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3. AUTHOR(S)  
Butz, W.P.; DaVanzo, Julie

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# **ECONOMIC AND DEMOGRAPHIC FAMILY BEHAVIOR IN MALAYSIA: A CONCEPTUAL FRAMEWORK FOR ANALYSIS**

**PREPARED FOR THE AGENCY FOR INTERNATIONAL DEVELOPMENT**

**WILLIAM P. BUTZ  
JULIE DA VANZO**

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PREFACE

The Rand Corporation and the Department of Statistics, Government of Malaysia, are collaborating in a survey and research project to investigate the influence of certain economic and institutional factors on couples' fertility behavior in Peninsular Malaysia. This project is funded by the U.S. Agency for International Development. The central focus is on identifying factors within the domain of direct public policy influence which directly or indirectly affect birth spacing and family size. The purpose is to estimate statistical relationships between these factors and the outcomes of interest, in order to strengthen the scientific basis for informed public policy choice concerning demographic behavior.

The project involves the development and field testing of survey instruments; the training of field personnel; the collection, coding, and cleaning of data; and the statistical investigation of research hypotheses. Project outputs will include both reports of research findings and materials of methodological and operational interest to investigators involved in similar or related projects. This report and its companion, *Economic and Demographic Family Behavior in Malaysia: Survey Instruments and Interviewer Instructions*, R-1835-AID, are the first products of the second type.

This report is a condensed and revised version of a research proposal written under a former AID contract and submitted to AID in October 1973. That submission resulted in the current project. This version of the proposal is being published now to communicate the goals and methods of this project to other researchers who are considering similar efforts or who seek a fuller understanding of the rationale lying behind the survey instruments presented in the companion report, R-1835-AID. The present report offers a specific illustration of how an economic framework for analyzing demographic behavior can be made operational and used to illuminate important policy questions.

SUMMARY

This report describes a research design for analyzing economic and institutional influences on demographic behavior and illustrates how hypotheses can be generated that might lead to useful insights for policymakers. The report shows how these hypotheses can be made operational and tested with retrospective and longitudinal household survey data. It also indicates avenues of potential policy influence and ways in which theory and data together can be used to strengthen the scientific base for policy choices in a particular country--in this case, Malaysia.

The research design described here provides a means of estimating the magnitude of key socioeconomic relationships among important facets of family activity in Peninsular Malaysia. We plan to investigate these relationships through econometric analyses of models that describe the joint influence of particular factors that directly or indirectly affect birth spacing, family size, and duration of breastfeeding.

Our conceptual framework for investigating these behavioral relationships views families as engaging in various market and nonmarket activities to satisfy their wants. These activities utilize the time of family members, along with goods and services purchased outside the family. Couples' activities regarding fertility, child care, schooling, and labor-force participation are viewed as responses to particular factors in their surroundings. Of particular interest are the effects on behavior of (1) changes in families' surroundings that affect the relative costs and rewards of various market and nonmarket activities and (2) changes in family wealth.

Seven hypotheses are derived from this conceptual framework:

1. Other things being the same, couples have fewer children where the woman's time has a comparatively high value in alternative uses, i.e., uses other than child care (opportunity cost).
2. Other things being the same, couples have more children where children contribute relatively more to household production

and household income, both as children and as adults; that is, where the economic value of children is high.

3. Where the woman's time has a relatively high value in alternative uses or the economic value of children is relatively low, usage rates of contraceptives are higher, other things being the same.
4. Couples who have recently lost a child will tend to have a subsequent closed birth interval<sup>1</sup> shorter than their average interval or than that of other couples in otherwise similar circumstances but without a recent child death. Curtailed lactation may be partly responsible, but the period between the onset of ovulation and the next conception is also shorter as couples seek to replace the lost child.
5. Other things being the same, women whose time has a relatively high value in alternative uses will tend to space the births of their children closer together so as to decrease the time spent out of the labor market caring for children.
6. Other things being the same, women whose time has a relatively high value in alternative uses will tend to stop breastfeeding their children earlier.
7. Mothers breastfeed less where alternative, nutritious infant foods are more available and where their prices are lower, other things being the same.

In this study, these hypotheses are formulated as equations whose coefficients can be estimated by regression techniques. We briefly discuss the data now being collected to test these hypotheses and present the initial forms of the equations we will use.

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<sup>1</sup>A *closed* birth interval is one that is bounded on both ends by a birth; an *open* birth interval is the time between the most recent birth and the present time.

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## I. INTRODUCTION

This report describes a research design for identifying and estimating key socioeconomic relationships among several important facets of family activity in Peninsular Malaysia. These relationships are to be investigated through econometric analysis of models that describe the joint influence of particular economic, institutional, and biomedical factors. The modeling and analysis should reveal factors in families' surroundings that directly or indirectly affect birth spacing, family size, and duration of breastfeeding. The community factors considered here, most of which can be influenced by public policy, include prices of agricultural and homecrafted products and of inputs used in household production; wages and availability of jobs for women and children; prices and accessibility of nutritious foods, medical services, and contraceptives; and characteristics of schools and other public programs.

Section II outlines a conceptual framework for analyzing family demographic and economic behavior and presents seven key research hypotheses derived from this framework that have guided our survey design and research. The policy relevance of each hypothesis is discussed, and the preliminary estimating equations for testing the hypotheses are presented.

Section III considers the characteristics of the data with which these hypotheses will be tested.<sup>2</sup>

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<sup>2</sup>The survey questionnaires being used to collect the data are presented along with interviewer instructions in a companion report, *Economic and Demographic Family Behavior in Malaysia: Survey Instruments and Interviewer Instructions*, by William P. Butz, Julie DaVanzo, Dorothy Z. Fernandez, Vasantha K. Kandiah, and Shaari bin Hj. Abdul Rahman, R-1835-AID, The Rand Corporation, forthcoming.

