The Impact of Family Planning Programs on Fertility: An Inquiry Into the Promise And Problems of Econometric Analyses Based on Cross-National Data

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TABLE OF CONTENTS

SUMMARY AND CONCLUSIONS

The high birth rates of developing countries are a major stumbling block to their economic development and, in the last decade, large family planning programs have been initiated in many countries in the hopes of reducing these rates. But it is difficult to tell what the magnitude of these programs' effect on fertility has been, or whether they have had any effect at all.

The problem is important and urgent, and there is clearly a need for an analysis on which policy recommendations can be based with some confidence. Since fertility is the consequence of many factors besides family planning programs, multivariate econometric techniques are appropriate for such a study. The urgency of the problem suggests that the data for an econometric study should be drawn from existing sources if at all possible. Published data from national censuses and records of vital statistics are thus a particularly attractive possibility. For these reasons, it is the purpose of this paper to examine the methodological issues involved in econometric studies based on cross-sections of countries, and to indicate the value and feasibility of undertaking studies of this type to investigate the impact of family planning programs in developing countries.

Theories of the Determinants of Fertility

As a guide for data collection, the investigation of any problem must begin with the development of a framework which suggests the factors that are likely to affect the variable of interest -- in this case, fertility. Section II reviews recent theories of fertility which have built on the traditional consumer theory of economics. For the most part, these theories apply to developed countries and cannot be transferred, without considerable adaptation, to developing countries. They do suggest, however, that we should

be looking for those factors that represent the satisfactions and more material rewards that children bring their parents on the one hand, and on the other, the direct and opportunity costs associated with having children. More specifically, some of the factors that seem particularly relevant to developing countries are the value of alternative issues of the mother's time, the child's potential contribution to family income, and the need for children to provide support for their aged parents.

Empirical Specification of the Model

Section III discusses the empirical specification of an econometric model that could be based on cross-national data. It begins by considering whether a study of fertility should also analyze the determinants of other elements of the social and economic structure -- i.e., should a simultaneous system of equations be specified? It is noted that, without a careful, well-grounded specification of each equation in the system, simultaneous equation methods may well introduce more problems than they solve. Given the lack of consensus on the empiricial specification for fertility equations, and the difficulty of finding appropriate data from developing countries for even one equation, there does not appear to be any reason to prefer simultaneous equation methods at present.

The variables that should be included in a fertility equation are then discussed. Most theories suggest that completed fertility is an appropriate measure for the dependent variable, because completed family size is expected to be the result of rational responses to environmental factors. A few theories argue that the timing of births is also a matter of rational choice and thus that birth rates are an appropriate measure for the dependent variable. Until one hypothesis is proven superior, both forms of the dependent variable should be tested whenever the data permit. In either

case there is general agreement that both the dependent and independent variables should, ideally, be defined for age-specific groups of women.

The family planning data should represent services delivered, since this is probably the measure of program activity most closely related to contraceptive use. Since it takes a minimum of nine months for contraceptive use to show up in birth rates, the data must obviously apply to the year preceding the year of the fertility data. The section then goes on to discuss the suitability of various measures for the opportunity cost of the mother's time, the productive services and direct costs of children, and other factors associated with fertility -- infant mortality, age at marriage, or type of sexual union, and "taste" variables.

The last part of Section III outlines a dynamic model which could be based on cross-national data, and which could produce a rough estimate of the speed of people's response to changes in the factors that determine fertility.

The Data Base for an Econometric Study: Cross-Sections of Nations

Section IV reviews some special considerations associated with the use of cross-national data and reports on the availability of data appropriate to a study of the impact of family planning.

Statistical problems of aggregate data are first discussed. The functional form of the relationship specified for use with national data should be consistent with the relationship that is believed to hold at the level of the individual, and with the method of aggregating used to arrive at national data. Since national data are the results of simply adding data on individuals, it is advisable to limit estimation to the linear functional form. Other statistical properties of aggregate data indicate that the equations should be weighted, and that it is desirable to have as many countries in the data base as possible, or to attempt to develop data for regions within countries.

The advisability of including both developed and developing countries in the data base is then examined. Several considerations -- measurement errors in the data, permissible functional forms for the equation, and the extent to which the purposes of the analysis require extrapolation beyond the conditions current in developing countries -- suggest that an econometric analysis should be limited to developing countries.

The availability of national data for developing countries is described in the text, and in detailed tables, with particular emphasis on fertility and family planning data. The most promising source for these kinds of data is the International Statistical Program Center, Bureau of Census. Eventually the Center will publish all the familiar measures of fertility -- crude birth rates, age-specific birth rates, completed fertility rates, and several others -- as part of the demographic profiles they are preparing for each country. Only eight of these profiles will be completed by January 1975.

In the meantime, the Center has, on its family planning data file, the crude birth rates for 46 developing countries for at least one year following the first available year of family planning data. Only 20 countries have age-specific birth rate data for a year following family planning data. The measure of family planning activities for the largest number of countries on the file, 43, is the number of new acceptors, by type of contraceptive. Other measures are available for only a few countries. None of these family planning data are age-specific, but the Center estimates that age-specific data could be compiled for about 17 countries. The Center does not now have available, but could assemble, many of the other data items that would be desirable for an econometric study. They estimate that it would take about one year to assemble the data for 43 countries.

Taken together, these facts indicate that a cross-national study would need about one year to collect the data, and that it would be limited to about 40 countries if the crude birth rate were used and between 15 and 20 if age-specific data were used.

An Alternative Data Source: Surveys

Section V briefly reviews some possible sources of survey data. The Roper Center at Williams College has a file of edited fertility surveys, but these do not appear sufficient to support analysis of more than a few countries. The World Fertility Survey is now encouraging and coordinating a series of fertility surveys which will be available several years from now. The data to be collected by these surveys are described. Several types of information which are not well represented in the WFS questionnaries are noted. In particular, it would be useful if the questionnaries asked more about the employment opportunities and school attendance of children, about arrangements for the support of the aged, and about the social status of the household and community standards for child rearing.

I. INTRODUCTION

The decline of fertility in developed countries, and the high rates of fertility in less developed countries, have long posed a challenging puzzle to demographers. On the one hand, they have tried to identify the causes behind the decline in birth rates throughout the developed world. On the other, they have been eager to find out whether the causes they think they have identified can be expected to produce the same result in the less developed countries as these countries proceed through the stages of economic development. The population explosion has stimulated further interest in these questions because policy makers have begun to ask whether, and how, this expected decline in birth rates can be hastened.

In the last decade large family planning programs have been initiated in a number of the less developed countries. But it is difficult to tell what the magnitude of their effect on fertility has been, or whether they have had any effect at all. One school of thought argues that it is unlikely that family planning programs have had an effect because fertility is primarily determined by social and economic factors. A more agnostic school maintains that any study of the impact of family planning programs must hold constant for the effects of socio-economic factors on the birth rate; otherwise, program effects may be obscured by concurrent changes in these other factors.

The problem is clearly an important one and a reliable analysis would be useful to policy makers. Because so many factors are likely to be involved, such a study should employ multivariate analytical techniques. Because the problem is urgent and data gathering is usually the most time-consuming part of any study, it would be desirable to base the analysis on information that is already available. Information is regularly collected, of course, through

censuses, registration requirements, tax forms, etc., and national data based on these sources are regularly published. These considerations suggest the value of investigating the potential and feasibility of econometric analyses based on data for a cross-section of countries.

At least since Adelman's article of 1963 (The American Economic Review, June 1963) social scientists have used cross-national data in econometric studies of the socio-economic determinants of fertility. As a rule, these studies have posited aggregate hypotheses about the relationships between national birth rates and measures of economic development (see, for example, the studies by Janowitz and Repetto, reviewed in Appendix A). A major concern in these studies has been the stability of the estimated relationships across developed and developing countries.

Two recent studies have attempted to explore the relationship between family planning programs and birth rates in developing countries.[1/] The World Bank focused on the strength of the association between birth rates and program inputs as compared to the association between birth rates and socio-economic factors; no attempt was made to estimate the underlying structural relationship. In his working paper, Anker considered the effects of family planning programs as part of a structural framework which he estimated from cross-national data. The measure of family planning programs available to him for this preliminary work -- the number of years the program had been in existence -- was unfortunately a crude one, but the results indicate that the programs act to reduce birth rates.

1/ Both studies are summarized in Appendix A.

It is the purpose of this paper to consider the full range of methodological issues involved in econometric studies based on cross-sections of countries, and to indicate the value and feasibility of further studies of this type. The questions that should be answered before such studies are undertaken will be addressed. What sorts of data are required? Are such data available, or can they be made available reasonably soon? What are the statistical problems of working with aggregate data? How good is the quality of these data? In short, is it feasible to use cross-national data to examine the impact of family planning programs and, if further studies are carried out, is there reason to believe that their results would be reliable and useful?

Plan of the Paper

There is a growing body of literature that suggests the factors to be considered in an analysis of fertility and that increasingly tries to pull them together into a single, coherent framework. Section II of this report reviews some of the theoretical work that has been done on the determinants of births and family size. Although most of this work has been designed to explain events in developed countries, it nevertheless helps generate hypotheses for empirical work on the less developed countries.

With this background, Section III takes up in more detail the empirical specification of a model to investigate the impact of family planning programs on fertility. Some of the pros and cons of trying to specify a simultaneous equation system are first discussed. Then the appropriate measures for the fertility and family planning variables, and for other variables that are theoretically indicated and potentially available, are considered. The possible uses of mixed cross-section/time series data to estimate behavioral lags and project completed fertility are described.

Section IV takes up the problems associated with using cross-sections of countries as the data base for an econometric study. General considerations in the use of such data -- the statistical difficulties associated with aggregate data, and the countries to be included -- are first discussed. Then the availability of appropriate cross-national data, particularly from the U.S. Census Bureau's International Statistical Program Center, is described in detail.

Survey information on individuals and households is a possible alternative source of data. Section V looks at two sources of such data -- the KAP surveys collected at the Roper Center of Williams College, and the surveys to be conducted under the auspices of the World Fertility Survey. Since these latter surveys are only now getting underway, the section mentions some types of questions which might usefully be added to the current versions of the WFS questionnaires.

II. THEORIES OF THE DETERMINANTS OF FERTILITY

Attempts to explain changes in fertility are based on the notion that fertility is not due entirely to forces beyond people's control, but is instead the result of rational responses to objective factors in their environment. Implicit in the development of behavioral theories and in the estimation and interpretation of regression equations, is the assumption that these responses are constant -- that is, changes (differences) in fertility are the result of changes (differences) in the environment, not of changes (differences) in people's response to it. As an example of a world consistent with this philosophy, suppose that birth rates depend on two variables -- women's job opportunities and child mortality. In this world, changes in the birth rate will depend on changes in these two variables, not in responses to them.

According to this philosophy then, if the regression equation explaining fertility is properly specified in terms of independent variables, functional form, lag structure, and the rest, the coefficients of the variables should be constant -- over time, across people in the same country, and across regions and nations. It is this underlying philosophy of behavioral regularity that supports the use of individuals, regions, or nations as potential data bases for econometric studies. And it is this philosophy that underlies the development of the theories that help to shape our data requirements.

A great many possible reasons have been advanced for the birth rate changes that have accompanied modernization. In a recent review article Leibenstein (1974) listed some of the best known:

- o the rising educational attainment of women;
- o the rising labor force participation of women;
- o changes in the rights and roles of women;

- o the dramatic decrease in infant mortality;
- o the decline in the religious beliefs that helped enforce high fertility;
- o urbanization;
- o compulsory education and child labor laws;
- o the decline of the extended family;
- o modern contraceptives;
- o private and governmental pension plans;
- o increasing socio-economic mobility.

