Demand or Ideation? Evidence from the Iranian Marital Fertility Decline [1]

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Abstract

Is the onset of fertility decline caused by structural socioeconomic changes, as affirmed by demand theory, or by the transmission of new ideas, as argued by ideation theory? The marital fertility decline in Iran before the Islamic Revolution provides an ideal, quasi-experimental, setting for addressing this question. Massive economic growth started around 1955, while big measurable ideational changes (the establishment of an aggressive official Family Planning Program and large improvements in the legal status of women) took place in 1967. The 1977 Iran Fertility Survey was carried out at just the right moment to separate these effects.

We argue that the Iranian marital fertility decline is better described by demand theory than by ideation theory. The decline started in 1959, just after the onset of massive economic growth, but well before the ideational changes. The decline closely paralleled the rapid growth of primary educational participation, as predicted by demand theory, and we found no evidence that the 1967 events had any effect on the decline, contrary to ideation theory. It was largely an urban decline, amounting to about four children per married woman in Tehran and somewhat less in smaller cities. It consisted mainly of increased spacing of births of all orders rather than of parity-specific stopping. More than one-quarter of the decline can be attributed to the reduction in child mortality, one of the key mechanisms of demand theory.

Several other findings support this main conclusion. The fertility decline was a period effect and not a cohort effect. It affected women of all educational levels equally, but it was greater among women whose husbands were more educated. This agrees with demand theory: families with better educated husbands also have higher socioeconomic standing and so participate more fully in modernization, hence having a greater fertility decline.

Why did the Family Planning Program not accelerate the fertility decline? This program emphasized the pill, and our data provide some clues that the decline was due in part to increased use of withdrawal rather than more modern methods.

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Introduction

What causes the onset of fertility decline? Traditional demographic transition theory, or demand theory, says that it is economic development and the resulting social modernization (Thompson, 1929; Notestein, 1945; Davis, 1945, 1963; Becker 1960, 1965, 1981; Schultz, 1969, 1976). In perhaps its most developed form (Easterlin, 1975; Easterlin and Crimmins, 1985), this theory says that actual fertility is influenced by the demand for children, the supply of children, and the cost of regulation.

The demand for children is a function of the cost of children (which increases with the amount of formal education they receive, the extent to which women work outside the home, and the opportunity cost in terms of other ways of spending money) and the benefits from children (which increase with the extent to which children work). The supply of children is a function of child mortality and is also affected by age at marriage and breastfeeding. The cost of regulation depends on the availability, cost, convenience and knowledge of contraception, as well as the psychic cost of using it. Economic development and social modernization raise the costs and lower the benefits of children, thus leading to reduced demand for children and hence fertility decline.

Doubt was cast on demand theory by the European Fertility Project (Coale and Watkins, 1986), which showed that the fertility decline in most European countries started at about the same time but under different economic and social conditions, that there were sharp differences across ethnic and linguistic barriers within the same country (e.g. in Belgium), and that most English-speaking countries followed similar patterns of fertility decline. This led several authors to postulate that fertility decline is produced by the diffusion of new ideas and knowledge about fertility regulation, rather than by changes in socioeconomic factors, a hypothesis that we will call ideation theory (Knodel and van de Walle, 1979; Freedman, 1979; Cleland and Wilson, 1987).

There are also difficulties with ideation theory, however. It is not as precisely formulated as demand theory, and so it is harder to test it in the usual way, by using it to generate predictions that can be compared with data. Also, there has been little direct observation of the diffusion of ideas and information about fertility control and of how this affects fertility behavior.

Much of the evidence for ideation theory consists of examples from different countries, but there are also counter-arguments. For example, the fact that fertility decline followed ethnic lines in some countries could be due to ethnic stratification rather than to the diffusion of ideas: demand theory would predict earlier declines for dominant ethnic groups. This may explain what happened in Belgium, where the dominant Walloons had an earlier decline than the subordinate Flemish (Lesthaeghe, 1977). Also, while the English-speaking peoples had similar patterns of fertility decline everywhere that they were dominant, the subordinate Irish had a much later decline (Knodel and van de Walle, 1979). The pattern of fertility decline among the French-speaking peoples also seems to have varied with their status. In Québec, and Canada generally, the French were subordinate and had a later decline than their English-speaking neighbors (Henripin and Péron, 1972; Lachapelle and Henripin, 1982), while in Belgium, the French were dominant and had a faster decline than the subordinate Flemish.

One influential version of the ideational hypothesis is due to Lesthaeghe (1983) who says that "a cost-benefit paradigm is necessary but not sufficient" and "should be complemented by an attempt to link the outcome of choice to alterations in ideational components as well." A major difficulty with testing hypotheses that might be formulated on the basis of this is that changes in the cost-benefit calculus tend to occur at about the same time as ideational changes and to be highly correlated with them in cross-sectional data, as Lesthaeghe's own factor analysis shows. His cross-sectional analysis of the 1963–70 decline in West European marital fertility does not show that the cost-benefit paradigm is insufficient on its own (Lesthaeghe, 1983:415). Indeed, fertility decline in Belgium, his leading case, was more correlated with economic than with ideational indicators (Lesthaeghe, 1983: Table 12).