## II. FROM CONCEPTUAL FRAMEWORK TO OPERATIONAL HYPOTHESES

### FAMILY BEHAVIOR AND ECONOMIC-DEMOGRAPHIC DEVELOPMENT

People in all societies attempt to satisfy their wants through various market and nonmarket activities that require both their time and a range of goods and services purchased outside the family. In communities having a low level of economic development, activities carried on within the household characteristically satisfy most families' material wants; participation in the labor market and purchases of goods and services are generally small compared with the time worked at home and the amount of goods produced and consumed there. In economically more-developed communities, on the other hand, families characteristically participate more in market activities, both by working for wages and by spending some of their income for goods they might be able to produce at home but choose to purchase instead.

These differences among families in economies at different stages of development are particularly noticeable in the areas of diet, clothing, housing, schooling, and health care. In traditional agrarian societies, these commodities are commonly produced at home, often with little or no use of outside goods and services. As societies develop, specialized public or private institutions arise that are able to produce and sell these goods more cheaply than families can. With the simultaneous development of labor markets, families can improve their material well-being by allocating more of their members' time to market jobs and by using goods produced and sold by specialized institutions. As discussed below, family behavior relating to fertility is also both directly and indirectly affected in this process.

The interactions that link these different facets of behavior are only partly understood, yet they affect people's responses to changing conditions and thereby influence the complex processes of behavioral change that constitute economic development. Increasing wealth probably induces some of these behavioral changes by enlarging the family's capacity to satisfy its wants. As it becomes wealthier, the family demands relatively more of some goods and services and relatively less

of others; its home and market behavior patterns shift to satisfy these changing wants. Other factors that induce changes in family behavior are shifts in the relative prices at which families sell their labor (time) and home-produced commodities and buy market goods. Some of these factors are more specifically related to particular kinds of behavior and may be more amenable to public policy influence than is family wealth. Without understanding behavioral interrelationships at the family level, however, it is difficult to know which of these prices and other factors governments should try to influence in order to induce specific types of economic and demographic change.

PROPOSED SOCIOECONOMIC AND BIOMEDICAL INFLUENCES ON FERTILITY, THE USE OF CONTRACEPTIVES, AND THE DURATION OF BREASTFEEDING

Figure 1 illustrates schematically our conceptualization of family behavior in the areas affecting the research concerns of this project.<sup>3</sup> It identifies most of the family and community factors thought to be important determinants of contraceptive behavior, fertility, and economic activity; it also states the direction and, where unambiguous *a priori*, the expected sign of hypothesized causal links among these factors. Our overall project aims at estimating the magnitude, statistical significance, and causal component of many of these relationships. However, as the hypotheses below indicate, our research is focused on particular variables and linkages, rather than the entire schema in Fig. 1. Nevertheless, the figure indicates the place of these variables in the broader framework of household behavior.

To illustrate the flow of influence in this schema, consider the influences on the observed birth interval, which, together with child mortality, determines completed surviving family size and hence the rate of population growth. The length of the birth interval is

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<sup>3</sup>The variables in Fig. 1 are divided into three types: (1) *current exogenous* variables, which are outside the control of families (but hopefully are within the control of policymakers), (2) *current endogenous* variables, jointly determined variables which are subject to family choice, and (3) *predetermined endogenous* variables, which were influenced by family choice in previous periods but are taken as given by the family in the current period.