The regression studies mentioned in Section I represent some of the early attempts to weave these diverse strands into a coherent explanation of the "demographic transition", and to extend their implications to countries still in the early stages of development.

More recently, the phenomenom of rising incomes brought about by economic development, and simultaneously declining birth rates, has intrigued students of consumer theory. If one thinks of children as a consumer good, and a normal one at that, one would expect birth rates to increase as rising incomes make it possible for people to afford more children. Economists have further noticed that, within the developed countries, higher income groups have fewer children. A new school of fertility theory has grown up, based on consumer theory, which continues to develop hypotheses that fertility is a function of objective social and economic circumstances, but which couches its hypotheses, and interprets its regression results, in terms of the consumption decisions of the household.

In this section we will examine some of the theories that have been developed by this school of thought. Based on this review, Section III will describe the kind of empirical model that might be specified to allow

us to examine the effect of family planning programs on fertility, controlling for the many other causal factors involved.

Models of Fertility Behavior Based on Consumer Theory. The consumer theory approach starts with the notion that births are the result of decisions made within the household. Since national birth rates are simply the sum of these household decisions, it is important to understand the factors that influence households.

The economic theory of fertility makes use of the standard apparatus of consumer theory. Willis (1973) illustrates the basic elements. The family is assumed to maximize its utility, which depends on commodities such as good health, children, transportation, etc. These commodities are produced by the family, which uses market goods and the time of family members in their production. The maximization process is constrained by the total available time of each family member and the money income that the family can earn by devoting some of its time to market work. Thus, the process involves the labor supply decisions of family members as well as the choice among commodities. The choice is further constrained by the wage rates and the prices for market goods that face the family. Since children are a long-lived "commodity", the theory is usually cast in terms of lifetime decisions about consumption and labor supply.

In Willis' model-- and again this is typical of other models as well -- both the number of children and the quality of the children enter the utility function, where quality is broadly defined to include all the characteristics of children that give satisfaction to their parents. Thus, in principle, the specification of the utility function allows parents to trade off quality against quantity. As we shall see, criticisms and subsequent modifications of the theory by Willis and others, are based on the observation/hypothesis that parents' willingness to substitute quantity for quality is

very limited in real life. The specification further implies that parents may increase their satisfaction by increasing the resources they devote to their children, thus raising their quality. And it adopts the conventions of production theory by assuming that child quality, like other commodities, can be produced with different combinations of market goods and the time of family members.

The central puzzle, as Lindert (1973) calls it, that these fertility models have tried to deal with is the fact that fertility declines as incomes grow in the course of development. Further, within developed countries, higher income/more highly educated people generally have fewer children. This raises the suspicion that children may be inferior goods -- a suspicion which has been uniformly (and perhaps too quickly?) rejected and has spurred a hunt for other explanations.

One tack that has been taken has been to look for price effects strong enough to offset the effects of higher incomes. One such price effect that is becoming widely accepted is the argument that the opportunity cost of women's time increases with their education (and their opportunities to use that education in market work). Since children are time-consuming and are, in fact, generally believed to be more time-intensive than other goods produced in the home, the true cost of children is higher for families in which the wife is more highly educated.

Other proposed price effects turn on the desired quality of the children. As Lindert (1973) points out, these are not true price effects since they do not treat the price of a <u>fixed</u> set of inputs. It is the essence of the quality argument that higher quality children require more inputs. There seems to be increasingly general agreement that this pushes the argument back to tastes and their formation. <u>Why</u> do higher income people want higher

quality children? What determines the quality they want?

Both Lindert (1973) and Leibenstein (1973, 1974) have attempted to deal with the problem by proposing preliminary models of taste formation. In doing this, they are responding to the same stimulus that gave rise to earlier fertility models — the desire to explain behavior as a set of consistent responses to objective, and hopefully measurable, phenomena.

Both have started from the point, made by Blake, Namboodiri (1972), and others, that people are social animals with tastes influenced by the social groups to which they belong, or aspire to belong. In particular, these groups determine standards for the raising of children and, equally important, parents do not feel free to select a standard of living for themselves independent of the one they select for their children. While this point leaves the formation and change of group norms unexplained, it raises the hope that objective correlates can be found to represent the effect of these norms on fertility.

Lindert's theory (1973) pushes tastes back a generation by hypothesizing that they are primarily a function of the way the potential parents themselves were raised. Their tastes for inputs per family member are determined by the "pattern of family time and commodity inputs into the couple as they were growing up." He argues that the apparent importance of other factors, such as the couple's current social class, is due to their correlation with this pattern of prior inputs.

The principal mechanism by which the couple's background is expected to have its effect depends on the relative social status of their upbringings. Lindert proposes that "a couple raised on inputs whose economic value was twice the social average would tend to put twice as much as the average family into each child." Thus, they will attempt to maintain the relative

status of their children, and themselves. But Lindert further assumes that, since a child represents a fixed input, the rate of return to investment in it will decline as the level of investment increases. Thus, although the couple received twice the human investment of their peers, they will not, when grown, be able to earn twice the income of their peers. If they want to maintain the same relative level of inputs for their children, they will have to have fewer children.

The empirical specification of the model is only sketched in Lindert's 1973 paper. In particular, the measure(s) to represent the couple's upbringings is nowhere defined. He does mention that, by his theory, most variables should be measured as deviations from an average in cross-section, or as changes over time for the specified group(s) in time series. He further points out that his theory has the advantage that it pushes taste variables into the past, which should allow their effects to be more clearly separated from the effects of current costs and income prospects, both functions of the current state of the economy.

Leibenstein's theory (1973, 1974) also rests on the human desire to maintain relative social status, but it is couched in terms of the transition from developing to developed countries. (Lindert's theory is designed to explain fertility differentials in the U.S.). In general, he argues that a fertility theory should be based not only on the economic changes development brings, but on the associated social changes.

He starts from the observation that the rising per capita income brought by economic development is accompanied by the shift of greater proportions of the population into the higher socio-economic groups. Thus, development reduces the income differentials between groups.

But people will want to maintain their relative status. Status is, in

part, a function of particular kinds of goods, such as education and consumer durables. The reductions in income differentials, in combination with the desire to maintain consumption of status goods, will put pressure on the expenditures for non-status goods, of which children are one. The argument grows a little vague at times, but generally partakes of the flavor of Lindert's theory: relative status is the key.

In his model, Willis (1973) does not develop a theory to explain parents' preferences for child quality. But he does experiment with the implications of the argument that adult consumption and child quality (which represents the children's consumption standards) cannot be set independently. Thus, child quality and adult consumption cannot be substitutes, and may even be complements. Further, child quality is likely to be quite unresponsive to its price (following Lindert, the price of the market good and time inputs that would be given up to achieve an additional unit). The upshot is that substitution will be much more likely to occur between adult consumption and the number of children in the family, rather than between adult consumption and child quality. The implications of the analysis come dangerously close to the conclusion that economists have been trying to avoid, as Willis notes that the number of children will decline with income even though children are not an inferior good "in the usual sense."

These recent theories accept the notion that family planning methods are also a matter of household choice, rather than simply a source of error in the results, as the original Becker model assumed (Namboodiri, 1972). Willis' theory has a particularly interesting implication in this regard. He shows that the costs of contraception, which may be primarily psychic rather than monetary, act as a subsidy for having an additional child, since they can be avoided by having another child. If contraceptives are introduced which have much lower costs, their effect is to raise the cost of having

another child. But they do not affect the costs associated with child quality. His analysis leads him to conclude that improvements in contraceptives can cause a greater proportionate drop in fertility than can a similar decline in the other costs of having and raising children.

One additional theory deserves mention as possibly having particular relevance for developing countries, with their heavy dependence on agriculture. Rosenzweig (1973) has developed a theory, for the U.S., of the determinants of farm fertility. The particular point of his thesis is that farm children, unlike city children, are productive assets even while they are young. (Other authors have hypothesized that this is an important factor in the fertility of the populations of less developed countries.) One of the implications of his hypothesis is that an increase in the price of farm products will raise the demand for farm children, because it will raise their productivity. Thus, a positive relationship between farm value, which reflects both prices and family income, and farm fertility cannot be taken as proof that farm children are normal goods. Similarly, factors that reduce the return to farm families of having children, such as increases in out-migration, will be associated with lower fertility.

Most of these theories have been developed to explain events in developed countries. Not all of the points they emphasize seem equally relevant to developing countries. For example, the stress on the opportunity cost of women's time arises in societies in which many women have high school and college degrees. Is this factor equally important, or even subject to the same interpretation, in societies where most women have only a primary education, if they have any at all? Features of children that are considered unimportant in developed countries seem likely to be very important in the heavily agricultural developing countries where children begin work

early; Rosenzweig's theory distinguishes between urban children, the majority in developed countries, who are hypothesized to have no value as labor, and farm children. As another example, children in developing countries are believed to be the best available pension plans for their parents; in developed countries, this function has been taken over by institutions outside the family and none of the fertility theories consider it as an explicit characteristic of children.

Thus, the theories that have been developed cannot be carried over intact into the consideration of developing countries. They require some adaptation. But their contribution has been to provide a framework that suggests the type of factors we should be looking for -- those factors that represent the satisfactions and more material rewards that children bring their parents on the one hand, and on the other, the direct and opportunity costs associated with having children.

III. EMPIRICAL SPECIFICATION OF THE MODEL

The purpose of this section is to outline the specification of an empirical model which might be used to investigate the effect on fertility of the family planning programs of developing countries. The theoretical models that have been reviewed give some direction to this process but, as Schultz (1974) has noted, there is no consensus on "the" correct specification for a fertility model. Some of the difficulty is due to a lack of specificity in the theoretical models, and some is due to the difficulty of finding empirical measures, especially for developing countries, of the desired variables. These problems will be discussed in the course of outlining the model. In addition to the theoretical work reviewed in Section II, hypotheses or variables suggested by empirical studies of developing countries are considered.

Many of the models, both theoretical and empirical, propose simultaneous equation systems of which fertility is one element. We will first review the other elements that have been proposed as part of a system, and discuss some general considerations for the construction of simultaneous equation models.

Then we will turn to the detailed consideration of the specification of a structural fertility equation, whether or not that equation is viewed as part of a simultaneous system. While the discussion is primarily concerned with the specification of an equation for use with cross-national data, many of the points apply with equal force to other types of data. Particular attention will be given to the definition of the fertility and family planning variables. Other proposed variables will be discussed under the heading "Rewards and Costs of Children."

A. Simultaneous Equation Systems

In most attempts to model some part of the real world, it seems reasonable to believe that the variable of interest is not determined in a vacuum,

but may be determined simultaneously with several other variables. For example, fertility models based on consumer theory generally start by asserting that fertility is simultaneously determined with all the labor supply and consumption decisions of the household, over the entire life of the household (Willis 1973, Lindert 1973, Rosenzweig 1973). Most theoreticians have accepted the criticism, made by Namboodiri (1972) among others, that it is much more reasonable to believe that households make decisions sequentially, revising their plans for the next time period in light of the outcomes of the decisions for the time periods just past. But even with this modification, the notion remains that fertility is part of a simultaneous system which includes all other major household decisions. In fact, it has been suggested that fertility is part and parcel of the household formation process (Willis 1973) and should be extended to include a theory of marriage.

A number of empirical models have adopted the suggestion that fertility is part of a simultaneous system and have estimated equation systems of varying degrees of extensiveness. In his review of some of the empirical literature, Schultz (1974) reports that it appears to be generally accepted that there are important simultaneous interactions between fertility, incidence of marriage, and the sex division of labor force participation. Anker (1974) estimated a three-equation model which included fertility, female employment, and secondary school enrollment as endogenous variables. DaVanzo (1972) estimated a larger system for Chile in which female labor force participation, the female wage, three types of marital status, fertility, child labor force participation, and child school attendance are the endogenous variables. Butz (1972) has suggested that still other variables, such as migration, are endogenous to the system.