In Lesthaeghe (1992) he further developed his arguments, but his statistical results were based on zero-order correlations and so did not establish that ideational factors have effects once economic ones are controlled for. In any event, his analyses suggest that the economic factors were more important. A cross-sectional analysis of nineteenth-century fertility decline in 600 districts of England and Wales concluded that cultural variables had no explanatory power once the standard macro-economic variables of traditional demographic transition theory had been controlled for (Friedlander, 1983; Friedlander, Schellekens and Ben-Moshe, 1991).

Detailed longitudinal studies which use time-ordering and individual data to separate socioeconomic from ideational effects provide a better way of comparing the two theories than aggregate cross-sectional studies. The former have been hard to carry out, however, because development and ideational changes tend to accompany one another. The period 1950–1977 in Iran constitutes a rare quasi-experiment which does allow this separation. Iran's economy grew very fast from about 1955, while in 1967, 12 years later, there were major measurable ideational changes, namely the establishment of an aggressive official Family Planning Program and the passing of the Family Protection Act, which greatly improved the status of women. The 1977 Iran Fertility Survey (IFS) was carried out at just the right moment to separate the effects of these two sets of changes.

Several other questions are of interest in their own right and are also related to the basic issue that we have just discussed. Is fertility decline a period effect or a cohort effect (or both)? If it is a period effect, then it affects childbearing women of all ages equally. If it is a cohort effect, then it affects only younger women at first, after which overall fertility declines as the affected cohorts make up a greater proportion of all women of childbearing age. Demand theory says that fertility decisions are determined by the costs and benefits faced by couples at the time the decisions are made, and so implies that fertility decline is a period effect. It is less clear what ideation theory implies, but cohorts tend to be marked for life by the ideas prevalent in their youth (Ryder, 1965), so that ideation theory would seem likely to imply that fertility decline is, at least in part, a cohort effect.

It is well established that urban women tend to have fewer children than rural women (Hobcraft, 1987). But is the fertility of migrants from rural to urban areas determined by their childhood (rural) residence, their current (urban) residence, or something in between? Previous studies with World Fertility Survey data have tended to use place of childhood residence to predict fertility (e.g. Entwisle and Mason, 1985). By arguments similar to those in the discussion of period and cohort effects, demand theory implies that fertility behavior is influenced by place of current residence rather than place of childhood residence, while ideation theory is likely to imply that place of childhood residence is an important predictor (perhaps as well as place of current residence).

It has been argued that both demand and ideation theories predict that a higher status of women leads to reduced fertility. Demand theory is formulated in terms of a household that balances costs and benefits, but the husband and wife may well perceive these costs and benefits differently, so that their relative weight in making decisions is important. The higher the status of the woman, the greater her weight in decision-making. Since women bear most of the physical burden and risk of childbearing, it has been common to assume that women look for a reduction in the number of pregnancies. Mason (1984) discussed some of the ways in which higher status of women could depress fertility, including that of giving women more power to achieve their (allegedly) lower fertility goals. However, Mason and Taj (1987), in an exhaustive review of published studies, found no evidence of systematic differences in average fertility goals between men and women.

Modernization may reduce fertility even if the mechanisms postulated by demand theory do not work. It is well established that more educated women tend to have less children (Cleland and Rodriguez, 1988), as do more urban women. Modernization tends to increase the proportion of more educated women and of urban women in the population, and thus to reduce fertility; we call this the compositional effect. Do these effects account for the entire fertility decline? If not, how much of it do they explain?

And finally, did the decline consist mainly of increased inter-birth spacing or of stopping after a certain number of births?

Background: Iran to 1977

The period up to 1977 in Iran is ideal for determining whether the onset of fertility decline was due to economic development or to large and measurable ideational changes in the form of an aggressive official Family Planning Program and laws that greatly improved the status of women. Rapid economic development started around 1955, while the ideational changes occurred in 1967; thus the timing of the onset of fertility decline enables us to compare the two competing theories. The 1977 IFS is of high enough quality and has enough detail to give a good estimate of the time at which fertility decline started.

The Pahlavi period in Iran started in 1925 with the coronation of Reza Shah Pahlavi as the ruler of a traditional and economically developing nation. The ensuing half-century saw a sustained effort to modernize and westernize Iran by government fiat. Until Reza Shah abdicated in 1941 and was succeeded by his son, this process was relatively gradual, and it was largely halted and even reversed in the first years of his son's reign. It resumed in the early 1950s and was accelerated by the Shah's "White Revolution" in 1963, ending with the Islamic Revolution in 1978-79 (Ebrahamian, 1982).

Most of the postwar period was characterized by rapid economic growth fueled by oil exports, and by rapid modernization imposed from above. Figure 1 gives some idea of the evolution of the Iranian economy during the period being studied. Oil production is shown in Figure 1(a) because this was the key motor of the economy. It grew steadily during the first half of the century, but the really dramatic growth started only in 1955; by 1974 oil production had reached ten times the highest pre-1955 figure. This was a major factor in the massive economic growth shown in Figure 1(b); total economic activity increased by a factor of four in half a generation.

Overall educational participation increased rapidly in Iran during the Pahlavi period.

