PDWAH 389

Specification Biases in Estimating the Influence of Child Mortality on Fertility.

Bun Song Lee and T. Paul Schultz

Introduction

The proximate cause for today's rapid population growth in low income countries is the postwar decline in mortality, which has been particularly large for infants and young children. The effect of this reduction in mortality on the birth rate will influence the future path of population growth. The magnitude of any such effect may also modify development priorities among categories of public expenditure and international assistance, such as among health, family planning and education programs and non human capital investments. This paper discusses some of the problems of estimating the influence of mortality on fertility, and illustrates alternative approaches by an analysis of the 1971 Korean Fertility-Abortion Survey and 1970 Korean Population Census.

To the extent that fertility is determined by preferences subject to resource constraints, it represents an individual or family choice. Information on the couple is generally assumed to be more satisfactory for evaluating the factors conditioning reproduction than information on aggregate conditions and behavior. Intuitively, observations on the individual couple come closer to testing theories of household behavior than do data averaged over groups, defined by region-of-residence or another supposedly exogenous socioeconomic characteristic. To estimate the same fertility (demand) function from data for population aggregates as estimated from data for households, the

This work was supported in part by the U.S. Agency for International Development from Grant No. AID-PHA-G-1185 administered through the Research Triangle Institute and the William and Flora Hewlett Foundation from a grant to the Yale Economic Demography Program. We acknowledge the helpful comments of Adrienne McElwain and Randall Olsen on an earlier draft of the paper. Bun Song Lee is an Associate Professor, Louisiana State University, and T. Paul Schultz Professor, Yale University.

aggregates must be defined independently of the variables conditioning the fertility outcome. In addition, the functional form and statistical structure of the process generating this relationship must be known and taken into account to infer without bias from the aggregated information the precise nature of the relationship pertaining to individual couples (Theil, 1954).[1]

Research on the multiple determinants of fertility relied heavily in the late 1960s on regression analyses of regional aggregate data from censuses and vital registration systems (Schultz, 1973). Analysis has more recently dealt with individual data drawn from household survey and census samples. But standard statistical techniques applied to these micro economic-demographic household data pose new problems for estimating the effect of child mortality on fertility.

The relationship in a society between child mortality and fertility over time may operate through channels of causation within and outside of the nuclear family unit. Any extra-nuclear family response to the regime of mortality that influences reproduction is likely to elude analyses that are based only on the couple's own-child mortality experience. Two mechanisms are frequently hypothesized to connect causally mortality and fertility, an ex post replacement response and an ex ante expectation response (Schultz, 1969, 1976; Ben-Porath, 1976; Preston, 1978). If one neglects the uncertainty that attaches to the unpredictability of births and deaths within a particular family and the imperfect information on which parents must base their decision, it can be shown that inelastic demands for surviving children in combination with

[1] For example, it may be reasonable to approximate most any monotonic function by a linear specification, if one is cautious of such estimates for what they are. But when the underlying true functions are nonlinear, aggregation may conceal and change substantially the apparent relationships.

plausible cost assumptions imply that parents would replace partially (i.e., incomplete replacement, on average) any of their own children that might die, if they were still biologically capable and if their demands for surviving offspring had not decreased due to other unanticipated developments (Schultz, 1976). This replacement effect for own-child loss might be evaluated from observations over time on the fertility behavior of couples and the survival of these births.[2]

But with the introduction of uncertainty and biological limitations on lifetime reproduction, a second mechanism by which fertility can respond to mortality is likely to increase in importance. Long-run expectations of probable levels of mortality and probable capacities of parents to have in their lifetime the number of surviving children they want will lead parents to adopt a reproductive lifetime strategy that anticipates events. This second expectation effect has also been called an insurance or hoarding response of parents and might involve, for example, the adaptation of social institutions, such as intergenerational transfers to youth, to influence the timing of marriage and childbearing in anticipation of future child and parent mortality conditions. No one has as yet devised an entirely satisfactory way to measure how these individual and social expectations are formed, or how large the

[2] No distinction is drawn here between biologically autonomous and behaviorally induced means by which a couple responds to its child mortality experience, since we do not know how to separate empirically the two mechanisms with any confidence. The biological effect operates largely by the shortening of breastfeeding when the deceased child had been nursing, and the cessation of hormones stimulated by suckling encourages the earlier resumption of ovulation. Hence, the women whose infants died while still nursing are involuntarily provided with additional reproductive capacity. See further discussion Schultz, 1976 Preston, 1978

expectation effect is, and whether it is achieved through variation in age at marriage or marital fertility rates. If, as is often assumed, the child mortality rate is a random variable at the individual level, there is no reason for an expectational response; the partial correlation between community mortality levels and individual fertility is in this case interpreted as due to the covariation of omitted regional variables that influence fertility. Individual data may be more useful for estimating the replacement effect of fertility to own-child mortality, while higher levels of aggregation, such as data for local communities or socioeconomic groups within such communities, may provide a better basis for estimating the combined magnitude of expectation and replacement effects on reproduction of actual and expected mortality variation across a population.[3] The statistical problems in separating these two affects may help to explain the diverse conclusions drawn from the empirical evidence of a relationship between child mortality and fertility (Schultz, 1976; Preston, 1978; Olsen, 1980).

Direct estimates of association among discrete measures of own-child mortality and a woman's cumulative fertility are a source of

[3] A strong association in Taiwan is noted between the timing of marriage for birth cohorts and the region's own-child mortality (Schultz, 1980). West European regional data also display a striking positive correlation between child mortality and nuptiality. A study of Philippine survey data introduced the average child death rate in the community of current residence together with the own-child death ratio as variables to account jointly for individual variation in age specific cumulative fertility (Harman, 1970). This empirical strategy, which we consider later in this paper, confirmed that both the community level proxy for expectations and the individual level measure of replacement were positively correlated with the number of children born in the Philippines. Clearly, individuals have much more information relevant to their expected mortality than the community level mortality rate, and there is no obvious way for the researcher to elicit all of this information (Keer and Wu, 1978).

additional problems (Williams, 1977; Brass and Barrett, 1978). A regression of children ever born, C, on the number of children dead, D, for a sample of mothers beyond childbearing age, yields a coefficient on D that is biased upward. This occurs even if fertility and the incidence of child mortality are independent processes. This obvious spurious correlation between between C and D led to the substitution of the child mortality ratio, namely, $r = D/C$, for the absolute number of children dead. But if observations pertain to individuals, the child mortality ratio is concentrated at discrete points on the unit interval that are themselves related to the level of fertility, and a spurious nonlinear association between these two variables may still arise though no causal basis for the relationship exists (Williams, 1977; Wallace, 1979). Nonetheless, if r is assumed to be a random variable, it can enter linearly as a regressor in the fertility equation without introducing bias.

In this paper, we explore statistical approaches to estimating the nonspurious relationship between an individual's own-child mortality and fertility. A standard demand model of fertility is developed in section 2 within which alternative specifications of child mortality are considered. In section 3 we specify empirically a fertility equation based on information from a 1971 Korean Fertility-Abortion Survey of 5,629 ever-married

women in combination with the ten percent sample survey of the 1970 Korean Census of Population. The object is to obtain estimates of the replacement effect of own-child mortality on fertility. The empirical findings are discussed in section 4 and the estimated parameters in the fertility equation are appraised for their sensitivity to the alternative specifications of the fertility-child mortality relation. Section 5 summarizes our findings

2. The Treatment of Child Mortality in the Micro Fertility Equation

Standard demand models of fertility suggest that a significant share of variation across a population in fertility should be accounted for by the opportunity value of women's and men's time, their non human wealth, the local opportunities for child labor, and the offsetting cost of rearing children. To this list of conventional income and relative price variables entering a reduced-form demand equation for fertility, economists and demographers have added child mortality as a conditioning variable (Freedman, 1967; Schultz, 1969). At issue here is how to estimate the response of fertility to child mortality, and how does the estimation strategy affect the estimated responsiveness of fertility to the traditional income and price variables. Models of sequential fertility decision making under uncertainty as to the qualitative characteristics of births, such as survival, sex, or intelligence, have thus far not led to any agreed upon testable predictions, unless a great deal is known, *a priori*, about the characteristics of the parents' utility function (Ben-Porath and Welch, 1972). Under more simplified static

assumptions about parent goals for surviving children, and the relation of costs to survivors, it is possible to show that if parent demands for survivors are relatively inelastic, their demand for births increase when they lose a child (Schultz, 1973). The prediction of this simple demand framework is that parents will be more likely to seek an additional birth if one of their prior children dies or is suddenly expected to die. But this replacement/expectation response will not be complete, that is, the response derivative of the number of children-ever-born with respect to the number of children-dead will be positive, but less than one, i.e, $0 < dC/dD < 1$. The child's death entails a loss of family wealth that should reduce the demand for all normal goods, including children. A reduction in mortality would, in this case, lead to a partially offsetting reduction in fertility, but the rate of population growth would presumably still increase.

A response derivative in excess of one requires a strong cross substitution effect in a more elaborate demand framework that recognizes a "quality" dimension to children that is a substitute for numbers of children in the parent's utility function. As mortality decreases it is reasonable to then conclude that child "quality" will appreciate in value relative to the "quantity" of children. These two attributes of children must be sufficiently close substitutes to parents, to assure that the decline in mortality induces parents actually to shift their consumption from fertility to investments in child "quality", leading to an over-compensating reproductive response, i.e., $dC/dD > 1$ (O'Hara, 1975).

Even if economic theory did prescribe the sign and size of the long run equilibrium reproductive response derivative with respect to child deaths, one might, nonetheless, want actual parameter estimates from different populations, for the means for restricting fertility in response to decreasing child mortality are not uniformly distributed across the world's populations. Many factors, such as education, are implicated as improving the effectiveness of contraceptive choice and practice, given the available technological options and prices. Actual reproductive responses to variation in child mortality might be expected to differ across socioeconomic groups within a society and across societies over time. Indeed, some evidence suggests that response derivatives are larger for upper income groups than for lower income groups, at least in urban Latin America in the 1960s (Schultz, 1978).