It is not the intent of this section to discuss the estimation methods that have been developed to meet the statistical problems posed by simultaneous systems. There are many such methods, but Monte Carlo studies of their small sample properties indicate that two stage least squares -- which is simple and inexpensive to use -- is about as good as other simultaneous equation estimators and, in the situations designed for the Monte Carlo experiments, frequently superior to ordinary least squares (Johnston, 1971). But it may be useful to make explicit some of the decisions required in the specification and estimation of simultaneous systems.

The first decision the investigator must make is how many endogenous variables to include. Since the world is a simultaneous system, he is unlikely to be able to isolate a small subset of variables that have no simultaneous linkages with the rest of the world. In practice then, the decision must be based on the degree of simultaneity between included and omitted variables, rather than on the absence of simultaneity. The decision to estimate a single equation rather than a simultaneous set of equations is thus seen to be based on a difference in degree, not in kind.

The results of using simultaneous equation estimators when single equation methods are appropriate are symmetric with the results of using single equation methods when simultaneous equation methods are called for -- both introduce bias. It seems reasonable then to suggest that the simultaneity of a set of variables should ideally be treated as another testable hypothesis, rather than as part of the untestable foundation of an econometric study. There are no rules to help choose the variables that should be included in the system; these depend on the theoretical specification. A test has recently been proposed for simultaneous equation bias in regressions estimated with single equation methods (Ramsey, 1974; Ramsey and Gilbert,

1972). Unfortunately, the test also picks up bias introduced by omitted variables and incorrect functional form. It is incapable of distinguishing between the three possible sources of bias.[1/]

If a simultaneous equation system is proposed, it is important that each equation be based on a careful, well-founded specification. Mis-specification problems are compounded in simultaneous systems since they affect not only the structural equation in question, but the estimates of the other structural equations as well, through the first stage predictions in 2SLS. Thus it is important if, for example, female labor force and fertility are believed to be part of a simultaneous system, to specify each equation with equal care and attention to the relevant theoretical and empirical work that has gone before; it is not enough simply to recognize their simultaneity and use simultaneous equation estimators. This view has obvious implications for the resources needed to specify a simultaneous model -- a simultaneous model requires considerably more work in the specification stage than a single

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1/ We are not aware of any tests to determine whether a variable initially specified as being endogenous to a system really is, given the hypothesized specification. In his paper, Anker applies a rule of thumb for the purpose. He concludes that female employment is not simultaneously determined with fertility when he finds that the coefficients in the employment equation change very little from the OLS to the 2SLS version. By the same test, the fact that the coefficient of child schooling increases in size and significance in the 2SLS equations leads him to conclude that it is simultaneously determined with fertility. No reference is given for this procedure and we know nothing about its statistical basis or validity.

equation model.[1/]

These limitations of simultaneous estimators have been touched on by other economists concerned with population policy. For example, Butz (1972) notes that simultaneous estimators are especially to be preferred when the specification is known to be good and the sample is large (emphasis supplied). Schultz (1974) observes that inadequate theory, hence an incomplete or incorrect specification, can offset the advantages of simultaneous estimators.

The conclusion would seem to be that the case for the superiority of simultaneous estimators, when applied to empirical versions of fertility models, has not been made. Given the lack of consensus on the empirical specification for fertility equations, and the difficulty of finding appropriate data from developing countries for even one equation, one could argue that ordinary least squares is to be preferred for the present. But, if simultaneous methods are selected, each structural equation in the system should be carefully specified, based on available theory and empirical work.

B. Specification of the Fertility Equation

1. The Dependent Variable

There are a number of commonly used measures of fertility. These include:

- the crude birth rate, i.e., the number of births per 1000 population;
- the general fertility rate, i.e.. the number of births per 1000 women of reproductive age, usually taken to be 15-49;

1/ It should be noted that a given variable may be simultaneously determined with another variable specified by theory, but not with any of the empirical measures available as proxies. For example, births to women 20-25 might be simultaneously determined with their labor supply decisions, but not with the employment of all women. Estimating a system based on inappropriate measures is a form of mis-specification.

- age-specific birth rates, i.e., the number of births to women in a specific age group, per 1,000 women in that age group;
- the total fertility rate, i.e., an age-standardized rate defined as the sum of age-specific birth rates;
- age-specific completed fertility, i.e., the number of children ever born to women in specific age groups.

The theories reviewed earlier all agree that completed family size is the result of rational responses to environmental factors. They thus support completed fertility as an appropriate measure of fertility. But they differ in their assumptions about the timing of births. Leibenstein (1973) argues that only the last child need be the result of a rational decision and thus that completed fertility is the only appropriate fertility measure. The timing of earlier children can be unplanned. The realism of this assumption is supported by survey data showing that contraceptive efficiency rises sharply when a family approaches the desired number of children (Lindert, 1973).

A second school of thought follows Namboodiri (1972), who has argued that births are the results of a series of sequential decisions, each a response to environmental factors. For example, Lindert's model is based on the notion of sequential decision making. This line of thinking points to birth rates as an appropriate fertility measure. From a policy point of view, birth rates may have an advantage over completed fertility in that they may reveal the effects of environmental changes, such as the introduction of family planning programs, more quickly.

Since neither hypothesis has been proven superior, an agnostic approach seems advisable. Both forms of the dependent variable should be tested whenever the data permit.

Most authors have stressed the need for fertility analysis to be based on age-specific data, whatever measure is used. This type of data avoids problems associated with differing age distributions across countries. It should also reflect timing decisions, e.g., the possibility that higher education and better employment opportunities induce women to space their children more closely so that they can return to the labor force quickly.

But to reap the full benefits of age-specific data, the independent variables as well as the fertility measure need to be age-specific. Then the education and job opportunities, say, of women 20-25 years can be linked directly to their fertility in those years. Basing estimates on age-specific fertility rates and population data for the independent variables would be conceptually muddy and unlikely to provide results any more useful than if population fertility rates were used.[1/]

1/ Age-specific data for enough countries would also make it possible to use equations with birth rates as the dependent variable to produce some rather interesting projections of completed fertility. Thus, suppose that we have separate equations for each 5-year age group of women, that we know the number of children already born to women now aged 20-25 in a given country, and that we want to project their completed fertility. If we have data for each of the independent variables specific to their age group, we can insert these values in the equations for the older groups and predict the fertility of the selected cohort as it ages. The sum of the predictions would yield completed fertility for the group. Comparison of these predictions with the predictions for older groups would suggest the trends to be expected.

Even if age-specific data are available for enough countries to permit estimation of the needed equations, there are likely to be methodological problems that must be solved before predictions can be made. For example, if we want to predict surviving children rather than total births, we will need to incorporate information on child mortality. But the idea seems worth exploring further because it could provide some illuminating predictions and simulations.

2. The Family Planning Variable

The major question that should be addressed by the model is: is there any evidence that a higher level of family planning services is associated with a significantly lower fertility rate? Thus the variable(s) used to measure family planning is of particular importance. The most appropriate measures would seem to be those that represent contraceptive services actually delivered to the client. Program inputs -- money spent, numbers of employees, etc. -- could serve as proxies for service data but, since the relationship between inputs and services is not a direct linear one, they are less appropriate.

Only one measure of family planning program activities -- new acceptors -- appears to be available for a large number of developing countries (see Section IV). It is generally available by major type of contraceptive. 1/

New acceptors is not the most desirable measure for the family planning variable. Its ability to represent actual use, which is presumably the factor that affects fertility, depends not only on the unknown relationship between acceptance and use, but on the age of a country's family planning programs. The older the program the more users there will be from previous years who will not be counted among the new acceptors of a current year. For newer programs acceptors may serve as a reasonably good proxy for use.

If acceptor data are available for several years for enough countries it might be possible to experiment with alternatives to the use of a single year's data. The simplest approach would be to sum the new acceptors for a period of perhaps five years. More complicated approaches might try to apply continua-

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1/ A new acceptor is supposed to be defined as a person who has not previously practiced family planning and who accepts some method of family planning under program auspices. But it is generally believed that, in many cases, supplies distributed by the program simply replace other methods or sources of supply. If our intention is to measure the effect of contraceptive use, then this lack of purity in the definition is a problem. But if, as here, the point is to measure the effect of the program, it is not a problem and an insignificant coefficient for the family planning variable is a valid possibility with a valid interpretation, i.e., that the program is not effective.

tion rates to the new acceptors from earlier years, but such sophistication is questionable since little is known that would help to establish an appropriate rate.

Two obvious points about the data requirements for the family planning variable should be made. The first is that the year of the family planning data should precede the year of the fertility measure since it takes a minimum of nine months for family planning services to affect fertility. With some of the other variables, those that change rather slowly, a case can be made that any year fairly close to the year of the fertility measure will do. But the family planning programs of most developing countries are quite recent and the fact that data are available for, say 1970, not only does not allow us to assume that the levels of acceptors and users were similar a few years earlier, it does not even allow us to assume that programs existed a few years earlier.

The second point is that if age-specific fertility measures are to be used, then the family planning data should also be age-specific. This is particularly important because family planning is the independent variable of primary interest, and therefore the one for which crude proxies are least acceptable, and because it is generally believed that the type of contraceptive method used differs substantially by age. For example, sterilization is believed to be accepted primarily by older women while younger women prefer reversible methods, such as the oral contraceptives. But the family planning data do not appear to be available by age group for many developing countries.[1/] It might be possible to aggregate age-specific data into broader age groups (e.g., 20-30 rather than the usual 5 year intervals) and use only data on the family planning methods believed to be preferred by that age group, but this approach is obviously very crude and is not recommended as a real solution to the problem.

1/ The International Statistical Programs Center, Bureau of Census, estimates that they could derive data for at least 12 countries, and possibly for another 5 -- see Section IV.

Finally, especially where the available data place a severe limit on the number of independent variables, one might want to combine the various method series into a single measure of family planning acceptance or use. Conceptually, the notion of "couple years of protection" would allow this to be done. It might be possible simply to sum user data across methods without doing too much violence to reality. But some assumptions would have to be made about the couple years of protection afforded an acceptor of each method. The lack of age-specific data might be a problem here since the years of protection provided by a sterilization, for example, will depend on age. On the other hand, the problem will be considerably reduced if we try to derive an aggregate measure for only a short period of time, and for programs that are not very old.

3. The Rewards and Costs of Children

The variables discussed in this section have been used or proposed in a number of regression studies of fertility in developing countries. Most of them follow the spirit of the consumer theory models of fertility, although the specific variables discussed may not arise directly out of those models.

Opportunity Cost of the Mother's Time. The theoretical models stress the "price effect" due to the opportunity cost of the time women spend in child rearing. In the pure form of the theory this time cost is represented by the woman's actual or potential market wage. For example, DaVanzo (1972) used the female wage to represent this cost in her study of Chilean fertility.

But wage data specific to women are seldom available for developing countries. Nor is it clear that, if they were, they would represent the theoretical concept as well as in developed countries. In developing countries the appropriate opportunity cost for many women is their marginal product in agricultural

work, usually as unpaid family laborers. In countries where it is common to hire farm labor, the wage of this labor, if available, might be a good proxy for women's time cost. Rosenzweig followed this approach in his study of U.S. farm fertility. But if most farm labor is unpaid family labor there probably is no good proxy.