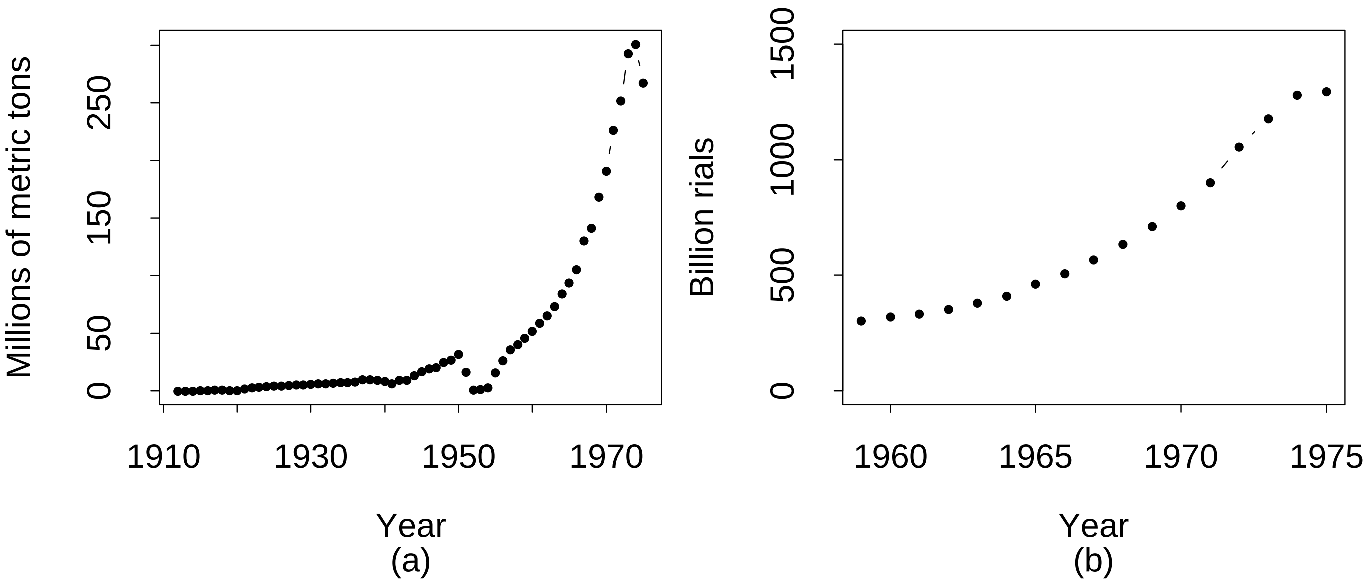

Figure 1: (a) Iranian output of crude petroleum, 1912-1975. (b) Iranian Gross Domestic Product at constant 1959 prices, 1959-1975. Source: Mitchell (1982).

Figure 2 shows the evolution of approximate participation rates according to aggregate official statistics, while Figure 3 shows the participation rates for the women in our sample, by cohort.

By and large, educational expansion paralleled the oil-fired economic growth that started in 1955. In the following 20 years, primary enrollments went up by a factor of five, second level enrollments by a factor of 14, and higher education enrollments by a factor of 10. Primary participation went from about a quarter in 1955 to 80% in 1975, so that near-universal primary education was one of the achievements of the period. Second level participation went from under one in ten to nearly half, while higher education participation was still low in 1975, even though it had increased from 1% to 7% in the twenty years.

Several political and legal changes aimed at improving the status of women were implemented during the period of our study. Prior to 1936, women played no economic role outside the home, had no access to education and were segregated. In 1936, Reza Shah introduced laws to prohibit the veiling of women and their segregation, but these met with much resistance and did not continue. However, his efforts toward establishing public education for girls and coeducation at the universities were successful. In 1963 women got the vote, and in 1967 the Family Protection Act was passed. This gave women greater equality in marriage, divorce and child custody, increased the legal age of marriage for women to 18, and banned