One issue we cannot adequately deal with here is the possibility of joint determination of fertility and child mortality. The empirical association between fertility and mortality may indicate that both are influenced by coordinated household allocation choices. Both might then be viewed as outcomes of an implicit household demand system, and these two outputs may also be jointly produced. In some instances increased fertility may raise the risks of child mortality, while increased child mortality may increase the biological potential for bearing subsequent births, as noted earlier. More generally, the stochastic disturbances in unconditional demand equations for fertility and for child mortality may not be statistically independent of one another because both are displaced from their normal level by unforeseen and unobserved events,

such as natural disasters or windfalls. The one-way causal effect of child mortality on fertility in this general demand system is not readily conceptualized or estimated unless information is available on an identifying variable that affects child mortality but does not affect directly fertility.[4]

What is ultimately needed is a priori theoretical insight into an observed identifying variable, such as a child vaccination program that reduces child deaths in some regions without altering appreciably the economic environment of families in those regions. Unfortunately, we lack information in this paper on such an identifying variable, and, therefore, assume for simplicity that variation in r across individuals is random and thereby independent of the disturbances in the fertility demand equation. A corollary of this assumption is that parents are unable to collect sufficient information to revise their expected value of r and

[4]Economists have been tempted to follow the lead of demographers by ordering lifecycle demographic events through time, to appraise the consequences of a child's death on subsequent reproductive behavior and thereby alleviate the simultaneous equations bias (Brass and Barrett, 1978; Ben-Porath, 1976; Park, et al., 1979). But these direct estimates of factors conditioning fertility are not free of bias because the observed population is selected on the basis of an endogenous choice variable, prior reproductive behavior. For example, it is common to measure fertility in these exercises as the parity progression ratio, namely whether or not a mother has another child by age b, given that she had exactly n births at age a, where, of course, $b > a$. This parity progression ratio is then conditioned using the linear probability model or the logistic model on the proportion of the mother's first n births dead when she was age a. Although this time ordering of events can also be used to analyze a sequence of subsequent birth intervals, both approaches suffer from consideration of selectively drawn samples that cannot be assumed representative of the entire population. Thus, residual variation in the equation describing who is likely to have already reached their n'th birth at age a will probably influence their subsequent reproductive behavior. Persistent unobserved factors that impact on many types of household lifecycle outcomes will be embodied in the disturbances in measured prior child mortality and in the subsequent parity progression probability. These direct estimates of the "structural" fertility equations have descriptive appeal, but remain inconsistent estimates of the desired parameters in the fertility equation.

act rather on the basis of the population average child mortality rate.[5] What we are assuming is that child mortality is essentially a random variable whereas fertility contains a component of systematic choice; undoubtedly the margin of control parents exercise over fertility is much greater, relatively speaking, than it is over child mortality.

The number of children ever-born is a discrete variable with typically small values. For a family with n births, the family mortality ratio can take on only n + 1 separate values; for example, a family with four births can experience a mortality ratio of 0.0, .25, .5, .75, or 1.0. Thus, if the family mortality rate is computed for individual families in a sample, the families will be concentrated at particular points on the unit interval. The coefficient estimates on the child mortality ratio when cumulative fertility is regressed on a nonlinear transformation of that ratio may, therefore, be biased, as Williams (1977) suggested by

[5]This is more plausible where r is relatively low, the number of children women have is moderate, and, of course, where perceptible socioeconomic differentials in mortality are small.

simple illustrations.[6] In an empirical study of contemporary U.S. data, Williams (1976) estimated a quadratic replacement relationship between cumulative fertility and the child mortality ratio—where the response derivative increased initially and then decreased.[7] In the next section we shall estimate and compare the linear and quadratic-form estimates.

6 Williams constructed two hypothetical populations, namely, a uniform and a "realistic" frequency distribution of fertility to examine the statistical effect of child mortality on fertility. Families in the former are distributed equally among alternative numbers of children-ever-born, whereas in the latter, the percentage of families at the different values of children-ever-born are equal to the actual frequency distribution of family sizes among older women in the U.S. 1965 National Fertility Study. In both populations the distribution of families according to number of child deaths is determined using the binomial probability tables in such a way that, by construction, the families in these populations do not respond to child mortality. Within each children-ever-born category, child mortality strikes randomly 20 percent of the children. The conditional probability of child death rates in a family is not independent of births, even though the binomial probability of child death is itself assumed to be independent of family size. When families with 100 percent mortality were retained in the fertility regression, a linear function of the child death rates does not help to explain children-ever-born. The regression bias arises for nonlinear transformations of the child mortality ratio that are not independent of fertility.

7 Her interpretation of this response pattern was that families who experience low mortality rates replace their losses more completely and therefore have a substantial positive response to mortality, i.e., $dC/dD > 0$. But those who experience very high mortality are often discouraged (and so revise downward their goal for surviving children, because they perceive the cost of attaining that goal as higher than they originally anticipated) or unable (due to underlying reproductive limitations, of which the child mortality may be one manifestation) to have complete replacement, and thus exhibit a smaller response to mortality, perhaps even negative. Based on this reasoning, Williams rationalized the inverse-U-shaped response pattern she found, and proposed the use of a quadratic form in the child death ratio instead of the linear form in the estimated cumulative fertility equation. But the quadratic specification of the child mortality ratio in the fertility equation may have exaggerated a spurious nonlinear component of the relationship.

To compensate for the spurious correlation between C and D or a nonlinear form of r, Wallace (1979) has proposed using a transformed measure of fertility that is by construction conditionally independent of child mortality. If there were no causal relationship between fertility and measured mortality, then a regression of Wallace's transfo measure of fertility on mortality would yield an unbiased estimate of "true" effect of mortality, that is, zero. But if the "true" effect of mortality on fertility is positive, then this estimate is downward bi (Wallace, 1979). The Wallace estimation strategy is warranted if the behavioral model is thought to link D to C or link a nonlinear function of r to C. An alternative approach for these specifications of the fertility equation would be an instrumental variable estimation procedure that would purge D or a nonlinear function of r of its spurious correlation with C. Since r is by assumption independent of C, it will be the instrument we use later to obtain unbiased two-stage estimates of such a specification of the fertility equation (Olsen, 1980).

To obtain the expected value of fertility conditional on child mortality, Wallace makes two assumptions about the process generating child mortality. First, as already noted, the probability of child mortality is assumed constant across the population such that its expected value must be equal to the average ratio in the population of women of a given age. Second, child mortality is assumed to be generated by a binomial process. Suppose we want to regress the number of births, C, on the number of child deaths, D, in a family. The expected number of child deaths conditional on numbers of births is:

$E(D|C) = \binom{C}{D}P^D(1 - P)^{C-D}$; $C,D = 1,2,\ldots,N$; $C \geq D$, where N is the largest number of children born in the population. The expected probability that a woman will have a specific number of child deaths is calculated from the actual fertility of the mother and our assumption that P is constant across mothers with different levels of fertility in each age group of mothers. The procedure is then reversed to calculate the expected value of fertility given that a certain number of child deaths are known to have occurred to the individual woman, defined as follows:

$$E(C|D) = \frac{\sum_{C=1}^{N} Cg(C)\binom{C}{D}P^D(1 - P)^{C-D}}{\sum_{C=1}^{N} g(C)\binom{C}{D}P^D(1 - P)^{C-D}}$$

where g(C) is the relative frequency of births by number for women of a given age. This expected value of fertility conditional on the number of child deaths tends to be positively correlated with the number of deaths and this is the quantity that Wallace subtracts from the actual level of fertility to obtain his dependent variable.

The same procedure is repeated to obtain the expected value of fertility conditional on a nonlinear function of the child mortality ratio, and since the conditional expectation of C given r and r^2 is the same as the conditional expectation given r, $C^* = C - E(C|r,r^2) = C - E(C|r)$, while if D is thought to be the correct variable in the fertility equation, we have $C^{**} = C - E(C|D)$.[8]

[8] Appendix B of this paper is available from the authors upon request which reports the frequency distribution of births by age groups of mothers, g (C) and illustrates how the expected value of fertility conditional on child mortality is calculated for the Korean sample. See Tables B-1 through B-4.

3. Empirical Specification of Explanatory Variables

The fertility equation is interpreted by us to be an unconditional household demand function, and includes, therefore, all appropriate price and income variables, but excludes other simultaneously determined household demand variables that might interact with or be jointly determined with fertility, such as mother's age-at-marriage or duration of marriage and mother's time allocation or labor force participation. To represent the nonlinear functional form of the cumulative fertility schedule with respect to age, age is introduced as single year dummy variables. The fertility equation is also estimated within five year birth cohorts to minimize problems of age aggregation due to interactions between age and other conditioning variables, and to avoid the need to impose an arbitrary "natural" age normalization on cumulative fertility (Boulier and Rosenzweig, 1978). Table A1 in Appendix A reports the descriptive statistics for the six five-year birth cohorts of Korean women analyzed below.

Education of wife and husband represents wage opportunities in the labor market and thus approximates the value of time. It is generally assumed that for the wife the substitution effect of the wage rate outweighs the income effect, prescribing a negative effect of the wife's education on fertility. The net effect of husband's education is not signed, however, and is frequently found to be positive or U shaped, at least in traditional agricultural societies where children are a productive asset (Schultz, 1973). Education is allowed to affect fertility nonlinearly by introducing five categorical educational attainment variables: no schooling, 1-6 years, 7-9 years, 10-12 years, and more than 12 years of schooling.

The mother's rural/urban background is summarized in four categories with reference to her birthplace, and longest residence before and after marriage. Our assumption is that relative prices favor higher fertility in rural areas and discourage large families in metropolitan urban areas. Particularly for older women who may have had many of their children in a prior residential area of Korea, these background effects may be important. The rapid recent rates of internal migration in Korea appear to be strongly related to fertility patterns (Lee and Farber, 1980).

