 (Philippines and Panama); most weak programs have little impact even with long operation (e.g., Pakistan/Bangladesh, Morocco, Kenya). Indeed, only three weak programs of long duration are in countries with CBR declines of over 10 percent—Egypt, Turkey, and Venezuela.

Family planning programs may be differentiated not only by level of program effort and duration, but by the objectives of the program. By a traditional classification, programs can be grouped into two categories, according to the nature of the population policy they are intended to implement: (1) "official policy to reduce the population growth rate. In addition to supporting family planning to implement this policy, countries in this category also support family planning for reasons of health and as a human right;" and (2) "official support of family planning activities for other than demographic reasons. Countries in this category usually support family planning for reasons of health and as a human right, but any antinatalist effect is a by-product, not an objective."[49] Grouping countries by this classification demonstrates an even sharper correlation with program effort:

Program effort	Number of countries and family planning policy: To reduce population growth rate	For other than demographic reasons	No policy and policy unknown
Strong	9	2	0
Moderate	12	3	0
Weak	10	20	0
None	0	30	38
Total	31	25	38

About two-thirds of the countries with policies to reduce population growth have either strong or moderate programs as against less than one-fifth of those with policies adopted

for other than demographic reasons. Demographic motivation for policy appears to make a substantial difference in the degree of implementation of program effort. Here too, the stronger policy position is associated with CBR decline, when social setting is controlled:

	Mean 1965–75 CBR decline (in percents) and nature of family planning policy		
Social setting	*To reduce population growth rate*	*For other than demographic reasons*	*No program and unknown*
High	28 (11)	21 (7)	3 (6)
Upper middle	15 (14)	4 (6)	2 (4)
Lower middle	7 (4)	4 (8)	2 (11)
Low	1 (2)	1 (4)	2 (17)

Only a high social setting substantially overcomes the weaker policy position; and in the lower right-hand combinations of the tabulation, as demarcated, little CBR decline occurs.

As we have noted, social setting and program effort are themselves correlated: 41 of the 94 countries fall on the diagonal of this classification, and thus provide no independent information on the relative impacts of the two sets of factors. How does the cross-tabulation look without them —that is, when limited to countries differentially located on the demand and supply sides as measured? The mean percentage declines for the countries that remain are:

	Mean 1965–75 CBR decline (in percents) and program effort				
Social setting	*Strong*	*Moderate*	*Weak*	*None*	*Total*
High	X	29	9	3	13
Upper middle	24	X	6	2	6
Lower middle	23	14	X	1	5
Low	—	—	1	X	1
Total	24	25	5	2	

Note that the differential effect of program effort remains—essentially between the upper and lower half—but that the effect of social setting is somewhat attenuated. We have boxed the combinations that yield essentially similar CBR declines; in this complex tabulation of several variables across many developing countries, only three such combinations remain when the diagonal cases are removed—with average CBR declines of about 27, 8 and 2 percent.

In a further compression, which minimizes borderline problems of classification on both sides of the table, we show the same countries (diagonals removed) reduced to a 2 × 2 array:

	Mean 1965–75 CBR decline (in percents) and program effort		
Social setting	*Strong and moderate*	*Weak and none*	*Total*
High and upper middle	28	5	10
Lower middle and low	17	1	3
Total	22	3	

Here the differential impact is even more striking: a ratio of about 7:1 for program effort as against 3:1 for social setting, or a CBR decline three times as great in low setting/high effort countries as in high setting/low effort countries (17 percent as against 5 percent). In short, with the diagonal countries removed the relationship of program effort to CBR decline by no means disappears: it remains strong, and indeed stronger than social setting.

An Exploratory Analysis—by Zenas Sykes*

We shall examine in detail the distribution of the declines in CBR from 1965 to 1975 (which we refer to more simply as "the data") and try to explain the observed distribution in terms of the contribution of social setting, program effort, and their interaction. The analysis will be carried out using methods developed primarily by Tukey.[50] In these procedures, the median is used as a measure of location and the midspread (the length of the interquartile range) as a measure of dispersion; goodness of fit is measured by the sum of residuals (deviations), without regard to sign, from fitted values rather than by the sum of squared residuals. We follow Tukey in defining an "outlier" as a data point that lies more than 1.5 times the midspread away from the ends of the midspread. Where residuals are normally distributed, this definition leads to classifying as outliers observations that lie more than 2.7 standard deviations from the mean; that is, only those observations in the extreme 0.35 percent of each tail of the distribution. Outliers more than three times the midspread away from its ends will be called "far out."

"Stem and Leaf" and "Schematic" Plots. The data of Table 12, which show values of CBR decline for all the countries studied, as well as median declines by cell, by row, by column, and overall, are displayed graphically in Figure 3. In this figure, we illustrate the two kinds of display that will be used in the remainder of this section—the "stem and leaf" plot and the "schematic" plot. A stem and leaf plot is a modification of the usual histogram that compactly shows both frequencies and actual values of the data, thus providing both a graphical summary and convenient calculation of median and midspread. The "stem" is the left-most column, while the "leaves" are the numbers to the right of the vertical bar. The stem gives the range, in this case the first digit of each value, and the leaves the second digit of the values. Thus, for example, the third line from the top in the stem-leaf plot in Figure 3 lists the three values 30, 31, and 32 as lying in the range 30–34 (3 begins the range 30–34, while 3. begins the range 35–39); these are the values for Taiwan, Barbados, and South Korea, respectively. The distribution is summarized by the values given for the median and midspread and by identification of the outliers, or alternatively in the schematic plot (bottom section of Figure 3). The "box" shows the length of the midspread, and the vertical

* The preceding analysis omitting the diagonals was done under the tutelage of Professor Zenas Sykes, School of Hygiene and Public Health, The Johns Hopkins University, who reviewed an early draft of this material. Professor Sykes became interested in the Table 12 distribution and, with our encouragement and gratitude, he prepared an analysis of the data using the techniques of "exploratory data analysis." We consider that analysis as a major, and new, contribution to the field, and we include it as a complete unit at this point.

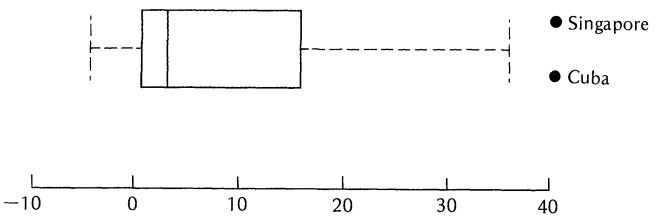
FIGURE 3 Stem-leaf and schematic plots of crude birth rate declines shown in Table 12

Stem-leaf plot (N = 94)

```
  4 | 00
 3. | 6
  3 | 012
 2. | 569999
  2 | 11223344
 1. | 66789
  1 | 0133
 0. | 5555555667799
+0 | 00000000000001111111112222222222222333334444
—0 | 11122244
```

Median = 3
Midspread = 15
Outliers: Singapore (+), Cuba (+)

Schematic plot



line through it gives the location of the median. The dashed lines (or "whiskers") on either side of the box terminate at the largest data point that is not an outlier. Outliers are shown as colored dots, beyond the whiskers, with country names. Black dots indicate "far out" observations. (These appear in Figure 5.)

The distribution shown in the stem-leaf plot in Figure 3 appears to be bimodal, with a major peak around 0 and a minor one in the low 20s. In fact, we can visualize the aggregate distribution as the sum of two symmetric component distributions centered at these modes.

Stem and leaf plots for the four rows and four columns of Table 12 appear in Figure 4. Examination of the first two panels (and perhaps the third) in the stem-leaf plots by social setting in Figure 4 (top section) reveals that the distribution of the values in the first two rows repeats the bimodality found in the aggregate distribution (Figure 3) and suggests that distinguishing countries by row classification (social setting) will not take us very far in explaining the aggregate distribution. By contrast, a combination of the plots of columns 1 and 2 (program effort; see Figure 4, bottom section) yields a distribution very close to the component distribution centered in the 20s in Figure 3 and combining columns 3 and 4 yields a distribution concentrated around zero. Thus, from this cursory review of the data we are led to believe that strength of program effort is the more important variable in analyzing the CBR declines.

Linear Models. In the remaining analysis we shall try to quantify this impression by fitting several linear models to the data as they are classified in Table 12. Our examination will move from aggregate effects to classification effects (i.e., social setting and program effort), and then to consideration of both effects simultaneously. We shall evaluate the quality of the fit by examining both the sum and distribution of the residuals: in a perfect fit, each residual would be zero, and what we shall look for is a fit with residuals distributed symmetrically around zero, and with a small dispersion, as measured by the midspread. To provide a convenient basis for comparison, the results are summarized in Table 16 and Figure 5.

First, we need base lines. The simplest model is to represent all 94 points (countries) by the overall median value of 3; that is, we compute residuals by subtracting the median value of 3 from each observation. This fit provides an upper base line with a sum of residuals, ignoring sign, of 759. A schematic plot of the resulting residuals appears at the top of Figure 5.

FIGURE 4 Stem-leaf plots of crude birth rate declines shown in Table 12 by level of social setting and program effort

By level of social setting

Row 1 High (N = 24)		*Row 2 Upper middle (N = 24)*	*Row 3 Lower middle (N = 23)*	*Row 4 Low (N = 23)*
4	00			
3.	6			
3	012			
2.	59999	6		
2	122	1344	3	
1.		6789	6	
1	01	3	3	
0.	5569	6779	5	5555
+0	122	00222444	00000001111223334	0000011112222233
—0	1	22	44	112

By level of program effort

Column 1 Strong (N = 11)		*Column 2 Moderate (N = 15)*	*Column 3 Weak (N = 30)*	*Column 4 None (N = 38)*
4	0	0		
3.	6			
3	012			
2.	99	5699		
2	1234	1234		
1.		689	67	
1		33	01	
0.			5566779	555559
+0		2	000000111222344	00000000111111222222222333344
—0			1124	1224

TABLE 16 Summary statistics for distribution of residuals from different fits

Fit number	*Type of median removed*	*Percent reduction in sum of residuals*		*Sum of residuals*	*Average residual*	*Median*	*Midspread*	*Number of outliers*
		Base = 0	*Base = 251*					
1	Total (overall median in Table 12)	na	na	759	8.1	0	15	2
2	Social setting only (row medians in Table 12)	23	34	587	6.2	0	6	19
3	Program effort only (column medians in Table 12)	57	85	326	3.5	0	5	5
4	Dichotomous program effort (strong or moderate versus weak or none)	55	81	345	3.7	0	5	7
5	Social setting and program effort (cell medians in Table 12)	67	100	251	2.7	0	3.5	10
6	Additive fit to Table 12	62	93	287	3.1	0	3.5	9
7	Collapsed (2 × 2) social setting and program effort	61	91	297	3.2	0	4	6
8	Additive fit to collapsed (2 × 2) version of Table 12	60	89	307	3.3	0	4	7

na = not applicable.

A natural lower base line for the sum of residuals is zero, attained for any model that fits the 94 data points exactly. How well does the classification scheme of Table 12 work relative to the zero base line? Computing country residuals from cell medians, we get a sum of 251. Thus, the classification by social setting and program effort "explains" some 67 percent [(759 −251)/759] of the residuals from the overall median. (In terms of squared residuals, the reduction is 89 percent from those around the overall median.) Examination of the fifth schematic plot in Figure 5 shows a symmetric distribution of residuals centered at 0 and with a midspread of 3.5, but with 10 outliers. These 10 CBR declines account for 103 (or 41 percent) of the total sum of 251; if they had the same average absolute residual as the remaining 84 countries (1.76), the total would be 166. This last figure is a reasonable "noise" level for these data, and implies that close attention should be given the 10 outlier countries in attempting a fuller explanation of observed CBR declines.

We can also use these residuals to define an alternative lower base line for the explanatory power of the other models we wish to fit to the data. A "perfect" fit for the cross-classified data could generate only the values of cell medians (in which case there would be zero residuals from these medians); there would remain, however, individual country residuals around the median for the cell in which the country lies. Hence, an appropriate lower base line is provided by the distribution of residuals from the cell medians. The sum of the residuals, without regard to sign (251), provides a measure of what a "perfect" fit would be. The difference between this sum and that for the upper base line (759 −251 = 508) is the largest reduction that can be achieved. In the sequel, we shall compare results of our fitted models both to this base line and to the zero base line.

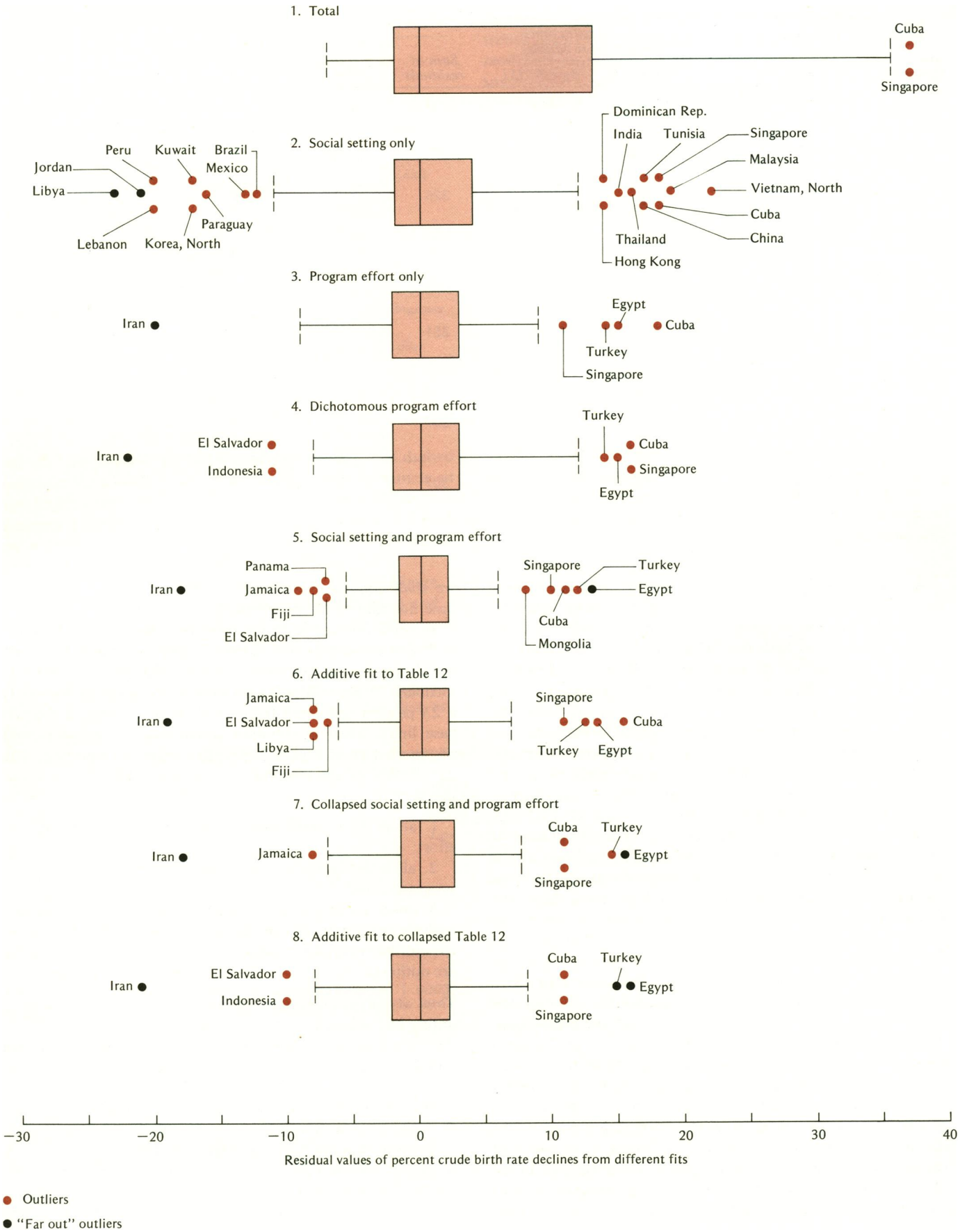
We now proceed to fit the two main effects—social setting and program effort—separately. First, we model the data on social setting and calculate country residuals from the row medians. These residuals sum (forgetting sign) to 587, only a 23 percent reduction from 759 (or 34 percent of the cell base line). Their distribution is summarized in the second schematic plot of Figure 5. This fit produces 19 outliers. The distribution of these outliers by cell of Table 12 is interesting in that:

1. all positive outliers have moderate or strong program effort;
2. all negative outliers have weak or no family planning programs; and
3. positive outliers are found in each row, while negative outliers are found only in the first row, and indeed all countries in the two right hand cells of row one except Venezuela are outliers.