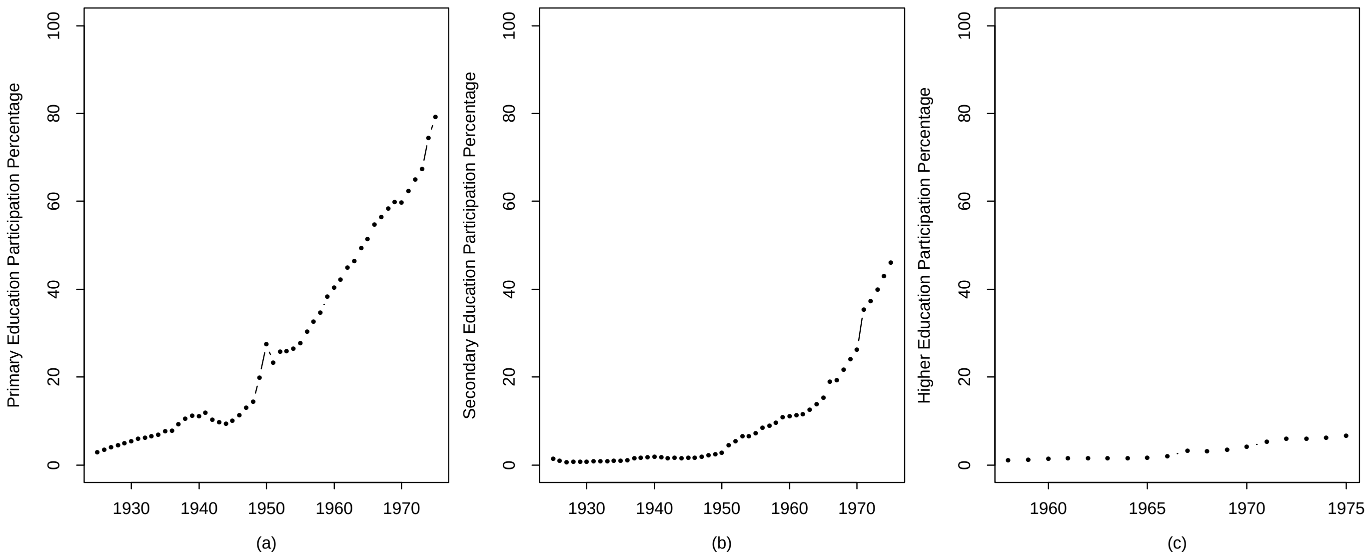

Figure 2: Overall educational participation in Iran, 1925-1975: (a) Primary; (b) Secondary; (c) Higher education. Source: Mitchell (1982).

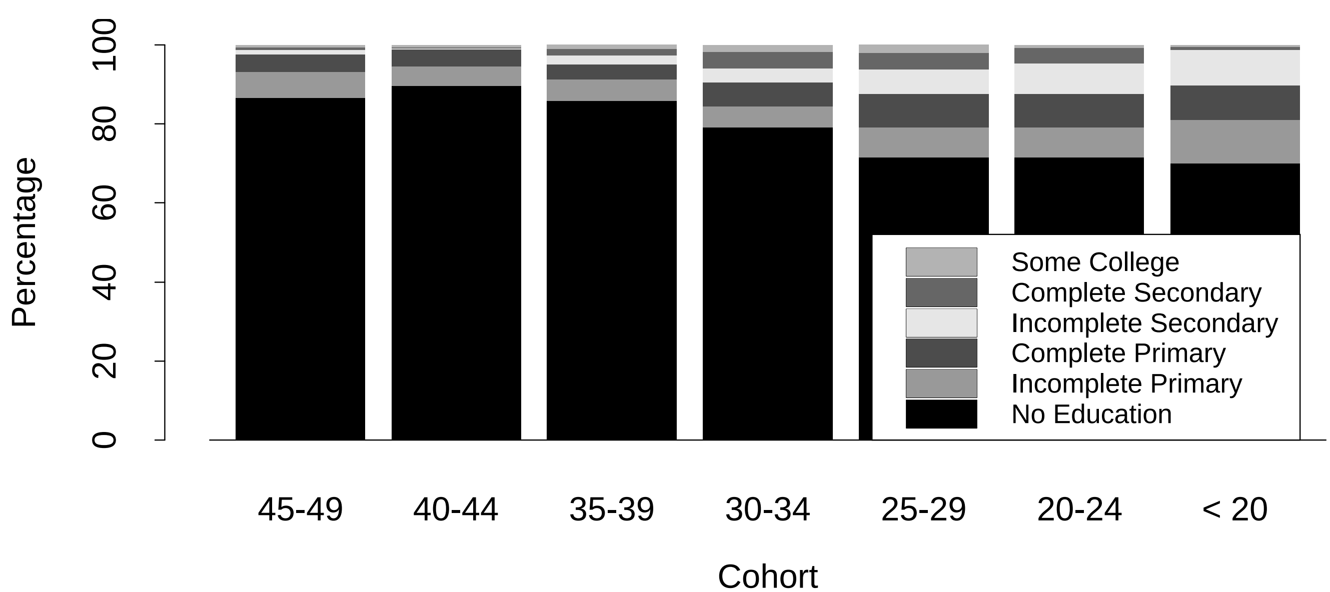

Figure 3: Composition of our sample in terms of educational attainment, by cohort.

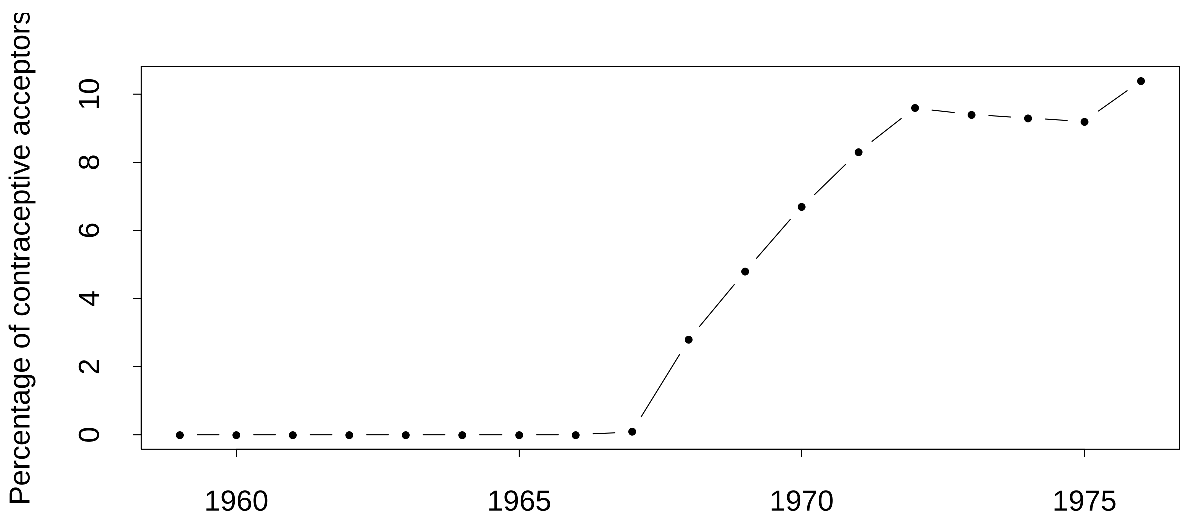

Figure 4: Percentage of women using contraceptives. Source: Nortman and Hofstatter (1978).

polygyny without the wife's permission. In 1967 an official Family Planning Program was established and the proportion of women using contraceptives rose from almost nothing in 1967 to a substantial proportion in 1977; see Figure 4[1] and Table 4.