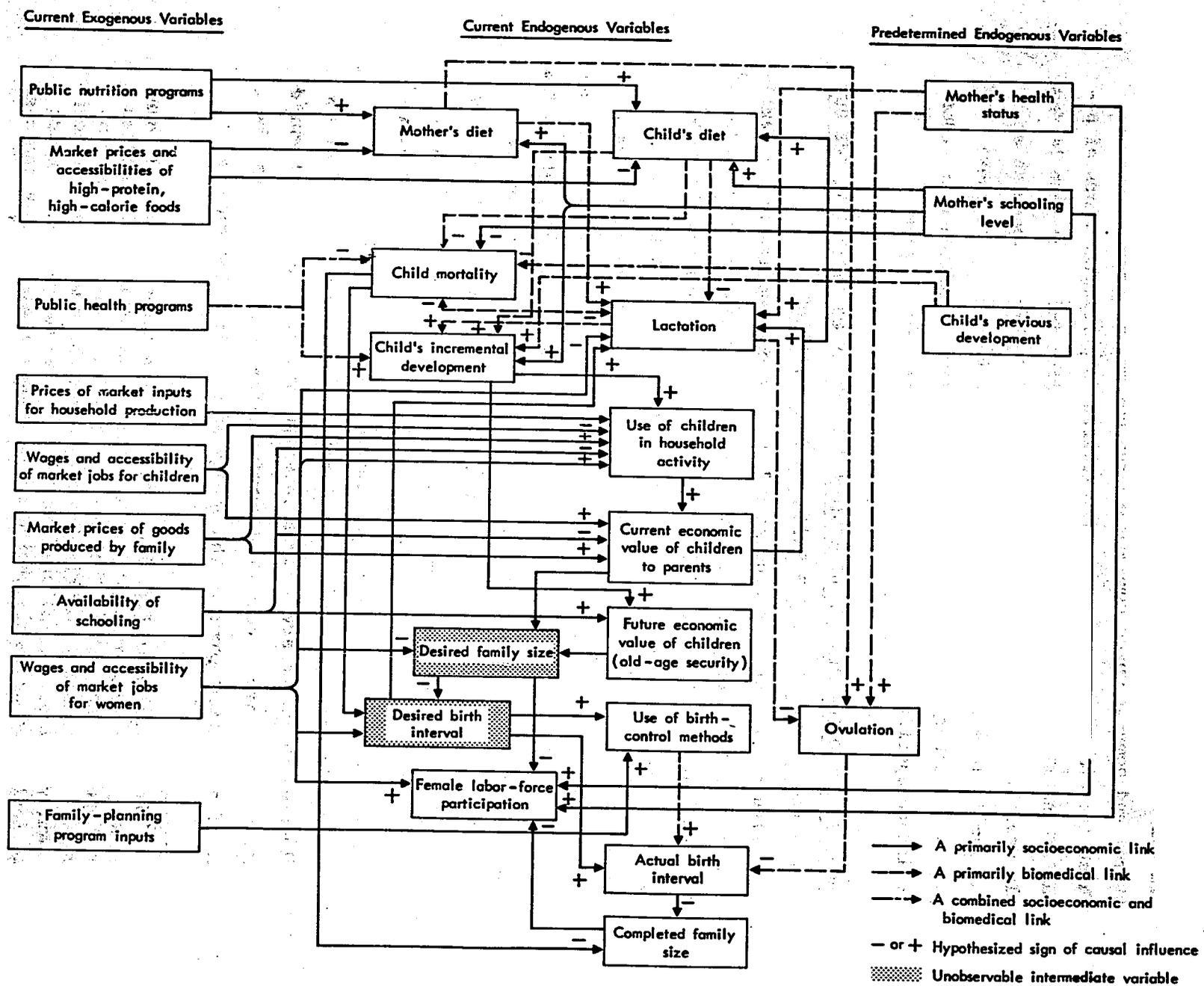


Fig. 1—Conceptualization of major factors affecting family behavior

determined by the length of postpartum infecundity following the previous birth, by the use of birth-control methods, and by the desired birth interval. If, for reasons discussed below, parents desire a relatively long interval, they may use some sort of birth-preventative method. Lactation may increase the length of the nonfecund period after a birth by delaying the onset of ovulation (postpartum amenorrhea). Thus, mothers who are aware of the contraceptive function of lactation and who wish a longer birth interval may breastfeed longer. As Fig. 1 indicates, length of lactation is also expected to be influenced by biomedical factors such as the mother's health and diet and by socio-economic factors such as work opportunities for women outside the home.

Many factors affect the *desired* birth interval and hence indirectly influence the observed interval. Desired family size may be an important determinant of desired birth interval; also, for a given desired family size, the preferred spacing of children may depend on the value of the mother's time outside the home. Women with high opportunity costs of time may wish to space the births of their children close together so as to minimize the amount of time they must be out of the labor force caring for children. Child mortality may also play an important role in determining desired birth intervals: If a child dies unexpectedly, the parents may, under some conditions, wish to shorten the birth interval in order to "replace" the child who has died (Ben-Porath and Welch, 1972).

Through these mechanisms, many public policies and community factors could affect observed birth intervals. Policies that affect the economic value of children to parents (e.g., policies that alter the work opportunities of children) may influence desired family size and hence the desired and actual spacing of children. Policies affecting opportunities for women to work outside their homes, and hence the opportunity cost of time spent with their children, may influence birth intervals directly by affecting the desired spacing of children and indirectly by affecting desired family size. The hypothesized effects on child mortality and length of lactation, and hence on birth-interval length, of prices and availability of medical care and nutritious foods, which may be influenced by public health and nutrition programs, are

also important. Programs affecting the availability and prices of contraceptives, including family-planning programs, may influence contraceptive use, and hence the length of birth intervals. Thus, there are a number of avenues of potential policy influence that could affect fertility behavior. By developing an operational model of these direct and indirect influences we can estimate the amount of fertility change, if any, that may be expected to follow particular changes in these community factors and public policies.

More broadly, Fig. 1 suggests how couples' activities regarding health, fertility, child care, schooling, and labor-force participation may be modeled as responses to particular factors in their surroundings. During estimation, known biological mechanisms will be considered as constraints on family behavior in a model that treats households as behavioral units that combine purchased inputs with the time and abilities of their own members to produce basic commodities that are in turn consumed in the home.<sup>4</sup> Consideration of simplified relationships among several household production activities may provide insight into the family-level relationships that are influenced by different community factors, including public programs, and will help to identify factors that affect the marginal productivities of particular family members' time and particular purchased inputs in the production of "enjoyment of children" and other basic "commodities." The economic production-function framework used to estimate the partial influences of these separate inputs will, we hope, identify a set of market prices and other factors that commonly change during the process of economic development and that are partly responsible for increases in families' wealth and income and decreases in family size. Government policies aimed selectively at such targets may augment the effectiveness of accompanying health, manpower, and family-planning programs by raising the demand for their services. The ultimate goal of our project is to identify policy levers that can affect the outcomes of interest to Malaysian policymakers.

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<sup>4</sup>Examples of empirical and theoretical research with models of this type can be found in Schultz (1974).

## PRELIMINARY RESEARCH HYPOTHESES AND MEASUREMENT OF VARIABLES

Each arrow in Fig. 1 represents a hypothesized cause and effect. Several of these cause-and-effect relationships are represented below as testable research hypotheses. These hypotheses can be formulated as equations whose coefficients are estimated by regression techniques. Many hypotheses can be tested in a single regression equation; for example, in an equation explaining observed birth interval, all variables in Fig. 1 whose arrows point to "observed birth interval" would be explanatory variables. If one of those, such as desired birth interval, is not directly observable, the observable variables explaining it would be used as proxies.

The seven hypotheses presented below have guided our surveying and research. We shall discuss the policy relevance of each of the hypotheses and illustrate the types of estimating equations that will be used to test them.

The testing of the hypotheses requires a combination of socioeconomic and biomedical information. The dependent and explanatory variables specifically identified in the hypotheses are tabulated below for each hypothesis, along with short descriptions of the survey information needed to construct these variables. Also shown are other factors that are expected to affect the variables; statistical estimation of hypothesized relationships must include these other factors in order to isolate partial influences. Finally, we show the potential avenues through which public policy might directly or indirectly influence the dependent variable.