Thus, atypically large declines in CBR are found in each social setting but only where there is substantial program effort. On the other hand, atypically small declines are found only where social setting is high and program effort is weak or absent.

Our next fit is based on program effort only. After subtracting from each observation the median observation for the column in which the country lies, the residuals are summarized on the third plot of Figure 5. This fit yields a large reduction (57 percent of the total) in the sum of residuals and leaves only five outliers. Combining this figure with those for cells (67 percent) and for rows (23 percent), we calculate easily that, with this measure, program effort is some-

FIGURE 5 Schematic plots of residuals for different fits



where between 1.9 (44/23) and 5.7 (57/10) times as important as social setting in "explaining" the data. A calculation analogous to that used in regression gives:

Social setting	.67 − .57 = .10
Program effort	.67 − .23 = .44
Interaction (subtraction)	.13
Total	.67

so that program effort appears 4.4 times as important as social setting.

Median Polish. We now fit row and column effects simultaneously, using the technique of "median polish" as described by Tukey. This procedure leads to a fit for each cell of the form

$$\text{fit} = \text{all} + \text{row} + \text{column},$$

with

$$\text{data} = \text{fit} + \text{residual}.$$

For purposes of this analysis it is convenient to merge the third and fourth rows of Table 12 in order to avoid problems with missing values in the bottom left cells. A glance at the entries in these two rows should make it clear that we are not losing any explanatory potential by combining them.

In median polish, we first remove row medians from the data, then remove column medians from the resulting residuals, and so on. The results of applying this technique to the data are shown below:

A. Effects and residuals

1	4.5	2.5	−5	5
−1.5	−1	.5	−2.5	1.5
0	−4	−1	.5	−1
21	16.5	−1	−1	3

B. Effects and fitted values

29	24.5	7	7	5
25.5	21	3.5	3.5	1.5
23	18.5	1	1	−1
21	16.5	−1	−1	3

In panel A the results are shown in a standard form suggested by Tukey: the overall effect (a CBR decline of 3) in the lower right corner, row effects (+5 for countries with the highest social setting and −1 for those with the lowest) in the right-most column, column effects in the bottom row, and median residuals from this fit by cell in the body of the table (above and to the left of the solid lines). The maximum effect for social setting is 6, while that for program effort, 22, is almost four times greater.

Each median in the body of Table 12 (for example, the entry in the fourth column of the first row) is the sum of the overall effect, the appropriate row and column effects, and the cell residual (2 = 3 + 5 − 1 − 5). Fitted values for the cell medians are given explicitly in panel B. The fitted values for the cells may be calculated by adding to the overall effect in this panel the appropriate row and column effects given there and in panel A.

The 12 residuals of panel A merit further comment. The three largest in absolute value (4.5, −4, and −5) are close to the maximum effect of social setting. Their location in the table indicates interaction between row and column effects—the positive residual is in the upper left of the table, while the two negative values lie in the upper right and lower left sections. Thus, if we travel upward in the fourth column to the highest level of social setting, we do not do nearly as well as we should expect from the fit (in fact, we do only two-sevenths as well). Similarly, if we move across the bottom row we do not do as well with a moderate family planning program as the fit suggests, while if we move to a moderate effort and high social setting we get about 18 percent more decline in CBR than the fit would suggest.

If we now turn our attention to the residuals from the fitted cell medians for the 94 individual countries, we find that the sum of residuals has been reduced to 287, some 93 percent of the maximum possible reduction from 759 to 251. It is pleasing that the distribution shown in Figure 5 (the sixth) is fairly symmetric around zero, that the midspread is small, and that there are only four outliers. All things considered, we are reasonably happy with this fit, although we shall see shortly that we can do as well with a further collapsed version of Table 12.

Our finding, that countries with substantial program effort have experienced CBR declines three or four times as great as those with high social setting, results primarily from the difference between column effects for the first two and the last two columns. If we turn our attention to the first two columns of Table 12 alone and carry out the analysis, the opposite conclusion is reached: with a move to high social setting, the fitted CBR decline (9 points) is one-and-a-half times as great as the 6-point difference between column effects for countries with moderate and strong program effort.

Collapsed Cross-Classification. The results up to now have shown that CBR declines are associated either with moderate or strong program effort or with high social setting. We therefore collapsed Table 12 to reflect this dichotomous classification of countries by both social setting and program effort, with the resulting median crude birth rate declines:

	Program effort		
Social setting	*Strong or moderate*	*Weak or none*	*Row total*
High	29 (14)	5 (10)	22 (24)
Other	20 (12)	1.5 (58)	2 (70)
Column total	24 (26)	2 (68)	3 (94)

NOTE: Number of countries is shown in parentheses.

Country deviations from cell medians in this 2 × 2 table sum to 297, or 61 percent of the sum of residuals from the overall median. This compares favorably with the 67 percent reduction achieved with the full classification of Table 12. The fit to these data, given below, indicates again that program effort is relatively 3.7 times as important as social setting:

A. Effects and residuals

0	−2	5
−3	.5	−1
21	−1	3

B. Effects and fitted values

29	7	5
23	1	−1
21	−1	3

Residuals from fitted values, summarized at the bottom of Figure 5, sum to 307, or 89 percent of the maximum achievable. Clearly, this model fits the 2 × 2 data table almost perfectly, and does quite well in summarizing the full Table 12.

A final simplification, suggested by our finding that the distribution of CBR declines could be represented as the sum of two component distributions, is to fit only the column dichotomy above. This yielded a sum of residuals of 345, so that this simple fit would be sufficient for many purposes. It stresses again that CBR declines are associated primarily with substantial (moderate or strong) program effort.

The adequacy of the various fits we have described to explain the data is summarized in Table 16 (and in Figure 5).

Testing Classification Rules. Thus far we have been concerned with assessing the relative importance of program effort and social setting insofar as they are associated with observed CBR declines. Both as a partial test of our findings and possibly to throw further light on these interrelationships, we now examine briefly the inverse question: given a CBR decline, how well can we classify the country by social setting and/or program effort?

All classification rules considered here are based on the distribution of CBR declines shown in the top section of Figure 3; the rules are applied either to row or to column classification alone. Countries were first classified dichotomously by column based on several splits in the distribution of CBR declines. Corresponding attempts at classifying countries by row were also made, and the results in each case assessed by tabulating the entries in a 2 × 2 table that shows the numbers of countries correctly and incorrectly classified; diagonal entries in the table show countries correctly classified, and off-diagonal entries those incorrectly classified. Consider, for example, the results of classifying a country with a CBR decline of 10 percent or more as having strong or moderate program effort and those with a decline of less than 10 as having either a weak program effort or no program. The numbers of countries so classified are shown in the row totals of the table below:

Number of countries classified in	Number of countries actually in: Columns 1–2	Columns 3–4	Total
Columns 1–2	25	4	29
Columns 3–4	1	64	65
Total	26	68	94

Thus, 29 countries had CBR declines of 10+ and therefore were classified as belonging to columns 1 and 2; 65 countries were similarly classified in columns 3 and 4. However, of countries having a CBR decline of 10+, 25 are found in columns 1 and 2, whereas 4 are found in columns 3 and 4. Thus, 25 were classified correctly and 4 incorrectly. Analogously, only 1 of the 65 countries assigned to columns 3 and 4 was incorrectly classified, giving a total of 5 errors with this rule. Note that while 29 countries actually had CBR declines of 10+, only 26 countries were judged to have moderate or strong program effort. Accordingly, we had to make at least 3 errors with this rule; while the table shows that we have misclassified 5 of the 94 countries, it is perhaps more accurate to report 2 errors out of 91.

The numbers below show that applying the same rule to distinguish countries in row 1 from all others would have resulted in 21 out of 94, or in 16 out of 89, errors.

Number of countries classified in	Number of countries actually in: Row 1	Rows 2–4	Total
Row 1	16	13	29
Rows 2–4	8	57	65
Total	24	70	94

Several other splits were tried, with these results:

Split	Total number of errors: Program effort	Social setting	Adjusted error proportion: Program effort	Social setting
10+	5	21	2/91	16/89
13+	3	23	2/93	20/91
14+	5	21	4/93	20/93
16+	6	20	4/92	20/94

In each case, countries with a CBR decline at or above the split shown were assigned to the first two columns (strong or moderate program effort) or to the first row (high social setting). Classification procedures by program effort work far better than those by row. The optimal rule is to classify countries with a CBR decline of 13 or more as having strong or moderate program effort, a procedure that results in classifying 91 of 93 countries correctly (after adjustment for one error necessitated by the data). The split on 10 is almost as good as the optimal rule, classifying 89 of 91 correctly.

For comparison, note that a random assignment to columns or rows (e.g., assigning countries on the basis of a coin toss), which would assume no relationship between CBR decline and a given variable, would produce on average one-half (47) correct assignments. For program effort we classify 98 percent or so correctly, and for social setting about 80 percent; relatively, we do 60 percent better assuming that high CBR decline is associated with high socioeconomic status, and some 95 percent better assuming CBR decline is associated with program effort, than assuming no association.

While our classification results are good, we acknowledge that it is not quite fair to test various schemes using the same countries from which the rules were suggested; a sounder test would be to classify further countries, given only their CBR decline, or to extrapolate these findings to the next ten years or so, with appropriate attention to the fact that some countries are approaching a lower asymptote for rates of CBR decline.

Let us summarize briefly. The record of the period 1965–75 is that large CBR declines in developing countries were strongly associated with substantial program effort, while high social setting was associated with only modest CBR declines, unless linked with significant family planning effort. Cross-classification of countries by social setting and program effort "explained" 67 percent of the observed variability of CBR declines around their median (89 percent if we use squared residuals), and we were able to fit the cross-classified data very well (93 percent of the possible reduction) with a simple additive model. From this model, we estimated that program effort was associated with three to four times the amount of CBR decline associated with social setting. We also found a positive interaction on CBR decline between social setting and program effort.

—Conclusion of Sykes section—

Summary and Conclusions

Let us start with the briefest distillation of our central findings:

Correlation and Regression Analysis

A series of correlations and multiple regressions were performed using various techniques and different sets of data on social setting, program effort, and fertility decline.

Though done in a variety of analytic ways and with different sets of data, these analyses all reveal a quite consistent overall result: the social setting factors, however measured, correlated around .65 with the 1965–75 CBR decline, and program effort adds another .15–.20, or about 25 percent, to the correlations (somewhat more in those analyses with fewer cases).

Major Analysis			*Summary*
1970 socioeconomic factors, program effort, and 1965–75 CBR declines using:		R^2	Analysis found strong association of CBR decline with socioeconomic factors, with even a few socioeconomic variables indicative of the complex whole. Significant additional association was found with addition of program effort (about 25 percent). Most of the effect was found to be joint, essentially in conformity with earlier study by Freedman and Berelson.
From 1–7 socioeconomic factors		.58–.66	
Program effort alone		.78	
Socioeconomic factors plus program effort		.83	
Net effect of social setting	.05		
Net effect of program effort	.17		
Joint effect	.58		
Further Modes of Analysis			
1. Path analysis			
Social setting	.67		A causal model was constructed in which social setting affects fertility decline directly and also through program effort. The indirect effect of social setting was found to be twice as large as its direct effect. The direct effect of program effort is quite large; its indirect effect is modest.
Direct effect	.23		
Joint and indirect effect	.44		
Program effort	.89		
Direct effect	.75		
Joint and indirect effect	.14		
2. Interaction effects			
1960 socioeconomic values and CBR declines, 1955–65 (38 cases)		.57	Analysis assumed relationship between socioeconomic variables and CBR decline is best reflected in Beta coefficients found before family planning programs were significant. Social setting found slightly less important than above; program effort very important.
Using those Beta coefficients:			
1970 socioeconomic values with CBR declines, 1965–75 (38 cases)		.53	
1970 socioeconomic values with CBR declines, 1965–75 (89 cases)		.47	
The last two, plus program effort		.78	
3. Change analysis			
Change in socioeconomic factors, 1960–70 with CBR declines, 1965–75 (35 cases)		.55	Analysis obtained approximately same level of association as using 1970 values, but data availability limits number of cases. Fewer variables permit more cases, but the R^2 values fall.
That plus program effort		.86	
4. Lag analysis			
Socioeconomic factors for 1960 with CBR declines, 1965–75 (48 cases)		.72	Essentially the same correlations were obtained as using 1970 values: for the 48 countries with 1970 data, .70; for the 66 countries adding program effort, .86.
That plus program effort, 1970–72 (66 cases)		.87	
5. Absolute CBR declines, 1965–75			
7 socioeconomic values, 1970 (89 cases)		.61	Results are essentially the same as for percentage decline.
7 socioeconomic values, 1960 (38 cases)		.64	
1970 socioeconomic values plus program effort		.79	

Cross-Tabulational Analysis

Now for the summary of the cross-tabulational analysis of the two indexes for the individual countries:

Social Setting and Program Effort	*Summary*
Differentiation of CBR decline by the two indexes of social setting and program effort in 4 categories each	Both differentiate: social setting by a factor of about 10 in the marginals, program effort by a factor of 15. There was a strong progression from upper left of table (high social setting, strong program effort) to lower right: 15–20 times as much fertility decline was found in the former as in the latter, with other values ranging rather regularly in between. Upper-left and lower-right cells set upper and lower limits of CBR reduction in developing countries for this period: from a high of about 30 percent, or 10–12 points off the CBR, to a low of essentially zero. These are the cells, of course, with the widest disparity in both modernization and program effort (not to mention ethnic differences also involved).
Qualitative factors	With the social setting index controlled, there is a clear relationship between CBR decline and ethnic status of the country (Muslim and African, low; Chinese, high), its island/density status, and its pace of social change.

Supplementary analyses	*Summary (cont'd.)*
Duration of family planning program	The older the family planning program, the larger the CBR decline: countries with programs in place by 1965 had average declines of 22 percent, those with policies established during 1966–68 average declines of 14 percent, and those with policies established later (or not at all) average declines of 0–2 percent.
Nature of family planning policy	Countries with policies to reduce population growth rates averaged about 18 percent in CBR decline; those with family planning programs for other than demographic reasons averaged only about 8 percent CBR decline; and those without programs had almost no fertility decline, perhaps 2 percent.
Exploratory data analysis	Using methods developed by Tukey and applied to the cross-tabulation of CBR declines by social setting and program effort, a special analysis by Zenas Sykes found that both factors are important but program effort "explains" much more of the CBR declines than does social setting, by a factor of about 4.

Accounting for the Fertility Decline

Let us try to take the summary one further step, in view of the policy issues and scientific disputes involved. Precisely how much of the observed fertility decline can be allocated to one or another influence—setting or program—cannot now be said with much assurance, given technical limitations in the state of the art and even basic conceptual differences as to how to go about providing an answer. There is a clear and present danger that even the degree of quantitative specifications we estimate below may be misunderstood, may be "taken too seriously," so we wish to preface the presentation with the caution that we are pushing against the limits of analysis—though these orders of magnitude may not be ludicrously removed from the truth, were that capable of being known.

So how account for the 1965–75 CBR decline? We take off from the way demographers decompose the crude birth rate into three components or major intermediate variables in order to account for fertility change up or down: change brought about by the age structure, by marriage patterns (mainly age at marriage), or by marital fertility itself. During the 1965–75 period, changes in age structure tended to increase the CBR somewhat, perhaps as much as 5–10 percent. Changes in age at marriage were quite significant downward, and, if we generalize from the relatively few countries for which we have adequate data (which are small numerically and unrepresentative as well, as in Table 5), then rising age at marriage accounted for rather more than one-third of the total decline, say, about 40 percent. Changes in marital fertility themselves accounted for the remainder of the decline, that is, about 70 percent.