Finally, three variables are drawn from the 1970 Census 10 percent sample survey public use data file to represent conditions in the household's community residence: agricultural and nonagricultural labor force participation rates for children age 14-19, and the average child mortality ratio for women in five-year age groups of mothers, age 25-29 to 45-49. The former two variables are intended to measure the community's labor force opportunities for child labor that would encourage higher fertility,

and the latter variable proxies the community's mortality regime that might influence mortality expectations or represent omitted environmental constraints that effect fertility apart from the direct replacement responses to own-child mortality experience. These three variables, because they pertain to the aggregate community of residence, cannot be affected appreciably by an individual's behavior, and are therefore exogenous to the family's reproductive behavior even though the child labor force participation patterns embody both aggregate supply and demand effects

The 1971 Korean Fertility-Abortion Survey was collected by the Korean Institute for Family Planning. Retrospective histories and social, economic, demographic and family planning information were collected from 5,629 ever-married women and their families. The county, city, or metropolitan district of current residence is used to merge with this household file additional information from the 1970 Census 10 percent sample survey. The cumulative fertility and own-child mortality data from the 1971 survey appear to be of high quality according to aggregate estimates of the levels and trends of fertility and child mortality. The 1970 Census retrospective child mortality data, however, may underreport slightly child death rates, particularly for younger mothers (Coale, et al., 1980). The decrease in mortality has been substantial, however. Expectation of life at birth is estimated as 45 years in 1942, 59 years in 1955-60, and 67 years in 1970-75 (Hong, 1978; Coale, et al., 1980). The total fertility rate (the sum of age specific birth rates) peaked at 6.0 in 1960, and had fallen to 4.3 by 1971 (Coale, et al., 1980).

Because much of this decline in fertility was accomplished by the delay of marriage, our working samples of currently-married women with at

least one birth may not represent this phenomena fully. Fertility equations estimated for mothers less than age 30 should, therefore, be interpreted with this selection criteria in mind.[9]

4. Empirical Findings

Seven specifications of the fertility equation are estimated for each of six age groups of Korean mothers. Due to space limitations Table 1 presents the regression results for only the 30-34 age group as a sample.[10] However, the coefficient estimates for r, r^2 and D along with R^2's for the other five age groups are reported in Table 2. For four of the specifications, (equations (1), (3), (5) and (7)), the dependent variable is observed cumulative fertility. Child mortality is specified in (1) by a quadratic function of the child mortality ratio, in (3) by a linear function of the child mortality ratio, and in (5) by a linear function of the number of children dead. Regression (7) is based on the same specifications as (5) but uses r as an instrument to obtain unbiased estimates of the response of C to D*. Regressions (2), (4) and (6) have the same explanatory variables but employ Wallace's (1979) adjustment of fertility, subtracting from observed

[9] There is no obvious reason why women who begin bearing children at an early age should be more or less likely than the average woman to replace deceased children. The mean age at first marriage for women had increased by 1971 to about 23 years, and therefore the composition of our samples of women 20-24 and even 25-29 is biased toward those that married and began childbearing at a relatively early age. But by age 30-34, relatively few Korean women remain single (1.3 percent in the 1970 Census) and 97 percent of the ever married women had one or more births. There is no obvious way to correct for this bias or judge its importance in a study of the reproductive replacement response to own-child mortality. Nonetheless, the expectational effect of the decline in mortality, if one exists, may be operating through the delay of marriage, and cannot be adequately assessed here.

[10] The complete set of regression results for the other five age groups is reported in Tables B-5 through B-9 in Appendix B, available on request from the authors.

Table 1
Alternative Specifications of Fertility - - Child Mortality Regressions
Women Aged 30-34

	Dependent Variables													
	1) C		2) C*		3) C		4) C*		5) C		6) C**		7) C	
	b	t	b	t	b	t	b	t	b	t	b	t	b	t
Intercept	3.060	(10.54)	-.308	(-1.14)	3.118	(10.16)	-.308	(-1.14)	3.219	(11.24)	-.364	(-1.27)	3.171	(10.8)
DA1	.271	(2.51)	.225	(2.24)	.377	(3.31)	.226	(2.25)	.336	(3.14)	.336	(3.16)	.349	(3.21)
DA2	.559	(5.40)	.432	(4.47)	.606	(5.53)	.432	(4.48)	.548	(5.32)	.545	(5.33)	.579	(5.52)
DA3	.665	(6.33)	.558	(5.71)	.769	(6.96)	.559	(5.74)	.682	(6.60)	.684	(6.62)	.732	(6.91)
DA4	.963	(9.22)	.753	(7.75)	1.066	(9.69)	.754	(7.79)	.946	(9.18)	.942	(9.15)	1.008	(9.54)
DWEDZ	-.082	(-.90)	-.129	(-1.52)	-.082	(-.85)	-.129	(-1.52)	-.083	(-.93)	-.081	(-.91)	-.072	(-.84)
DWED69	-.376	(-3.28)	-.406	(-3.79)	-.429	(-3.53)	-.407	(-3.80)	-.387	(-3.41)	-.388	(-3.42)	-.422	(-3.63)
DWED912	-.410	(-2.67)	-.398	(-2.78)	-.579	(-3.58)	-.399	(-2.80)	-.513	(-3.40)	-.512	(-3.39)	-.534	(-3.45)
DWED12U	-.763	(-2.73)	-.709	(-2.73)	-.867	(-2.94)	-.709	(-2.73)	-.774	(-2.81)	-.776	(-2.82)	-.838	(-2.97)
DHEDZ	.137	(1.02)	.134	(1.07)	.158	(1.11)	.134	(1.07)	.143	(1.08)	.140	(1.06)	.142	(1.05)
DHED69	-.305	(-3.09)	-.139	(-1.52)	-.363	(-3.47)	-.140	(-1.53)	-.313	(-3.20)	-.317	(-3.24)	-.347	(3.47)
DHED912	-.411	(-4.16)	-.229	(-2.49)	-.425	(-4.06)	-.229	(-2.49)	-.377	(-3.86)	-.384	(-3.94)	-.419	(4.18)
DHED12U	-.485	(-3.40)	-.333	(-2.51)	-.469	(-3.12)	-.333	(-2.51)	-.410	(-2.92)	-.418	(-2.98)	-.480	(3.33)
r	5.597	(12.73)	.569	(1.39)	1.228	(5.28)	.527	(2.58)						
r^2	-7.956	(-11.47)	-.077	(-.12)										
D									.739	(14.02)	.196	(3.71)	.346	(5.52)
PBBSM1	-.102	(-.78)	-.182	(-1.50)	-.109	(-.79)	-.182	(-1.50)	-.139	(-1.09)	-.136	(-1.06)	-.105	(-.80)
PBBSM2	-.113	(-.88)	-.087	(-.72)	-.115	(-.85)	-.087	(-.72)	-.095	(-.75)	-.091	(-.72)	-.100	(-.77)
PBBSM3	-.155	(-1.56)	-.172	(-1.87)	-.142	(-1.35)	-.172	(-1.87)	-.138	(-1.41)	-.134	(-1.37)	-.136	(-1.36)
MICR	2.649	(1.75)	.595	(.42)	3.484	(2.18)	.603	(.43)	1.718	(1.15)	1.739	(1.16)	3.144	(2.05)
PPAGR	1.061	(2.27)	.903	(2.08)	.882	(1.79)	.901	(2.08)	.768	(1.67)	.739	(1.60)	.826	(1.75)
PPNAG	-.290	(-.42)	-.388	(-.61)	-.586	(-.81)	-.391	(-.61)	-.647	(-.95)	-.689	(-1.02)	-.627	(-.90)
R^2 (F)	.371		.223		.297		.223		.388		.274		(27.02)	

Note: DA1, DA2, DA3 and DA4 are dummy variables with suffixes denoting the deviation of the mother's age from the youngest age in the five-year-age-interval. For example, DA1 has a value 1 in age group 30-34 if the mother's age is 31. Small b refers to the regression coefficients and t to their t-statistics.

Table 2

Alternative Specifications of Fertility — Child Mortality Regressions

Selected Explanatory Variables	Dependent Variables													
	1) C		2) C*		3) C		4) C*		5) C		6) C**		7) C	
	b	t	b	t	b	t	b	t	b	t	b	t	b	t
Women Aged 20-24														
r_2	3.152	(4.40)	-.971	(-1.40)	.058	(.29)	-.029	(- .15)						
r^2	-3.574	(-4.48)	1.089	(1.41)										
D									.303	(2.48)	-.075	(- .61)	.039	(.29)
R^2(F)	.296		.254		.258		.250		.270		.246		(6.93)	
Women Aged 25-29														
r_2	5.168	(11.52)	-.209	(-.48)	1.063	(5.30)	.149	(.81)						
r^2	-6.867	(-10.11)	.598	(.92)										
D									.735	(11.07)	.206	(3.11)	.412	(5.48)
R^2(F)	.343		.212		.275		.211		.337		.248		(20.89)	
Women Aged 35-39														
r_2	8.076	(14.75)	1.863	(3.73)	2.519	(8.31)	1.270	(4.89)						
r^2	-11.161	(-11.87)	-1.190	(-1.39)										
D									.876	(18.27)	.278	(5.79)	.514	(9.01)
R^2(F)	.365		.167		.277		.166		.418		.243		(24.46)	
Women Aged 40-44														
r_2	8.891	(10.63)	.136	(.18)	2.849	(7.36)	1.350	(4.11)						
r^2	-12.00	(-8.07)	2.411	(1.84)										
D									.816	(16.45)	.103	(2.09)	.460	(8.01)
R^2(F)	.311		.151		.251		.148		.409		.174		(15.92)	
Women Aged 45-49														
r_2	11.996	(11.30)	1.421	(1.56)	2.576	(4.98)	.977	(2.41)						
r^2	-15.293	(-9.91)	-.721	(-.55)										
D									.931	(16.41)	.060	(1.07)	.414	(5.57)
R^2(F)	.272		.084		.133		.083		.402		.101		(5.42)	

cumulative fertility the expected value of fertility for each woman conditional on the measure of her own child mortality that enters the specific form of the fertility equation.