### Hypothesis 1

The first two hypotheses deal with determinants of completed family size, which is significantly, though complexly, related to population growth rates. Hypothesis 1 states that the value of the time a woman spends caring for children--that is, the value of such time in alternative activities--is an important determinant of family size. One important alternative activity is work in the labor market. For working women, the value of time with children can in some circumstances be measured by their market wage rate. For nonworking women, a *potential* wage rate (the wage they would earn if they worked) can be estimated based on the wages of working women with similar personal,

family, and community characteristics.<sup>5</sup> Alternative ways of estimating the opportunity cost of time spent with children, especially when economically productive time use is somewhat compatible with child care, are briefly discussed below.

The wage rate available to women might be influenced by policy in several ways. Wage and employment policies may affect wage rates directly; other policies may affect wage rates indirectly by helping women attain characteristics that would increase their market productivity (e.g., more education, better health); still other policies might affect the compatibility of available jobs with simultaneously caring for children or the relative attractiveness of jobs that are less compatible with simultaneous child care.

*Hypothesis 1: Other things being the same, couples have fewer children where the woman's time has a comparatively high value in alternative uses, i.e., uses other than child care (opportunity cost).*

Basis for Measurement or Estimation	Other Factors that Influence the Variable	Potential Avenues of Policy Influence
Dependent variable: Current surviving family size		
Family roster and retrospective pregnancy-history information.	Child mortality, economic value of children, family income, and other factors shown in Fig. 1 that affect desired family size and completed family size.	Public health programs or other policies that affect the prices or availability of medical services. Family-planning programs or other policies that affect desired family size or the prices or availability of contraceptives.
Explanatory variable: Opportunity cost of the woman's time with children		
Estimated value of marginal product of woman's time in another use (nonmarket or market). Estimation requires data on the woman's time input and amount and value of "product" produced. For activities compatible with caring for children, the opportunity cost of child care can be estimated as the difference between the woman's value marginal product when children are present and her value marginal product when they are not. If labor-market work is the alternative considered, a woman's (potential) wage rate will be used to measure the opportunity value of her time with children; for nonworking women, a wage rate will be estimated on the basis of wages of working women with similar characteristics (e.g., education, health).	Woman's schooling, age, job training, and work experience; prices of goods used at home by mothers.	Wage and employment policies; job training programs; education and health policies; availability and prices of publicly provided child care.

<sup>5</sup> See Cogan (1975) for a discussion of alternative techniques for estimating the value of a housewife's time.

Hypothesis 2

The economic value parents attach to children is hypothesized to be another important determinant of desired and completed family size. In a less-developed economy, children may become economically useful at an early age. Any policy that affects the economic value of children (e.g., child labor laws, compulsory schooling laws) may have important repercussions on family-size decisions. Children may be valuable to parents not only for their contribution during childhood to the household's well-being, but also as a source of old-age support. The future value of children to parents can be affected by policy in several ways: Schooling and health policies that make children more productive will increase their earning power as adults; policy can also affect the attractiveness of children relative to other forms of old-age security, for example, retirement programs.

*Hypothesis 2: Other things being the same, couples have more children where children contribute relatively more to household production and household income, both as children and as adults; that is, where the economic value of children is high.<sup>6</sup>*

Basis for Measurement or Estimation	Other Factors that Influence the Variable	Potential Avenues of Policy Influence
Dependent variable: Current surviving family size		
See Hypothesis 1.	Factors shown in Fig. 1 that affect family size.	See Hypothesis 1.
Explanatory variable: Economic value of children (as children) to parents		
Children's time spent in household production activities; market prices of goods produced in household production; wages earned by children; ages at which children begin helping in household activities.	Prices of market inputs into household production; quantities of complementary factors of production, e.g., land; sex composition of children (male children may be more or less productive in particular household activities than female children).	Child labor laws; compulsory schooling laws; availability and costs of schooling.
Explanatory variable: Future economic value of children (as adults) to parents		
Expected future support by children; amounts that grown children of similar characteristics typically contribute to their parents in this community.	Children's education; availability, rates of return, and risk of other sources of old-age security, e.g., savings, pensions, retirement programs, and returns on monetary and real assets.	Availability and costs of schooling; public health programs; public retirement programs; government savings plans; public policies that affect the availability or prices of monetary or real assets.

<sup>6</sup> Current economic models of parental decisions concerning number of children and investment in children (e.g., the De Tray and Becker and Lewis studies in Schultz, 1974) do not yield an unambiguous prediction here. In the Malaysian setting, however, we think the hypothesized effect is likely.

Hypothesis 3

Hypothesis 3 deals with contraceptive usage rates. It predicts several characteristics of populations in which family-planning programs are expected to be relatively successful. The first three hypotheses in combination, therefore, suggest community and individual factors that are systematically associated with variations across families in contraceptive usage rates and family size. Since use of contraceptives may not be a necessary condition for reductions in family size,<sup>7</sup> none of these three hypotheses is necessarily dependent upon the others for its empirical verification.

*Hypothesis 3: Where the woman's time has a relatively high value in alternative uses or the economic value of children is relatively low, usage rates of contraceptives are higher, other things being the same.*

Basis for Measurement or Estimation	Other Factors that Influence the Variable	Potential Avenues of Policy Influence
Dependent variable: Contraceptive usage rates		
Current and retrospective information on contraceptive usage.	Availability and prices of family-planning information and devices, family income, and other factors shown in Fig. 1 that affect the use of birth-control methods.	Local family-planning programs; other government policies that affect the prices and availability of contraceptives.
Explanatory variable: Opportunity cost of woman's time		
See Hypothesis 1.	See Hypothesis 1.	See Hypothesis 1.
Explanatory variable: Economic value of children (as children and as adults) to parents		
See Hypothesis 2.	See Hypothesis 2.	See Hypothesis 2.

Hypotheses 4 and 5

Hypotheses 4 and 5 deal with determinants of birth intervals. The birth interval is important for several reasons: Other things being the same, the shorter the birth interval, the higher the

<sup>7</sup> A conscious decision to delay a birth may be carried out by longer lactation, abstinence, withdrawal, or induced abortion, all methods that do not require the use of contraceptives.

fertility rate for the period;<sup>8</sup> also, a very short birth interval may be detrimental to the health of the newborn infant and the mother.