Figure 5 shows the trend in infant mortality from 1956 to 1976 in our data. While still high in 1976, at 117 per 1000, this had declined from 300 per 1000 in 1956. Demand theory predicts that this reduction in infant mortality would have led to a reduction in marital fertility. Our analysis below shows this to have been the case, and quantifies its extent.

Data

Our analysis is based on data from the IFS which was carried out in 1977 as part of the World Fertility Survey (WFS). It consists of the full fertility histories of a sample of married women of whom the oldest were born in 1926; our data thus covers the Pahlavi period almost exactly. It was not fully analyzed at the time it was collected because of the revolutionary situation in Iran.

[1] According to Nortman and Hofstatter (1978), the proportion of "acceptors" had reached 11% in 1977, based on official statistics. According to our own data, the number was somewhat higher, with 19% of respondents reporting current use of the pill and 25% reporting current use of any type of modern contraceptive in 1977 (Aghajanian, 1992). This discrepancy is not too surprising, since one would expect any official count to miss users.

Figure 5: Infant mortality in Iran, 1956-1976, from our data. Source: Aghajanian, Gross and Lewis (1993).

The IFS was based on a nationally representative sample of ever-married women aged less than 50. Based on a multistage random sampling procedure, 6,056 households were visited and all ever-married women who were less than 50 years old were interviewed. This procedure resulted in interviews with a total of 4,932 women. There were 42 nonresponses for an effective sample size of 4,890. There was a total of 16,997 births in 77,088 ever-married-woman-years for parities 1 and above. Here we focus on marital fertility, starting with the time of first birth.

In general it seems reasonable to expect high quality data from the IFS. However, in data collection in a developing country with a low female literacy rate, errors in the dates of events and the number of children ever born are to be expected. Estimates of the levels and trends of fertility depend on the extent to which women forget to mention births, misreport the dates of births or misreport their own ages.

The quality of the IFS has been comprehensively assessed by Aghajanian, Gross and Lewis (1993), who conclude that the survey data are of good quality, at least as good and in many respects better than that of WFS data from comparable countries. Trussell (1984) indicated that the errors present in WFS data of this quality do not change the substantive conclusions from complex regression analyses. The single biggest problem is that, while respondents were asked both the month and the year in which each event occurred, the month was missing in a majority of cases, and so we have worked only with the year of occurrence. Otherwise there were few missing data. We have excluded those women who had missing data on any of the quantities of interest to us here; for parities two and above, this led to the exclusion of only 8% of the intervals. The amount of missing data is small and our analysis shows no systematic differences between women with and without missing data.

Methods

Discrete Event History Analysis

Our data are in the form of event histories and so event history analysis (e.g. Tuma and Hannan, 1984) is the method of choice. We are working with discretized data which include only the calendar year of each event, and so we used a discrete-time event history analysis method (Allison, 1984). In this approach, each woman-year of exposure is treated as a separate case, with the response being the occurrence or not of an event in that year; the baseline hazard rate and the effects of covariates are modeled by logistic regression. Here we describe our models briefly; a fuller description of the methods is given in Raftery, Lewis, Aghajanian and Kahn (1993).

The resulting data set was modeled by the logistic regression model

$$\begin{aligned} \text{logit}(\pi_{iky}) &= \log\left(\frac{\pi_{iky}}{1-\pi_{iky}}\right) \\ &= \beta_0 + \sum_{j=1}^{p} \beta_j x_{jiky}, \end{aligned} \tag{1}$$

where x_{jiky} is the jth covariate for the ith woman at parity k in calendar year y, and $\beta_0, \beta_1, \ldots, \beta_p$ are unknown regression coefficients. This model was estimated by maximum likelihood. The covariates considered for inclusion in equation (1) include functions of age, duration t, parity k, birth cohort, calendar year y (i.e. period), and individual characteristics of the woman such as her education and that of her husband, where she grew up and where she lived at the time of interview, and her age at marriage. We therefore had the classic demographic problem of modeling age, period and cohort, with, in addition, duration and parity. Thus there are, in a sense, five clocks running simultaneously. We dealt with this by exploiting the longitudinal nature of the data, and also by modeling these effects parametrically whenever it made theoretical sense and was well supported by the data. This broke the formal identities that can make estimation impossible.

Figure 6: Estimated fertility rates with fitted logistic-quadratic curve.