Alternative proxies that have been used are female employment, or labor force participation, and female education. Schultz, for example, notes that female education is frequently used as a proxy for female wage rates. This seems reasonable enough for developed countries, where we know that education has a strong correlation with wage rates. It seems less plausible for developing countries where most women have only a few years of primary education, if they have any. If educational levels are low and the main possibility for work outside the home is farm labor, it is not clear that a woman's productivity, hence her opportunity cost, has any relation to her few years of education. Any possible relationship seems particularly unlikely to appear when female education is represented by a proxy such as the percentage with some primary education. Measures of literacy, if these are independently defined, might be more useful, although adult illiteracy was insignificant in Anker's study.

Anker (1974) uses measures of female employment and female labor force participation. He bases the former on the service and industry sectors, on the hypothesis that these sectors provide "child-competing" jobs, while agricultural work does not. A similar sort of hypothesis seems to be suggested by data for Egypt, presented by Bindary, et.al. (1973), which show that higher female labor force participation rates are associated with lower fertility in urban areas, but with higher fertility in rural areas. The difficulty is that the agricultural nature of the work may also be associated with a greater value for children as productive assets, as discussed

below. Thus there do not seem to be, for developing countries, any measures of the time cost of child rearing that are subject to unequivocal interpretation.

The Productive Services and Direct Costs of Children. A number of studies have hypothesized that children in developed countries are important productive assets to their parents. From a very early age they are capable of contributing to family income, either monetarily or in kind. One measure of this that has been used is child labor force participation (See DaVanzo, 1972, Schultz, 1974). Where this is defined to include unpaid work in family businesses or on farms, it is a very general measure of the productive contribution of children. Where it measures only participation in the paid labor force, it applies specifically to their direct contribution to money income.

As noted in Section II, Rosenzweig (1973) has developed the hypothesis for the United States that farm children are productive assets. He is then led to test variables such as farm value (a proxy for farm income), and farm product prices as determinants of U.S. farm fertility. The possibility of getting farm value or farm income measures for developing countries seems remote. For countries with substantial markets in farm products, price measures might be possible, although difficult to make comparable in cross-section. More realistically, Rosenzweig's model may suggest a basis for the inclusion and interpretation of a variable representing either the proportion of the population in agriculture, or the proportion that owns some rural land. A positive coefficient for either variable could be taken as support for the greater value of children as productive assets in rural areas. The model also suggests the value of collecting data on items that indicate the possibilities for child labor in the family business -- whether

it be farm or non-farm. For example, information on the type and size of family business could be useful.

Child schooling is usually treated as the opposite side of the child productivity coin. It is, of course, a direct cost of children to some extent -- definitely so if education is not provided free by the state. But a child in school is also unable to contribute to family income. Thus child schooling can be interpreted as an opportunity cost measure of children's potential product. The variable generally used is some measure of children's attendance at school (Anker, 1974, DaVanzo, 1972, Schultz, 1974). It is variously argued that primary schooling is the appropriate measure, because it is more widely available and thus affects more children, and that secondary schooling is the appropriate measure because it represents larger direct costs and larger opportunity costs (since the child is older).

Through the family structure, children in developing countries serve still other functions that have been transferred to institutions outside the family in developed countries. For example, extended families serve as a means of insuring their members against the risks of ill health and the insecurity of old age. Parents' desire to have enough children, especially enough sons, to guarantee a secure old age is frequently put forward as a determinant of fertility. This leads to the hypothesis that fertility will decline once formal pension plans are introduced. Unfortunately, the data needed to test the hypothesis, information about the coverage and benefits of plans in developing countries, or about less institutionalized ways of supporting the elderly, are not available. Anker (1974) attempted to use the years each program had been in existence as a proxy; he has noted that the International Labor Office has a survey underway to collect pension plan data from developing countries.

The theories reviewed in Section II emphasize that, in fertility models, it is even more important than in most applications of consumer theory to specify the determinants of preferences. Anker specified adult illiteracy as a measure of tastes in his analysis but the variable turned out to be statistically insignificant.

Leibenstein and Lindert have both proposed theories of taste formation that build on the notion of relative social status. Leibenstein's model makes explicit use of his observation that income differentials are compressed in the course of economic development. This suggests that a measure of relative income differentials may serve as a good proxy for tastes in a fertility equation. All of which fits in nicely with Repetto's preliminary work (1974), which indicates that a more equal distribution of income is associated with lower fertility.

Other Variables. A number of other variables have been included in empirical and theoretical studies of fertility and will be briefly mentioned here.

One of the most important is child mortality. Child mortality has been represented, on the one hand, as a cost of producing a surviving child and, on the other, as a factor necessitating additional births in order to insure a given number of surviving children. A number of studies have found that high infant and child mortality acts to increase fertility.

Another variable is age at marriage. This primarily reflects the assumption that most fertility occurs within marriage and that late marriages result in reduced fertility. Where marriage is not the predominant form of sexual union, fertility is expected to reflect the incidence of the different types. In her study of Chile, DaVanzo (1972) found some support for this view. But in a study of Barbados, Ram and Ebanks (1973) found no relationship between fertility and the type or stability of sexual union.

Consumer theories of fertility specify lifetime income as an important determinant of fertility. For developed countries, it is possible to generate predictions of lifetime income, at least if data on individuals are being used, (see Willis, 1973). But for developing countries it is not even clear that a reasonable measure of current income is available. A major problem is the fact that a substantial portion of income in developing countries is "in kind" income for which no monetary measure is possible. When the data base is cross-national, an additional difficulty is introduced by the need to reduce the different income measures to a comparable monetary unit.

C. Estimation of the Response to Changes Over Time

The preceding pages have discussed the types of environmental factors that have been hypothesized to influence fertility, but nothing has been said about the speed of the response to these factors. Realistically, parents' response to some external change -- say a decline in the child mortality rate -- may take place gradually over a number of years. It would be useful for policy purposes to have some idea how long this adjustment period is.

If we accept the assumption of constant response coefficients over time,[1/] we can justify the use of the sort of model generally used for stock-adjustment problems, to estimate the response lag. This application differs from the usual application in two ways. First, the data base would consist of two (or more) cross-sections of observations recorded at different times -- say during the 1960

1/ This means that changes in fertility over time are the result of changes in environmental factors and not in the responses to them. For example, if the birth rate for women 20-25 years of age in 1970 differs from the birth rate for the same age group in 1960, this is assumed to be due to differences in the environmental factors facing this group of women in the two years.

and 1970 censuses -- for each of a sample of nations. Second, the variable to be analyzed is not a physical stock like the number of residential dwellings, but must be represented as a sort of behavioral stock.

The notion of estimating lags from two or more cross-sections when long time series are not available was developed by Grunfeld (1961). In his econometric model of the U.S. health care sector, Feldstein (1967) applied the technique to a behavioral variable -- health insurance ownership. He argued that insurance ownership is a type of behavior that, once begun, is likely to be maintained, and thus that adjustments to changes in external factors will occur gradually. His results, based on cross-sectional data for 1950 and 1960, indicate that there is a behavioral lag in insurance ownership but that, plausibly, the response time of insurance ownership is much faster than the response time of physical stocks such as hospital beds.

Following this approach, we can hypothesize that birth rates are, in a sense, a behavioral stock. This will be true if they depend not only on the personal characteristics and immediate environment of the current generation of parents, but also on the history of social and cultural attitudes reflected in the behavior of past generations and in society's expectations of the current generation. We can then further hypothesize that the present generation behaves as though it has an "ideal" birth rate in mind, based on its own characteristics and environment, and that it adjusts toward that birth rate, away from past birth rate levels, with a lag.

Denote the fully-adjusted, or ideal, birth rate by BR* and the actual birth rate by BR. Then the lagged adjustment of the actual toward the ideal birth rate is represented by the following equation:

[1] $$BR - BR_{-1} = \lambda(BR^* - BR_{-1})$$

The change in the birth rate from one period to the next is thus hypothesized to be a proportion of the difference between the ideal rate and the rate in the previous period. If we specify BR* as a function of a number of (observable) environmental factors, e.g.,

$$BR^* = b_0 + b_1 JOBS + b_2 CM$$

(where JOBS represents the job opportunities for women and CM represents child mortality), and select cross-sections from two censuses, as Feldstein did, so that the response is measured over a ten-year period, equation [1] becomes

$$BR - BR_{-10} = \lambda(b_0 + b_1 JOBS + b_2 CM - BR_{-10})$$

$$BR = \lambda b_0 + \lambda b_1 JOBS + \lambda b_2 CM + (1 - \lambda) BR_{-10}$$

The coefficients of this equation represent "short run" effects (in this case, effects within 10 years). The full long run effects can be estimated by dividing these coefficients by λ, which can in turn be computed from the coefficient for BR_{-10}.[1/]

The method is obviously a crude one. For example, it assumes that the speed of adjustment is the same for all variables. But it might provide a useful first approximation to the behavioral lags that influence birth rates.

1/ If, contrary to the hypothesis, full adjustment to the changed conditions occurs within the time period, the coefficient for BR_{-10} will be insignificantly different from zero.

IV. THE DATA BASE FOR AN ECONOMETRIC STUDY: CROSS-SECTIONS OF NATIONS

It was observed in the Introduction that summary data for nations offer an attractive data base because they are likely to be more readily available than are other sources of data. This section will review some general considerations that relate to the use of national data for the estimation of a fertility model, and will report on the availability of data appropriate for such a model.

Section IV-A discusses the general statistical problems associated with the use of any kind of aggregate data, whether the basis for aggregation is the geographic boundaries of a nation, the calender limits of a year, or something else. Section IV-B considers whether the data base should include developed, as well as developing, nations. Section IV-C describes the data that are now available or that could be developed for an econometric study based on data for nations.

A. Statistical Problems with Aggregate Data

The relationships proposed for estimation with national data have been derived from fertility models based on the behavior of the individual household. As Allen (1966) has noted, whenever we take the view that the aggregate relationship of interest is the result of many individual relationships, "there must be an explicit translation, through aggregation, from micro-relations to appropriate macro-relations."

In the present case we are given the form of aggregation. Virtually all national data are simply linear sums -- of dollars, acres, people with specific characteristics, etc. Given our assumption of constant response coefficients, we have no difficulty in moving from a micro-equation to a macro-equation; but only one functional form is consistent with the type of aggregation specified -- the additive, linear form.[1/] This is easy to see if we consider,

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1/ This point should not be confused with the requirement that all regression equations be linear in the parameters. Nonlinear functional forms can be transformed into linear forms for estimation -- witness the frequent use of double log equations to represent the multiplicative form. But we are specifying here that the original hypothesized form of the equation must

for example, a micro-relation in the log form. Summing over individuals we conclude that the macro-relation requires variables of the form $\sum_i \log X_i$. But national data provide us with variables in the form $\sum_i X_i$ (or $\sum_i X_i/N$), and it is not true in general that $\Sigma \log X_i = \log \Sigma X_i$.

Thus relationships estimated from aggregate data, at least if these are seen as arising from the behavior of smaller units, should probably be limited to the linear functional form. Justification for this form is at hand in the argument that the linear form provides a reasonable approximation, over a fairly narrow range of variation in the variables, to many other functional forms. As indicated above, this argument further suggests that the regression analysis should be limited to data for LDC's.

Johnston (1971) has developed the argument that, even if the micro-relation meets the assumptions that underlie regression analysis, in particular the homoscedasticity of the error terms, the macro-relation will not, in general, satisfy those conditions. The difficulty can be corrected by weighting the observations. The appropriate weights are the numbers of micro-units represented by each aggregate observation. For national data, this will generally be the population or some subset of it, e.g., the number of women 20-25 in each country.