In Hypothesis 4, child mortality is the explanatory variable. This variable may be affected by public health and nutrition policies.

Hypothesis 4: *Couples who have recently lost a child will tend to have a subsequent (closed) birth interval shorter than their average interval or than that of other couples in similar circumstances but without a recent child death. Curtailed lactation may be partly responsible, but the period between the onset of ovulation and the next conception is also shorter, as couples seek to replace the lost child.*<sup>9</sup>

Basis for Measurement or Estimation	Other Factors that Influence the Variable	Potential Avenues of Policy Influence
Dependent variable: Length of birth interval--defined as the period between the termination of one pregnancy and the next conception <sup>10</sup>		
Retrospective and longitudinal pregnancy history.	Women's wage opportunities (see Hypothesis 1), lactation, contraceptive use, and other factors shown in Fig. 1 that affect the desired and actual birth interval.	Family-planning programs or other policies that affect the prices or availability of contraceptives.
Explanatory variable: Recent mortality of children		
Retrospective and longitudinal information on the ages and sex of children who have died.	Prices and availability of medical care, prices and availability of nutritious foods, lactation, and other factors shown in Fig. 1 that affect child mortality.	Public health and nutrition programs; other government policies that affect the prices and availability of nutritious foods and/or medical services.

<sup>8</sup> However, this may be a misleading indicator of long-term trends in fertility, because shorter birth intervals may mean that parents are concentrating the period of childbearing, without having more children.

<sup>9</sup> However, because child deaths are costly (both in emotional costs and resource costs), parents who experience a high rate of child mortality may reduce their desired family size.

<sup>10</sup> In our empirical analyses of Hypotheses 4 and 5, we will also analyze the differential impacts of the factors hypothesized to affect the pregnancy interval on the lengths of the two component parts of that interval: the length of postpartum amenorrhea (estimated as the amount of time between the termination of pregnancy and the first postpartum menstruation) and the subsequent period at risk before the next conception. The period of postpartum sterility actually extends to the first ovulation, which may occur before or after the first menstruation. However, the difficulty of detecting ovulation leads us to proxy the period at risk as the time between the first postpartum menstruation and the next conception. The period of amenorrhea is primarily biologically determined but may be behaviorally affected to the extent

**Hypothesis 5:** *Other things being the same, women whose time has a relatively high value in alternative uses will tend to space the births of their children closer together so as to decrease the time spent out of the labor market caring for children.*

Basis for Measurement or Estimation	Other Factors that Influence the Variable	Potential Avenues of Policy Influence
Dependent variable: Length of birth interval (see Hypothesis 4)		
See Hypothesis 4.	Use of birth control, lactation, and other factors in Fig. 1 that affect actual and desired birth interval.	See Hypothesis 4.
Explanatory variable: Opportunity cost of woman's time		
See Hypothesis 1.	See Hypothesis 1.	See Hypothesis 1.

Hypotheses 6 and 7

Hypotheses 6 and 7 deal with determinants of women's breastfeeding practices. The frequency and duration of lactation is an important variable in a fertility study because biomedical studies have established that frequent and intensive breastfeeding and lengthy postpartum lactation tend to delay the return of postpartum ovulation and thus increase the average duration of postpartum infecundity. Thus the biologically determined part of the birth interval is affected by a woman's breastfeeding behavior. (Most previous studies of birth intervals have not explicitly considered variations in this portion of the interval.) Lactation is also important because of its influence on child health and development.

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that women are aware of the link between the length of postpartum amenorrhea and breastfeeding; the latter is assumed to be completely behaviorally determined.

Conception date will be estimated as the date of pregnancy termination less pregnancy length. In our empirical work we will use the length of the period between pregnancies, rather than births, to measure the conceptual variable "birth interval."

Because of the difficulties in dealing with open birth intervals (i.e., the period following a woman's most recent birth), only closed intervals will be considered in testing this hypothesis (there may be many observations on the same woman). To determine how a child death affects whether or not a couple has another birth, the hypothesis can be rephrased in terms of the influence of a child death on the probability of a subsequent birth or on the number of children ever born.

Hypothesis 6: *Other things being the same, women whose time has a relatively high value in alternative uses will tend to stop breastfeeding their children earlier.*

Basis for Measurement or Estimation	Other Factors that Influence the Variable	Potential Avenues of Policy Influence
Dependent variable: Duration of breastfeeding		
Length of breastfeeding in retrospective and longitudinal pregnancy history.	Whether the woman is aware of the contraceptive properties of lactation; factors shown in Fig. 1 that affect lactation.	Information on the advantages and disadvantages of breastfeeding available through public health, nutrition, or family-planning programs; government policies or programs that affect prices or availability of nutritious foods; government policies or programs that affect prices or availability of healthful or harmful infant foods.
Explanatory variable: Opportunity cost of woman's time		
See Hypothesis 1.	See Hypothesis 1.	See Hypothesis 1.

The relationship between breastfeeding and the prices and availabilities of alternative foods proposed in Hypothesis 7 is important because government policies may be able to affect the latter.

Hypothesis 7: *Mothers breastfeed less where alternative, nutritious infant foods are more available and where their prices are lower, other things being the same.*

Basis for Measurement or Estimation	Other Factors that Influence the Variable	Potential Avenues of Policy Influence
Dependent variable: Duration of breastfeeding		
Same as Hypothesis 6.	Same as Hypothesis 6.	See Hypothesis 6.
Explanatory variable: Prices and availability of infant foods		
Community surveys of prices and availability of infant foods.	The prices and supplies will be considered exogenous of individual family behavior.	Government policies or programs that affect the prices or availability of infant foods, both healthful and harmful.