There is a clear pattern to the relationship between fertility and age, with a rapid increase followed by a more gradual decrease; it makes sense to represent it in a parametric form if this is well supported by the data. To do so, we calculated the number of woman-years and the number of births to women of that age in our data set for each year of age below 50. Dividing the number of births by the number of woman-years gives an estimate of the average age-specific marital fertility. This is well fit by a logit-quadratic polynomial function of age, namely

$$\text{logit(fertility)} = \gamma_0 + \gamma_1 a + \gamma_2 a^2 \quad (R^2 = 0.94), \tag{2}$$

where $a = (\text{age} - 31)/10$. The parameters γ_0, γ_1 and γ_2 are estimated by including a and a^2 as independent variables in the model (1). The raw estimated fertility rates are shown together with the fitted curve given by equation (2) in Figure 6. The good fit of the curve is clear.

We also modeled the effect of duration t parametrically. We calculated the average fertility rate by duration t, using the method just described for age (but using only parities 2 and higher). For durations 3 and higher, the fertility rate declines almost exactly exponentially ($R^2 = .99$ in a weighted logarithmic regression). We therefore coded duration using four covariates: one dummy variable each for durations $t = 0$, 1 and 2, and one further variable equal to

$$\begin{cases} 0 & \text{if } t = 0, 1, 2 \\ \text{logit}(ab^t) & \text{if } t \geq 3, \end{cases} \tag{3}$$

where $a = 0.726$ and $b = 0.795$.

Parity is coded linearly as the number of previous births.[2] Cohort was coded in 5-year age groups, 15–19, 20–24, ..., 45–49. Initially, period was coded as in Table 3, with dummy variables for periods chosen so as to make the standard errors similar. Later, for exploratory purposes, period was coded with a dummy variable for each year, and finally, models were fit in which the period effect was modeled parametrically.[3] Child mortality is measured as 0 if the previous child had died by the time of the survey, and 1 if not.[4]

Several of the independent variables considered are categorical but ordered; these include educational attainment and size of place of current residence. One possibility is to code these as sets of dummy variables, but this is often unparsimonious and computationally expensive. Instead we searched for transformations of the variables that were theoretically meaningful and well supported by the data, as follows. We carried out ordinary least squares linear regression with each birth as a case. The length of the interval ending in that birth was the dependent variable, and the independent variables were the same as those in equation (1), with the exception of duration; calendar year was coded as the year at the beginning of the interval. The variables were not, however, coded linearly. Rather, the ACE technique (Breiman and Friedman, 1985; see DeVeaux, 1989, for an exposition) was used to find the monotonic (nonparametric) transformation of each variable that made the regression as linear as possible. The results were used to suggest theoretically meaningful *parametric* transformations for use in equation (1).

Educational attainment is coded in six categories: none (0), incomplete primary (1), complete primary (2), incomplete second level (3), complete second level (4), and higher (5). The ACE transformation of the respondent's education indicated that the effect was linear

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[2]We also fitted models that coded parity as a set of dummy variables, but the linear coding accounts for most of the variability and fits much better according to BIC. The one difference relates to parity 1, and we dealt with this by including a dummy variable for parity 1.

[3]Our data were in terms of the Iranian calendar, which runs from March 21 to March 20, and differs by 621 years from the Western calendar. Thus, for example, when we refer to the year 1970, we mean Iranian year 1349, which actually went from March 21, 1970 to March 20, 1971. In all our parametrizations of the period effect, there was a dummy variable for 1977, included because only part of this year was observed.

[4]We also fitted models in which child mortality was measured as 0 if the previous child had died before the next child was born, as reported by the mother. However, these models fitted less well and indicated a smaller (although still large) effect of child mortality. We interpreted this as indicating that there were substantial errors in the reported *time* of death of children, but that *whether* or not they had died was accurately reported, and so we used the latter as our measure.

Table 1: Means and standard deviations for variables in the study.

variable	*mean*	*standard deviation*
Year of birth	1945	9.6
Size of place of residence	1.2	1.6
Woman's education	0.5	1.1
Husband's education	0.9	1.3
Place of childhood residence	1.7	0.5

when coded this way and so no transformation was needed. Husband's education was coded in the same way as wife's education.

Size of place of residence was originally coded in eight categories ranging from the largest, Tehran (1), to isolated farm dwellings (8). The ACE transformation was fairly linear between 1 and 5, but there was almost no change between 5 and 8. Categories 6–8 are all rural, while category 5 consists of small towns. We amalgamated categories 5–8 to form a single category. This indicates that there were no systematic differences in marital fertility between rural and small town residents in terms of the size of their place of residence, but that for city dwellers the size of the place where they live did have an effect. Finally, we coded the resulting five categories as follows: rural (0), small towns (1), cities below 100,000 (2), cities above 100,000 (3) and Tehran (4). In this way, rural women constitute a baseline from which differences are measured. Place of childhood residence was coded in two categories: city (1) and village (2).

Descriptive statistics for some of the key variables are shown in Table 1.

We based model comparison on the BIC statistic (Raftery, 1986a, b), in the form

$$BIC = -\chi^2 + p \log n, \tag{4}$$

where χ^2 is the likelihood ratio test statistic for comparing the null model with no covariates with the model of interest, p is the number of independent variables in the model of interest (not counting the intercept) as defined by equation (1), and n is the sample size, i.e. the number of cases (woman-years) in the logistic regression (1). With this definition, the *smaller* BIC is, the better the model. For the model with no covariates, BIC is zero, so a positive BIC indicates a model that is worse than the null model.