How do we account for those shifts in magnitudes? Here again, definitive answers are not forthcoming, but some reasonable approximations can be offered based on our study —to be considered not as certain designations but rather as first orders to be tested and refined again, often in specific countries of some size, as we show below:

Major intermediate variables	*Approximate contribution to 1965–75 CBR decline*	*Comment*
Age structure	Slight negative contribution, say —5–10 percent	A single decade is a short time for substantial change in age structure, but because of the high fertility of earlier decades the proportion of married women of reproductive age in the population increased slightly, thus contributing higher fertility, other things being equal.
Marital patterns	Substantial, say 35–45 percent	
attributable to changes induced by social setting	25 percent	Modernization tends to delay marriage; $R^2 = .62$ with our seven social setting variables.
attributable to legal sanctions and organized pressure (i.e., deliberate program), mainly in China	5–10 percent	Assumes that about one-fourth of China's decline comes from this campaign, with a slight addition from Tunisia on marriage age and perhaps one or two other places.
unattributed causes	5–10 percent	
Marital fertility	Major, say 55–70 percent	
attributable to changes induced by social setting in fertility norms and with fertility control services provided from nonprogram sources	40–45 percent	The direct effect of the basic determinants of traditional demographic analysis, that is, the $R^2 = .66$ of the 55–70 percent.
minus a small effect from lessened lactation as a result of increased modernization	—5 percent	Shorter postpartum lactation has a slight tendency to raise fertility; indeed it appears to be the only important proximate determinant of fertility in addition to those mentioned above.[51]
attributable to organized family planning program effort (contraception, sterilization, abortion)	10–15 percent	Total explained minus that attributed to SES × percent due to change in marital fertility (.83 — .66) × (.55–.70).
unattributed	10–15 percent	Unexplained × percent due to change in marital fertility (1.00 — .83) × (.55–.70).

By this sort of accounting, then, the "credit" or source of the fertility decline analyzed here would come down to something like this:

Variable	*Age structure*	*Marital patterns*	*Marital fertility*	*Total*
Social setting		25 percent	40–45 percent — 5 percent lactation = 35–40 percent	60–65 percent
Program effort family planning			10–15 percent + 5 percent spillover = 15–20 percent	15–20 percent
legal sanctions and organized pressure		5–10 percent		5–10 percent
Consequence of earlier demographic trends	—5–10 percent			—5–10 percent
Unknown		5–10 percent	10–15 percent	15–25 percent
Total	—5–10 percent	35–45 percent	60–75 percent	approximately 100 percent

Quickly to repeat, these numbers are by no means precisely nor solidly documented; we have pushed them to their limits, well beyond the scientifically provable, in order to give a general idea of how things stand, given the present state of the art. And this of course refers to the total set of countries; such accounting could be different indeed within individual countries.

Actually, in the way our initial regression analyses were done, the correlation of socioeconomic factors with CBR decline ($R^2 = .66$) was maximized since these factors were considered in that model as prior and given, selected empirically as the most powerful and themselves uninfluenced to any degree by program effort (at least as yet, although such influence is the ultimate objective of program effort). Then the correlation with program effort is residually additional (increasing the R^2 by .17), and it adds far more than any socioeconomic factor beyond the first few in combination. Indeed, the Beta values for program effort are much larger than those for the socioeconomic factors. In other words, its values capture a far higher degree of association with CBR decline than do the socioeconomic factors; this is consistent with the cross-tabulational analysis and, as we shall see, with the predictive potential of the values.

That is what the data show from the standpoint of statistical correlation. Is that "explanation" or, even more, "causation"? This raises muddy and obscure epistemological questions on which qualified men of good will can and do differ in interpretation, and for our part we are almost prepared to leave it at that—except that we are persuaded, to repeat, (1) that the joint effect is more effective than either alone; (2) that program effort makes a substantial difference, not merely a trivial one; (3) that for policy purposes, given the wide disparity in developmental and family planning funding, great precision is not required for economic judgments as to policy; and (4) that from the scientific standpoint, it is in any case not attainable at this time. Further to the questions of precision and causation, deponent sayeth not.

A General Summary for the Policymaker

Finally, if we were asked to summarize the whole exercise for the informed policymaker, rather than the scientist, what would we say? Recognizing that to be a most legitimate responsibility (yet claiming all the caveats we can and referring doubts and criticisms to the academic haven of "need for further research"), our reply would go something like this:

- To begin with, there are of course all sorts of problems with data of this kind. Data on fertility and fertility change are far from adequate, but for some countries the data are quite good and where data are really bad they show no change in fertility anyway. No doubt different analysts would come up with a slightly different set of numbers, but it now seems clear that there have been significant fertility declines —some quite spectacular—in a sizable number of developing countries. The socioeconomic and demographic data are not as complete as we would like, and there are always questions of how accurate they are. We consider that large differences are correctly (if not always precisely) reflected in the data and that small differences don't matter much anyway. Our measure of program effort, centered on a given period in time, is essentially based on the subjective judgments of knowledgeable people, but judgments made on 15 different aspects of the program, some of them objective measures. Again, we are confident that those programs getting high scores are better programs, as these things go, and those getting low scores are less good. In the empirical event, a dichotomy of program effort captures the major discrimination, and program duration does reasonably well by itself.
- We studied 94 developing countries, containing 2.8 billion people or 98 percent of the population of all developing countries. We concentrated on the period 1965–75, during which there was substantial fertility decline in Asia (about 17 percent), quite a bit in the Americas (about 12 percent), but almost none in Black Africa (though Tunisia, Egypt, and Mauritius did have significant declines on that continent). The large countries, those with populations of 35 million or more, showed greater declines than did smaller countries—13–16 percent as compared with 6–7 percent. China affects that average, to be sure, and we may well be underestimating China's decline (we use a CBR of 26 for 1975), but the conclusion remains essentially the same if China is left out of the analysis. Even so, several large countries have had hardly any change and still have high

fertility—Bangladesh, Pakistan, Nigeria—and the changes in Mexico and Brazil are quite recent and still rather small.

- We looked at the data in a variety of ways: simple cross-tabulations of program effort and an index of socioeconomic variables; simple correlations between the variables; multiple regression analyses using both 1970 values of socioeconomic variables and, for the alternative lag theory, the 1960 values; change in the socioeconomic variables over time; a special form of regression analysis called path analysis in which program effort is considered to be partly a function of socioeconomic level; and a relatively new type of analysis called exploratory data analysis.
- From such data and analyses, we found that the level of "modernization" as reflected in our seven socioeconomic factors has a substantial relationship to fertility decline: the better-off countries, particularly those near the top, do better than the less well-off. That was to be expected in sociodemographic theory. But we also find, as a less-expectable finding, that on balance family planning programs have a significant, independent effect over and above the effect of socioeconomic factors. Some of the analyses show program effort to be more important than socioeconomic factors, but even the path analysis, which assumes program effort to be a function of the socioeconomic variables, shows that a good program effort adds substantially to the amount of fertility decline accounted for. Weak programs might as well not exist, so far as fertility reduction is concerned.
- Moreover, the longer a family planning program has existed, the greater its effect (although there are several weak programs that have existed for many years). In addition, countries that have adopted population policies with demographic goals in order to reduce fertility or rates of natural increase have had much more fertility decline than countries with family planning programs adopted only for health or humanitarian reasons or with none at all.
- The key finding probably is that the two—social setting and program effort—go together most effectively. The joint analysis appears to "explain" or predict about 83 percent of the total variance in fertility decline. Countries that rank well on socioeconomic variables *and also* make substantial program effort have on average much more fertility decline than do countries that have one *or* the other, and far more than those with neither. The policy implications are that, if a country wants to reduce its fertility, it should seek a high degree of modernization (which of course all do, and find costly and difficult) and it should adopt a substantial family planning program; for countries at or near the bottom of the socioeconomic scale, however, the results would probably be slight and the administrative implementation very difficult. In such settings it requires a special kind of determination—as found in India, Indonesia, and China in the early to mid-1970s—to implement a strong program effort in a deprived setting. In short, without wishing to be misunderstood, one could conclude that the Bucharest judgment that family planning effort is of little consequence is itself of little consequence.

Some Final Observations

Assuming for the moment that the data are reasonably valid, what is to be made of all our findings as a prediction or "explanation" of the observed fertility declines?

There are still some conceptual issues in assessing determination of fertility trends that remain muddy. If development increases motivation for fertility control, which is then satisfied by a family planning program in the absence of other sources, how is the credit for the subsequent decline to be allocated? What if under the same social conditions the same decline of fertility would appear in the absence of program effort, but only N years later? What if development establishes a general infrastructural capability that then is utilized to launch a strong program effort, which in turn has a demonstrable effect? Questions of this kind are largely bypassed in the current state of the art.

Given the received wisdom, is our result believable—that program effort has a substantial effect on CBR decline? What are the possible explanations for this result? We can identify five, which need not be mutually exclusive but may be supplementary on such a complex matter:

1. There is the technical dismissal—that the finding is based on faulty data, faulty mode(s) of analysis, and/or faulty classifications. That is of course possible, though we have taken what pains we could on all these counts. If this is the fact, however, it would presumably apply equally to formally similar studies in the scientific literature, as cited above—from which the traditional wisdom has itself emerged.

2. It might be that fertility was already declining in countries undertaking family planning programs and that such programs served merely an expediting or facilitating role, not an initiating one. In the absence of program effort, by this argument, equivalent declines would have occurred, but perhaps in a somewhat longer period of time. Unfortunately, social science does not know how to test for the what-would-have-happened-if condition—and not just in this field—but programs, if economic of resources as weighed against alternatives, can be considered effective even if relegated to a facilitating role. And given the power of demographic momentum, expediting a slower rate of growth is itself a valuable product.

3. If it is development or modernization or some traditional component(s) thereof that lead to (account for, determine, cause) fertility decline, such development also generates not only the establishment of family planning policy but the actual implementation of the program; this is the indirect or infrastructural argument. In this view, the programs arise only in order to satisfy the motivation that development itself creates. Here again there is the question of the quantitative allocation of "credit," in magnitude and time (which we have tried to measure, as reported above). If program effort is simply "another" discriminating factor within social setting, then its additional effect as compared to further socioeconomic factors needs to be taken into account, since it is of different magnitude as well as different kind (including legitimation and spillover). Moreover, the cases off the diagonal—for example, India and Indonesia in one direction and Mexico and Brazil in the other—need to be explained in this line of argument.

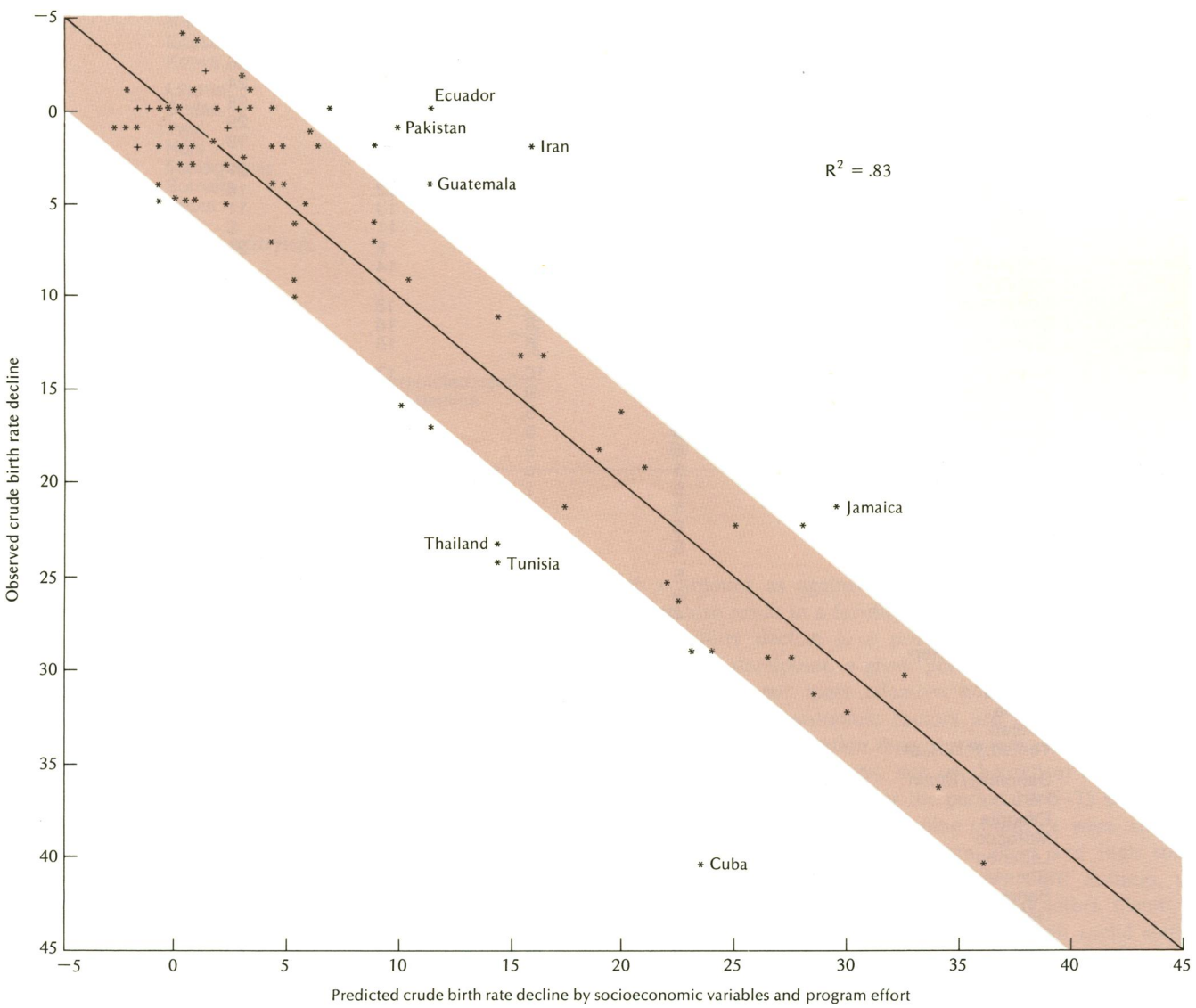
4. Perhaps the determinants of fertility decline, as individually independent, identifiable, and discrete factors, whether of the demand or the supply type, need to give way as concept to the "holistic process" of societal transforma-

tion—in which fertility change goes along with all the other changes in a mutually interdependent manner. In this conception,[52] fertility change is not "caused" by education, urbanization, lowered mortality, women's status, ethnic status, or family planning programs but is part of a whole historical movement in which, as someone has said, everything goes over the dam together. This point of view does some violence to the common-sense view, and still one scientific view, that such changes are somehow individually accountable, and in any case does not make obsolete either the question that some factors are more closely associated with fertility change than others, within the "holistic process," or the policy issues of efficient intervention.

5. Perhaps the finding is correct, and program effort does make a substantial difference to fertility decline over the period of a decade, along with social setting.[53]

We conclude by noting the predictive potential of our analysis—on the ground that prediction has something to do with explanation. The seven socioeconomic factors and program effort together yield a predicted CBR decline quite close to the observed decline (see Table 17 and Figure 6), with an R^2 of .83. Outside the colored band (which includes all cases plus or minus 5 percentage points from perfect correlation) fall only 17 countries, and 9 of them are marginal (i.e., within 6 points of perfect correlation). By this overall measure, the major deviants are Cuba (16 points off), Iran (14), Ecuador and Tunisia (11), Pakistan and Jamaica (9), and Thailand (8). Moreover, as ex-

FIGURE 6 Percent observed and predicted crude birth rate declines, by socioeconomic and program variables: 94 developing countries, 1965–75



NOTE: In this Figure and in Figures 7 and 8, an asterisk (*) indicates that a decline for one country falls at this point and a plus sign (+) indicates that a decline for more than one country falls at this point. In this figure, only those countries that fell 7.5 points off the predicted CBR decline are named.