When actual fertility is regressed on the quadratic and linear form of the child mortality ratio (compare regressions (1) and (3)), all age groups display the nonlinear relationship noted by Williams (1976). The partial association between fertility and own-child mortality ratio increases initially and then decreases, reaching its maximum effect when the child mortality ratio is approximately one-third.

But if the conditional dependence between fertility and the child mortality ratio is removed, under our working assumptions, the remaining association does not appear nonlinear. In the case of the sample aged 40-44, the squared child mortality ratio receives a higher t statistic than the linear term of this variable, but the simple linear specification is still preferable on statistical grounds.[11] These Korean data suggest that the nonlinear response function found by Williams (1976) is also present in Korean data, but may be accounted for by the spurious conditional dependence of fertility on the nonlinear form of the child mortality ratio, as proposed by Wallace (1979).

---

[11] The t values for the regression coefficients of r and r^2 in regress: (2) of Table 2 are the basis for concluding that the quadratic speci tion is not supported by these data. However, since r^2 is uniquely determined by r, the investigation of separate t values for the two regression coefficients is not satisfactory. Another approach is to calculate the statistical significance of the response, or $dC^*/dr = \beta + 2\lambda r$ where β is the regression coefficient on r. and λ is the coefficient on r^2 in regression (2) of Table 2. The variance of this response estima is then $Var(\hat{\beta}) + 4r\ Cov(\hat{\beta},\hat{\lambda}) + 4r^2 Var(\hat{\lambda})$. Evaluating this response (and its standard error), one obtains .56 (.33), 1.75 (.37), .48 (.43) and 1.28 (.49) for the age groups 30-34, 35-39, 40-44, 45-49, respectively Only for ages 35-39 and 45-49 are the estimated responses significantly different from zero at the 5 percent level; in the linear specification they are all statisically significant after age 29.

The Wallace adjustment also reduces the association between (adjusted) fertility and the number of children dead in equation (6) by 70 to 94 percent for women over the age 24. The regression coefficient on the child mortality ratio in the adjusted fertility equation (4) is also markedly reduced, even though it should not be biased in the original specification (3). Although these adjusted fertility regression coefficients on the child mortality variable are biased downward, if the true replacement response is positive, they suggest a lower bound on the true value. The instrumental variable estimates of regression (7) are substantially larger than Wallace's estimates (6), but only about half the size of the direct estimates (5) that include the obvious spurious component

Table 3 converts the seven estimated specifications of the fertility equation in Table 2 into comparable response derivatives of number of children born with respect to number of children dead, evaluated at the sample means, i.e., dC/dD. The direct estimates of the quadratic function in the child mortality ratio (1) imply implausibly large response values, in excess of 75 percent of full compensation for all age groups, i.e., dC/dD > .75. It seems unlikely that young mothers could exhibit such large replacement responses. The direct estimates of the linear function of the number of children dead (5) also imply large responses increasing with age.

From regression (6) the potentially downward biased Wallace estimates of the response derivative range from about .2 from age 25 to 34, to .3 for age 35-39, dropping thereafter to .1. The unbiased instru-

Table 3

Comparisons of Estimates of Response Derivative from Different Regressions, namely, dC/dD

Derived from Regressions, Table 2.	Age Group of Mothers 20-24	25-29	30-34	35-39	40-44	45-49
1) $C = f(r, r^2)$	1.788	1.690	1.056	1.081	.815	.756
2) $C^* = f(r, r^2)$	-.603	-.061	.146	.322	.138	.167
3) $C = f(r)$	.038	.432	.317	.487	.453	.365
4) $C^* = f(r)$	-.019	.062	.138	.252	.222	.145
5) $C = f(D)$	.303	.735	.739	.876	.816	.931
6) $C^{**} = f(D)$	-.075	.206	.196	.278	.103	.060
7) $C = f(D^*)$	.039	.412	.346	.514	.460	.414

Note: Regressions (1) and (2): $C = \alpha + \beta r + \lambda r^2$; the derivative response, $dC/dD = (\beta + 2\lambda r)/(C + (\beta + 2\lambda r)r)$.
Regressions (3) and (4): $C = \alpha + \beta r$; the derivative response, $dC/dD = \beta/(C + \beta r)$.
Regressions (5),(6) and (7): $C = \alpha + \beta D$; the derivative response, $dC/dD = \beta$.

Table 4

Reduced Form Regressions of the Duration of Marriage Equation by Age Group of Mothers

Selected Explanatory Variables	Age Group of Mothers 20-24	25-29	30-34	35-39	40-44	45-49	50-54
MICR	6.39	8.46	12.2	8.76	2.15	8.47	14.6
	(1.78)	(2.61)	(3.70)	(2.98)	(.55)	(2.40)	(3.69)
$\bar{r}$	-.194	.851	.755	.329	1.63	.513	-.0684
	(.39)	(1.71)	(1.58)	(.68)	(3.06)	(1.22)	(.15)
R^2	.3061	.3654	.4646	.5432	.4619	.5271	.4938
Mean Dependent Variable	3.18	6.19	11.57	17.91	24.39	29.99	35.27
Mean Age at Marriage	19.3	21.3	20.9	19.6	18.1	17.5	17.3
Sample Size	397	1001	1132	1048	779	538	387

Note: All independent variables as listed in Table 1 are included in the regression above.

mental variable estimates of the response derivative from regression (7) range from .35 to .51 for these age groups. The direct unbiased estimates of regression (3) imply a similar range of from .32 to .49. Thus, the specification choice between regression (3) and (7) does not affect greatly the estimated response derivative, whereas the Wallace adjustment appears to underestimate the response derivative in (6) and (2) where it is appropriate, and in (4) where it is not.[12]

In evaluating how expectations of parents regarding child mortality influence their reproductive behavior, the strategy adopted here is to add to the list of conditioning variables the current residential community's child mortality ratio (MICR), calculated from a 1970 Census sample. But the deficiencies of this approach are obvious; development has proceeded at different rates in different regions of Korea, stimulating high rates of internal migration. Thus, for many parents, the current residential area is not that which they confronted when they were first married, when their mortality expectations may have had the strongest independent effect on their reproductive behavior before their own children experienced the risks of mortality. However, in the unbiased

[12] Period specific replacement response rates have also been estimated by sequential analyses of these data. An epidemiological study by Park, et al. (1979) appraised the effect of infant deaths on subsequent fertility, measured both as the length of closed birth intervals (CBI) after a birth of a given order, and as the probability of a mother progressing to the next birth order (PPB). Their direct analysis of PPB data suggests that the survival status of the previous and penultimate birth is inversely associated with the probability that a mother continues on to her next birth (Park et al., 1979, Tables 6, 7, and 8). A procedure for combining their CBI and PPB respons estimates implies an overall replacement response, or dC/dD in our notation, of .24 before 1955, rising .31 in 1955-64, to .53 in 1965-71. Comparisons between these period response rates calculated from birth intervals and the cohort response rates estimated here are unfortunately not possible, but magnitudes are not dissimilar.

regressions on actual cumulative fertility, regression (3) Table 2, the anticipated positive expectational response is evident only for women age 30 to 39.

Another approach for evaluating how mortality expectations might influence fertility is to consider decisions that have a bearing on fertility, but which occur before personal experience is gained of own-child mortality and thus before replacement can occur. A study in Taiwan found that the age at marriage across regions is closely associated with the level of child mortality in that region and this pattern was interpreted as consistent with the expectation hypothesis (Schultz, 1980) To explore this possibility in Korea, Table 4 reports regressions of duration of marriage on the same list of reduced-form explanatory variables included in the fertility equation in Table 1.[13] Age at marriage is approximately the mirror image of the duration of marriage within an age group as estimated here. All of the regression coefficients on the community child mortality ratio are positive, and all but one is significantly different from zero at the five percent level. A change in the child mortality ratio as observed between women age 45-49 and 30-34, or from .201 to .078, (Table A1) would

[13] Due to space limitation Table 4 reports coefficient estimates only for the community and individual's child mortality rate variables. The coefficient estimates for other explanatory variables are reported in Table B-10 of Appendix B.

according to these regressions, be associated with a decrease of approximately one year in marriage duration. This effect represents about a third of the dramatic change in age at marriage that actually occurred in Korea across these age cohorts. The individual's child mortality ratio may be interpreted in this context as a proxy for imperfect information that persons retain about their family-specific health status; the regression coefficient on this individual variable (which is known with certainty only in the future) is significantly different from zero in only two out of the seven age groups of mothers, but in those instances it is positive (Table 4). These marriage duration regressions suggest that community level child mortality does influence the timing of marriage, probably through its effect on mortality expectations.

The other coefficients in the fertility equation are affected by the alternative specifications of child mortality,[14] even though modestly in many cases. The direct inclusion of the quadratic in the child mortality rate or the number of child deaths in previous research estimating fertility determination equations from household data may have produced biased estimates of the effect of other exogenous conditioning factors considered in these studies.