Translating Event History Parameters into Total Fertility Rates

An approximate way of translating event history parameters into (marital) Total Fertility Rates (TFRs) is as follows. Let $\bar{\pi}$ be the average value of π_{iky} as defined by equation (1), $\bar{L} = \text{logit}(\bar{\pi})$, and $\bar{f}$ be the fertility rate corresponding to $\bar{\pi}$. Note that $\bar{f}$ and $\bar{\pi}$ are not the same, because years in which there was a birth are counted more than once in the denominator of $\bar{\pi}$, but not of $\bar{f}$. We have $\bar{\pi} = \bar{f}/(1+\bar{f})$, so that $\bar{f} = e^{\bar{L}}$. Now, approximately,

$$\text{TFR} = 1 + A\bar{f} = 1 + Ae^{\bar{L}}, \tag{5}$$

where $A = (C - B - 1)$, B is the average age at first birth and the age-specific fertility rate is approximated by

$$\text{fertility rate (age)} \approx \begin{cases} \bar{f}, & \text{if } D \leq \text{age} \leq C \\ 0, & \text{if not,} \end{cases}$$

(provided that $B \geq D$). From our data we have estimated $D = 15$, $C = 42$, $B = 19$, so that $A = 22$.

As an example, let us examine the effect of the woman's education on fertility (Table 3 below). Our estimation of model (1) is based on 77,088 cases including 16,997 births, so that $\bar{\pi}$ is $16997/77088 = 0.2205$, corresponding to $\bar{L} = \text{logit}(0.2205) = -1.263$, $\bar{f} = e^{-1.263} = 0.283$, or about $\text{TFR} = 1 + 22\bar{f} = 7.2$. The average educational attainment is 0.5, and the event history parameter for this variable is -0.17. Thus, for education 0, $\bar{L} = -1.263 + (0 - 0.5) \times (-0.17) = -1.178$, so that $\text{TFR} = 1 + 22e^{-1.178} = 7.77$. For education 5, $\bar{L} = -1.263 + (5 - 0.5) \times (-0.17) = -2.028$, so that $\text{TFR} = 1 + 22e^{-2.028} = 3.90$. Thus the average difference in TFR between women with some higher education and those with no education was about $7.77 - 3.90 = 3.87$, or about four children.

The average effect on TFR of a change in an independent variable x whose event history parameter is β is about $A\beta e^{\bar{L}}$, by differentiating equation (5) with respect to x. For our data, this is about $22e^{-1.263}\beta = 6.2\beta$, on average. Thus we can "read" the tables of event history parameters in this article in a rough way by multiplying them by about 6 to gauge the effect on TFR of a unit change in the independent variable.

Exploratory Regression Change-Point Modeling

In order to pinpoint the time at which the fertility decline started, and to identify its best predictors, we carried out an analysis in three stages. First we fitted an event-history model in which period was coded as a set of dummy variables, one for each year. Then we did an exploratory regression analysis with the estimated period effect as the dependent variable. Finally, guided by these results, we fitted further event history models in which the period effect is modeled parametrically as a function of substantive independent variables; our final conclusions are based on those. We now describe the exploratory regression change-point modeling methods.

We first fitted a change-point regression model to the estimated set of period effects, $y(t)$, namely

$$y(t) = a_0 + a_1 y_1(t) + a_2 y_2(t), \tag{6}$$

where

$$y_1(t) = \begin{cases} t & \text{if } t \leq t_0 \\ t_0 & \text{if } t > t_0, \end{cases} \tag{7}$$

$$y_2(t) = \begin{cases} 0 & \text{if } t \leq t_0 \\ (t - t_0) & \text{if } t > t_0. \end{cases} \tag{8}$$

Here t_0 is the change-point representing the time at which fertility started to decline. To estimate t_0, we fitted the model (6) for each possible value of t_0 and chose the value which gave the best fit as measured by the R^2 value, denoted by $R^2(t_0)$; this is the maximum likelihood estimator.

An approximate interval estimate follows from a Bayesian calculation. Given the data and a prior distribution that gives equal prior probability to each possible value of t_0, the posterior probability that the change-point occurred at t_0 is approximately $\{1 - R^2(t_0)\}^{-T/2}$, where T is the number of years. A set of values of t_0 that account for, say, 95% of the posterior probability is a Bayesian 95% confidence interval. We based model comparison again on BIC, in the form $BIC = T \log(1 - R^2) + p \log n$. This is equal to zero for the null model with no independent variables, and in this case, the *smaller* BIC, the better the model. We used a stepwise forward procedure for selecting variables, guided by BIC.[5]

Modeling Unobserved Heterogeneity

Heckman and Singer (1984) have pointed out that event history analysis results can be sensitive to unobserved heterogeneity. To see whether this was the case here, we estimated versions of our preferred model that included unobserved heterogeneity, namely

$$\text{logit}(\pi_{iky}) = \beta_0 + \sum_{j=1}^{p} \beta_j x_{jiky} + \epsilon_i, \tag{9}$$

[5] For the data analyzed in this article, a stepwise procedure guided by significance tests at the 5% level gave the same result.

where ϵ_i is an observed woman-specific random effect representing unmeasured characteristics that affect fertility, such as fecundability and coital frequency. We assume that $\epsilon_i \overset{\text{iid}}{\sim} N(0, \sigma^2)$.