Finally, Johnston notes that the standard deviations of coefficients estimated from aggregate data will be greater than those that would be obtained from the corresponding individual data. This means that aggregate data give less precise coefficient estimates and, partly in consequence, are less able to discriminate between alternative models. Monte Carlo results published by Orcutt, et.al., (1968), while designed to study time series problems and thus limited in their applicability to cross-section data, show that aggregate data can be subject to problems of bias and imprecision in the estimates. Both of

these problems are substantially reduced, for their model, by either increasing the number of observations at the same level of aggregation, or by developing data for a somewhat lower level of aggregation (in the cross-section context, this might mean regional rather than national data). This suggests the value of two types of data collection or generation efforts: the expansion of national data files to include as many countries as possible; and attempts to develop regional data from national censuses, vital statistics, and other sources.

B. Should the Data Base Include Both Developed and Developing Nations?

Applied to nations, the conceptual framework outlined in Section II would suggest that differences in national fertility rates are the result of consistent individual responses to the different environments of those nations. In particular, we can hypothesize that differences in the environments of developed and less developed countries are responsible for the large differences in birth rates between these two groups of countries, and that both should be included in an econometric analysis.

There is, however, some disagreement on this point in the literature. Repetto (1974) notes the high degree of measurement error in the birth rate data of LDC's and argues that most of the variation among LDC's is probably due to this error. Repetto believes that the differences between LDC's and DC's are due to the differences in their socio-economic conditions and thus, that both should be included in the analysis. Anker (1974), on the other hand, argues that the large differences between LDC's and DC's guarantee good regression fits, but are difficult to interpret and probably misleading.

To help gauge the importance of Repetto's point about the accuracy of LDC data, we calculated the mean and standard deviation of the birth rates for

the 76 LDC's used by Anker (U.N. Demographic Yearbook, 1971). Eighty-two percent of the countries fell within 20 percent (one standard deviation) of the mean. This suggests that a relatively small percentage of error in the data could establish Repetto's point. We need then to determine the likely size and nature of the errors in LDC vital statistics.

It is generally agreed that the data for less developed countries are "by and large quite inaccurate" (Scheuch, 1966), but there is little in the way of hard information about the degree of inaccuracy. It is also generally believed that counts of events obtained from registrations, such as births, are far from complete in less developed countries, and thus that the available birth rate data are consistently too low. Repetto's point depends on a random error -- sometimes too large, sometimes too small -- to create an appearance of wide variation between LDC's. The fact that the level of the birth rate is considerably understated for LDC's does not mean that the variation among LDC's is mis-represented to the same degree. This is a question of the relative inaccuracy of the statistics for LDC's.

But if reported LDC rates are consistently too low, this may create other problems when LDC's and DC's are analyzed together. Since the statistics of DC's are generally believed to be much more accurate than those of LDC's, the reported variation in birth rates probably understates the true variation substantially, and this may result in biases in the estimated coefficients.

Anker's position can be given two interpretations. The first is inconsistent with the conceptual framework that underlies regression analysis -- that is, he may suspect that fertility differences between LDC's and DC's should be attributed to differences in responses, rather than to environmental differences.

The second fits easily into the conceptual framework. Regression work involves the fitting of linear, or simple non-linear, functional forms to relationships which may be more complex in fact. Over a relatively narrow range of observation--say, the range represented by LDC's--a linear approximation may be reasonably good. Over a wider range of variation--say that between LDC's and DC's--it may be a poor approximation to parts of the relationship, leading to inaccurate predictions over some of the range.

Chart I illustrates the point. The curved line represents the true relationship, with the observations clustered somewhat more heavily at either end than in the middle, representing the clustering of LDC's and DC's. Both line A and line B correctly indicate the direction of the relationship. But line A, fitted by using all the observations, is clearly a poorer representation of the segment of the curve that applies to LDC's than is line B, estimated on the basis of the LDC's alone. If we want to predict the effect of a small increase in X (X_0 to X_1) on the fertility of country M, our prediction will be more accurate if we use line B than line A.

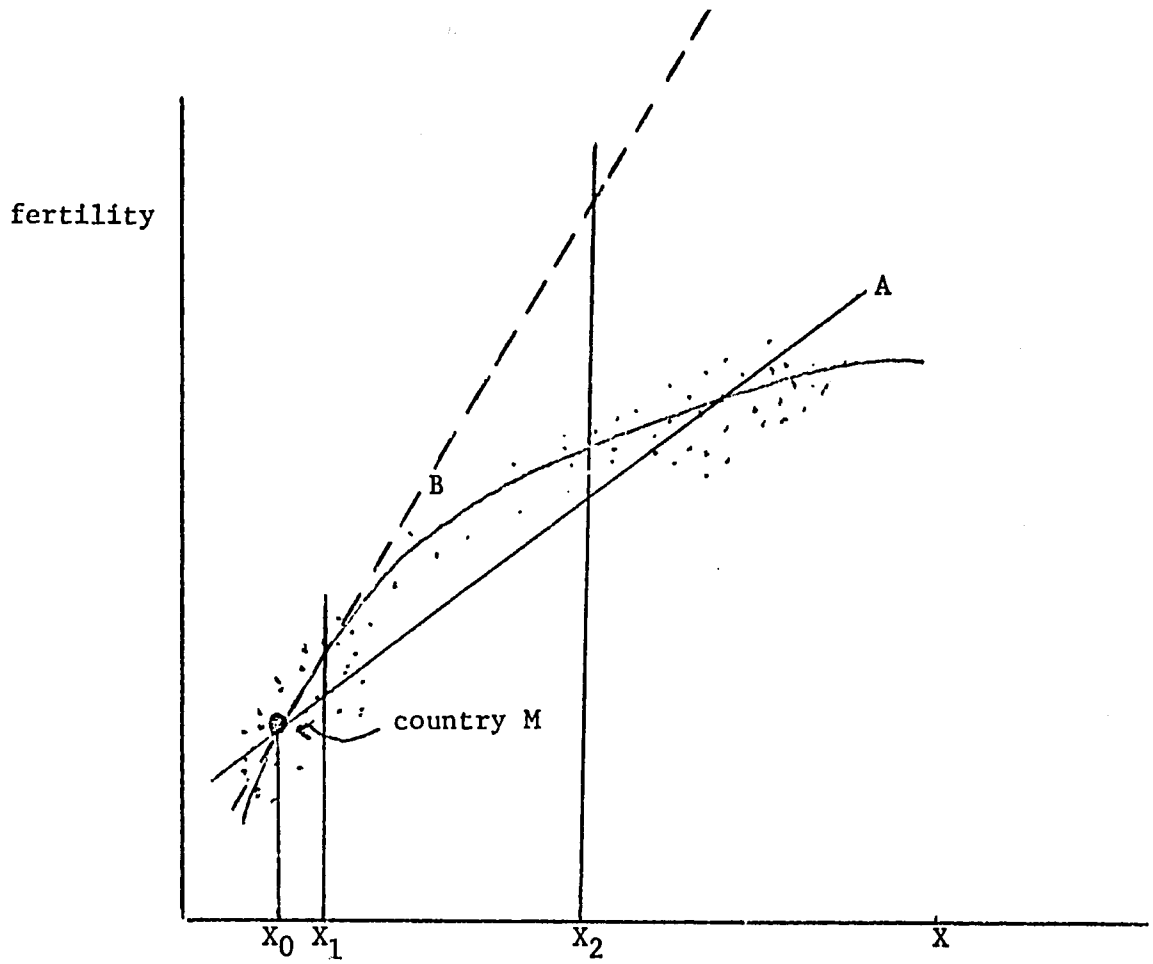

Chart I.

On the other hand, if we want to know what is likely to happen under conditions of rapid and extensive change in socio-economic conditions (a change from X_0 to X_2, for example) we should probably examine both LDC's and DC's. Otherwise we will be extrapolating far beyond the range of observation available for LDC's, and yet ignoring available information about the countries in that range--the developed countries. Returning to Chart I we see that prediction of the effects of a change from X_0 to X_2 is much more accurate if we use line A rather than line B.

As the illustration serves to suggest, the decision about whether to use LDC's and DC's together in the analysis can depend, in part, on the purpose of the analysis and the extent of the extrapolation this suggests we will want. If we are interested in knowing what will happen to LDC birth rates given relatively small changes in socio-economic conditions--i.e., we assume they will remain LDC's, then we should probably limit the analysis to LDC's. But if we are interested in examining the effects of larger changes in the independent variables, we should probably include the developed countries.

Three points emerge from this discussion. In the decision to combine LDC's and DC's the investigator should especially consider:

(1) The range of observation needed for the predictions the research is intended to produce. If relatively small extrapolations from current LDC conditions are wanted, then it may be best to limit the analysis to LDC's.

(2) The relative measurement errors in the data from the two groups of countries and the nature of the biases these may cause.

(3) The possibility that, if both LDC's and DC's are included in the investigation, particular attention should be given to experimenting with nonlinear functional forms.

In the present case, a major part of the interest in an econometric analysis would be to find out whether measures of family planning are significant determinants of LDC fertility. This, of course, involves no extrapolation at all. With respect to measurement errors in national data we know nothing precise, but it is generally agreed that they exist, that they differ between developed and less developed countries, and that they are quite large for the latter. Finally, as noted earlier, regressions based on aggregate data should probably be limited to linear functional forms. Taken together, these points indicate that estimation of a fertility model, for the purpose of investigating the effect of family planning programs on LDC fertility, should be based on data from LDC's alone.

C. Availability of Cross-National Data

This section summarizes the availability of national data on fertility, the activities of public and private family planning programs, and other demographic and socio-economic determinants of fertility. It deals only with national data; data for regions within countries are not available. Since not all measures are available for all countries for even one year, the section reports on the availability of each data item for each country in recent years from two major data sources -- the Population Council, and the International Statistical Program Center. Annually since 1970, in its Reports on Population/ Family Planning, the Population Council has published "Population and Family Planning: A Factbook" by Dorothy Nortman. The Factbook provides measures of fertility and family planning activities for developing countries. The International Statistical Program Center (ISPC), a part of the U.S. Census Bureau,

compiles data series on countries other than the United States for other federal agencies, on a contract basis. It has compiled two data files -- the Family Planning File, and the Demographic Country Profiles -- which provide many of the available fertility, family planning and other measures for the developing countries.

1. Fertility Data

Available measures of fertility include crude birth rates, general fertility rates, age-specific birth rates and completed fertility rates, as well as child/women ratios (see Section III for definitions).

All of these fertility measures will be part of the Country Demographic Profiles, currently being compiled at the International Statistical Program Center (ISPC). Country Demographic Profiles have been completed for three countries (Ghana, Costa Rica and Taiwan), and profiles for 5 more countries (India, Philippines, Mexico, El Salvador and Indonesia) will be completed by January, 1975. ISPC will not venture a guess about its 1975 time-table for completion of the remaining profiles, although it is their intent to produce profiles for every country in the world.

ISPC also has crude birth rates, general fertility rates, and age-specific birth rates currently on a second data file, the Family Planning File; this file does not include completed fertility rates. Table 1 shows the availability of these fertility measures, by year, for all of the 46 less developed countries on the file. All 46 have crude birth rates for at least 1 year following the first available year of family planning data; 43 countries have crude birth rates for at least 2 years following the first available year of family planning data. Twenty-four of the less developed countries on the file have age-specific birth rates, but only 20 meet the requirement that they follow the first available year of family planning data. Of these 20, 14 countries have rates for 2 years.

The Population Council file, as reported in Population and Family Planning: A Factbook, contains only one measure of fertility, the crude birth rate, for 67 developing countries.

2. Family Planning Data

Available measures of the activities of family planning programs include data on the numbers of new acceptors, client revisits, current users, program contraceptives distributed, facilities, and personnel associated with organized family planning activities. Also, data are available on the commercial distribution of contraceptives. Two organizations -- the Population Council and the International Statistical Program Center of the U.S. Census Bureau have archived these family planning data.

The Population Council compiles its data from published reports of family planning program administrators, both public and private, supplemented by reports from the Population Council field staff and others. The data are adjusted, when possible, for errors and comparability and published in the Factbook.