5. Conclusions

Household survey data on individuals are being used increasingly to estimate the preconditioning effects of personal and environmental

14 Given growing evidence of the association between own child mortality and mother's education, it was anticipated that the Wallace adjustment of fertility would reduce the partial association between this measure of fertility and the mother's education, by removing one way through which education is correlated with the parts of the expected value of fertility conditional on child mortality beyond its linear expansion.

variables. Among discrete demographic phenomena, however, empirical regularities may represent spurious correlation in addition to causal association. This paper considered one such case, between a couple's incidence of own child mortality and its cumulative lifetime fertility. The problem arises because of the discrete nature of fertility and the conditional effect of fertility on the frequency distribution of child deaths and child death ratios.[15]

Our working hypothesis has been that child mortality is a random variable whose expected value does not vary across women of the same age with different numbers of children. The Korean data analyzed here are internally consistent with this hypothesis for women age 40 to 49, but for younger women a weak positive relationship is noted between r and C across parity, which may suggest the need to reconsider this assumption in subsequent work. If fertility is specified as a linear function of the child mortality ratio, the fertility equation can be estimated directly without bias, as shown in regression (3) of Table 2. If the correct specification of the fertility equation is as a linear function of the number of deceased children, then an unbiased two-stage estimation procedure suggested by Olsen (1980) may be adopted, where the instrumental variable is the child mortality ratio itself, r. Estimates of this specification of the fertility equation are reported in regression (7). In either specification the response derivative of fertility with

15 An analogous statistical-demographic problem arises in the interpretation of a ratio measuring the proportion of children of one sex, when it is treated as a conditioning variable in a fertility equation. In this latter case of the sex ratio, a nonlinear response has also been noted (Ben-Porath and Welch, 1972), and we would surmise that it also embodies a spurious correlation as in the case dealt with here. DeTray (1980) has also stressed the deficiency of this empirical specification for measuring the strength of "son preference" from micro-demographic regressions.

respect to child deaths is of about the same magnitude, ranging from .3 to .5, for the various five year age groups of women from age 20 to 49. Alternatively, Wallace's (1979) procedure that adjusts fertility for the spurious correlation between D and C and between a nonlinear function of r and C implies estimates of the replacement response derivative that are only half the size of those obtained by the two unbiased methods.[16] In addition to demonstrating the quantitative importance of the spurious correlation problem for estimating from household data the fertility replacement response to own child mortality, we have also found that estimates of the fertility effects of other conditioning variables may be changed substantially by common but inappropriate specifications of the fertility equation.

Either of the unbiased specifications of the fertility equation implies an estimate of the replacement response between one-third and one-half. According to these estimates this fraction of the population growth increasing effect of the decline in child mortality is offset by the scaled down reproductive achievements of Korean parents. Although this is only one of many factors behind the recent large reduction in Korean fertility, it is far from negligible, and it might raise the priority otherwise assigned to child health programs in a rapidly growing population.

[16] Hauskopf and Wallace (1979) and Olsen (1980) indicate why this fertility adjustment procedure should overcompensate for the spurious correlation problem. Our empirical evidence confirms that this procedure --- underestimate substantially the replacement response derivative.

REFERENCES

Ben-Porath, Y. and F. Welch, Chance, Child Traits, and Choice of Family Size, R-1117-NIH/RF, Santa Monica, CA: The Rand Corp., 1972.

_____, "Fertility Response to Child Mortality: Micro-Data from Israel," Journal of Political Economy, vol. 84, no. 4, part 2 August 1976, S-163-S178.

Boulier, B. and M.R. Rosenzweig, "Age, Biological Factors, and Socioeconomic Determinants of Fertility: A New Measure of Cumulative Fertility for Use in the Socioeconomic Analysis of Family Size," Demography, Vol. 15, No. 4, November 1978, pp. 487-497.

Brass, W. and J.C. Barrett, "Measurement Problems in The Analysis of Linkages Between Fertility and Child Mortality," in Preston, S.H. (ed.), The Effect of Infant and Child Mortality on Fertility, New York: Academic Press, 1978.

Coale, A.H., L.J. Cho, and N. Goldman, Estimation of Recent Trends in the Republic of Korea, Committee on Population and Demography, Report No. 1, National Academy of Sciences, Washington, D.C., 1980

DeTray, D. and Z. Khan, "On the Care and Handling of Regression Specifications in Fertility Research," Pakistan Development Review, August 1977, pp. 309-324.

_____, "Son Preference in Pakistan," paper presented at Population Association of America meetings, Denver, April 1980.

Freedman, R., "Norms for Family Size in Underdeveloped Countries," Proceedings of the Royal Statistical Society, ser. B, 159:222-45, 1967.

Harman, A.J., Fertility and Economic Behavior of Families in the Philippines, RM-6385-AID, Santa Monica, CA: The Rand Corp., 1970.

_____, D.M. and Hsin-Ying Wu, "Effects in Rural Taiwan and Urban Morocco: Combining Individual and Aggegate Data," in Preston, S.H. (ed.), The Effect of Infant and Child Mortality on Fertility, New York: Academic Press, 1978.

Hong, S., Population Status Report: Korea, Korea Development Institute, Seoul, 1978.

Korean Economic Planning Board, 1970 Population and Housing Census Report, vol. 2, 10% Sample Survey, 4-2 Fertility, Republic of Korea, 1973.

Lee, B.S., R. Paddock and B.F. Jones, Development of an Econometric Fertility Model for Less Developed Countries: The New Home Economics Approach to Female Status and Age at Marriage and Fertility. Interim Report prepared for the Agency for International Development, Research Triangle Institute (21U-1536), 1978.

Lee, B.S. and S. Farber, Investigation of the Influence of Rural to Urban Migration on Migrants' Fertility in Less Developed Countries, Interim Report for Agency for International Development, Louisiana State University, Baton Rouge, LA, April 1980.

Mauskopf, J. and T.D. Wallace, "Child Replacement and Fertility: Adjusting for Spurious Correlation", mimeo, Duke University, Durham, N.C., November 1979.

O'Hara, D.J., "Microeconomic Aspects of the Demographic Transition," Journal of Political Economy, vol. 83, no. 6, December 1975, pp. 1203-1216.

Olsen, R.J., "Estimating the Effect of Child Mortality on the Number of Births," Demography, Vol. 17, No. 4, pp. 429-444, November 1980.

Park, C.B., S.H. Han, and M.K. Choe, "The Effect of Infant Death on Subsequent Fertility in Korea and the Role of Family Planning," American Journal of Public Health, vol. 69, no. 6, June 1979, pp. 557-565.

Preston, S.H. (ed.), The Effect of Infant and Child Mortality on Fertility, New York: Academic Press, 1978.

Schultz, T.P., "An Economic Model of Family Planning and Fertility," Journal of Political Economy, vol. 77, no. 2 March/April 1969, pp. 153-180.

_____, "A Preliminary Survey of Economic Analyses of Fertility," American Economic Review, Supp. vol. 63, no. 2, May 1973.

_____, "Interrelationships Between Mortality and Fertility," in R.G. Ridker, (ed.), Population and Development, Baltimore: The Johns Hopkins University Press, 1976.

_____, "Fertility and Child Mortality Over the Life Cycle: Aggregate and Additional Evidence," The American Economic Review, vol. 68, No. 2, May 1978, pp. 208-215.

_____, "An Economic Interpretation of the Decline in Fertility in a Rapidly Developing Country," in Population and Economic Change in Less Developed Countries, R.A. Easterlin (ed.), National Bureau of Economic Research, Chicago: University of Chicago Press, 1980.

Theil, H., Linear Aggregation of Economic Relations, Amsterdam: North Holland Publishing Co., 1954.

Wallace, T.D., "Child Replacement and Fertility: Adjusting for Spurious Correlation," mimeo, Duke University, Durham, N.C., May 1979.

Williams, A.D., "Fertility and Reproductive Loss," unpublished Ph.D. dissertation, University of Chicago, 1976.

_____, "Measuring the Impact of Child Mortality on Fertility: A Methodological Note," Demography, vol. 14, no. 4, November 1977, pp. 581-590.

Data Appendix Table A-1

Variable Definitions, Sample Means, and Standard Deviations:

Currently Married Korean Mothers, 1971*

Definition of Variable (and Symbol)	Age of Mother					
	20-24	25-29	30-34	35-39	40-44	45-49
Dependent Variables						
Children Ever Born (C)	1.51 (6.91)	2.40 (1.07)	3.78 (1.38)	4.93 (1.66)	5.83 (2.03)	6.54 (2.40)
Children Ever Born minus expected births given deaths $C^{**} = C - E(C\|D)$[1]	-.002 (.682)	-.003 (1.00)	-.003 (1.26)	-.001 (1.46)	.015 (1.72)	.043 (1.95)
Children Ever Born minus expected births given death ratio $C^{*} = C - E(C\|r,r^2)$[1]	-.008 (.650)	-.049 (.936)	-.062 (1.15)	-.046 (1.32)	.012 (1.62)	.182 (1.83)
Mortality Variables						
Number of Children Dead (D)	.063 (.263)	.158 (.430)	.337 (.633)	.541 (.857)	.951 (1.20)	1.42 (1.50)
Ratio of Children Dead to Born (r = D/C)	.037 (.162)	.052 (.147)	.078 (.152)	.096 (.149)	.144 (.170)	.201 (.200)
Community Child Death Ratio, all ages[2] (MICR)	.118 (.027)	.116 (.027)	.115 (.026)	.117 (.027)	.117 (.026)	.118 (.027)
Exogenous Variables						
Mother's Schooling:*						
none (DHEDZ)	.093	.131	.229	.328	.476	.638
1-6 years (suppressed)	.557	.528	.517	.488	.406	.279
7-9 years (DWED69)	.199	.196	.134	.101	.064	.039
10-12 years (DWED912)	.131	.112	.102	.076	.045	.039
13+ years (DWED12U)	.020	.033	.019	.007	.009	.006
Father's Schooling:*						
none (DHEDZ)	.035	.051	.081	.133	.259	.366
1-6 years (suppressed)	.345	.281	.319	.357	.358	.361
7-9 years (DHED69)	.229	.236	.191	.194	.169	.145
10-12 years (DHED912)	.290	.285	.258	.202	.140	.074
13+ years (DHED12U)	.101	.148	.151	.113	.073	.054
Mother's Background:*[3]						
Urban (PBBSM1)	.171	.154	.152	.120	.073	.054
Town/Urban (PBSM2)	.108	.126	.102	.094	.090	.095
Village/Town (PBBSM3)	.249	.258	.229	.193	.194	.182
Village (suppressed)	.471	.463	.517	.593	.602	.610
Community Proportions:[2]						
Children age 14-19 in agricultural labor force (PPAGR)	.163 (.157)	.151 (.151)	.154 (.151)	.175 (.150)	.175 (.149)	.181 (.149)
Children age 14-19 in nonagricultural labor force (PPNAG)	1.75 (.109)	1.81 (.107)	1.78 (.106)	1.62 (.103)	1.63 (.101)	1.60 (.101)
Number of Women in Sample	397	1001	1132	1049	779	538

*Standard deviations are reported in parentheses beneath means, except for binary variables, such as categorical education and background variables, for which the standard deviation is $\sqrt{m(1-m)}$, where m is the relative frequency or mean of the binary variable.