### ESTIMATING EQUATIONS FOR TESTING THE HYPOTHESES

In the following we present preliminary forms of the equations we will use to test the seven key hypotheses described above. The specific forms of these equations should be viewed as the starting points from which our empirical work will proceed. Since our research plan allows interaction between data and estimation procedures, we anticipate

considerable reformulation of these initial equations as data become available and are explored.

For simplicity, the equations are given here in linear form. Whenever the expected sign of a coefficient is unambiguous *a priori*, it is indicated in parentheses above the coefficient. The particular survey instruments that contain the information needed to construct the variables are noted after each variable definition.<sup>11</sup>

As noted earlier, the relationships we will analyze are interrelated. Many of the explanatory variables in the equations below are probably endogenous in our system of estimating equations; hence, simultaneous-equation estimation techniques are required to produce parameter estimates with desirable statistical properties. We plan to use such techniques to estimate the equations below.

Hypotheses 1 and 2 can be tested in the following equation:

$$N = \alpha_0 + \overset{(-)}{\alpha_1} \hat{W}_f + \overset{(+)}{\alpha_2} W_c + \overset{(+)}{\alpha_3} R_c^* + \overset{(-)}{\alpha_4} M_c + \overset{(-)}{\alpha_5} CE + \overset{(+)}{\alpha_6} I + \overset{(+)}{\alpha_7} TM + u_N$$

where N = number of children currently living (from questionnaires SR1, SR2).

$W_f$  = opportunity cost of the woman's time with children.<sup>12</sup>

<sup>11</sup>The instruments are: SR1, Household Record Form; SR2, Retrospective Questionnaire for Ever-Married Women; SR3, Retrospective Questionnaire for Husbands; SR4, Time Budget; SR5, Income and Wealth; SR6, Attitudes and Expectations of Ever-Married Women and Their Husbands; and SR7, Community Data. The content of each of these instruments is briefly summarized at the end of this report.

<sup>12</sup>The opportunity cost of a woman's time with children will be measured initially by her (potential) market wage rate. An equation explaining female wage rates (SR2, SR4) as a function of personal and community characteristics will be estimated for a sample of all women with wage rates; multiple observations (for different time periods) may be used for a given woman. The initial specification will be as follows:

$$\ln W_f = \beta_0 + \overset{(+)}{\beta_1} Ed + \sum_{i=2}^7 \overset{(+)}{\beta_i} Cert_{i-1} + \overset{(+)}{\beta_8} Tr + \overset{(+)}{\beta_9} Exp + \overset{(-)}{\beta_{10}} (Exp)^2 + \overset{(+)}{\beta_{11}} YCJ + \overset{(-)}{\beta_{12}} YCJ^2 + \beta_{13} A + \beta_{14} A^2 + \sum_{i=15}^{17} \beta_i D_{i-14} + u_{W_f}$$

- $W_c$  = average economic value of children (as children), calculated from data on the wages and home productivity of children (SR 4) and information on the ages at which children become useful in various household and market activities (SR6).
- $R_c^*$  = expected future economic value of an adult child to parents (SR6); this variable can also be measured by considering how much money, goods, or services a grown child of similar characteristics typically contributes to parents in this community (SR6).
- $M_c$  = child mortality (number of children the woman has given birth to who have died (SR2)).
- CE = an index of effectiveness of contraceptive practice (a weighted average of effectiveness of various methods used, weighted by the proportion of time each method was used (SR2)).

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where  $E_d$  = number of years of schooling the woman has completed (SR1).  
 $Cert_i$  = a vector of 0 - 1 dummies indicating the highest schooling certificate the woman has received,  $i = 1, \dots, 6$  (SR1).  
 $Tr$  = number of full-time equivalent weeks spent in job-related courses or training programs (SR2).  
 $Exp$  = number of years of total labor-market work experience (SR2).  
 $YCJ$  = number of years on current job (SR2).  
 $D_i$  = dummies indicating whether the respondent lives in a metropolitan, urban-large, or urban-small area,  $i = 1, \dots, 3$  (SR1, SR2).  
 $A$  = age (SR1, SR2).  
 $u_{Wf}$  = error term.

This equation will be used to predict a potential wage for nonworking women. See Cogan (1975) for a discussion of alternative techniques for estimating the value of the time of nonworking women.

Alternatively, the value of a woman's time in a nonmarket use other than child care can be estimated by calculating the value marginal product of that time from information on her time allocation (SR4), amount and value of product produced in household production (SR5), and quantities of other inputs used in household production (SR5). For activities that can be done while caring for children (joint production), the opportunity cost of time spent with children can be estimated as the reduction in value marginal productivity when the activity is done with children present compared to when it is done with no children present (SR4, SR5). These estimation methods take into account the fact that many productive activities (including some outside the home) undertaken by women in less-developed countries are quite compatible with simultaneous child care. A woman's value marginal product may not be highly correlated with the opportunity cost of her time with her children.

I = family income, defined, for example, as average income since first year of marriage, including wages, payments in kind, and returns on assets (SR2, SR3, SR4, SR5)

IM = total number of years married (SR2).

$u_N$  = error term.<sup>13</sup>

The sample for this equation will be all ever-married women (i.e., who have been married at some time, regardless of their present marital status). The equation will be estimated separately for the three main ethnic communities of Malaysia to determine whether the underlying parameters differ among the ethnic groups. This will enable us to determine whether behavioral differences among the three groups are mainly due to differences in the environmental constraints these families face (levels of explanatory variables) or whether the groups differ in the way in which they respond to changes in their environment (behavioral parameters). If the coefficients do not differ significantly by race, ethnic groups can be pooled and race dummies can be used (alone and in interaction terms). We will also test for age differences in coefficients and for differences between urban and rural subsamples. These same procedures will be followed for all the equations presented below.<sup>14</sup>

Hypothesis 3 will be tested in an equation explaining a measure of contraceptive usage since marriage:

$$C = \gamma_0 + \gamma_1^+ W_f + \gamma_2^- W_c + \gamma_3^- R_c^* + \gamma_4^+ FP + \gamma_5^- P_{BC} + \gamma_0 I + \gamma_7 Ed_f + u_C$$

<sup>13</sup> Because N is bounded from below (by zero), a technique appropriate for estimating a relationship determining a limited dependent variable, for example, Tobit analysis, will be used to test Hypotheses 1 and 2.