TABLE 17 Observed and predicted 1965–75 crude birth rate declines: 94 developing countries

Country	Observed crude birth rate decline (in percents)	Predicted crude birth rate decline by (in percents)		
		Socio-economic variables plus program effort	Socio-economic variables	Program effort
Singapore	40	36	26	33
Cuba	40	24	27	19
Hong Kong	36	34	28	29
Korea, South	32	30	19	30
Barbados	31	29	26	27
Taiwan	30	33	27	30
Chile	29	23	20	21
Trinidad and Tobago	29	23	25	19
Mauritius	29	26	23	26
Costa Rica	29	27	21	27
Malaysia	26	23	17	23
Colombia	25	22	18	21
Tunisia	24	15	9	16
China	24	u	u	32
Thailand	23	15	13	15
Vietnam, North	23	u	u	26
Panama	22	25	19	24
Fiji	22	28	24	28
Jamaica	21	30	23	29
Dominican Rep.	21	18	12	18
Philippines	19	21	14	21
Sri Lanka	18	19	23	16
Egypt	17	11	10	11
Turkey	16	10	11	8
India	16	20	8	24
El Salvador	13	17	14	17
Indonesia	13	16	7	18
Venezuela	11	14	18	10
Brazil	10	6	16	1
Mongolia	9	6	15	1
Mexico	9	10	17	6
Honduras	7	9	8	10
Nicaragua	7	5	12	1
Zaire	6	5	4	5
Paraguay	6	9	17	5
Korea, North	5	u	u	1
Papua New Guinea	5	1	3	1
Laos	5	0	1	1
Kuwait	5	6	4	1
Tanzania	5	3	2	5
Cen. African Rep.	5	—1	—2	1
Malawi	5	—1	0	1
Algeria	4	5	7	5
Guatemala	4	11	10	12
Syrian Arab Rep.	4	5	11	1
Angola	4	—1	—3	1
Cameroon	3	1	1	1
Burma	3	3	8	1
Bhutan	3	u	u	1
Yemen, P.D.R. of	3	1	4	1
Dahomey/Benin	3	3	1	5
Peru	2	5	11	1
Ethiopia	2	—2	—2	1
Morocco	2	6	9	6
Lebanon	2	9	21	1
Ghana	2	4	4	5
Bangladesh	2	2	—1	5
Guinea	2	—1	—2	1
Mozambique	2	0	3	1
Iran	2	16	7	18
Khmer/Kampuchea	2	1	5	1
Chad	2	—1	—2	1
Togo	2	0	—1	1
Jordan	1	7	16	1

TABLE 17 Observed and predicted 1965–75 crude birth rate declines: 94 developing countries (continued)

Country	Observed crude birth rate decline (in percents)	Predicted crude birth rate decline by (in percents): Socio-economic variables plus program effort	Socio-economic variables	Program effort
Ivory Coast	1	0	—1	1
Pakistan	1	10	9	11
Bolivia	1	2	5	1
Upper Volta	1	—2	—4	1
Nigeria	1	2	2	4
Yemen	1	u	u	1
Niger	1	—2	—3	1
Burundi	1	—1	—1	1
Senegal	0	0	0	1
Sierra Leone	0	0	2	1
Saudi Arabia	0	—1	—2	1
Vietnam, South	0	2	1	1
Mauritania	0	—2	—1	1
Rwanda	0	—1	—1	1
Ecuador	0	11	16	8
Kenya	0	7	6	8
Liberia	0	3	2	5
Sudan	0	3	4	5
Iraq	0	4	11	1
Haiti	0	3	5	5
Madagascar	0	1	2	1
Somalia	0	—2	—1	1
Nepal	—1	4	—2	8
Mali	—1	—2	—4	1
Libyan Arab Rep.	—1	1	—4	1
Zambia	—2	1	2	1
Afghanistan	—2	1	—2	5
Congo	—2	4	4	1
Uganda	—4	0	4	1
Lesotho	—4	2	3	1
Number of countries with predicted decline over 5 points off observed decline		17	35	23
R of observed with predicted		.91	.81	.89
R^2 of observed with predicted		.83	.66	.79

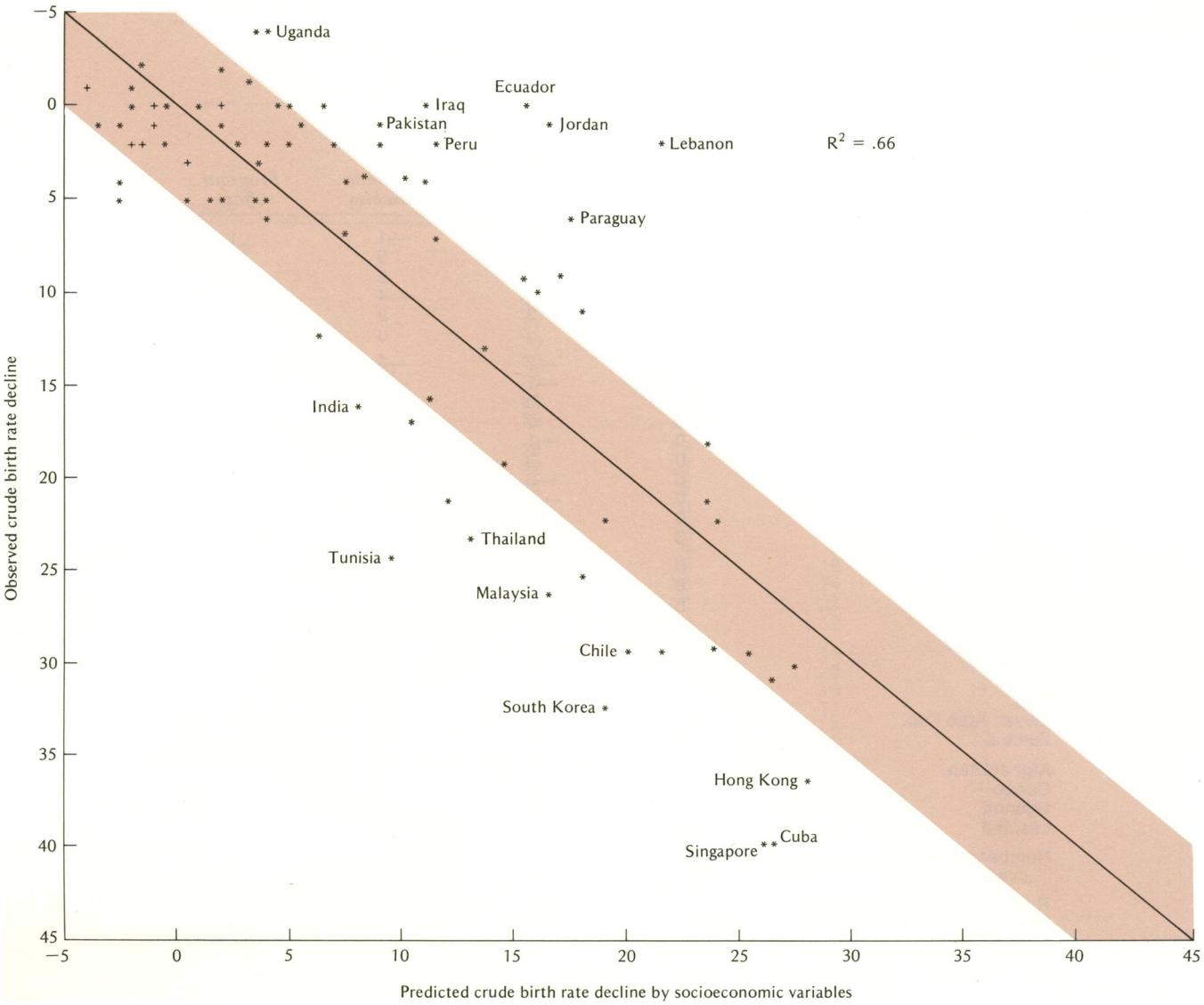
u = unavailable.

pected from both our correlational and cross-tabulational analyses, this combination does substantially better in predicting CBR decline than either the socioeconomic factors or program effort alone, with the latter being more predictive than the former (Table 17 and Figures 7 and 8). As is indicated in the table, twice as many countries fall outside the band when only socioeconomic variables are used as compared with the prediction based on the combination, and half again as many as with program effort alone.

It remains for us to emphasize that throughout this paper we have been concerned with the *effectiveness* of influences upon fertility decline, not with the *efficiency* of policy interventions, defined as effectiveness per dollar of investment. From the policy point of view, it is typically efficiency that is at issue since resources are inevitably limited. In this connection a rational approach to policy would be to ask, for example, how much it would cost to achieve a change in the socioeconomic factors that would result in a fertility decline of x amount as against a change in program effort that would also result in a fertility decline of x amount (assuming that fertility decline is a proximate objective of policy). From this standpoint, a given policy may be most efficient even though not most effective.[54] In the real world, of course, the socioeconomic factors are far more expensive and difficult of realization than is program effort. Policy rests on realizable interventions, not on theoretical explanations.

In any case, the record for the period 1965–75 shows that large CBR declines in developing countries were strongly associated with substantial program effort and high social setting was associated with only modest CBR declines, unless linked with significant family planning effort. Countries with both significant program effort and high social setting had an average CBR decline of about 30 percent; those with only significant program effort, a decline of about 20 percent; those with high social setting alone, a drop of 5 percent; and those with neither, a zero change.

FIGURE 7 Percent observed and predicted crude birth rate declines, by socioeconomic variables: 94 developing countries, 1965–75



If the past record can be extrapolated to the future, a country that wished to reduce its CBR substantially would be well advised to institute a family planning program of at least moderate strength. Given the existence of a moderate program effort, improving social setting takes precedence; but relying only on enhanced social setting would appear to result in a slower decrease in CBR than could be achieved with explicit attention to the intermediate or instrumental variable of fertility control services, as a supplementing and expediting policy measure.

As always in such analyses, one would like to have more complete, more timely, more appropriate, more valid data —not to mention more incisive methods of analysis. But at least we trust that this analysis suggests how the question of international and cross-cultural determinants of fertility decline can be approached at the macro level. To revert to our title, we hope that we have thus illuminated the conditions of fertility decline in developing countries, 1965–75.

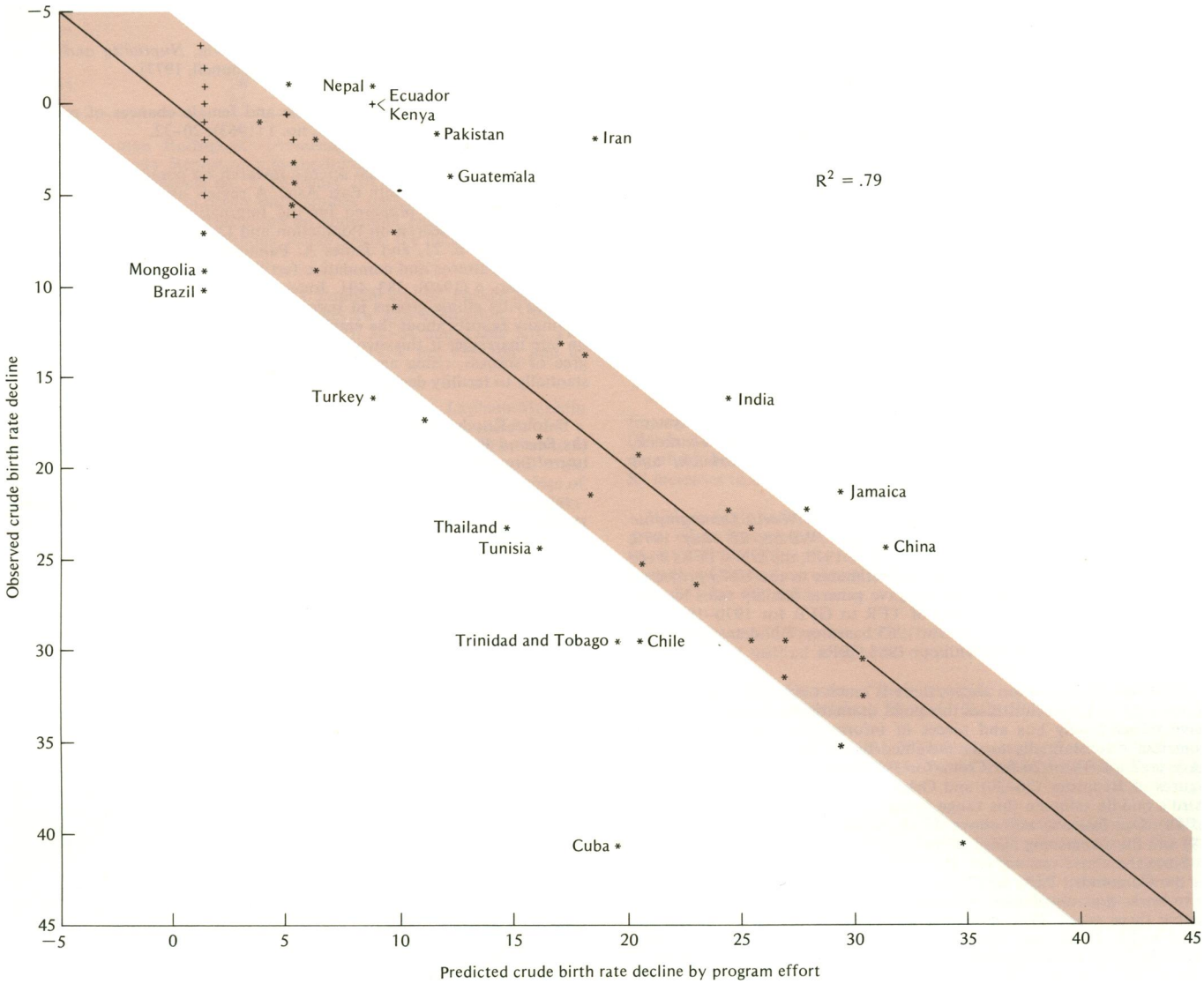
Notes

[1] For example, in France the birth rate began to decline before the end of the 18th century, and in the United States by the beginning of the 19th century. Ansley J. Coale, "The history of the human population," *Scientific American* 231, no. 3 (September 1974): 48. A similar decline was noted in Austria-Hungary in the 19th century; see Paul Demeny, "Early fertility decline in Austria-Hungary: A lesson in demographic transition," *Daedalus* (Spring 1968): 502–522.

[2] See, for example: Ronald Freedman and Bernard Berelson, "The record of family planning programs," *Studies in Family Planning* 7, no. 1 (January 1976); Ronald Freedman and John Y. Takeshita, *Family Planning in Taiwan* (Princeton University Press, 1969) chapter 13; Tieng Pardthaisong, *The Recent Fertility Decline in the Chiang Mai Area of Thailand,* Papers of the East West Population Institute, no. 47, (Honolulu, 1978); W. Brass, "Impact of the family planning programme on fertility in Mauritius," *IPPF Medical Bulletin* 10, no. 4 (August 1976): 1–2; Terence H. Hull, Valerie J. Hull, and Masri Singarimbun, "Indonesia's family planning story: Success and challenge," *Population Bulletin* 32, no. 6: 1–52.

[3] John Bongaarts, "A framework for analyzing the proximate determinants of fertility," *Working Papers* (New York: Center for Policy Studies, The Population Council, January 1978) p. 1.

FIGURE 8 Percent observed and predicted crude birth rate declines, by program variable: 94 developing countries, 1965–75



[4] World Bank, *Population Policies and Economic Development*, a World Bank Staff Report, coordinating author, Timothy King, Appendix B, "The relationship between program inputs, socioeconomic levels, and family planning performance: A regression analysis" (Baltimore: Johns Hopkins University Press, 1974) pp. 149–163; Bernard Berelson, "An evaluation of the effects of population control programmes," in H. B. Parry, ed., *Population and Its Problems: A Plain Man's Guide* (Oxford: Clarendon Press, 1974) pp. 133–168; K. S. Srikantan, *The Family Planning Program in the Socioeconomic Context*, (New York: The Population Council, 1977); Ronald Freedman and Bernard Berelson, 1976, pp. 1–40.

[5] Kingsley Davis, "Population analysis and social behavior," paper presented at the Conference on Research in Human Relations (New York: The Rockefeller Foundation, [early 1950s]) pp. 3–4.

[6] A. J. Coale, "The demographic transition reconsidered," *International Conference, Liege, 1973* (Liege: IUSSP, 1973) vol. 1, p. 65.

[7] For a recent review see Nancy Birdsall, "Analytical approaches to the relationships of population growth and development," *Population and Development Review* 3, nos. 1–2 (March–June 1977): 63–102, especially "Macro-determinants research," pp. 79–82.