[1]These transformations of the cumulative fertility variable for a woman are defined and discussed in the text. See also Wallace (1979).

[2]Community variables are derived from the public-use-file of the ten percent sample survey of the Korean Population Census of 1970. Of the 184 communities, the 1971 survey was clustered in 42: 7 wards (gu) in Seoul, 4 wards in Busan, 7 cities (shi) and 24 counties (gun). The child death ratio for women in age groups 25-29 to 45-49 are averaged to obtain the community child death ratio over all ages. The child labor force participation proportion is the average of the rates calculated in each community for girls and boys.

[3]Three regions are distinguished for each woman: birthplace, longest residence before and after marriage. According to the rural and village/town,city locations, the woman is allocated to one of the four urban-rural background categories. For further details see Lee, et al. (1978).

Statistical Appendix B
Table B-1

Mean Child Death Ratio, P,
and Frequency Distribution of Births, g(C), by Age Groups of Korean Mothers

	Age Group of Mothers					
	20-24	25-29	30-34	35-39	40-44	45-49
P	.0417	.0657	.0894	.1099	.1617	.2171
g(1)	.5895	.2058	.0442	.0276	.0231	.0186
g(2)	.3224	.3716	.1245	.0390	.0281	.0390
g(3)	.0755	.2768	.2606	.1163	.0719	.0669
g(4)	.0127	.1129	.2880	.2069	.1245	.0781
g(5)		.0290	.1838	.2469	.1566	.1059
g(6)		.0020	.0707	.2173	.2041	.1468
g(7)		.0010	.0221	.0858	.1849	.1989
g(8)		.0	.0053	.0420	.1220	.1375
g(9)		.0010	.0	.0114	.0424	.1208
g(10)			.0010	.0057	.0347	.0428
g(11)				.0010	.0064	.0297
g(12)					.0013	.0074
g(13)						.0056
g(14)						.0019
Total	1.000	1.000	1.000	1.000	1.000	1.000

Table B-2

Calculated Values of $E(D|C)$ for Korean Mothers Age 20-24,

For Whom Child Death Probability is .0417

Number of Child Deaths, D	Number of Children Ever Born, C			
	1	2	3	4
0	.9583	.9183	880	.8433
1	.0417	.0799	1149	.1468
2		.0017	0049	.0094
3			00007	.0003
4				.000003

Table B-3

Expected Number of Children Born, E(C|D),
Conditional on the Number of Child Deaths, by Mother's Age Group

Number of Child Deaths, D	Age Group of Mothers					
	20-24	25-29	30-34	35-39	40-44	45-49
0	1.471	2.328	3.601	4.608	5.147	5.122
1	1.799	2.771	4.108	5.201	5.966	6.239
2	2.585	3.466	4.601	5.774	6.677	7.174
3		4.364	5.298	6.370	7.321	7.936
4			6.038	7.040	7.989	8.635
5			6.923	7.789	8.573	9.348
6				8.572	9.191	10.10
7					9.772	10.90
8						11.67

Table [illegible]

Expected Number of Children Born, E(C|r),

Conditional on the Child Mortality Ratio, by Mother's Age Group

	Age Group of Mother			
r = D/C	20-24	25-29	30-34	35-39
0	1.4915	2.3282	3.6021	4.5778
1/10				10.0
1/9				9.0
1/8			8.0	8.0
1/7			7.0	7.0
1/6			6.0	6.0
1/5		5.0	5.0137	5.0709
1/4	4.0	4.0	4.0342	4.3965
3/11				11.0
2/7			7.0	7.0
3/10				10.0
1/3	3.0	3.0082	3.2741	4.3984
3/8				8.0
2/5		5.0	5.0031	5.0206
3/7		7.0	7.0	7.0
4/9				9.0
1/2	2.0094	2.1067	2.8015	3.7490
5/9				9.0
4/7				7.0
3/5			5.0	5.0
5/8			8.0	
2/3		3.0005		
3/4			4.0003	
4/5			5.0	
1	1.0227	1.1162	1.2769	1.2406

Table B-5

Alternative Specifications of Fertility — Child Mortality Regression
Women Aged 20-24

Explanatory Variables	1) C		2) C*		3) C		4) C*		5) C		6) C**		7) C	
	b	t	b	t	b	t	b	t	b	t	b	t	b	t
Intercept	1.240	(4.35)	-.192	(- .70)	1.244	(4.25)	-.193	(- .70)	1.156	(3.98)	-.353	(-1.21)	1.242	(4.24)
DA1	.066	(.44)	.116	(.80)	.018	(.12)	.130	(.90)	.038	(.25)	.031	(.21)	.019	(.13)
DA2	.268	(1.97)	.291	(2.21)	.223	(1.60)	.304	(2.31)	.201	(1.46)	.192	(1.39)	.224	(1.61)
DA3	.411	(3.20)	.440	(3.53)	.416	(3.15)	.439	(3.52)	.412	(3.15)	.411	(3.14)	.416	(3.16)
DA4	.515	(4.14)	.552	(4.58)	.499	(3.91)	.557	(4.62)	.496	(3.92)	.496	(3.91)	.500	(3.93)
DWEDZ	.513	(4.31)	.553	(4.80)	.478	(3.92)	.564	(4.90)	.462	(3.99)	.467	(3.83)	.478	(3.93)
DWED69	-.268	(-2.85)	-.272	(-2.98)	-.283	(-2.93)	-.267	(-2.93)	-.271	(-2.83)	-.275	(-2.87)	-.283	(-.294)
DWED912	-.349	(-2.63)	-.357	(-2.78)	-.361	(-2.65)	-.353	(-2.75)	-.355	(-2.63)	-.358	(-2.65)	-.361	(-2.66)
DWED12U	-.269	(- .99)	-.281	(-1.08)	-.284	(-1.02)	-.277	(-1.06)	-.269	(-1.02)	-.263	(-1.02)	-.284	(-1.03)
DHEDZ	.209	(1.11)	-.013	(- .07)	.384	(2.04)	-.066	(- .37)	.324	(1.72)	.351	(1.86)	.379	(2.00)
DHED69	-.129	(-1.45)	-.141	(-1.63)	-.142	(-1.55)	-.137	(-1.59)	-.131	(-1.45)	-.131	(-1.44)	-.141	(-1.55)
DHED912	.009	(.10)	.008	(.08)	none	none	.010	(.11)	.020	(.20)	.019	(.19)	.000	(.00)
DHED12U	-.134	(- .83)	-.131	(- .84)	-.138	(- .84)	-.130	(- .84)	-.121	(- .74)	-.123	(- .75)	-.137	(-.84)
r	3.152	(4.40)	-.971	(-1.40)	.058	(.29)	-.029	(- .15)						
r^2	-3.574	(-4.48)	1.089	(1.41)										
D									.303	(2.48)	-.075	(- .61)	.039	(.29)
PBBSM1	-.129	(-1.05)	-.136	(-1.14)	-.171	(-1.35)	-.123	(-1.04)	-.167	(-1.34)	-.164	(-1.31)	-.169	(-1.35)
PBBSM2	-.132	(-1.07)	-.139	(-1.17)	-.183	(-1.46)	-.124	(-1.04)	-.185	(-1.48)	-.181	(-1.45)	-.181	(-1.45)
PBBSM3	-.124	(-1.25)	-.107	(-1.12)	-.146	(-1.44)	-.100	(-1.05)	-.154	(-1.54)	-.148	(-1.47)	-.144	(-1.43)
MICR	-.209	(- .15)	-.421	(- .31)	.429	(.30)	-.615	(- .45)	.506	(.36)	.621	(.44)	.420	(.29)
PFAGR	.081	(.18)	-.113	(- .27)	-.095	(- .21)	-.060	(- .14)	.029	(.07)	.042	(.10)	-.089	(-.20)
PPNAG	.341	(.51)	.159	(.25)	.389	(.57)	.144	(.22)	.595	(.88)	.625	(.92)	.390	(.57)
R^2 (F)	.296		.254		.258		.250		.270		.246		(6.93)	

Note: DA1, DA2, DA3 and DA4 are dummy variables with suffixes denoting the deviation of the mother's age from the youngest age in the five-year-age-interval. For example, DA1 has a value 1 in age group 20-24 if the mother's age is 21.