The International Statistical Program Center data are also compiled from reports by administrators of either national family planning programs or private family planning associations. In addition, the Center uses the Population Council's data, data from the International Planned Parenthood's Reports to Donors (annual) and from IPPF's Overview, 1972, by Horacio Gutierrez, as well as from other studies. ISPC data are not adjusted for comparability or misreporting, but qualifying notes are given regarding estimates of the level of misreporting whenever possible. Since the ISPC data files contain all the information that is on the Population Council files, plus additional information, they appear to be the more desirable data source.

Table 1.

Selected Fertility Measures and Family Planning Data
Available from the International Statistical Program Center (Bureau of Census),
by country and year

	Fertility Measures		Family Planning Program Measures							
			New Acceptors (1,000)							
	Births Per 1,000 Population	Age-Specific Fertility Rates	Total	Oral Contraceptives	IUD	Condom	Foam, Cream, Jelly	Injection	Sterilization	Other
Latin America										
Argentina	65-72	65	70-72	70-72	70-72					
Barbados	65-72	65-70	65-72	69-72	69-72	69-72	69-72			70-72
Brazil	69-72	65	67-72	66-72	66-72					
Chile	65-71	65	68-72	68-72	68-72					67-72
Colombia	69-72	65	65-72	66-72	65-72					70,72
Costa Rica	65-72	65-72	66-72	66-73	66-72				72	67-72
Dominican Republic	68-72	65-72	68-73	68-73	68-73					66-72
Ecuador	69-72	65-67	66-72	66-72	66-72					68-73
El Salvador	65-72		72	72	72					66-72
Guatemala	65-72		65-73	65-73	65-73				72	72
Honduras		69,71	68-72	68-72	68-72			65-73		68-73
Jamaica	65-73		69-72	69-72	69-72	69-72	69-72	70		70-72
Mexico	65-70	65	66-72	70-72	70-72			70-72		70-72
Nicaragua	69,71		68-73	68-72	68-72					68-72
Panama	65-72	65-70	72-73	72-73	72-73				72-73	
Paraguay	70,72	65,70	70-72	70-72	70-72					70-72
Peru	65-72	65,70	70-72	70-72	70-72			70-72		70-72
Puerto Rico	65-72	65-71	70-71	71	71	71	71			71
Trinidad and Tobago	65-72	65-70	69-71	69-71	69-71				70-71	69-71
Uraguay	67-72		70-72	70-72	70-72					70-72
Venezuela	70-72	65	65-72	65-72	65-72				65-72	65-72

Table 1. Continued

Family Planning Program Measures

	Client Revisits (1,000)							Current Users (1,000)
	Total	Oral Contra-ceptives	IUD	Condom	Foam, Cream, Jelly	Injec-tion	Other	
Latin America								
Argentina	70-72	70-72	70-72				70-72	
Barbados	70-72	70-72	70-72				70-72	
Brazil	66-72	71	71				71	66-72
Chile	70-72	70-72	70-72				70,72	
Colombia								
Costa Rica	67-73	72	72				72	
Dominican Republic	71-73	71-73	71-73				71-73	
Ecuador	70-72	70-72	70-72				70-72	66-72
El Salvador	72	72	72				72	
Guatemala	65-73	65-73	68-73			71-73	71-73	
Honduras	68-73	71-73	71-73					
Jamaica	69-72	69-72	69-72	69-72	69-72	72	70-72	72
Mexico	66-72	70-72	70-72			70	70-72	
Nicaragua	71-72	71-72	71-72				71-72	
Panama	70-73	70-73	70-73				70-73	
Paraguay	70-72	70-72	70-72				71-72	72
Peru	70-72	70-72	70-72				70-72	
Puerto Rico								
Trinidad and Tobago								70-71
Uraguay	70-72	70-72	70-72					
Venezuela	69-72	70-72	70-72				70-72	

Table 1. Continued

	Non-Program Family Planning Activity Measures	
	Oral Contraceptives	Sterilizations
Latin America		
Argentina	1/	
Barbados		70-72
Brazil	1/	
Chile	1/	72
Colombia	1/	
Costa Rica	65-69	
Dominican Republic		
Ecuador		
El Salvador		
Guatemala		
Honduras		
Jamaica		
Mexico	1/	
Nicaragua		
Panama		
Paraguay		
Peru		
Puerto Rico		
Trinidad and Tobago		
Uraguay		
Venezuela		

1/ 1967 and 1968 survey data on the average monthly distribution of oral contraceptives is available from a Sollins and Belsky article published in the June 1970 issue of Report on Population/Family Planning (The Population Council).

Table 1. Continued

	Fertility Measures		Family Planning Program Measures								
	Births Per 1,000 Population	Age-Specific Fertility Rates	New Acceptors (1,000)								
			Total	Oral Contra-ceptives	IUD	Condom	Foam, Cream, Jelly	Injec-tion	Sterili-zation	Rhythm	Other
Africa											
Egypt	65-72	66,70	66-72	66-72	66-72						71-72
Ghana	68-72	71	71-73	71-73	71-73						71-73
Kenya	70-72		68-73	68-73	68-73	72		72-73			68-73
Liberia	70-72	70	70-71	70-71	70-71						70-71
Mauritius	65-72	65-71	65-72	65-72						65-73	65-72
Nigeria	68-72		65-72	65-72							65-72
Sierra Leone	70-72	70	68,70-71	70-71	70-71						70-71
Tanzania	67-72	67	70-71	70-71	70-71			71			70-71
Tunisia	65-70	67	65-72	65-72	65-72	65-72			65-70,72-73		65-72
Uganda	70-72		65-72	71-72	71-72	71		71			71-72
Asia											
Afghanistan	70-72		72	70-72	70-72	71-72					70,72
Hong Kong	65-72	65-72	66-67	66-72	66-72	66-72			66-67,69,71-72		
India		2/	66-71		66-71				66-71		66-71
Indonesia	69-72	3/	71-73	68-73	68-73	71-73	71-73		70-71		68-70
Iran	69-72			69-73	69-73						
Korea	65-73	65-70		68-71	65-72				65-72		
Malaysia	65-67,71-72	65-71	67-72	67-72	67-72	67-72		67-72	67-72		67-72
Nepal	72			67-70	66-70				67-70		
Philippines	70-73	71	65-73	65-73	65-73	71-72				65-73	65-73
Singapore	69-72	65-71	65-71	65-72	65-72	65-72		68-71	65-71		65-72
Sri Lanka	65-72	65-69	66-72	66-72	66-72				66-72		66-72
Taiwan	69-72	69-72	65-73	67-73	65-73	70-73					
Thailand	69-72		68-73	68-73	68-73				68-73		
Turkey	66,70-72		68-72	65-72	68-72						
Laos	70-72		69-73	71-73	71-73	71-73		71-73			71-73

2/ 1968 age-specific birth rates are available from Johns Hopkins (the 1968 National Sample Registration) at ISPC.
3/ 1971 age-specific birth rates are available at the ISPC from Iskandar estimates.

Family Planning Program Measures

	Client Revisits (1,000)						
	Total	Oral Contra-ceptives	IUD	Condom	Foam, Cream, Jelly	Injec-tion	Other
Africa							
Egypt							
Ghana	71-73						
Kenya	68-73						
Liberia	70-71						
Mauritius							
Nigeria	65-70						
Sierra Leone	70-71						
Tanzania	70-71						
Tunisia							
Uganda	71-72						
Asia							
Afghanistan	71-72	71-72	71-72	71-72			
Hong Kong	65-72						
India							
Indonesia	71-73	71-73	71-73	71-73			71-73
Iran							
Korea							
Malaysia							
Nepal							
Philippines	71-73	71-73	71-73		71-73		71-73
Singapore	65-71	66-71	66-71	66-71		68-71	66-71
Sri Lanka							
Taiwan							
Thailand							
Turkey							
Laos							

Table 1. Continued

Family Planning Program Measures

	Current Users (1,000)						
	Total	Oral Contra-ceptives	IUD	Condom	Rhythm	Sterili-zation	Other
Africa							
Egypt	69-70,73	69-70,72-73	69-70,73				70,72-73
Ghana							
Kenya	71	71	71				
Liberia							
Mauritius	66,69-72	66,69-72	66,69-72	66,69	66,69-72		66,69-72
Nigeria							
Sierra Leone							
Tanzania							
Tunisia	65-70,72-73	65-70,72-73	65-70,72-73	65-70		65-70,72-73	65-70,72-73
Uganda							
Asia							
Afghanistan							
Hong Kong							
India			66-71			66-71	66-71
Indonesia							
Iran							
Korea	65-70		66-70	60-72			
Malaysia							
Nepal							
Philippines							
Singapore							
Sri Lanka							
Taiwan							
Thailand							
Turkey							
Laos							

Table 1. Continued

Family Planning Program Measures

	Contraceptives Distributed (1,000)									Facilities	Personnel
	Total	Oral Contraceptives (cycles)	IUD (units)	Condoms (units)	Aerosol Foam (containers)	Foam Tablets (bottles)	Jelly, Cream	Injection	Other		
Africa											
Egypt		66-69	66-69							70	
Ghana										70-73	71-72
Kenya	71	71	71					71		70-73	
Liberia										70-71	69-71
Mauritius		70-72		70-72						68-72	72
Nigeria		70-71		70-71	70		70-71	71		70	70-71
Sierra Leone		70-71		70-71	70-71	71				65-71	
Tanzania		70-71		70-71	71		71	71		70-71	
Tunisia		70		71			71			71-72	71-72
Uganda		70-71		70-71			70-71	71		70-72	72
Asia											
Afghanistan		71		71			71			69-72	
Hong Kong		71-72								65,67,69,71-72	
India	65-71			65-71		65-71	65-71			65-67,71	
Indonesia										70-73	
Iran		69-73		70-73						68-73	71
Korea				65-70						66-70	65,70-72
Malaysia		68-69		67-68						65-68	
Nepal		67-70		67-70						68-71	
Philippines		70-71		71			68-72			70-73	71-72
Singapore		66-71		66-71					66-71	65-67,71	66-71
Sri Lanka										66-67,70	
Taiwan		67-72		70-72						72	65,68-72
Thailand		72									
Turkey										70,72	
Laos										72-73	

Table 1. Continued

Non-Program Family Planning Activity Measures

	Contraceptives Distributed					Current Users			New Acceptors			
	Oral Contra-ceptives	IUD	Condoms	Foam	Cream	Total	Oral Contra-ceptives	IUD	Total	Oral Contra-ceptives	IUD	Othe
Africa												
Egypt	66-70	66-70				69-73	69-73	69-73				
Ghana	70		70	70	70							
Kenya												
Liberia												
Mauritius												
Nigeria												
Sierra Leone												
Tanzania												
Tunisia	68-69											
Uganda												
Asia												
Afghanistan												
Hong Kong												
India			68-71									
Indonesia												
Iran	68-73											
Korea												
Malaysia	67-69											
Nepal												
Philippines	70											
Singapore									66-68	66-68	66-68	66-68
Sri Lanka												
Taiwan												
Thailand	72											
Turkey												
Laos												

The ISPC family planning files include the following annual series on governmental and private planning program activities, whenever available for 46 less developed countries for the period beginning 1965, or the first year family planning services were offered, through 1973:

(1) the number of new acceptors of family planning services, by type of contraceptive, 1965-73.

(2) the number of client revisits, by type of contraceptive, 1965-73.

(3) the number of current users of contraceptives, by type of contraceptive, 1965-73.

(4) the number of contraceptives distributed, by type of contraceptive, 1965-73.

(5) the number of facilities, 1965-73.

(6) the number of personnel, by type of personnel, 1965-73.