[8] From another kind of literature, note this observation from *The Forsyte Saga* (from chapter I of *In Chancery*):

> Thus, of the ten old Forsytes twenty-one young Forsytes had been born; but of the twenty-one young Forsytes there were as yet only seventeen descendants; and it already seemed unlikely that there would be more than a further unconsidered trifle or so. A student of statistics must have noticed that the birth rate had varied in accordance with the rate of interest for your money. Grandfather 'superior Dosset' Forsyte in the early nineteenth century had been getting ten per cent for his, hence ten children. Those ten, leaving out the four who had not married, and Juley, whose husband Septimus Small had, of course, died almost at once, had averaged from four to five per cent for theirs, and produced accordingly. The twenty-one whom they produced were now getting barely three per cent in the Consols to which their father had mostly tied the Settlements they made to avoid death duties, and the six of them who had been reproduced had seventeen children, or just the proper two and five-sixths per stem.
>
> There were other reasons, too, for this mild reproduction. A distrust of their earning powers, natural where a sufficiency is guaranteed, together with the knowledge that their fathers did not die, kept them cautious. If one had children and not much income, the standard of taste and comfort must of necessity go down; what was enough for two was not enough for four, and so on—it would be better to wait and see what Father did. Besides, it was nice to be able to take holidays unhampered. Sooner in fact than own children, they preferred to concentrate on the ownership of themselves, conforming to the

growing tendency—*fin de siècle*, as it was called. In this way, little risk was run, and one would be able to have a motor car. . . . In the meantime, no more children!

Thus did Galsworthy anticipate Becker and Easterlin!

[9] United Nations, Department of Economics and Social Affairs, *Population Bulletin*, no. 7-1963, "With special reference to conditions and trends of fertility in the world" (United Nations, 1965); Dudley Kirk, "A new demographic transition?" in *Rapid Population Growth; Consequences and Policy Implications* (published for the National Academy of Science by the Johns Hopkins University Press, 1971) pp. 138–145; K. S. Srikantan, 1977.

[10] Kirk, 1971, pp. 145–146.

[11] United Nations, 1965, p. 150.

[12] Paul Gregory, John Campbell, and Benjamin Cheng, "Differences in fertility determinants: Developed and developing countries," *Journal of Development Studies* 9 (1972): 233–241; Steven E. Beaver, *Demographic Transition Theory Reinterpreted: An Application to Recent Natality Trends in Latin America* (Lexington, 1975); World Bank, 1974.

[13] The primary sources are the various yearbooks of the UN system, including the *Demographic Yearbook*, the *Statistical Yearbook*, UNESCO's *Statistical Yearbook*, FAO's *Production Yearbook*, and *World Tables* by the World Bank.

[14] Data contained in United Nations' *Selected World Demographic Indicators by Countries, 1950–2000*, ESA/P/WP.55, 28 May 1975, were used to estimate total fertility rates. For 1975, the UN's TFRs were adjusted by the ratio of our 1975 CBR estimates to the UN's projected CBRs. For 1965, the United Nations gave general fertility rates but not TFRs. We assumed that the ratio of TFR to GFR for 1970–1975 was a constant, then estimated TFRs for 1965 based on UN data, and finally adjusted them to correspond with our 1965 CBRs.

[15] To repeat the caution above, there is much uncertainty about some of the figures. China illustrates this point dramatically, since the Chinese have released only bits and pieces of information—and, of course, it contributes substantially to the weighted figures in view of its size. We have used a CBR of 26 for China for 1975, which is consistent with the figures of Bannister (26–30) and Orleans (27), and is somewhat below Aird's middle estimate (his range being 21–34, with the medium value of 28). Our figure is well above the dramatic figure of Brown (CBR of 19) and the astonishing figure of Ravenholt (CBR of 14).

Since the above was written, the Chairman of the Central Committee of the Communist Party in China, Hua Kuo-feng, stated that their goal is to lower the annual rate of population growth to less than 1 percent within three years. That statement was made in March 1978. Assume their goal is an increase of 1 percent in 1981 and that the crude death rate will be 7–8 per 1,000: This would imply a goal of a crude birth rate of 17–18 in 1981. Assume further that their ambitious plans are to at least equal declines experienced in some developing countries of 1–1.5 points per year: This would suggest a crude birth rate of 24–27 for 1975, and 22–24 for 1977. If mortality is falling rapidly, the estimated crude birth rate for 1975 and 1977 would be slightly higher than the figures just quoted.

Similarly, for Brazil we have chosen to base our estimate for 1965 on Carvalho rather than on Merrick or Berquo although a strong case can be made for using either of the latter figures. Similarly, most observers agree that fertility is declining in India, though there is less consensus on the level of fertility; the Indonesian figures are less firm but there is substantial evidence that fertility has begun to decline; and some students of demographic trends in Pakistan argue that fertility has declined in that country but we have yet to see the evidence. For sources, see: Judith Bannister, "Implementing fertility and mortality decline in the People's Republic of China–Recent official data," in *The Current Vital Rates and Population Size of the People's Republic of China and Its Provinces*, Ph.D. dissertation, Food Research Institute, Stanford University, 1977, paper presented at the Annual Meeting of the Population Association of America, St. Louis, April 1977; Leo A. Orleans, "China's birth rate, death rate, and population growth: Another perspective," in Report Prepared for the Committee on International Relations, US House of Representatives, by the Congressional Research Service, Library of Congress, September 1977; John Aird, Letter to *People* 4, no. 2 (1977): 49–51; Lester R. Brown, "World population trends: Signs of hope, signs of stress," *World Watch Paper* 8 (October 1976); R. T. Ravenholt, Letter to *People* 3, no. 4 (1976): 51; J. A. M. Carvalho, "Regional trends in fertility and mortality in Brazil, *Population Studies* 28, no. 3 (August 1974); Thomas W. Merrick, "Interregional difference in fertility in Brazil, 1950–1970," *Demography* 11, no. 3 (August 1974); Elsa S. Berquo, "Fecondite," in *La Population du Bresil*, CICRED Series, 1974.

[16] M. Badrud Duza and C. Stephen Baldwin, *Nuptiality and Population Policy* (New York: The Population Council, 1977).

[17] J. C. Caldwell, "Fertility decline and female chances of marriage in Malaya," *Population Studies* 17, no. 1 (1963): 20–32.

[18] Gavin W. Jones, "Social science research on population and development in East and South-East Asia: A review and search for directions," Draft report prepared for the International Review Group of Social Science Research on Population and Development (Mexico City, January 1978) p. 21, and James A. Palmore and Ariffin bin Marzuki, "Marriage patterns and cumulative fertility in West Malaysia," *Demography* 6, no. 4 (1969): 383–401. Jones points out that marriage patterns also vary by ethnic groups in Indonesia and Thailand. Moreover, there are many reports about the emphasis the mainland Chinese have placed on late marriage; if this strong campaign has had even a moderate degree of success, rising age at marriage probably has contributed substantially to fertility decline in China.

[19] John Knodel, *Fertility and Family Planning in Thailand: Results of the Second Round of a National Survey*, Paper no. 19 (Bangkok: Institute of Population Studies, Chulalongkorn University, 1977).

[20] Ansley J. Coale, "The demographic transition," *The Population Debate: Dimensions and Perspectives* (United Nations, 1975) p. 353.

[21] Paul Demeny, 1968, p. 510.

[22] N. B. Ryder, "Fertility" in Philip M. Hauser and Otis Dudley Duncan, eds., *The Study of Population* (University of Chicago Press, 1959) p. 410.

[23] Economic Commission for Europe, "Recent demographic trends in Europe and the outlook until the year 2000," in *The Population Debate: Dimensions and Perspectives*, (United Nations, 1975) p. 277.

[24] For a sample of recent reviews on the matter, see Bernard Berelson, "Social science research on population: A review," *Population and Development Review* 2, no. 2 (June 1976): 219–266; Bernard Berelson, "Social science research for population policy," paper prepared for The International Review Group of Social Science Research on Population and Development, June 1977; Nancy Birdsall, "Analytical approaches to the relationship of population growth and development," *Population and Development Review* 3, nos. 1–2 (March–June 1977); John C. Caldwell, "Toward a restatement of demographic transition theory," *Population and Development Review* 2, nos. 3–4 (September–December 1976): 321–366; Robert H. Cassen, "Population and development: A survey," *World Development* 4, nos. 10–11 (1976): 785–830; Coale, 1973, pp. 53–72; Susan H. Cochrane, "Education and fertility: What do we really know?", Population and Human Resources Division, World Bank, March 1977; Interdisciplinary Communications Program, *The Policy Relevance of Recent Social Research on Fertility*, an ICP Staff Report (Washington, D.C.: Smithsonian Institution, September 1974); Research Triangle Institute, *Social and Economic Correlates of Family Fertilty: A Survey of the Evidence*, prepared by Karen Oppenheim Mason and Abraham S. David, project leaders, September 1971; Nwanganga Shields, "Female labor force participation and fertility: Review of empirical evidence from L.D.C.," Population and Human Resources Division, World Bank, February 1977; Michael Teitelbaum, "Relevance of demographic transition theory for developing countries," *Science* 188 (2 May 1975): 420–425.

[25] Infant mortality rates are not available for many of the developing countries and, where not available, are inferred from model life tables. This procedure leads to a high correlation between the two measures, but we have retained both inasmuch as separate data are available for a number of countries.

[26] For further discussion along this line, see Ronald Ridker, ed., *Population and Development: The Search for Selective Interventions* (Baltimore: Johns Hopkins University Press, 1976).

[27] A recent publication of the World Fertility Survey, for example, found that the average "time of travel to perceived nearest outlet" for methods of fertility regulation was as follows (in minutes):

Area	India	Panama	Turkey
Medians			
Urban	15	15	10
Rural	30	30	30
Means			
Urban	26	19	13
Rural	51	31	57

SOURCE: German Rodriguez, "Assessing the availability of fertility regulation methods: Report on a methodological study," *World Fertility Survey, Scientific Report no. 1*, February 1977, Table 3.9.1, p. 52. The data are taken from in-depth pilot studies designed to determine the feasibility of obtaining information on household and community availability of fertility control methods. Accordingly, the data should be considered as illustrative.

[28] As initially presented in Robert J. Lapham and W. Parker Mauldin, "National family planning programs: Review and evaluation," *Studies in Family Planning* 3, no. 3 (March 1972): 31–34 and Table 2.B. The same index was used in Bernard Berelson, 1974, pp. 133–168; and in Freedman and Berelson, 1976.

[29] Twenty countries were included in the original Lapham-Mauldin list; another 23 were added in the Freedman-Berelson extension; and a final 11 were added for this paper: China, North Vietnam, Cuba, Panama, Brazil, Iraq, Nicaragua, Bolivia, Papua New Guinea, Uganda, and Mali. Since the original classification was done around 1970–71, the ratings of a few countries were revised in the light of later developments—Pakistan/Bangladesh downward in view of the suspension of program activities associated with the 1970–71 civil war and its aftermath; the Philippines and Indonesia upward in view of their intensified efforts as of about 1970–72. In general, as will be seen later, this classification correlates strongly with both duration of program effort and demographic commitment in policy (as against health or human rights). Furthermore, 17 of the 26 strong and moderate programs had numerical demographic targets around 1969–70 as against only 3 out of 29 weak programs (counting Pakistan/Bangladesh as one).

[30] For further detail on several countries, see Freedman and Berelson, 1976, pp. 20–29.

[31] We have benefited in this analysis from the consultation and advice of Professor Leo Goodman of the University of Chicago, to whom we express our gratitude.

As a technical reminder, we briefly describe the measures utilized in this section.

Coefficient of Correlation. Where the relationship between two variables is found or assumed to be a straight line, the value of $\sigma' / \sigma y$ is termed the coefficient of correlation. The symbol R is used to represent it. When values of Y are estimates from values of X according to a straight-line equation, then the proportion of the variation in Y which is so accounted for is indicated by the notation R_{yx}' which is read "the coefficient of correlation between y and x." The coefficient of correlation may therefore be defined:

$$R_{yx} = \frac{\sigma y'}{\sigma y}$$

Coefficient of Determination. Where both X and Y are assumed to be built up of simple elements of equal variability all of which are present in Y but some of which are lacking in X, it can be proved mathematically that R^2 measures that proportion of all the elements in Y which are also present in X. For that reason, in cases where the dependent variable is known to be causally related to the independent variable, R^2 may be called the coefficient of determination. It may be said to measure the percentage to which the variance in Y is determined by X since it measures the proportion of all the elements of variance in Y which are also present in X. Since the coefficient of determination is the most direct and unequivocal way of stating the proportion of the variance in the dependent factor which is associated with the independent factor, it should be used in preference to the correlation coefficient.

Partial Correlation. Coefficients of partial correlation measure the correlation between the dependent factor and each of the independent factors, while eliminating any (linear) tendency of the remaining independent factors to obscure the relation. The other factors are "held constant," that is, are assumed to have the same values. The partial correlation coefficient $R_{12.3}'$ or $p_{12.3}$ is the correlation between variables 1 and 2 in a cross section of individuals *all having the same values of variable 3*. "Partial correlation does not involve the notion of independent and dependent variables; it is a measure of interdependence. On the other hand, the *multiple correlation coefficient* applies to the situation in which one variable, say Y, has been singled out to examine its joint relation with the other variables. In the population, the multiple correlation coefficient between Y and $X_1, X_2 \ldots X_k$ is defined as the simple correlation coefficient between Y and its linear regression $B_1X_1 + B_2X_2 \ldots + B_kX_k$ on $X_1 \ldots X_k$. Since it is hard to attach a useful meaning to the sign of this correlation, most applications deal with its square." (George W. Snedecor and William G. Cochran, *Statistical Methods* (Ames: The Iowa State University Press, 1967), p. 402.

The Beta Coefficient. The coefficient of regression measures the slope of the regression line; that is, it shows the average number of units of increase or decrease in the dependent variable that occur with each increase of a specified unit in the independent variable. When each value of a variable is expressed in deviation from the standard deviation of that variable, the Beta coefficient shows the average number of units of increase or decrease. Partial correlations measure how much a given variable reduces the variation in the dependent variable after all the other variables except it are taken into account. Partial correlations and Beta coefficients are two different measures of the relative importance of different factors. Their exact values differ but usually the rank and relative size of the two measures are similar.

[32] Substituting percentage urban for percentage of population living in cities of 100,000+ does not affect the R^2 value with this set of socioeconomic variables.

[33] In such correlations, the results depend upon where one starts. For example, the correlation between program effort and CBR decline (R^2) is .74 (thus more predictive than the 7 socioeconomic factors taken together), and as from one to all seven of those factors are added, the R^2 increases to between .82 and .83.

[34] Here again, another multiple R^2 plateau asserts itself: when program effort is combined with from one to six of the demand variables, the R^2's all fall within the range .821 to .828. Only when the "intensifier" variable of newspaper circulation is added does it increase, and then to only .843 for the entire array.

[35] Freedman and Berelson, 1976, Table 10 and the tabulation on p. 19. The replicated method is reported on p. 40 of that publication.

[36] Otis Dudley Duncan, "Path analysis: Sociological examples," *American Journal of Sociology* 72, no. 1 (July 1966): 3.

[37] M. G. Kendall and C. A. O'Muircheartaigh, *Path Analysis and Model Building*, No. 2/Tech 414, World Fertility Survey, Technical Bulletins, March 1977.

[38] The path coefficients for each of the seven socioeconomic variables and CBR declines range from .08 to .30 (GNP per capita and life expectancy), and the corresponding path coefficient between program effort and CBR decline range from .88 to .69. The indirect effects of the socioeconomic variables through program effort range from .05 to .46.

[39] For a similar analysis of direct and indirect effects, see Srikantan, 1977.

[40] There are several different measures of change that can be used, and we have used three. First, the difference in percentages in 1960 and 1970: for example, for school enrollment we subtracted the percentage enrolled in 1960 from the percentage enrolled in 1970. Second, the percentage change in the variable between the two dates: for example, life expectancy at birth in 1960 was subtracted from life expectancy at birth in 1970, and that figure multiplied by 100 was divided by life expectancy at birth in 1960. Third, in the case of literacy, the difference in percentage literate 1960 to 1970 as a ratio of the proportion illiterate at the earlier date and multiplied by 100; we label this as proportionate increase 1960–70. More generally, we sought the measure of change that was most closely associated with CBR decline, and for each variable used the measure that could explain the largest amount of variance in the CBR decline.

[41] D. V. McGranahan, C. Richard-Proust, N. V. Sovani, and M. Subramanian, *Contents and Measurement of Socioeconomic Development*, (New York: Praeger Publishers, 1972), and *Research Data Bank of Development Indicators* prepared by the Statistical Unit of the Institute, United Nations Research Institute for Social Development, Report No. 76.3, Geneva, 1976.