TABLE 8-6

Alternative Specifications of Fertility — Child Mortality Regressions
Women Aged 25-29

	Dependent Variables													
	1) C		2) C*		3) C		4) C*		5) C		6) C**		7) C	
	b	t	b	t	b	t	b	t	b	t	b	t	b	t
Intercept	2.057	(8.30)	-.232	(-.97)	2.034	(7.81)	-.230	(-.96)	2.085	(8.38)	-.230	(-.92)	2.058	(8.17)
DA1	.126	(1.36)	.114	(1.28)	.114	(1.17)	.115	(1.29)	.114	(1.22)	.111	(1.19)	.111	(1.18)
DA2	.258	(2.84)	.273	(3.13)	.269	(2.83)	.272	(3.12)	.253	(2.78)	.248	(2.72)	.258	(2.80)
DA3	.578	(6.25)	.510	(5.74)	.575	(5.92)	.510	(5.74)	.556	(5.99)	.554	(5.96)	.566	(6.01)
DA4	.863	(9.54)	.731	(8.41)	.913	(9.62)	.727	(8.38)	.826	(9.06)	.823	(9.02)	.880	(9.52)
DWEDZ	.034	(.37)	.001	(.01)	.025	(.26)	.002	(.02)	.033	(.35)	.042	(.45)	.035	(.37)
DWED69	-.217	(-2.48)	-.224	(-2.67)	-.249	(-2.71)	-.221	(-2.64)	-.229	(-2.60)	-.227	(-2.59)	-.238	(-2.67)
DWED912	-.195	(-1.51)	-.216	(-1.74)	-.237	(-1.74)	-.213	(-1.71)	-.240	(-1.86)	-.236	(-1.81)	-.221	(-1.68)
DWED12U	-.460	(-2.35)	-.465	(-2.47)	-.533	(-2.60)	-.458	(-2.44)	-.501	(-2.55)	-.502	(-2.56)	-.516	(-2.60)
DHEDZ	.318	(2.28)	.169	(1.26)	.319	(2.18)	.169	(1.26)	.245	(1.75)	.228	(1.62)	.288	(2.03)
DHED69	-.266	(-3.35)	-.284	(-3.72)	-.280	(-3.36)	-.282	(-3.70)	-.285	(-3.57)	-.286	(-3.58)	-.282	(-3.49)
DHED912	-.337	(-3.80)	-.353	(-4.15)	-.356	(-3.83)	-.352	(-4.13)	-.343	(-3.85)	-.346	(-3.88)	-.356	(-3.96)
DHED12U	-.376	(-2.86)	-.364	(-2.88)	-.347	(-2.51)	-.366	(-2.90)	-.343	(-2.59)	-.344	(-2.60)	-.354	(-2.64)
r	5.168	(11.52)	-.209	(-.48)	1.063	(5.30)	.149	(.81)						
r^2	-6.867	(-10.11)	.598	(.92)										
D									.735	(11.07)	.206	(3.11)	.412	(5.48)
PBBSM1	-.117	(-1.10)	-.095	(-.93)	-.091	(- .81)	-.098	(- .96)	-.070	(- .65)	-.075	(- .70)	-.102	(-.95)
PBBSM2	-.075	(- .74)	-.080	(-.82)	-.086	(- .80)	-.079	(-.81)	-.061	(- .60)	-.065	(- .64)	-.088	(-.85)
PBBSM3	-.056	(- .68)	-.041	(-.52)	-.039	(- .45)	-.043	(-.54)	-.033	(- .40)	-.036	(- .43)	-.047	(-.56)
MICR	.705	(.56)	.773	(.64)	1.497	(1.14)	.704	(.59)	.904	(.72)	.895	(.71)	1.322	(1.04)
PPAGR	.661	(1.70)	.512	(1.37)	.627	(1.54)	.515	(1.38)	.548	(1.41)	.533	(1.37)	.596	(1.51)
PPNAG	-.054	(- .09)	-.017	(-.03)	-.151	(- .24)	-.009	(-.02)	-.246	(- .41)	-.245	(- .41)	-.125	(-.21)
R^2 (F)	.343		.212		.275		.211		.337		.248		(20.89)	

Table B-7

Alternative Specifications of Fertility — Child Mortality Regressions
Women Aged 35-39

	Dependent Variables													
	1) C		2) C*		3) C		4) C*		5) C		6) C**		7) C	
	b	t	b	t	b	t	b	t	b	t	b	t	b	t
Intercept	3.195	(9.16)	-1.023	(- 3.21)	3.310	(8.90)	-1.011	(-3.17)	3.447	(10.35)	-1.154	(-3.46)	3.472	(10.1)
DA1	.203	(1.56)	.247	(2.07)	.290	(2.09)	.256	(2.15)	.226	(1.82)	.225	(1.81)	.265	(2.07)
DA2	.362	(2.88)	.258	(2.24)	.511	(3.82)	.274	(2.39)	.434	(3.62)	.435	(3.63)	.465	(3.77)
DA3	.416	(3.01)	.273	(2.16)	.615	(4.21)	.294	(2.35)	.464	(3.53)	.468	(3.56)	.549	(4.06)
DA4	.691	(5.34)	.441	(3.73)	.844	(6.15)	.457	(3.89)	.689	(5.57)	.692	(5.60)	.779	(6.12)
DWEDZ	.207	(1.96)	.054	(.56)	.267	(2.37)	.060	(.62)	.149	(1.47)	.147	(1.45)	.221	(2.12)
DWED69	-.508	(- 3.24)	-.472	(- 3.30)	-.552	(-3.30)	-.477	(-3.33)	-.487	(-3.25)	-.488	(-3.26)	-.514	(-3.33)
DWED912	-.502	(- 2.30)	-.661	(- 3.32)	-.511	(-2.20)	-.662	(-3.33)	-.498	(-2.39)	-.499	(-2.39)	-.525	(-2.45)
DWED12U	-.090	(- .16)	-.382	(- .76)	-.106	(- .18)	-.384	(- .76)	-.091	(- .17)	-.093	(- .18)	-.164	(-.30)
DHEDZ	.201	(1.43)	.076	(.59)	.295	(1.96)	.086	(.67)	.251	(1.86)	.255	(1.89)	.261	(1.89)
DHED69	-.054	(- .44)	-.084	(- .75)	.006	(.04)	-.077	(- .69)	.047	(.41)	.047	(.41)	-.012	(-.09)
DHED912	-.164	(- 1.29)	-.031	(- .27)	-.125	(- .93)	-.027	(- .23)	-.106	(- .88)	-.104	(- .86)	-.137	(-1.10)
DHED12U	-.202	(- 1.06)	-.039	(- .23)	-.172	(- .84)	-.036	(- .21)	-.063	(- .34)	-.064	(- .35)	-.165	(-.88)
Y	8.076	(14.75)	1.863	(3.73)	2.519	(8.31)	1.270	(4.89)						
Y^2	-11.151	(-11.87)	-1.190	(- 1.39)										
PBBSM1	-.392	(- 2.32)	-.275	(- 1.79)	-.508	(-2.83)	-.287	(-1.87)	.876	(18.27)	.278	(5.79)	.514	(9.01)
PBBSM2	-.388	(- 2.33)	-.328	(- 2.16)	-.430	(-2.42)	-.332	(-2.19)	-.381	(-2.36)	-.380	(-2.36)	-.428	(-2.59)
PBBSM3	-.226	(- 1.79)	-.164	(- 1.42)	-.277	(-2.06)	-.170	(-1.47)	-.313	(-1.97)	-.314	(-1.97)	-.385	(-2.35)
HICR	3.141	(1.81)	1.279	(.81)	3.058	(1.65)	1.270	(.80)	-.195	(-1.61)	-.195	(-1.61)	-.243	(-1.95)
PPAGR	2.729	(4.72)	2.141	(4.06)	2.607	(4.23)	2.128	(4.03)	1.688	(1.01)	1.669	(1.00)	2.477	(1.45)
PPNAG	2.001	(2.26)	1.649	(2.04)	1.778	(1.88)	1.625	(2.01)	2.397	(4.34)	2.390	(4.32)	2.442	(4.30)
									1.055	(1.24)	1.044	(1.23)	1.401	(1.61)
R^2 (F)	.365		.167		.277		.166		.418		.243		(24.46)	

Table B-8

Alternative Specifications of Fertility — Child Mortality Regressions

Women Aged 40-44

Dependent Variables

	1) C		2) C*		3) C		4) C*		5) C		6) C**		7) C	
	b	t	b	t	b	t	b	t	b	t	b	t	b	t
Intercept	4.670	(8.63)	-.367	(-.77)	5.089	(9.08)	-.451	(-.95)	5.149	(10.34)	-.066	(-.13)	5.173	(10.1)
DA1	.097	(.52)	-.001	(-.0)	.028	(.14)	.013	(.08)	-.012	(-.07)	-.001	(-.01)	.010	(.05)
DA2	.223	(1.15)	.225	(1.32)	.228	(1.13)	.224	(1.31)	.232	(1.30)	.234	(1.31)	.229	(1.24)
DA3	.488	(2.47)	.281	(1.62)	.401	(1.95)	.298	(1.72)	.390	(2.14)	.396	(2.17)	.414	(2.20)
DA4	.342	(1.78)	.202	(1.20)	.337	(1.69)	.203	(1.20)	.348	(1.96)	.344	(1.94)	.353	(1.92)
DWEDZ	.424	(2.66)	.177	(1.26)	.393	(2.36)	.184	(1.30)	.321	(2.17)	.321	(2.17)	.369	(2.42)
DWED69	.047	(.17)	-.068	(-.27)	.107	(.36)	-.080	(-.32)	.114	(.44)	.115	(.44)	.070	(.26)
DWED912	-.993	(-2.71)	-.795	(-2.47)	-.965	(-2.53)	-.800	(-2.48)	-.898	(-2.65)	-.891	(-2.63)	-.939	(-2.68)
DWED12U	-.975	(-1.38)	-.952	(-1.53)	-1.054	(-1.43)	-.936	(-1.50)	-.917	(-1.40)	-.897	(-1.37)	-1.032	(-1.53)
DHEDZ	.105	(.62)	.245	(1.64)	.141	(.80)	.238	(1.59)	.067	(.43)	.067	(.43)	.118	(.729)
DHED69	-.371	(-1.94)	-.193	(-1.14)	-.436	(-2.18)	-.180	(-1.06)	-.302	(-1.70)	-.294	(-1.65)	-.401	(-2.16)
DHED912	-.308	(-1.41)	-.197	(-1.02)	-.429	(-1.89)	-.172	(-.90)	-.204	(-1.01)	-.195	(-.97)	-.385	(-1.85)
DHED12U	-.136	(-.43)	-.040	(-.14)	-.258	(-.78)	-.016	(-.06)	-.062	(-.21)	-.047	(-.16)	-.244	(-.80)
r_2	8.891	(10.63)	.136	(.18)	2.849	(7.36)	1.350	(4.11)						
r^2	-12.00	(-8.07)	2.411	(1.84)										
D									.816	(16.45)	.103	(2.09)	.460	(8.01)
PBBSM1	-.043	(-.17)	.019	(.09)	-.168	(-.64)	.044	(.20)	-.096	(-.41)	-.092	(-.40)	-.108	(-.45)
PBBSM2	-.464	(-1.82)	-.133	(-.59)	-.449	(-1.69)	-.136	(-.60)	-.362	(-1.54)	-.367	(-1.56)	-.368	(-1.51)
PBBSM3	-.419	(-2.16)	-.137	(-.80)	-.435	(-2.15)	-.134	(-.78)	-.420	(-2.35)	-.421	(-2.35)	-.385	(-2.08)
NICR	.373	(.14)	-1.100	(-.46)	-.407	(-.14)	-.943	(-.39)	-3.194	(-1.27)	-3.003	(-1.19)	-1.266	(-.48)
PPAGR	1.987	(2.30)	1.746	(2.30)	2.192	(2.44)	1.705	(2.24)	1.960	(2.46)	1.932	(2.42)	2.129	(2.58)
PPNAG	-.076	(- .06)	-.414	(-.36)	-.108	(-.08)	-.408	(-.36)	-.661	(-.55)	-.665	(-.55)	-.229	(.19)
R^2 (F)	.311		.151		.251		148		.409		.174		(15.92)	