<sup>14</sup> Hypotheses 1 and 2 could also be tested in an equation explaining the number of children *ever born*. All signs would be expected to be the same, except  $\alpha_4$ , which would now be ambiguous. It would also be desirable to include a measure of community child mortality rates (measured from vital statistics, an average of all survey families' mortality experience (SR2), or respondents' opinions regarding levels and changes in infant and child mortality rates (SR6)), as well as  $M_c$  (the family's own mortality experience) in an equation explaining number of children ever born. (This allows parents to compensate for *expected* child deaths in planning their families.)

where C = amount of time contraceptives were used as a proportion of time at risk to pregnancy since marriage, where time at risk is defined as number of months married less total number of months pregnant, months in postpartum amenorrhea, or months with husband absent (all from SR2); information on the periods of time during which contraceptives were used is collected in the retrospective contraceptive use history in SR2.

FP = an index of community family-planning program activity; the measure used will vary directly with program expenditures per woman of childbearing age and with number of family-planning workers per eligible woman, and inversely with distance to the nearest family-planning center (SR7).

P<sub>BC</sub> = index of level of community prices of contraceptives (SR7).

Hypotheses 4 and 5 will be tested in an equation such as the following:<sup>15</sup>

$$BI = \delta_0 + \overset{(-)}{\delta_1} M_{c,r} + \overset{(-)}{\delta_2} W_f + \overset{(-)}{\delta_3} CE + \overset{(-)}{\delta_4} W_c + \overset{(-)}{\delta_5} R_c^* + \overset{(+)}{\delta_6} L + u_{BI}$$

where BI = length of pregnancy interval, defined as the number of months between the termination of one pregnancy and the estimated date of next conception (termination date of next pregnancy less length of that pregnancy).

M<sub>c,r</sub> = recent child mortality (number of children who died in the year or two prior to the end of the birth interval under consideration (SR2)).<sup>16</sup>

<sup>15</sup> If the variable CE refers to the period of risk in question,  $\delta_3$  is expected to be positive. However, if CE refers to the whole reproductive period, the sign of  $\delta_3$  is ambiguous *a priori* (women who are using effective contraceptive methods may space their pregnancies closer together, knowing they can prevent future pregnancies once they have reached their target family size).

<sup>16</sup> In subsequent tests, we will explore whether the pregnancy response to a child death depends on the age and/or sex of the child who died (SR2).

A sample of all closed pregnancy intervals will be used to estimate the coefficients of this equation. Thus there may be several observations for each woman (but only women with two or more pregnancies will be considered). Whenever possible, the explanatory variables will be lagged to correspond to the time period of the birth interval under consideration.<sup>17</sup>

We will also estimate the differential effects of these explanatory variables on the lengths of the two component parts of the pregnancy interval--the length of postpartum amenorrhea and the subsequent period at risk before the next conception--in the following equations:<sup>18</sup>

$$PPA = \xi_0 + \xi_1^{(+)}L + u_{PPA}$$

$$PR = \mu_0 + \mu_1^{(-)}M_{c,r} + \mu_2^{(-)}W_f + \mu_3^{(-)}CE + \mu_4^{(-)}W_c + \mu_5^{(-)*}R_c + u_{PR}$$

$$BI = PPA + PR$$

where PPA = length of postpartum amenorrhea, estimated as the number of months between pregnancy termination and first postpartum menstruation (SR2).

PR = length of period at risk, estimated as the number of months between the first postpartum menstruation following one pregnancy and the estimated date of next conception (pregnancy termination date less length of pregnancy) (SR2).

A sample of all durations of lactation will be used to test Hypotheses 6 and 7 in the following equation:

<sup>17</sup> Because the reliability of the retrospective data may decrease for events further in the past and also because the underlying behavioral parameters may change over time, we will also estimate the equation for a subsample of recent pregnancy intervals (e.g., within the 5 or 10 years prior to the survey).

<sup>18</sup> Note that the length-of-lactation variable, L, appearing in the equation explaining postpartum amenorrhea, PPA, is itself a function of many of the explanatory variables in the BI equation. Hence, the length of postpartum amenorrhea indirectly depends on these same factors.

$$L = \eta_0 + \eta_1^{(-)} W_f + \eta_2^{(+)} P_{IF} + \eta_3^{(-)} M_{c,L} + \eta_4^{(-)} X \cdot (DFS - N) + u_L$$

where L = duration of lactation (SR2).

$P_{IF}$  = index of the average community price of common infant foods (SR7).

$M_{c,L}$  = a dummy that equals 1 if a breastfeeding child died during the lactation period under consideration (SR2).

X = a dummy that equals 1 if the woman is aware of the negative relationship between breastfeeding and the chance of becoming pregnant again, and 0 otherwise (SR6).

DFS = total number of children desired (SR6).

### III. MEETING DATA REQUIREMENTS THROUGH HOUSEHOLD SURVEYS

#### DESIRABLE DATA CHARACTERISTICS

Since many of the relationships that characterize family socioeconomic, demographic, and biomedical phenomena are time-dependent, aggregation of data over either families or time may severely limit the amount of information in the resulting sample. Therefore, it is desirable to have retrospective or longitudinal survey data on individual families if the relationships summarized in Fig. 1 are to be disentangled.

The biomedical and demographic data should, at a minimum, describe the outcome of each pregnancy and the length of the postpartum amenorrhea, the length of time each child was breastfed, when foods other than breast milk were first given daily, and the use of contraceptives during each pregnancy interval.<sup>19</sup> The socioeconomic data should document the amounts of time that each household member spends in activities that generate income, that children spend in other productive and useful activities such as child care and housework, and that mothers spend in activities that reduce the amount or effectiveness of the time they spend in child care or breastfeeding. These data should also detail the family's assets and income flows.