(7) the number of contraceptives distributed by the commercial sector (non-program distribution, i.e., total number of contraceptives distributed exclusive of those distributed under family planning programs), by type of contraceptive, 1969-73.

As Table 1 shows, not all of these series are available for all 46 less developed countries for even one year during the period 1965-73. The number of current contraceptive users is the measure which most closely approximates contraceptive use, but it is available for only 11 less developed countries. "Couple years of protection", an estimate which requires data on the number of contraceptives distributed, the number of I.U.D.'s inserted, and the number of sterilizations performed, is also conceptually appealing; an enterprising person could estimate it for 30 less developed countries.

The number of new acceptors, a less appropriate measure, is the most readily accessible for the most countries, 43 (21 are Latin American countries, 10 are African and 12 are Asian). There are, however, follow-up studies which provide continuation rates and these might permit the conversion of new acceptor counts into estimates of users. Or it might be that acceptor

rates can be substituted for user rates as a measure of contraceptive use. A comparison by country of 1973 user rates and acceptor rates for 19 less developed countries, done at the World Bank, indicated that differences were small and systematic, reflecting the length of time a program had been in existence.

There are also problems with the comparability and the quality of new acceptor data. First, definitions vary from country to country. Second, counts tend to be overreported, which sometimes is related to the definitional problem. A new acceptor is generally defined to be a person not previously practicing contraception who decides to begin practice with a given method under program auspices. However, acceptor data may include persons who change from one method to another, persons who change from one program to another, and persons who temporarily stopped practice. Virtually all studies of the validity of new acceptors have found them to be inflated (according to the Demographic Data System Branch of International Statistical Programs Center at the Bureau of the Census). This is not only because of overcounting due to definitional problems or other counting errors due to limited accounting and communications facilities but, in some instances, to falsification of records in order to meet quotas. However, as noted earlier, the International Statistical Programs Center footnotes known cases and the Population Council attempts adjustments for known cases.

No age-specific family planning data are currently available from the ISPC file. However, upon request, ISPC is capable of compiling, from administrative reports on family planning programs, age-specific new acceptor series for 12 less developed countries -- Hong Kong, India, Indonesia, Korea, Malaysia, Philippines, Singapore, Thailand, Barbados, Jamaica, Dominican Republic, and

Costa Rica -- and the Center believes it might be possible to get such data for another 5 countries by using data which is not currently part of ISPC reference material.

The ISPC is currently in the process of updating their family planning file and the updated ISPC family planning files will be available in September in printed form. The files are also currently on computer disc in variable format, but no decision has yet been made regarding the distribution of discs or tapes. This could require changing the file to a fixed format and adjusting data for comparability.

3. Other Demographic and Socio-Economic Data

Section III suggested a number of other data items which it would be desirable to have, consistently defined, for the 46 less developed countries that have collected both family planning data and fertility data. These include:

(1) female labor force participation by sector (agriculture, other)

(2) child labor force participation

(3) infant mortality

(4) average family income and/or average monthly earnings by sex

(5) distribution of the population by educational attainment and by sex

(6) economically active population by occupation group and by sex

(7) female mean age at marriage

(8) female marital status (married, single, other)

(9) average number of surviving children per family or percent of families with children under 6 years old

(10) average number of adult members per family

(11) life expectancy of females over 15 years old

(12) age-specific school enrollment ratios (primary school and secondary school)

(13) number of unpaid family workers

(14) annual intra-country migration rates or rural-urban migration rates

(15) percent of the population covered by pensions or percent of the elderly receiving pensions

Six of these data items -- female labor force participation by sector, infant mortality, primary school enrollment rates, female mean age at marriage, number of surviving children per 1,000 women by age group and life expectancy of females -- will be available or derivable from data items in the "Country Demographic Profiles," currently being compiled at the International Statistical Program Center. Again, these files are currently available for only 3 countries and data for 5 more countries will be available January 1975. ISPC will not commit themselves to a date when all countries will have profiles.

Other data sources provide a few of these data items for most of the specified countries. They include the World Handbook of Political and Social Indicators by Charles E. Taylor and Michael C. Hudson, and the Quantitative Analyses of Modernization and Development by Frederick H. Harbison, Joan Marlhnic and Jane R. Resnick. Both files are available on magnetic computer tape in a machine readable form.

The World Handbook of Political and Social Indicators contains measures for selected developed and developing countries,circa 1965, including crude birth rates, infant mortality, sectoral income distributions, measures of ethnic and linguistic fractionalism, numbers of Christian communities, numbers of Islamic communities, agricultural area and density, and degree of urbanization.

Quantitative Analyses of Modernization and Development contains measures, circa 1970, for 112 developing and developed countries such as crude birth rates, life expectancy at birth, first and second level school enrollment ratios, percent of females enrolled in the first, second, and third levels of education, and percent of population living in cities 20,000 and over.

Also, most of the items are available from Censuses, registration data, statistical yearbooks, surveys, or special reports. The ISPC is capable of assembling, on request, most of these data items from the above sources for most of the 43 countries which have family planning and fertility data available. There are two types of data which ISPC would not be able to compile -- pension data and migration data. Also, they will produce these items by age-specific female group whenever possible. They estimate that this would take about 1 week per country, or about 1 year for all 43 countries. Table 2 shows the availability -- whether these data items will be contained in ISPC "Country Demographic Profiles" or whether ISPC can compile them from primary sources -- of these other demographic and socio-economic data items.

Table 2.
SELECTED DEMOGRAPHIC AND SOCIO-ECONOMIC DATA
AVAILABLE FROM THE INTERNATIONAL STATISTICAL PROGRAM CENTER (BUREAU OF CENSUS)

VARIABLES	I S P C Will be Published in Country Demographic Profiles	I S P C Is Capable of Compiling Upon Request
1a. Female labor force participation by sector (agriculture, other)	X	
b. Female labor force participation by sector, and by age group		X
2. Child Labor Force Participation		X
3a. Infant mortality	X	
b. Infant mortality, by female age group		A/
4a. Average monthly earnings by sex C/		X
b. Average monthly earnings by sex, and by age group C/		B/
5a. Family income by sex C/		
b. Family income by sex, and by age group C/		X
6. Education:		
a. Percent of childern age 5 to 14 years actually enrolled in primary school	X	
b. Percent of childern age 5 to 14 years actually enrolled in secondary school		X
c. Percent distribution of population by educational attainment, by age and sex		X
7. Occupation:		
a. Economically active population, by occupational group and by sex		X
b. Economically active population, by occupational group and by sex, by age group		B/
8. Number of family workers		X
9a. Female mean age at marriage	X	
b. Female mean age at marriage, by age group		X

Table 2. (continued)

VARIABLES	I S P C Country Demographic Profiles	I S P C Is Capable of Producing Upon Request
10. Marital status (single, married, other) by age group		X
11a. Number of surviving children per 1000 women, by age group	X	
b. Number of surviving children under 6 per 1000 women, by age group		X
12. Number of adult family members per 1000 married women, by age group		X
13a. Life expectancy of females	X	
b. Life expectancy of females, age 15 and over		X

A/ Primary data sources do not provide data necessary for this compilation.
B/ It is not known whether primary sources provide data for this compilation in most cases.
C/ Data is presented in the currency of the specified country.

V. AN ALTERNATIVE DATA SOURCE: SURVEYS

Sample surveys of individuals and households offer an alternative source of data for the estimation of a fertility model. Surveys have several advantages over aggregate data. Scheuch (1966) reports that it has been shown that sample surveys can be more accurate than censuses, registrations, and other attempts at complete enumeration, because the interview process gives some control over the quality of the information recorded for each respondent. Also, while the theory of fertility is useful for pointing out the types of variables likely to be important, it cannot yet offer much guidance about functional form. Data for individuals and households are not subject to the same restrictions on functional form as are aggregate data and can support a good deal of useful experimentation.

We have investigated two sources of survey data. The next section briefly describes the collection of KAP surveys held by the Roper Center of Williams College. The following section discusses the data that will be collected by the surveys conducted under the guidance of the World Fertility Survey. It also discusses the WFS work on community variables, and outlines some information which fertility theory suggests is important, but which is not requested on the current versions of the WFS questionnaries.

A. The Roper Center

The Roper Center at Williams College has a collection of 68 KAP surveys from 30 countries -- surveys of birth control knowledge, attitudes, and practice. These surveys provide information on the sample family's history of births and use of contraceptives. They also contain varying amounts of information about the socio-economic and demographic characteristics of the family. At a minimum, all of the ones that have been processed by the Center

give: number of children and adults in the household; ages of wife and husband; occupations of wife and husband; incomes of wife and husband; and religion of wife and husband.

The surveys for 11 countries are based on representative national samples of households. The 1971 survey of India contains representative samples for 14 states as well. The remaining surveys are more limited in their geographic coverage, drawing their samples from cities, regions, communities, or urban or rural areas within the country.

The Center has edited the surveys for 19 of the 30 countries in the collection, and stored them on machine readable tapes. It does not have the funds to process the rest of the surveys. Table 3 lists the surveys available from the Center, shows whether they have been processed, and notes nationally representative samples.

B. The World Fertility Survey

The World Fertility Survey is a program to help countries carry out "nationally representative and internationally comparable" sample surveys of fertility (Sprehe, 1974). These surveys will collect three levels of information -- individual data, household data, and community data. The field work phase of the surveys is to be carried out during the years 1974-77.

The household and individual questionnaires have been developed, although they are still subject to modification. The household questionnaire is quite brief and collects basic information -- age, sex, education, marital status, and a small amount of information on births -- about each member of the household. From this information women in the household are selected to answer an individual questionnaire.

Table 3.
KAP SURVEYS AVAILABLE FROM THE ROPER CENTER

A. PROCESSED KAP SURVEYS

	Country	Year
	Argentina, Buenos Aires (CELADE)	1964
	Brazil, Rio De Janeiro (CELADE)	1964
	Brazil, Sao Paulo	1966
	Colombia, Bogata (CELADE)	1964
	Costa Rica, San Jose (CELADE)	1964
	Ecuador, Quito and Guayaquil (CELADE)	1965
	Guatemala, Guatemala City (CELADE)	1965
*	India	1964
*	India (urban)	1967
*	India (northern)	1969
*	India	1971
*	Jamaica	1956
*	Korea (urban)	1965
*	Korea (rural)	1965
*	Korea (urban)	1966
*	Korea (rural)	1966
*	Korea (urban)	1967
*	Korea (rural)	1967
*	Korea (urban)	1968
*	Korea (rural)	1968
	Lebanon	1959
	Mexico, Mexico City (CELADE)	1964
	Mexico, patients	1971
	Mexico, non-patients	1971
	Morocco, urban, women under 50 years	1966
	Morocco, urban, men	1966
	Morocco, urban, single women	1966
	Morocco, urban, women 50 years and over	1966
	Pakistan, East, Comilla-Kotwali Thana	1968
	Panama, Panama City (CELADE)	1964
	Philippines, Dumaguete City	1967
	Sierra Leone	1969
	Tunisia	1964
	Venezuela, Caracas (CELADE)	1964

* Surveys which are drawn to be representative of all households in the country.

Table 3 (continued)
KAP SURVEYS AVAILABLE FROM THE ROPER CENTER

B. UNPROCESSED KAP SURVEYS

	Country	Year
	Brazil, Guanabara	1969
*	Chad (Women only)	1970
*	Costa Rica	1965
*	France	1956
*	France (INED No.095)	1966
*	France (INED No.096)	1967
*	France (INED No.097)	1968
*	France (INED No.098)	1969
*	Ghana	1965-1966
	Hong Kong	1967
	Hungary	1965-1966
*	India	1970
	Israel	1968
	Kenya, wives	1969
	Kenya, matched husbands	1969
	Kenya, separated husbands	1969
	Korea	1970-1971
	Korea	1971
	Martinique	1969
	Netherlands	1969
	Niger	1970-1971
*	Nigeria	1972
	Pakistan, East, Dacca	1963-1964
*	Peru	1960-1961
	Philippines	1968
	Philippines, Cebu	1969
*	Puerto Rico	1953-1954
	Thailand, Bangkhen	1967-1968
*	United States, GAF-I	1955
*	United States, GAF-II	1960
*	United States, NFS	1965
*	United States, AIPO	1965
*	United States, AIPO	1967
*	United States, AIPO	1968
*	United States, ORC for Population Commission	1971
	Upper Volta	1969

* Surveys which are drawn to be representative of all households in the country.