[42] Srikantan has analyzed fertility decline as a function of family planning programs and socioeconomic factors for 20 program countries and for 10 countries in East and Southeast Asia (with an overlap of 8 countries in the two groups). He employed a variety of statistical techniques, including correlations, partial and multiple correlations,

path analysis, and principal component analysis. He identifies five types of effects, namely, direct socioeconomic effects, direct program effects, infrastructural effects on program inputs of socioeconomic factors, spillover of program inputs to the nonprogram sector, and substitution of program services for nonprogram birth control. He summarizes his major findings as follows:

> Analysis of 20 program countries drawn from different cultural regions indicates that the direct effects of the socioeconomic indicators and the program outputs were substantial and about equal. The infrastructural effect was about one-half as large, and the spillover effect about one-fourth as large. An analysis of a more homogeneous group of ten countries in East and Southeast Asia in greater depth showed that the direct effect of the socioeconomic indicators is about as large as the program spillover effect, while the indirect effect of the socioeconomic indicators was three-fourths as large and the program output effect one-half as large (pp. 232–233).

[43] Under some conditions, as our colleague Anrudh Jain reminds us, "improvements in social setting may also increase the birth rate especially if there are changes in breastfeeding, abstinence, occupational related separation, and mortality. Thus the total and relative contributions of demand and supply factors may be underestimated in this analysis" (personal communication, 1978).

[44] As against individual country, where the range is from 40 percent decrease (Singapore and Cuba) to 4 percent increase (Lesotho and Uganda).

[45] For example, see Dudley Kirk, "Factors affecting Moslem natality," in Bernard Berelson et al. (eds.), *Family Planning and Population Programs* (The University of Chicago Press, 1966), pp. 561–579; and Irene B. Taeuber, "Policies, programs, and the decline of birth rates: China and the Chinese populations of East Asia," in Minoru Muramatsu and Paul A. Harper (eds.), *Population Dynamics* (Baltimore: Johns Hopkins Press, 1965), pp. 99–104. Note also that ethnic differences—linguistic and cultural—are closely associated with fertility rates in developed countries as well, e.g., in Belgium (R. Lesthaeghe and E. Van de Walle, "Economic factors and fertility decline in France and Belgium," in Ansley J. Coale (ed.), *Economic Factors in Population Growth,* (New York: Macmillan, 1976); or in Spain (Ansley J. Coale, "The demographic transition reconsidered"); or other countries (Bernard Berelson, "Ethnicity and fertility: What and so what," Working Paper, Center for Policy Studies, Population Council, 1978).

[46] For example, see *People* 4, no. 2 (1977) on "Aspects of islands." And this notion may apply not only to islands in the literal sense; reports from China remark the same effect from restrictions on outmigration from villages.

[47] Taeuber, 1965, p. 100. Note that this measure of "precipitant social change" differs from the more gradual changes in exclusively socioeconomic factors reviewed in the correlational material. When the latter are classified into a 4-part index, it does not differentiate well among CBR declines—not nearly so well as the social-setting index.

[48] The dating and duration of programs is taken from Walter B. Watson (ed.), *Family Planning in the Developing World: A Review of Programs,* A Population Council Factbook, (New York: Population Council, 1977), footnote to Table 1, p. 2; and from Dorothy Nortman, assisted by Ellen Hofstatter, "Population and Family Planning Programs: A Factbook," *Reports on Population/Family Planning,* no. 2, eighth ed. (October 1976): Table 6.

[49] Nortman and Hofstatter, 1977, p. 21.

[50] Because these methods may be unfamiliar to many readers, we have included brief explanations of them as they arise in the analysis. For a complete description, see John W. Tukey, *Exploratory Data Analysis* (Reading, Mass.: Addison-Wesley, 1977). For an introductory summary, see Donald R. McNeil, *Interactive Data Analysis* (New York: Wiley, 1975).

[51] Bongaarts, 1978.

[52] This is the case in the following conclusions by Frank Wm. Oechsli and Dudley Kirk, "Modernization and the demographic transition in Latin America and the Caribbean," *Economic Development and Cultural Change* 23, no. 3 (April 1975): 391–419. These conclusions do, however, put aside the questions of "causation":

> In fact, we cannot easily distinguish between cause and effect in the complex of changes we label 'modernization.' We can say that modernization, at some level, is associated with a given mortality level, and we can say that the birth rate tends to stay high until some critical level of development is reached and then tends to decline as development proceeds, but we cannot say that development 'causes' declining birth and death rates; rather, certain patterns of change in these vital rates are parts of the process of development.
>
> Similarly, we might argue that one or the other of the variables is the key element in causing, say, birth-rate declines, but such an argument, at present levels of understanding, often seems to be more an exercise in developing intuitively pleasing and plausible explanations than a serious research aim.
>
> Thus, the theoretical basis for the present study avoids attempts to outline specific causal chains and, instead, proceeding from the postulate that development is an orderly holistic process with some empirically determinable consistencies, attempts to fit changes in birth and death rates into the process (pp. 403–404).

[53] Our colleague Geoffrey McNicoll made the following comment on an earlier version. We include it with his permission and our thanks in view of its intrinsic value:

> I take it as tautology that (marital) fertility declines when there is an appropriate shift in the micro-level calculus encompassing perceived benefits and costs of having children or endeavoring not to have them. Effective antinatalist-policy measures must impinge on this micro-setting. At the national level, policies tend to be either focused directly on fertility (propaganda about family size, subsidizing contraceptives, etc.) or focused indirectly (i.e., have other primary goals, such as educating women, but incidentally change the micro-setting of fertility decision making). Looked at from this level, then, it is hardly surprising at least in the early stages of transition to find a measure of "program effort" (directly addressing fertility) more closely tied to a fertility change than is a broad-based measure of development.
>
> But there is another dimension involved in addition to 'breadth' of policy content: this is closeness to the individual decision making setting. Pulling a lever at the national level—say, pouring money into a family planning program or into an educational system—may have virtually any outcome depending on the internal workings of that program or system. What matters is how things change at the bottom. Your index of program effort spans both national and local levels (e.g., customs regulations on the one hand, home visits on the other) —with more emphasis on the latter than is the case with your components of development (although certainly this is a matter of judgment). In a sense, then, there is more scope for slips twixt cup and lip on the development side than on the program effort side. (Personal communication.)

[54] For an exploration along this line, see Robert Haveman and Bernard Berelson, "Intervention strategy and resource allocation for fertility reduction," forthcoming.

Appendix A: Recent Macro-Studies of Fertility Determinants

Author(s)	*Dating of data*	*Countries included*	*Fertility measure(s)*	*Demand factors*	*Supply factors*	*Mode(s) of analysis*	*Findings*
Weintraub, 1962	Early 1950s	30 developed and developing	Crude birth rate	Per capital income Population in farming Infant mortality	None	Partial regression analysis	"Income increments generate birth-rate increases" and "birth rates decline with urbanization and decrease in infant mortality." (p. 816)
Adelman, 1963	1947–57	37 developed and developing	Live births per 1,000 females in 7 age groups	Per capita income Nonagricultural employment and labor force Education index: literacy and newspaper circulation per capita Population density (and in preliminary but not final analysis, infant mortality and percent rate of growth of per capita income)	None	Regression analysis	Age-specific birth rates vary directly with per capita income; negatively with nonagricultural employment, education index, and population density. "Regression model accounts for roughly 50 to 70 percent of the total variance in age-specific birth rates among countries." (p. 320)
Russett et al., 1964	c. 1960	38 developed and developing	Crude birth rate	Per capita GNP Adult literacy Rate of change in GNP per capita Marriages per 1,000 population aged 15–44 Roman Catholic percentage of population	None	Regression analysis	"The R^2 of .81 indicates that we have explained over four-fifths of the variance." (p. 314) "The major effect (always with the other variables controlled) is produced by variations in literacy, but each of the other variables except percentage Catholic bears an important relation to birth rates." (p. 315)
Heer and Turner, 1965	1960 with some variance	18 in Latin America: unit of analysis the largest political units within the nations totalling 318	Child-woman ratio (ratio of children under 5 to women aged 15–49)	Ratio of males to females of reproductive age Percent of females in labor force Percent in urban areas: locally; nationally Percent literate: locally; nationally Percent of labor force in agriculture: locally; nationally	None	Zero order, multiple, and partial correlations	Highest relationship to child-woman ratio with proportion of females in labor force, then local urbanization, then national literacy, then national agricultural employment (R^2's from .055 to 0.84); others much lower. "When all eight independent variables are considered 44 percent of the variance in fertility is explained." (p. 285)
United Nations, 1965	1960s	125 developed and developing, divided into high fertility group (GRR above 2) and low fertility group (GRR below 2)	Gross reproduction rate	Per capita income Per capita energy consumption Urbanization Nonagricultural employment Hospital beds Life expectancy at birth Infant mortality Early marriage Female literacy Newspaper circulation Radio receivers Cinema attendance	None	Histogram analysis: averages for six levels of fertility from low to high Simple correlation coefficients	Correlations of GRR with the independent variables range from .54 to .84 but "only low" coefficients within high or low fertility countries taken separately. Indication of certain "threshold zones" of social and economic indicators "for a shift from high to low fertility." (pp. 146–150)
Heer, 1966	Early 1950s	41 developed and developing	General fertility rate for males (number of births divided by male population aged 15–54)	Per capita income, ages 15–64 Newspaper circulation per population aged 15 and over Infant mortality (and as "control variables," population density and increase in per capita energy consumption)	None	Cross-sectional analysis Zero order correlations Multiple regressions	Fertility is directly related to per capita income and to infant mortality, inversely related with per capita newspaper circulation (partial-R's from .04 to .42). (p. 423)

Appendix A: Recent Macro-Studies of Fertility Determinants (continued)

Author(s)	*Dating of data*	*Countries included*	*Fertility measure(s)*	*Demand factors*	*Supply factors*	*Mode(s) of analysis*	*Findings*
Adelman and Morris, 1966	1957–62	55 developing	"Crude fertility rate" (presumably CBR)	Per capita GNP Size of traditional agricultural sector Basic character of social organization Extent of literacy Extent of mass communication Degree of cultural and ethnic homogeneity Significance of indigenous middle class Type of religion Effectiveness of democratic institutions Degree of freedom of political opposition and press Degree of factionalization of parties Basis of political party system Strength of labor movement Political strength of the military Degree of administrative efficiency Degree of centralization of political power Extent of social mobility Strength of traditional elite Extent of nationalism and sense of national unity Degree of commitment of leadership to promoting economic development Extent of government participation in economic activity Degree of social tension Extent of stability of political system	None	Factor analysis of grouped data	Major correlation with fertility rate explaining 47 percent of intercountry variation (factor loading of —.68) is the factor that "summarizes the social and cultural changes associated with urbanization and industrialization. To be more specific, Factor I may be interpreted to represent the transformation of values and institutions accompanying the breakdown of traditional organizations." (p. 137) Factor II, adding 11 percent to explanation of variance, indicates that a "typically Western configuration of political traits is generally associated with lower fertility." (p. 139) Weaker still ("quite small") are the III and IV Factors: leadership characteristics and social and political stability. The first two factors together indicate "development of the spirit of rationalist individualism." (p. 142) Finally, the net effect of adding per capita GNP "seems to be negligible." (p. 142)
Friedlander and Silver, 1967	Late 1950s and early 1960s	18 developed; 20 intermediate; 47 underdeveloped	Crude birth rate (live births per 1,000 married women aged 15–49)	Gross domestic product National income per: economically active person; person aged 15–64 Consumption expenditures per: economically active person; person aged 15–64 Infant mortality Child mortality (aged 0–14 years) Population density Illiteracy Education index, persons aged 25 years and over Percent population with secondary education or more Dependency ratio Compensation of workers Political system (Communist, non-Communist) Economically active males in: agriculture; nonagriculture Years of compulsory education Lower limit of economically active population (in years)	None	Regression analysis, "basic" and "refined"; independent variables generally limited to 5 per regression; typically income, education, child mortality, density, and one other	For all countries combined, positive correlations between birth rate and illiteracy, child mortality, agricultural population, nonfarm self-employed, and overcrowded housing; negative correlation between birth rate and Communism and level of education.

					Social security participants Percent change in child mortality Growth of GDP Radios per 1,000 population Dwellings with inside piped water Average number of persons per room Dwellings with three or more per room Predominant religion: Catholic, Protestant; Christian, non-Western Index of achievement motivation Domestic and foreign mail per capita Ratio of male to female illiteracy Protein/calories consumption Calories per capita Linguistic homogeneity			
	Kirk, 1971	1960–64	25 Latin American countries; 17 Asian countries; 15 Islamic countries	Crude birth rate	Urbanization Economically active males not in agriculture Literacy, 15 years and over Telephones per 1,000 population Hospital beds per 1,000 population Newspaper circulation per 1,000 population Female expectancy of life at birth Per capita GNP Per capita energy consumption School enrollment as percent of population aged 5–19	None	Zero-order correlations Regression analysis	"These selected measures of development . . . collectively . . . explain some 90 percent of the variance of birth rates in Latin America" (p. 139); each one explains from 47 percent–87 percent in linear regression. Establish "threshold range" for each variable "at which fertility declines may be expected to occur." (p. 141) Similar analysis for Asia (economic and educational variables have highest correlations) and for Islamic (educational highest). Important differences by cultural regions.
	Janowitz, 1971	c. 1960	57 developed and developing	Gross reproduction rate	Per capita income Percent of labor force in agriculture Percent of women illiterate Infant mortality Life expectancy at birth	None	Regression analysis (plus technical critique on the use of cross-sectional regression equations to predict fertility changes through time in other studies)	Fertility varies with developmental measures but caution needed in using cross-sectional relationships to predict fertility change in developing countries. Much less correlation within developing countries than in the developed or total array.
	Kasarda, 1971	1930–69, by four decades	78 developed and developing	Crude birth rate Child-woman ratio	Mainly females economically active in 3 nonagricultural categories, but also: urbanization; industrialization; education; child labor	None	Zero-order and partial correlations	"Strong negative association . . . between both fertility measures and percentages of females employed for wages or salaries." (p. 310) Unpaid and self-employed categories have small and inconsistent R's. Strong inverse correlation with urbanization, industrialization, and education; positive correlation with child labor.
	Ekanem, 1972	1953–63	32 developing	Crude birth rate	Illiteracy Labor force in agriculture Urbanization Infant mortality rate Per capita GNP, 10 years and older	None	Zero-order correlations Multiple regression analysis of demand factors against fertility at two points in time	"Increased economic development implies a decreased illiteracy and a decreased IMR; a decreased illiteracy and IMR are optimal conditions of low fertility." (p. 398) (Partial R's of approximately .1 to .4, R^2's of .26 and .37)

Appendix A: Recent Macro-Studies of Fertility Determinants (continued)