Additional data are required to link the socioeconomic and biomedical relationships with factors that reflect the influence of public policies and other environmental factors on individuals' purposeful behavior. In general, these include social and economic determinants of desired family size, of desired child spacing, of the usage of various birth-control methods, and of parents' demand for "high-quality" children.

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<sup>19</sup> Ideally, the biomedical data should also describe the diet of each pregnant woman, the weight and condition of her infant at birth, the intensity of breastfeeding, her children's weight and indicators of their mental and physical development at several intervals, and the diet of each lactating woman and her children. However, special measuring devices, lengthy questionnaires, and extensive training are required to get most of this information accurately.

In addition to these biomedical and socioeconomic data, information is needed on community factors affecting families' behavior that may be influenced by public policy--for example, characteristics of public programs, such as those indicated in the left-hand column of Fig. 1.

#### SURVEY INSTRUMENTS

In our study, the socioeconomic, biomedical, and community data outlined above are being collected in a twelve-month, three-round survey of 1,200 households that each contain an ever-married woman under 50 years of age. Seven questionnaires have been developed for this survey; the contents of each are briefly summarized below.<sup>20</sup>

SRI: Household Record Form. Questionnaire SRI is administered to the female head of household or another adult female household member who has lived with the household for at least one year. The questionnaire is administered during the first survey round, and information is updated during subsequent rounds.

This questionnaire records the demographic characteristics of all persons who currently live in the household, of other persons who live with the household for at least three of the last twelve months, and of any other living children of female members of the household. This information is used to determine which household members are eligible respondents for the other questionnaires. Each household member is at this point assigned an identification code that is used in other questionnaires and subsequent survey rounds. Information is recorded here also on the educational attainment of all children of female family members, including those who no longer live with their mother.

The following specific items of information are collected in SRI: relationships among household members; number of months each member resided in the household in the last twelve months; community (ethnic group); sex, birthdate, age, and marital status of each household member; literacy (reading and writing ability) in Malay, English, and

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<sup>20</sup>The actual survey instruments and interviewers' instructions, as well as information on the survey design, sample, and interviewer training procedures, are presented in Butz, et al., R-1835-AID, op cit

other languages; current attendance in school; highest level of schooling completed by each member; highest school certificate obtained; and basic characteristics of the last school attended by each member.

SR2: Retrospective Questionnaire for Ever-Married Women. This questionnaire is administered to one ever-married woman under 50 years of age per household.<sup>21</sup> It is given during the first survey round and updated during subsequent rounds.

It elicits a life history of pregnancies, lactations, first postpartum menstruations, contraceptive use, marital status changes, migration, house characteristics and household composition, help with children, and education and training of each respondent, as well as a work history that includes occupation, amount of time worked for each job held, and earnings documented at intervals of not more than three years. The information in SR2 is documented from age 15, age at first marriage or age at first pregnancy, whichever is earliest.

SR3: Retrospective Questionnaire for Husbands. This questionnaire is administered to present husbands of respondents to SR2. Like SR2, it is administered during the first survey round and updated during subsequent rounds.

The husband retrospective questionnaire elicits a life history, from age 15 or first marriage (whichever is earliest) to the present, covering schooling and training, marital status changes, occupations, earnings, amount of time worked, property owned, and gifts, inheritances and dowries received.

SR4: Time Budget. This questionnaire is administered in each survey round to the same ever-married women and husbands as are given SR2 and SR3.

For all market and nonmarket activities, including all jobs, unpaid family work, schooling, training, cottage industry, housework, and child care (but excluding recreational activities and sleep), SR4 documents the number of hours spent doing the activity in the last seven days the activity was performed, the number of weeks the activity was

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<sup>21</sup> If there is more than one ever-married woman under 50 years of age in a household, one is selected at random (using a Kish procedure) as the respondent for SR2.

performed in the last four months, the rate of pay (if any) in cash and/or kind earned for the activity, distance from home to the place of the activity, amount of help received, and presence of children less than 11 years old while the activity was being performed. Time use of eligible male and female respondents, of their children living with them, and of hired workers is documented.

SR5: Income and Wealth. Data on income and wealth are collected for each household in the sample. The respondent is the male head of household if he is present; if he is not present or is unable to give complete information on all categories covered in this questionnaire, other household members are interviewed. SR5 is administered during each survey round.

This questionnaire gathers information on all income (except that covered in SR4) received by the household in the last twelve months, quantities of property and durable goods owned, and changes in these components of wealth in the last twelve months. Data are collected on agricultural production, ownership of animals, businesses owned, services performed, gifts from non-household members, inheritances or dowries received, income from insurance, pensions, retirement programs, or interest, income received from renting out rooms, houses, or land, ownership of land, and possession of durable goods. In addition, SR5 collects information on money borrowed or interest paid in the last twelve months and on whether the respondent or his spouse is covered by the government retirement program, has any kind of insurance, and/or has had money in a bank or savings account in the last twelve months.

SR6: Attitudes and Expectations of Ever-Married Women and Their Husbands. This questionnaire is administered to the same women and husbands as are given SR2 and SR3. It is administered only once during the survey.

The Attitudes and Expectations questionnaire elicits information about ages at which sons and daughters became helpful in various activities, expected occupations and educational attainment of children, help in cash, goods, and services that respondents have given to their parents and help they receive or expect to receive from their own children. Other types of expected old-age support, desired family size,

number of respondents' siblings, education and occupation of respondents' parents, and opinions regarding various fertility-related areas.

SR7: Community Data. Community information is assembled for each of the 49 primary sampling units in the sample from administrative records and by interviewing knowledgeable persons (e.g., the village headman and midwife). These data are collected once during the survey. Information collected includes prices of contraceptives, maternity services, and infant foods, characteristics of local schools, family-planning programs, and job markets for women and children, and various other data pertinent to the particular primary sampling unit.

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