Table B-9

Alternative Specifications of Fertility — Child Mortality Regressions
Women Aged 45-49

	Dependent Variables													
	1) C		2) C*		3) C		4) C*		5) C		6) C**		7) C	
	b	t	b	t	b	t	b	t	b	t	b	t	b	t
Intercept	6.318	(7.92)	.673	(.99)	7.521	(8.75)	.730	(1.08)	7.214	(10.11)	1.991	(2.80)	7.322	(9.53)
DA1	-.082	(-.30)	-.002	(-.01)	.071	(.24)	.006	(.02)	.186	(.75)	-.137	(.55)	.093	(.35)
DA2	-.046	(-.16)	-.302	(-1.25)	.052	(.17)	-.297	(-1.24)	.154	(.61)	.132	(.52)	.043	(.16)
DA3	.165	(.56)	-.255	(-1.01)	.229	(.71)	-.252	(-1.00)	.254	(.95)	.209	(.79)	.228	(.80)
DA4	-.226	(-.80)	-.303	(-1.26)	-.160	(-.52)	-.300	(-1.25)	-.387	(-1.53)	-.430	(-1.70)	-.156	(-.57)
DWEDZ	.245	(1.01)	.395	(1.91)	.186	(.71)	.392	(1.90)	-.059	(-.27)	-.070	(- .32)	.188	(.80)
DWED69	.055	(.11)	.133	(.30)	.019	(.03)	.131	(.30)	-.078	(-.17)	-.100	(- .22)	.045	(.09)
DWED912	-.004	(-.01)	.168	(.36)	-.015	(-.02)	.167	(.36)	-.059	(-.12)	-.062	(- .13)	-.031	(-.06)
DWED12U	-.888	(-.70)	-.603	(-.56)	-.683	(-.50)	-.594	(-.55)	-.718	(-.63)	-.798	(- .70)	-.657	(-.53)
DHEDZ	-.393	(-1.75)	-.300	(-1.57)	-.423	(-1.73)	-.301	(-1.57)	-.478	(-2.36)	-.489	(-2.42)	-.409	(-1.87)
DHED69	-1.206	(-3.99)	-.582	(-2.25)	-1.278	(-3.88)	-.585	(-2.26)	-1.088	(-3.98)	-1.121	(-4.11)	-1.138	(-3.86)
DHED912	-.341	(-.85)	.108	(.32)	-.303	(-.69)	.110	(.32)	-.224	(-.62)	-.239	(- .66)	.273	(-.69)
DHED12U	-.973	(-1.99)	-.509	(-1.22)	-1.236	(-2.32)	-.521	(-1.25)	-.802	(-1.81)	-.798	(-1.81)	1.093	(-2.29)
r_2	11.996	(11.30)	1.421	(1.56)	2.576	(4.98)	.977	(2.41)						
r^2	-15.293	(-9.91)	-.721	(-.55)										
D														
PBBSM1	-.435	(-1.13)	-.317	(-.96)	-.451	(-1.07)	-.317	(-.96)	.931	(16.41)	.060	(1.07)	.414	(5.57)
PBBSM2	-.192	(-.54)	-.158	(-.52)	-.248	(-.64)	-.160	(-.53)	-.212	(-.61)	-.230	(- .66)	-.344	(-.91)
PBBSM3	-.832	(-2.83)	-.463	(-1.84)	-1.034	(-3.23)	-.472	(-1.88)	-.280	(-.88)	-.270	(- .85)	-.229	(-.66)
MICR	-1.854	(-.47)	-1.052	(-.31)	-3.377	(-.78)	-1.124	(-.33)	-.790	(-2.98)	-.798	(-3.01)	-.891	(-3.12)
PPAGR	-.360	(-.28)	-.292	(-.27)	-1.131	(-.81)	-.328	(-.30)	-5.778	(-1.61)	-5.593	(-1.56)	-3.423	(-.88)
PPNAG	-1.078	(-.56)	-1.822	(-1.11)	-2.173	(-1.04)	-1.874	(-1.15)	-1.012	(- .87)	-1.107	(- .96)	-.819	(-.66)
									-3.269	(-1.89)	-3.247	(-1.88)	2.174	(1.17)
R^2 (F)	.272		.084		.133		.083		.402		.101		(5.42)	

39

Table B-10

Reduced Form Regressions of the Duration of Marriage Equation

by Age Group of Mothers

Explanat	Age Group of Mothers						
	20-24	25-29	30-34	35-39	40-44	45-49	50-54
MICR	6.39	8.46	12.2	3.76	2.15	8.47	14.[illegible]
	(1.73)	(2.61)	(3.70)	(2.98)	([illegible]55)	(2.40)	(3.60)
r	-.194	.851	.755	.329	1.63	.513	-.0684
	(.39)	(1.71)	(1.53)	(.68)	(3.06)	(1.22)	(.15)
DA1	.247	.499	1.11	1.84	1.32	1.29	1.31
	(.64)	(2.06)	(4.72)	(8.35)	(4.90)	(5.31)	(5.06)
DA2	.811	1.11	2.19	2.92	2.28	1.49	1.73
	(2.33)	(4.70)	(9.73)	(13.8)	(8.27)	(5.97)	(6.38)
DA3	1.32	1.76	3.21	4.28	3.84	3.57	3.25
	(3.99)	(7.34)	(14.1)	(18.5)	(13.6)	(9.87)	(11.8)
DA4	2.02	3.28	4.41	5.51	4.66	4.10	3.93
	(6.33)	(13.9)	(19.5)	(25.3)	(17.0)	(16.5)	(13.1)
DWEDZ	.931	.844	.324	.441	.491	.773	-.0032
	(3.05)	(3.52)	(1.63)	(2.46)	(2.15)	(3.61)	(.02)
DWED69	-.567	-.753	-.720	-.527	-.182	.089	-.246
	(2.34)	(3.31)	(2.88)	(1.99)	(.45)	(.19)	(.31)
DWED912	-.570	-.658	-1.94	-1.36	-1.20	-1.23	-1.69
	(1.67)	(1.95)	(5.83)	(3.68)	(2.29)	(2.55)	(2.11)
DWED12U	-.958	-1.78	-2.83	-.644	-3.25	-5.98	-3.24
	(1.38)	(3.50)	(4.66)	(.69)	(3.22)	(5.35)	(2.43)
DHEDZ	1.24	.224	.479	.603	.485	.480	.535
	(2.63)	(.62)	(1.64)	(2.53)	(2.01)	(2.42)	(2.49)
DHED69	-.496	-.725	-.658	-.571	-.467	-.449	-.342
	(2.18)	(3.30)	(3.05)	(2.77)	(1.71)	(1.67)	(.95)
DHED912	-.358	-.950	-1.04	-.874	-.892	-.015	-.220
	(1.42)	(4.12)	(4.82)	(4.08)	(2.87)	(.04)	(.53)
DHED12U	-.802	1.53	-1.14	-1.61	-.754	-.788	-.358
	(1.95)	(4.47)	(3.67)	(4.97)	(1.66)	(1.82)	(.53)
PBBSM1	-.241	-.105	.400	-.849	-1.14	-1.08	-.228
	(.76)	(.38)	(1.41)	(2.98)	(2.19)	(3.16)	(.52)
PBBSM2	-.540	-.363	.723	-1.27	-.803	-.243	-.555
	(1.71)	(1.37)	(2.59)	(-4.52)	(2.21)	(2.69)	(1.05)
PBBSM3	.458	-.346	-.406	-.156	-.949	-.248	-.0691
	(.80)	(1.61)	(1.89)	(.73)	(3.42)	(.95)	(.21)
PPAGR	.06	1.41	-.165	.238	.515	-.352	2.15
	(.95)	(1.39)	(.18)	(.24)	(.42)	(.32)	(1.71)
PPNAG	.979	1.51	-1.23	-.167	-2.38	1.32	2.64
	(.57)	(.98)	(.82)	(.11)	(1.29)	(.78)	(1.33)
Intercept	.72	4.23	9.13	14.70	21.51	26.71	30.92
R^2	.3061	.3654	.4646	.5432	.4619	.5271	.4938
Mean Dependent Variable	18	6.19	11.57	17.91	24.39	29.99	35.27
Mean Age at Marriage	.3	21.3	20.9	19.6	18.2	17.5	17.3
Sample Size		1001	1132	1048	779	338	387

[a]See Table A-1 for variable definitions.