Author(s)	*Dating of data*	*Countries included*	*Fertility measure(s)*	*Demand factors*	*Supply factors*	*Mode(s) of analysis*	*Findings*
Gregory et al., 1972	1965	25 developed and 15 developing	Crude birth rate	Per capita income Infant mortality (weighted by rural ratio) Illiteracy rate Religion (Catholic) Female labor participation rate (plus per capita energy consumption and population density to "explain" per capita income)	None	Regression analysis through simultaneous equations	Illiteracy rate most important factor in developing countries, that and female labor force participants in developed (except for possible reverse effect of the latter). Small "elasticity multipliers" of .14 to .22 at best. (pp. 236–237)
World Bank, 1974, Appendix A	Early 1960s	64 developed and developing	General fertility rate (annual number of births per 1,000 women of reproductive age)	Life expectancy Persons per square kilometer Per capita income Percent share of GNP to poorest 40 percent Newspaper circulation per 1,000 population	None	Simple correlations Multiple regressions	"Fertility rate is negatively correlated with per capita income, life expectancy at birth, population density, effective literacy, and distribution of income. . . . Taken together . . . the indicated variables are able to explain about eighty percent of inter-country variance in the general fertility rate." (pp. 47–48)
World Bank, 1974, Appendix B	1970–73	19 developing	Acceptor rate User rate, in program User rate, total	Per capita GNP Female secondary school enrollment Death rate Proportion population in urban areas Newspaper circulation per 1,000 persons Density of population per square kilometer	Service points Personnel positions Funds expended or allocated for a family planning program	Regression analysis	"Inputs appeared to be the more important explanation of acceptor rates. The relative dominance of inputs over socio-economic variables held also in explaining variation in program user rates. With respect to total user rates, however, socio-economic variables appeared to have greater explanatory power than program input variables although the difference was marginal." (p.158) Eight independent variables explain 92 percent of the variance for program user rates, with service points accounting for 62 percent; for total user rates the eight accounted for 85 percent of the variance.
Repetto, 1974 (apparently expanded version of World Bank, Appendix A, 1974)	1965–70	68 developed and developing	Gross reproduction rate Approximation of fertility rate (births per half the population aged 15–64)	Income distribution Infant mortality Female literacy Income per capita Newspaper circulation Share of the smaller 60 percent of land holders in the total agricultural area Dispersion of education attainment Average caloric intake per person per day	None	Regression analysis	"With one exception, over 60 percent of the total variation in fertility is accounted for by the model. . . . There is a consistently close relationship between more equitable income distribution and lower fertility." (p. 9) For 44 developing countries only, "explanatory power of the model fell considerably . . . and the regression coefficient of income distribution became statistically insignificant although still positive in sign." (p. 13)
Berelson, 1974	c. 1970	26 developing	Program acceptors as percent of married women of reproductive age Program users as percent of married women of reproductive age	Index of development based on per capita GDP, infant mortality, female enrollment in school	Index of program strength	Cross-tabulations of categorized countries	"Both factors are important. At each level of program the developmental setting makes about a three-fold difference in annual acceptance and at each level of development the programmatic effort makes a two-fold difference." (p. 153)

Oechsli and Kirk, 1975	Early 1960s for total group; 1950–c. 1970 for detailed analysis	Initial analysis involving 11 developed and developing with populations of 1 million or more. Mainly a detailed analysis of 25 Latin American and Caribbean countries with populations over 200,000	Crude birth rate	Per capita GNP (for total group) for Latin America-Caribbean analysis: literacy; life-expectancy at birth; primary school enrollment; male labor force in nonagriculture Urbanization Hospital beds Newspaper circulation Telephones installed Secondary school enrollment Gross domestic product Composite developmental index	None	Cross-sectional analysis on total groups Mainly, multiple correlation analysis plus a "corresponding system" with fitted logistic curves analyzed against birth rates at 4 points in time over about 20 years	For total group "declining natality as economic well-being increases" (p. 393), "the $500 GNP range marks roughly a level of well-being that signals the possibility of probable natality decline." (p. 395). For the detailed analysis, "the fitted curve accounts for better than 80 percent of variance" in the birth rate. (p.405) The developmental index appears to signal natality decline by groups of countries; and mortality decline reaches "an exceedingly low level before the natality decline begins." (p. 416)
Bhattacharyya, 1975	c. 1950	52 developed and developing	Crude birth rate	Per capita income Rural/urban income inequality Infant mortality rate Education	None	Cross-tabulations of categorized countries, plus some multiple regression analysis	Per capita income has higher correlation but rural/urban inequality is additionally related. Education and infant mortality have higher R's in the multiple-group regression analysis, especially education.
Beaver, 1975	1950–70 by 5 year intervals	24 Latin American countries with over 500,000 population in 1950	Crude birth rate Age-sex standardized birth rate Gross reproduction rate	Crude death rate Life expectancy at birth Urbanization Education: literacy; percent in primary and secondary school Level of living: net domestic product per capita; GNP per capita; phones per 100,000 population Land resources (land availability) per 1,000 population Resources in the money economy corrected by expectations (rate of exchange in GDP over 5 years) Cultural background (approximate racial composition)	None	Analysis of changes over time Regression analysis	"Basic causal forces of the demographic transition are operating in the Latin American region. . . . Accelerating rates of change in development indicators and mortality decline have been followed by increasingly rapid rates of natality declines in the countries where the birth rate has fallen significantly." (p. 120) "For the period 1950–1970 the independent variables together account statistically for 65.4 percent of the variance in the age-sex standardized birth rate and 76.7 percent of the variance in the crude birth rate." (p. 124)
Hohm, 1975	c. 1960 for demand variables; c. 1965 for fertility	67 developed and developing	Total fertility rate	Coverage and benefit levels of long-term social security programs Infant mortality rate Newspaper circulation per 1,000 population aged 15 and over Per capita GDP of economically active population	None	Zero-order correlations Multiple regression analysis	". . . the social security variables may have a greater independent effect on fertility than do the traditional correlates of fertility. . . . (p. 641) The social security indices on the whole are at least as important as control variables in predicting fertility" (p. 642) although the Beta coefficients are only around .2.

Appendix A: Recent macro-studies of fertility determinants (continued)

Author(s)	*Dating of data*	*Countries included*	*Fertility measure(s)*	*Demand factors*	*Supply factors*	*Mode(s) of analysis*	*Findings*
Freedman and Berelson, 1976	c. 1973	46 developing, ranging from 27 to 46 in different tabulations	Acceptors as percent of nonusers Contraceptive users as percent of MWRA Crude birth rates Percent decline in CBR, 1960–73	Index of "social setting" (development) based on per capita GDP infant mortality Female enrollment in school	Index of "program effort"	Cross-tabulations of categorized countries Multiple regression analysis of original data	"Country performance is associated with both social setting and program efforts, in about a 7-to-1 ratio from the doubly favored to the doubly deprived areas. The social setting also affects the quality of the programmatic infrastructure; still, the program effort has a clear, substantial, and independent effect upon performance. "Program effort appears to be associated along with social setting in both level and decline of birth rates, but for technical reasons definitive answers are not available, particularly with regard to the substitution effect—which is probably present to some (unknown) degree but unlikely to be of sufficient magnitude to account for the entire impact of moderately good programs. (p. 35)
Srikantan, 1977	c. 1970	3 separate studies: 75 developed and developing for thresholds; 20 developing with programs; 10 developing in Asia for effects of family planning programs	Crude birth rate General fertility rate Acceptors and users, by source and method Births prevented	Life expectancy Marriage age GDP per capita GDP from agriculture, forestry, and fishing Energy consumption per capita Population and work force in agriculture, forestry, and fishing Literacy School enrollment Urbanization (20,000+, 100,000+) Radios, Hospital beds, Physicians, nurses, midwives, Newspaper circulation (per 1,000 population) Infant mortality rate	Medical personnel per 1,000 population Program expenditures Legal and administrative conditions	Correlation and regression analysis Cluster analysis Path analysis	"What are the major implications of these results? First, it is seen that both socioeconomic development and a family planning program have substantial, independent, and about equal impact on fertility reduction. Furthermore, socioeconomic indicators and program effects have certain important interactive effects on fertility. Socioeconomic indicators facilitate implementation of a program and through this means result in fertility reduction. This infrastructural effect is about one-half as great as the direct effects. The program inputs have a spillover effect on the nonprogram sector, which is at least one-fourth as large as the direct effect of the program or the socioeconomic indicators. These interactive effects can be realized only if both socioeconomic development and a family planning program are present." (p. 233)
Shin, 1977	1958 1968	63 developed and developing	Crude birth rate	Economic development (per capita income, per capita energy consumption) Social development (newspaper circulation, physician ratio, urbanization) Infant mortality rate	None	Factor analysis Path analysis Correlation analysis	". . . the three independent variables account for about 47 percent and 62 percent of the variance, for 1958 and 1968 respectively." (p. 404) ". . . our model does not adequately explain longitudinal variations in birth rates." (p. 406)

SOURCES FOR APPENDIX A
(IN CHRONOLOGICAL ORDER)

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* The indented titles under Heer, Ekanem, and Hohm take issue with those authors on technical grounds. Massey and Tedrow criticize the "misinterpretations, misunderstandings, and errors" in imputing causal power to correlational analysis: and their rectification finds an underlying factor (societal modernization) "of a basic social process that is itself accompanied by a decline in fertility" (p. 437). Janowitz argues that "factors that explain variations in birth rates" may not have the "same impact in explaining trends" (p. 481). Khan cautions on inconsistencies, incomparabilities, and clerical mistakes making for poor quality of data —to which Ekanem rejoins in his last sentence that such "data . . . have always been accepted as being of poor quality" (p. 371)! Kelly et al. find that when they control for "socioeconomic development, or modernization" with a five-factor index, the correlation between social security programs and fertility disappears, to which Hohm rejoins with technical points and new data.

Appendix B: Status of Women

There is some agreement that the position of women in society is significantly related to the level of fertility, though there is substantial difference about specifics. For example the World Population Plan of Action states that one important way to moderate fertility is through "the full integration of women into the development process, particularly by means of their greater participation in educational, social, economic and political opportunities, and especially by means of the removal of obstacles to their employment in the nonagricultural sector wherever possible" (para. 32).

We searched for but did not find an accepted index of women's status in developing countries. There are many possible indexes of women's position within a country[1] and some useful analyses of appropriate indicators,[2] but data are rarely available in a reliable form or quantity.

[1] Elise Boulding et al., *Handbook of International Data on Women,* (Sage Publications, New York: John Wiley and Sons, 1976).

[2] Constantina Safilios-Rothschild, "A cross-cultural examination of women's marital, educational and occupational options," *Acta Sociologica* 14, no. 1–2 (1971), and "Methodological problems involved in the cross-cultural examination of indicators related to the status of women," manuscript, 1972.

In view of its special interest in connection with fertility decline, we include here a more detailed consideration of the status of women—which might have been included as another socioeconomic variable had sufficient data of a suitable measure been available. Female enrollment in school and female employment in nonagricultural occupations correlate highly with male enrollment and employment, and thus reflect educational and industrial status rather than female status. As noted, we looked for but did not find a valid index of female status in developing countries with reasonably available data.

The one indicator of female status we found to be distinctive was the percentage of young women never married, particularly for the 20–24 age group. The zero order correlation of this variable with the 1965–75 CBR decline for the 56 countries for which data are currently available is .56, higher than the corresponding correlations of percent of population living in cities of 100,000 or more (.45) or GNP per capita (.11) with CBR decline. Similarly, in a multiple regression analysis in which the percentage of women aged 20–24 never married is added to the seven socioeconomic variables we used earler, the Beta coefficient for CBR decline is larger than that for school enrollment and is equal to literacy. Thus, female status would have been included, if more data

TABLE B1 Status of women variables as predictors of crude birth rate declines: 94 developing countries, 1965–75

	Beta coefficients												
	Percent females never married					*Percent aged 15–64*							
Regression number	*Aged 15–19*	*Aged 20–24*	*Adults literate*	*Primary and secondary school enrollment*	*Life expectancy*	*in nonagricultural labor force*	*Program effort*	*R*	R^2	*N*[a]	*Degrees of freedom*	*F-statistics*	*Significance level*
	Using 1970 female values												
1	.24	−.05	.03	−.06	.34	.28		.70	.50	40	33	5.44	<.05
2		.11	−.01	.06	.37	.25		.70	.49	40	34	6.49	<.05
3		−.06		.12	.53	.23		.75	.56	56	51	16.44	<.01
4				.01	.70	.14		.78	.61	91	87	46.21	<.01
	1970 female level		Substituting 1970 male values										
5	.19	.14	.24	−.02	.11	.14		.72	.51	39	32	5.63	<.05
6		.25	.25	.03	.16	.11		.71	.51	39	33	6.79	<.05
7		.19		.02	.54	.04		.73	.54	52	47	13.56	<.01
8				−.02	.73	.07		.77	.59	85	81	39.26	<.01
	Using 1960–70 change in female levels												
9	−.05	.06	.20	−.18	−.02	.40		.53	.28	24	17	1.11	NS
10	−.01	.25		−.08	.16	.47		.58	.34	33	27	2.77	NS
11				−.16	.10	.36		.39	.15	75	71	4.14	<.01
	1970 female level		Male minus female 1970 levels										
12	.29	.37	.14	−.00	.13	−.02		.70	.48	38	31	4.87	<.05
13		.43		−.14	.17	.16		.66	.43	52	47	9.01	<.01
14		.46			.17	.18		.61	.37	56	52	10.36	<.01
15		.46			.21			.59	.34	56	53	13.94	<.01
	1960–70 change in female level		Male minus female 1970 levels										
16	−.02	.56	.37	−.33	.20	−.09		.81	.65	25	18	5.64	<.05
17	.25	.23		−.75	.02	−.07		.79	.62	39	33	10.87	<.01
18		.55	.36	−.34	.21	−.10		.81	.65	25	19	7.14	<.05
19		.35		−.30	.36	.03		.74	.55	37	32	9.66	<.01
20			.06	−.13	.41	.19		.55	.30	39	34	3.64	NS
21				−.20	.40	.29		.60	.35	76	72	13.13	<.01
22	.08	−.08		−.02	.29	.11	.81	.93	.87	37	30	33.80	<.01
23				.02	.18	.10	.82	.93	.86	76	71	107.62	<.01

[a] Number of countries.
NS = Not significant at .05 level.

had been available and if the same relationship were to hold for a larger number of countries. However, we apparently "recapture," in the magnitude of the R^2, what is lost by omission of female status by adding other variables.

The list of variables for which a moderate amount of data are available includes:

percentage of women aged 15–19 never married
percentage of women aged 20–24 never married
percentage of adult women who are literate
percentage of women of relevant ages who are enrolled in primary and secondary school
life expectancy at birth for females
percentage of women aged 15–64 employed in the nonagricultural labor force

In addition, we examined the changes of these variables over time, in this case changes from 1960 to 1970. And finally, we constructed indexes of male/female differences for these variables, except for age at marriage. We shall examine the relationship of these variables to fertility decline, first looking at the levels of the female indicators, then at their change over time, and finally at male/female differentials (Table B1).

The R^2 between the level of the above variables around 1970 and fertility decline is .50, which indicates an appreciable relationship but less than some of the sets of variables considered earlier. Moreover, if one substitutes male indicators for literacy, school enrollment, life expectancy at birth, and labor force participation in nonagriculture, the result is about the same (.51), and similarly for various combinations—all of which suggests to us, as noted, that female and male indicators for these variables are a reflection of the degree of development in these respects rather than a singular indication of female or male status.

Data on changes in the above variables are available for relatively few countries (24–33) and produce R^2's that are quite low (.28–.34). Male minus female indicators for literacy, secondary school enrollment, life expectancy at birth, participation in the nonagricultural labor force, and change in percentage of young women never married (15–24) gives a relatively high R^2 of .65, but we have data for only 25 countries for this set of variables. Finally, the ratio of female to male values on the different socioeconomic variables seems a promising approach but is flawed because constant differences at different levels (e.g., 80/95 versus 30/15) give quite different values and often are unrelated to level of development generally, as well as to changes in CBR.

In conclusion, female and male measures on the typical socioeconomic variables appear to reflect level of development rather than sex status as such; the most distinctive measure we could find for a reasonable number of countries did not add to the overall correlation of CBR decline with "modernization"; it still may be that, as differences between men and women narrow with regard to literacy, primary plus secondary school enrollment, life expectancy (with female life expectancy surpassing that of males), and participation in the nonagricultural labor force and as the proportion of women marrying at early age decreases, fertility declines.

Appendix C: Notes on Social Setting

In our initial version of what grew into this paper—presented at the 1977 IUSSP conference—we classified countries by their status on the seven demand factors. We divided each of the factors roughly into thirds, on the following basis:

Factor	*Top 3rd*	*Middle 3rd*	*Bottom 3rd*
Percentage of adult population literate, 1970	≥60	22–59	<22
Percentage aged 5–19 enrolled in primary and secondary school, 1970	65+	40–64	<40
Life expectancy, 1970 (years)	55+	43–54	<43
Infant mortality rate, 1970	<100	100–144	≥145
Percentage of adult males in nonagriculture, 1970	40+	20–39	<20
GNP per capita, 1970 (US$)	450+	185–449	<85
Percentage population living in cities of 100,000+	20+	10–19	<10

We then classified countries by the number of times they fell into the top third. That gave a less even distribution than the rank order classification used in the text, although the overlap is considerable (R = .89) as shown in Table C1. We also classified countries by the sum of values of the seven socioeconomic variables after each was converted to zero mean and unit variance. The correlation between that classification and the one used is .85.