The individual questionnaire first asks about the age, childhood residence, schooling, and literacy of the respondent. Countries are encouraged to add questions about religion, tribe, or language if these are relevant. The interview then moves on through six sizeable sections which ask about the (female) respondent's:

- o maternity history
- o contraceptive knowledge and methods ever used
- o marriage history
- o fertility planning (e.g., detailed information on contraceptive use, whether last child was planned, ideal number of children)
- o work history
- o current or last husband's background

The questionnaire for community level variables is in the process of being developed. In an occasional paper put out by the World Fertility Survey, Ronald Freedman (1974) has discussed the rationale for such a questionnaire, proposed sample questions, and outlined some of the problems. The rationale is, of course, that people are influenced not only by their own characteristics but by those of the community in which they live. This notion, well developed in other fields, is only beginning to make its appearance in economic theories of fertility (see discussion of Lindert's and Leibenstein's theories in Section II).

Freedman recommends that community data be collected for each community or village, under 10,000 population, which contains a sampling unit from the national survey. Community data can be derived in at least two ways -- from official sources, such as national censuses, or by aggregating the sample responses from the community. The community questionnaire proposed by the WFS is designed to elicit information from local officials and leaders when the other sources are not available.

The types of information recommended for such a questionnaire include:

- Distance and time of travel to other towns, mail and telephone facilities, radios and newspapers.
- Health levels, including infant mortality, and facilities.
- Family planning facilities and use of family planning services.
- Educational attainment, school enrollments, and distance to schools.
- Availability of electric power.
- Agricultural development level, including use of modern farming equipment, fertilizers, etc., market orientation, land tenure and average size of farm holding.
- Industrial employment.
- Contact with governmental structure.
- Ethnic/religious/language composition of the community.

The economic theories of fertility reviewed in Section II suggest the importance of several types of information which are not well represented in the WFS questionnaires. The first type has to do with the rewards and costs of children. For example, information about the employment and school attendance of children in the household is not requested on the individual questionnaire. The community information proposed includes questions about school enrollment, but none about child employment in paid or family work. Questions about the family farm or business -- its type, size, and other characteristics -- could provide useful indications of the opportunities for children to work. Also, no information is requested about enrollment in formal pension plans, or about other less formal arrangements for the support of the elderly; these are expected to replace one of the functions of children.

A second type of information has to do with the relative social status of the household, and the "child quality" standards of the household and the community. Some of the proposed community variables are expected to have their

effect on fertility by way of the family's standards for their children's upbringings. For example, Freedman notes that "where there is a significant group in the population who are better educated and living in better circumstances, aspirations for the mobility of one's children may be aroused by perception of a new range of possiblities." In addition to the questions already proposed about household education and occupations, and community education, it could be useful to ask questions about other measures of household status -- such as income, perceived social status, and material wealth, at least of the visible sort (house, farm buildings, herds). Questions about community "child quality" standards might also be useful -- e.g., questions about the community's expectations as to the educational attainment, occupational choice, and geographic mobility of its children.

Appendix A

RECENT CROSS-NATIONAL STUDIES OF FERTILITY : FOUR LITERATURE SUMMARIES

Richard Anker
"An Analysis of International Variations in Birth Rates: Preliminary Results," Population and Employment Working Paper No. 3, International Labour Office, Geneva, April 1974.

This study uses regression analysis of cross-national data to investigate the determinants of fertility. The hypotheses are explicitly generated from recent fertility theory in which children are viewed as mixed consumption/investment goods, and household decisions about the number of children are related to the costs and benefits of children, of alternatives to children, and to family resources. The study explicitly examines relevant policy variables--in particular, family planning and pension programs. Fertility is hypothesized to be simultaneously determined with female employment and children's education, and equations are estimated for all three variables.

The dependent variable in the fertility equation is the crude birth rate, used because it is available for more countries than the theoretically preferable gross reproduction rate. The analysis is based on data for less developed countries only--76 in all--because Anker apparently believes that the variation between developed and developing countries is attributable to causes other than those responsible for the variation among developing countries. The selected countries meet three criteria: they have market economies, justifying comparison of their income data; they have populations of at least 500,000 so that the results will not be dominated by many tiny countries; their per capita incomes fall below $1,000 U.S., classifying them as less-developed countries. Note that the population criterion was not necessary since the problem of small countries could have been solved by weighting the observations by population in the regression computations.

Estimates are shown and discussed for all three equations in the system, but this summary will report only the results for the fertility equation. On the basis of the theory, the fertility equation was hypothesized to be a function of adult education (parental tastes), female employment (woman's opportunity cost), children's education (direct cost of children), life expectancy at birth (to represent survivorship probabilities), and government family planning and pension programs. The family planning and pension programs are represented by the number of years each program had been in existence in the year for which birth rate data were available. In the case of the pension variables, Anker argues that the age of the program is likely to be correlated with its coverage.

Anker (continued)

Ordinary Least Squares Results

Variable	Measure	Coefficient
adult education	adult illiteracy	insignificant
female employment	(1) female employment in modern, child-competing, industries	negative and marginally significant
	(2) female labor force participation rate	negative and significant
children's education	secondary school enrollment rate	negative and significant
probability of child's survival	life expectancy at birth	insignificant
family planning	years government program in existence	negative and significant
pension program	years government program in existence	negative and significant

As the table above indicates, the results accord fairly well with Anker's hypotheses. The significant coefficients are all negative, as expected. Anker speculated that the poor results for "life expectancy at birth" might indicate that it acts with a lag, or that it is a poor measure of survivorship probabilities, but no experiments with lagged values or alternate measures were apparently carried out. Experiments with binary representation of the family planning variables, to reduce the effect of extreme values, supporced the initial results. Similar experiments with the pension program failed to support the initial results and suggested that this variable was acting as a proxy for European cultures.

Two stage least squares was then used to re-estimate the three equations. The major difference was that the coefficient for children's education was larger and more significant in the 2SLS fertility equation than in the OLS equation. Anker concludes that the 2SLS estimates support the hypothesis that fertility and children's education are simultaneously determined, but that there is little support for the notion that female employment is simultaneously determined with the other two variables.

Anker (continued)

The study is still in progress and the author proposes to experiment with a number of possible improvements. First, he will attempt to get better measures for the family planning and pension program variables. Data are currently being collected by the ILO which will yield a measure of pension program coverage in 25 LDC's, and he hopes to be able to get data on the size of family planning programs from the International Planned Parenthood Federation. The paper does not indicate whether he is aware of the data collected by the Population Council or by the U.S. Bureau of Census.

Second, Anker has developed an equation to relate the birth rate to the gross reproduction rate and plans to use estimates of the GRR in future regressions. Since his equation demonstrates that the two are very highly correlated, it is not clear what real gain there would be from using the indirect fertility measure.

Finally, Anker proposes to experiment further with the specification of the other two equations in the system -- child's education and female employment.

Janowitz, Barbara S.
"An Empirical Study of the Effects of Socio-economic Development on Fertility Rates," Demography, Vol. 8, No. 3,(August 1971), pp. 319-330.

This study uses regression analysis of cross-national data to investigate the relationships between measures of socio-economic development and birth rates. It follows in the footsteps of earlier studies by Adelman, and Friedlander and Silver, both of which are critically reviewed in the article. The primary focus of the study is the ability of regressions estimated from cross-section data to predict changes in birth rates over time. The effect of family planning programs is not considered.

The dependent variable is the gross reproduction rate (GRR)--an age-standardized birth rate--for female births only; no reason is given for restricting the measure to female births. The proposed model is strictly ad hoc, with virtually no justification given for the inclusion of: per capita income; proportion of the labor force in agriculture (a measure of industrialization); percentage of women illiterate; the infant mortality rate; and the expectation of life at birth. The data base consists of 57 developed and developing countries, with 4 countries from Africa, 15 from Asia, and 12 from Latin America.

Ordinary least squares estimates indicate that the GRR is negatively related to expectation of life and positively related to female illiteracy. Both coefficients are statistically significant. The other variables were dropped because of collinearity. The author then introduces regional dummies to correct for the regional pattern observed in the residuals. Regressions estimated for the developed and developing countries separately indicate that the coefficients are stable. Finally, the estimated regressions are used to predict changes in birth rates from 1880 to 1960 for 5 European countries, and the predictions are compared with actual birth rates.

Repetto, R.C.
"The Relationship of the Size Distribution of Income to Fertility and the Implications for Development Policy,"
Harvard University: Center for Population Studies, Research Paper No. 3, March 25, 1974.

This study reports some preliminary regression results on the relationship between income distribution and the fertility rate for a sample of 64 LDC's and DC's. Both types of countries are included, on the argument that much of the variation among LDC's is measurement error, while the variation between LDC's and DC's is due to systematic socio-economic differences.

The discussion adopts the framework of the economic theory of fertility, but the selection of variables appears to be ad hoc: per capita income, life expectancy, population density, newspaper circulation, and income distribution. Income distribution is included because per capita income, which is heavily influenced by high incomes, may not be a good measure of the incomes actually facing the majority of the population--who account for a more than proportionate share of the births. Stepwise regression is used to select the final variables. Two measures of income distribution -- the income share of the bottom 40 percent of the population and the Gini coefficient -- both show that greater equality of incomes is associated with lower birth rates.

World Bank
"The Relationship Between Program Inputs, Socio-economic Levels, and Family Planning Performance: A Regression Analysis"
Draft, June 1974

As part of its white paper on population and family planning, the World Bank staff has carried out two cross-section regression studies, one of the 16 states of India, the other of 19 selected developing countries, to investigate the relationships between family planning program outputs and measures of program inputs and socio-economic conditions. The study is of some interest for this project because the crude birth rate was one of the "output" measures used--the other two were acceptor and user rates--in the analysis based on the states of India. The availability of data on family planning program inputs was the primary factor in the selection of the cross-sections for study. For the 19 LDC's, most of these data were taken from the publications of the Population Council. The Indian government's Ministry of Health and Family Planning provided data for the 16 Indian states.

Primarily because of deficiencies in the data, the analysis investigated associations between the variables, but made no attempt to specify or estimate structural relationships. The reported results emphasize the R^2's of combinations of variables selected by stepwise regression; no coefficients are reported. Considerable attention is given to the explanatory power of program input variables as compared to socio-economic variables, and to the degree of correlation between the two sets of variables.

For the regressions based on the states of India, the regression package could choose from 9 different measures of program personnel, service points, and expenditures, and 9 socio-economic variables (electricity consumption, crude death rate, hospital beds, female secondary school enrollment, proportion of population in "developed" districts, urban population, per capita income, literacy rate, and miles of surfaced roads). An example of the results is the finding that electricity consumption explains 60 percent of the interstate variation in user rates.

Crude birth rates were also related to program inputs and socio-economic variables; the socio-economic variables explained a higher proportion of the variation. The analysis treated the birth rate as a program output measure of the same sort as user and acceptor rates. It was related directly to program inputs as measured by personnel, service points, and expenditures. Consequently the relationship between the intermediate program outputs--acceptor and user rates--and the ultimate "output", birth rates, was not investigated.

Appendix B
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