This alternate index of social setting discriminates about the same, perhaps slightly better, in CBR decline, with or without program effort, than the equivalent data in Table 12, as shown below:

	Program effort				
Social setting	*Strong*	*Moderate*	*Weak*	*None*	*Total*
High					
Rank orders	30	29	9	3	19
Top thirds	31	28	10	4	24
Upper middle					
Rank orders	24	18	6	2	10
Top thirds	25	22	5	3	13
Lower middle					
Rank orders	23	14	1	1	3
Top thirds	24	16	7	1	8
Low					
Rank orders	—	—	1	2	2
Top thirds	23	14	2	2	3
Total	29	21	4	2	9

TABLE C1 Level of country's social setting based on rank order and on rankings in top thirds

Social setting	*Number of times in top third on seven factors*			
	High (6–7)	*Upper middle (4–5)*	*Lower middle (2–3)*	*Low (0–1)*
High	Barbados Chile Costa Rica Cuba Hong Kong Jamaica Korea, South Kuwait Lebanon Mexico Panama Singapore Taiwan Trinidad and Tobago Venezuela	Brazil Colombia Fiji Jordan Libyan Arab Rep. Mauritius Paraguay Peru	Korea, North	
Upper middle	Dominican Rep.	Ecuador Malaysia Mongolia Philippines Sri Lanka	China Congo El Salvador Guatemala Iran Iraq Nicaragua Syrian Arab Rep. Thailand Tunisia Turkey Zambia	Algeria Egypt Ghana Honduras Morocco Zaire
Lower middle			Vietnam, South	Angola Bolivia Burma Cameroon Haiti India Indonesia Ivory Coast Kenya Khmer/Kampuchea Lesotho Liberia Madagascar Mozambique Nigeria Pakistan Papua New Guinea Saudi Arabia Senegal Uganda Vietnam, North Yemen, P.D.R. of
Low				Afghanistan Bangladesh Bhutan Burundi Cen. African Rep. Chad Dahomey Ethiopia Guinea Laos Malawi Mali Mauritania Nepal Niger Rwanda Sierra Leone Somalia Sudan Tanzania Togo Upper Volta Yemen

Appendix D: Socioeconomic (Demand) Measures: 94 Developing Countries, circa 1960

Country	*Percent adults literate*	*Percent aged 5–19 enrolled in primary and secondary school*	*Life expectancy (in years)*	*Infant mortality rate*	*Percent males aged 15–64 in nonagricultural labor force*	*GNP per capita (in 1974 US$)*	*Percent population in cities of 100,000+*
Afghanistan	3	5	34	u	15	102	3
Algeria	10	28	47	179	29	773	16
Angola	u	11	33	u	26	355	5
Bangladesh	22	25	40	147	13	105	u
Barbados	98	64	64	60	66	642	0
Bhutan	u	u	37	u	6	u	0
Bolivia	39	41	43	86	28	197	12
Brazil	61	47	57	180	39	506	26
Burma	60	41	44	u	26	88	5
Burundi	14	12	35	150	14	84	0
Cameroon	19	34	37	180	18	211	3
Cen. African Rep.	7	18	36	200	10	212	u
Chad	6	8	35	160	6	124	u
Chile	84	69	57	125	55	671	32
China	u	u	53	u	30	u	11
Colombia	63	45	56	83	36	351	24
Congo	16	53	37	180	43	305	16
Costa Rica	84	68	62	80	38	575	22
Cuba	u	64	63	u	48	u	28
Dahomey/Benin	8	14	35	110	17	118	u
Dominican Rep.	65	61	51	101	25	403	12
Ecuador	68	51	53	100	33	365	18
Egypt	26	43	46	120	36	222	26
El Salvador	49	50	49	76	26	308	10
Ethiopia	6	5	35	u	13	73	3
Fiji	u	60	64	36	38	555	0
Ghana	19	30	38	156	29	427	11
Guatemala	32	33	46	92	24	370	12
Guinea	9	12	35	u	16	108	4
Haiti	15	21	44	172	13	162	6
Honduras	45	41	43	u	20	283	8
Hong Kong	70	62	65	42	85	669	88
India	28	27	43	139	28	119	9
Indonesia	39	35	41	166	22	121	10
Iran	16	29	46	200	38	516	17
Iraq	18	46	46	u	41	567	21
Ivory Coast	5	24	37	138	12	283	6
Jamaica	82	62	64	52	43	727	23
Jordan	32	53	47	54	47	335	13
Kenya	20	29	44	u	17	142	5
Khmer/Kampuchea	33	35	42	u	20	u	6
Korea, North	u	u	54	u	42	u	16
Korea, South	71	65	54	91	31	189	23
Kuwait	15	72	60	u	90	9302	53
Laos	28	13	40	u	20	u	5
Lebanon	u	49	58	105	53	u	27
Lesotho	59	55	40	181	9	73	0
Liberia	9	21	38	u	24	309	0
Libyan Arab Rep.	22	37	47	u	39	1068	21
Madagascar	u	28	37	133	10	183	5
Malawi	22	31	36	148	10	80	u
Malaysia	53	57	53	75	38	380	10
Mali	2	6	35	123	7	75	3
Mauritania	11	4	37	187	9	154	0
Mauritius	61	60	59	70	56	419	17
Mexico	65	50	58	74	37	713	19
Mongolia	36	61	52	u	32	u	17
Morocco	14	25	47	149	30	329	19
Mozambique	8	29	37	200	23	288	3
Nepal	9	8	37	u	7	95	2
Nicaragua	50	45	47	70	26	400	14
Niger	1	3	37	u	5	145	u
Nigeria	15	21	35	163	26	166	5
Pakistan	15	22	43	142	37	86	7
Panama	73	66	62	70	34	584	24
Papua New Guinea	29	u	41	u	15	271	0
Paraguay	75	61	56	u	32	368	18
Peru	61	58	50	92	37	521	15
Philippines	72	68	51	121	27	230	14
Rwanda	16	31	37	u	7	99	0

Appendix D: Socioeconomic (Demand) Measures: 94 Developing Countries, circa 1960 (continued)

Country	Percent adults literate	Percent aged 5–19 enrolled in primary and secondary school	Life expectancy (in years)	Infant mortality rate	Percent males aged 15–64 in nonagricultural labor force	GNP per capita (in 1974 US$)	Percent population in cities of 100,000+
Saudi Arabia	3	7	38	u	26	831	8
Senegal	6	15	37	u	21	366	12
Sierra Leone	7	14	37	u	26	u	5
Singapore	50	78	65	35	84	857	69
Somalia	2	4	36	u	14	103	u
Sri Lanka	75	75	62	57	40	103	10
Sudan	13	11	42	u	13	154	3
Syrian Arab Rep.	30	44	48	u	41	277	26
Taiwan	59	73	65	31	44	358	30
Tanzania	10	15	38	190	13	121	2
Thailand	68	59	51	116	18	171	7
Togo	10	24	35	127	15	142	u
Trinidad and Tobago	93	75	64	45	68	1264	0
Tunisia	16	46	47	u	36	u	16
Turkey	39	46	51	187	31	446	12
Uganda	35	30	44	u	12	211	2
Upper Volta	2	4	33	182	8	92	0
Venezuela	63	70	59	54	53	1446	29
Vietnam, North	65	u	42	u	20	u	6
Vietnam, South	u	46	40	u	20	170	11
Yemen	3	u	38	u	16	u	u
Yemen, P.D.R. of	u	11	38	u	27	u	24
Zaire	31	u	40	104	25	105	6
Zambia	29	31	40	u	21	404	u
Mean	34	38	46	119	29	448	13
Standard deviation	27	22	10	51	17	1033	14

u = unavailable.

Appendix E: Changes in Socioeconomic Variables: 94 Developing Countries, 1960–70

	Proportionate increase			Percent increase			
Country	Percent adults literate	Percent aged 15–19 enrolled in primary and secondary school	Percent population in cities 100,000+	Life expectancy	Percent males aged 15–64 in nonagricultural labor force	Percent decrease in infant mortality rate	Annual percent increase in GNP per capita, 1965–70
Afghanistan	5	9	5	15	3	u	0
Algeria	u	24	−1	11	4	19	3
Angola	u	33	4	13	4	u	2
Bangladesh	1	10	u	0	1	5	1
Barbados	83	31	0	6	2	30	7
Bhutan	u	u	0	14	1	u	u
Bolivia	u	25	6	7	5	−87	2
Brazil	13	21	6	6	2	39	4
Burma	5	31	13	11	5	u	−1
Burundi	u	6	0	12	3	−7	2
Cameroon	u	38	4	10	4	39	6
Cen. African Rep.	u	27	u	11	4	19	1
Chad	2	9	u	10	5	19	0
Chile	27	45	13	8	2	37	2
China	u	u	1	14	4	u	u
Colombia	11	33	18	7	8	9	3
Congo	u	94	16	14	5	18	4
Costa Rica	36	22	1	8	7	13	3
Cuba	u	33	6	9	5	u	u
Dahomey/Benin	16	10	u	15	4	−35	2
Dominican Rep.	11	15	10	11	4	2	4
Ecuador	8	29	4	11	5	9	2
Egypt	8	16	1	11	2	u	0
El Salvador	15	18	0	14	4	12	1
Ethiopia	u	7	2	9	3	u	2
Fiji	u	6	0	7	5	39	5
Ghana	13	19	4	13	4	22	0

Appendix E: Changes in Socioeconomic Variables: 94 Developing Countries, 1960–70 (continued)

Country	*Proportionate increase*			*Percent increase*			
	Percent adults literate	*Percent aged 15–19 enrolled in primary and secondary school*	*Percent population in cities 100,000+*	*Life expectancy*	*Percent males aged 15–64 in nonagricultural labor force*	*Percent decrease in infant mortality rate*	*Annual percent increase in GNP per capita, 1965–70*
Guatemala	11	7	0	13	4	10	3
Guinea	u	14	3	15	4	u	0
Haiti	u	1	6	10	2	24	–1
Honduras	13	17	6	20	3	u	2
Hong Kong	21	42	45	7	–2	52	6
India	7	18	2	12	4	6	2
Indonesia	34	12	2	12	7	16	4
Iran	14	35	7	10	5	30	7
Iraq	28	2	15	11	5	u	2
Ivory Coast	12	26	9	14	3	–12	3
Jamaica	1	11	6	7	6	37	3
Jordan	44	4	18	11	8	33	–2
Kenya	10	18	2	12	4	u	4
Khmer/Kampuchea	11	–26	1	7	2	u	u
Korea, North	u	u	3	10	5	u	u
Korea, South	58	31	20	10	14	34	9
Kuwait	15	18	69	11	–4	u	–5
Laos	6	17	1	0	3	u	u
Lebanon	u	43	35	8	11	38	u
Lesotho	u	20	0	13	4	39	4
Liberia	13	10	0	13	4	u	6
Libyan Arab Rep.	7	57	4	11	18	u	10
Madagascar	u	28	0	14	4	23	2
Malawi	u	–12	u	11	4	20	3
Mali	8	11	1	6	3	–54	1
Mauritania	u	6	0	7	4	27	2
Mauritius	–2	3	0	9	2	19	–2
Mexico	25	38	23	7	4	8	3
Mongolia	27	44	6	14	5	u	u
Morocco	9	9	7	11	5	11	2
Mozambique	u	–1	1	14	9	30	7
Nepal	4	12	1	14	1	u	1
Nicaragua	17	15	8	11	8	36	1
Niger	4	5	u	4	2	u	–4
Nigeria	u	u	6	14	4	4	4
Pakistan	6	7	9	12	0	4	4
Panama	19	32	0	6	7	17	4
Papua New Guinea	u	u	0	14	3	u	3
Paraguay	21	13	3	10	2	u	2
Peru	33	40	12	10	3	–47	1
Philippines	41	59	3	12	6	32	2
Rwanda	u	16	0	10	3	u	5
Saudi Arabia	u	17	4	14	5	u	7
Senegal	0	14	7	8	3	u	–3
Sierra Leone	4	10	2	14	4	u	2
Singapore	38	–5	55	7	–2	40	10
Somalia	u	2	u	11	3	u	1
Sri Lanka	23	–8	–3	8	1	12	3
Sudan	9	11	2	12	3	u	–2
Syrian Arab Rep.	15	39	6	11	2	u	2
Taiwan	53	19	9	5	21	38	6
Tanzania	12	8	1	14	3	12	4
Thailand	34	–2	1	12	3	31	5
Togo	u	25	u	15	3	–28	4
Trinidad and Tobago	56	24	0	7	1	24	2
Tunisia	14	35	4	12	3	u	3
Turkey	20	43	8	10	7	22	4
Uganda	7	–1	2	11	3	u	3
Upper Volta	u	3	0	11	4	1	2
Venezuela	52	17	17	9	4	9	1
Vietnam, North	u	u	3	12	3	u	u
Vietnam, South	u	43	6	0	3	u	–1
Yemen	u	u	u	13	3	u	u
Yemen, P.D.R. of	u	35	–13	13	5	u	u
Zaire	u	u	13	7	4	–11	3
Zambia	10	29	u	11	3	u	1

u = unavailable.

Appendix F: Social Setting and Duration of Program

A detailed tabulation, equivalent to Table 12 but using program duration instead of program effort, is shown in Table F1.

The major deviations are these: In the first column, Venezuela (which did not really implement its nondemographic policy) and Pakistan (where the vigorous effort post-1965 was interrupted by the civil war and its political aftermath). In the second column, the upper middle mixed cell (with some countries pursuing the policy more vigorously than others, e. g., Thailand as against Morocco or Iran). In the third column, the mixed high cell and the Philippines (where the program was strongly pursued in the 1970's). In the fourth column, perhaps Mexico and Brazil, whose social setting is somewhat advanced compared to the others.

TABLE F1 1965–75 Crude birth rate declines (in percents), by social setting and duration of program: 94 developing countries

Social setting	*Program duration*								*Row means*
	1965 or earlier		*1966–68*		*1969–73*		*1973 or later or no program*		
	Country	*Decline*	*Country*	*Decline*	*Country*	*Decline*	*Country*	*Decline*	
High	Singapore	40	Barbados	31	Panama	22	Brazil	10	
	Cuba	40	Chile	29	Paraguay	6	Mexico	9	
	Hong Kong	36	Trinidad and Tobago	29			Korea, North	5	
	Korea, South	32	Costa Rica	29			Kuwait	5	
	Taiwan	30	Colombia	25			Peru	2	
	Mauritius	29	Jamaica	21			Lebanon	2	
	Fiji	22					Jordan	1	
	Venezuela	11					Libyan Arab Rep.	−1	
	Mean	30	Mean	27	Mean	14	Mean	4	19
Upper middle	Tunisia	24	Malaysia	26	Philippines	19	Mongolia	9	
	China	24	Thailand	23	Algeria	4	Zaire	6	
	Sri Lanka	18	Dominican Rep.	21	Guatemala	4	Syrian Arab Rep.	4	
	Egypt	17	El Salvador	13	Ghana	2	Zambia	−2	
	Turkey	16	Honduras	7	Iraq	0	Congo	−2	
			Nicaragua	7					
			Morocco	2					
			Iran	2					
			Ecuador	0					
	Mean	20	Mean	11	Mean	6	Mean	3	10
Lower middle	Vietnam, North	23	Indonesia	13	Nigeria	1	Angola	4	
	India	16	Papua New Guinea	5	Haiti	0	Cameroon	3	
	Pakistan	1	Bolivia	1	Uganda	−4	Burma	3	
			Kenya	0			Yemen, P.D.R. of	3	
							Mozambique	2	
							Khmer/ Kampuchea	2	
							Ivory Coast	1	
							Senegal	0	
							Saudi Arabia	0	
							Vietnam, South	0	
							Liberia	0	
							Madagascar	0	
							Lesotho	−4	
	Mean	13	Mean	5	Mean	−1	Mean	1	3
Low	Bangladesh	2	Nepal	−1	Tanzania	5	Laos	5	
					Dahomey/Benin	3	Cen. African Rep.	5	
					Sudan	0	Malawi	5	
					Mali	−1	Bhutan	3	
					Afghanistan	−2	Ethiopia	2	
							Guinea	2	
							Chad	2	
							Togo	2	
							Upper Volta	1	
							Yemen	1	
							Niger	1	
							Burundi	1	
							Sierra Leone	0	
							Mauritania	0	
							Rwanda	0	
							Somalia	0	
	Mean	2	Mean	−1	Mean	1	Mean	2	2
Column means		22		14		4		2	9

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