Bayesian estimation of $\beta_0, \beta_1, \ldots, \beta_p, \sigma^2$ and all the ϵ_i is carried out at the same time using a version of the Gibbs sampler (Gelfand and Smith, 1990; Smith and Roberts, 1993) with 800 iterations. A flat prior distribution for $\beta_0, \beta_1, \ldots, \beta_p$ and $\log(\sigma^2)$ is used. This yields an estimate of the full posterior distribution, and hence exact confidence intervals, as well as standard errors.

Results

Event History Modeling Results

Table 2 shows the fits of various event history models. In Raftery *et al.* (1993) we established that age, duration, parity, (woman's) education and husband's education all have effects and so these are included throughout.[6]

A comparison of models 1, 2, 3 and 4 indicates that period has a strong effect but not cohort. A comparison of models 2, 5, 6 and 7 shows that place of current residence has a large effect and that place of childhood residence does not explain anything more. Model 8 indicates that death of the previous child increased fertility.

Table 3 shows the estimates for the preferred model, with and without population heterogeneity. The estimates were similar, and we focus on the results from the model that includes population heterogeneity. The effects of woman's education, husband's education, place of residence and death of the previous child were all large and significant. The education coefficient translates into a difference of about four children between the TFR for women with no education and those with some higher education (as we worked out above). Husband's education also has a significant effect, which is about one-third as large as that of the woman's own education.

Place of residence also has a big effect, with a difference of about 1.5 children between the most urban women (those living in Tehran) and rural women. Child mortality has a large effect, with the death of the previous child doubling the fertility rate in the following interval.[7] The interval following the second birth was about one-third longer on average

[6] In Raftery *et al.* (1993) we modeled parity 1 and parities 2+ separately. However, the main difference between them is that the average birth-interval length differs much more between parities 1 and 2 than between parities k and $(k+1)$ for $k \geq 2$. Thus, here we modeled all parities (1 and above) together and included a dummy variable for parity 1.

[7] The ratio of the fertility rate when the previous child was dead to that when the previous child was

Table 2: Period, cohort or child mortality? Model fits. All models include age, duration, parity, woman's education and husband's education. The preferred model is shown in bold.

#	*Other variables*	χ^2	p	*BIC*
1	None	13359	10	−13247
2	Y_3	13505	18	−13302
3	C	13394	16	−13214
4	Y_3 C	13525	24	−13255
5	Y_3 S	13621	19	−13407
6	Y_3 Ch	13566	19	−13352
7	Y_3 S Ch	13632	20	−13407
8	**$\mathbf{Y_3}$ S M**	**14531**	**20**	−14306
9	Y_3 S M C	14560	26	−14268
10	Y_3 S M Ch	14537	21	−14300
11	Y_1 S M	14592	37	−14176

NOTE: The independent variables are as follows:
$\underline{Y}_3$ = period (coded as in Table 3 below);
C = cohort (7 levels);
S = size of the place (5 categories) in which the woman resides;
Ch = place of childhood residence (city/village);
M = child mortality (1 if the previous child was alive; 0 if not);
$\underline{Y}_1$ = period (coded as one dummy variable for 1900–1952, and one for each year 1953–1977).
The quantities χ^2, p and BIC are defined by equation (4).

Table 3: Estimates for the preferred model in Table 2.

Variable	Without Heterogeneity β	Without Heterogeneity t	With Heterogeneity β	With Heterogeneity t	95% Interval Lower	95% Interval Upper
Intercept	−0.89	−14.5	−0.67	−10.9	−0.83	−0.58
Age (linear)	−0.41	−17.9	−0.36	−17.0	−0.41	−0.32
Age (quadratic)	−0.31	−18.4	−0.31	−19.6	−0.34	−0.28
Duration 0	−2.23	−33.3	−2.38	−39.0	−2.50	−2.26
Duration 1	0.48	9.6	0.36	8.2	0.27	0.43
Duration 2	1.31	26.7	1.23	34.7	1.15	1.28
Duration 3+	2.55	25.9	2.44	33.9	2.30	2.58
Parity 1	0.23	7.7	0.22	6.6	0.16	0.31
Parity	−0.05	−8.1	−0.08	−10.8	−0.09	−0.06
–1953	−0.05	−1.0	−0.04	−0.7	−0.14	0.08
1954–1958	0.09	2.1	0.11	2.6	0.02	0.19
1959–1963	0.21	5.5	0.23	6.7	0.16	0.29
1964–1966	0.06	1.4	0.08	2.4	0.01	0.15
1967–1969	0.14	3.6	0.17	5.3	0.11	0.22
1970–1972	0.13	3.6	0.16	5.1	0.10	0.22
1973–1974	0.09	2.2	0.11	3.0	0.04	0.18
1977	−0.25	−4.8	−0.23	−5.5	−0.32	−0.15
Woman's education	−0.17	−10.2	−0.18	−11.5	−0.21	−0.15
Husband's education	−0.05	−4.7	−0.06	−5.2	−0.08	−0.04
Size of place of residence	−0.06	−8.8	−0.07	−7.7	−0.09	−0.05
Child mortality	−0.74	−30.4	−0.77	−39.5	−0.81	−0.73

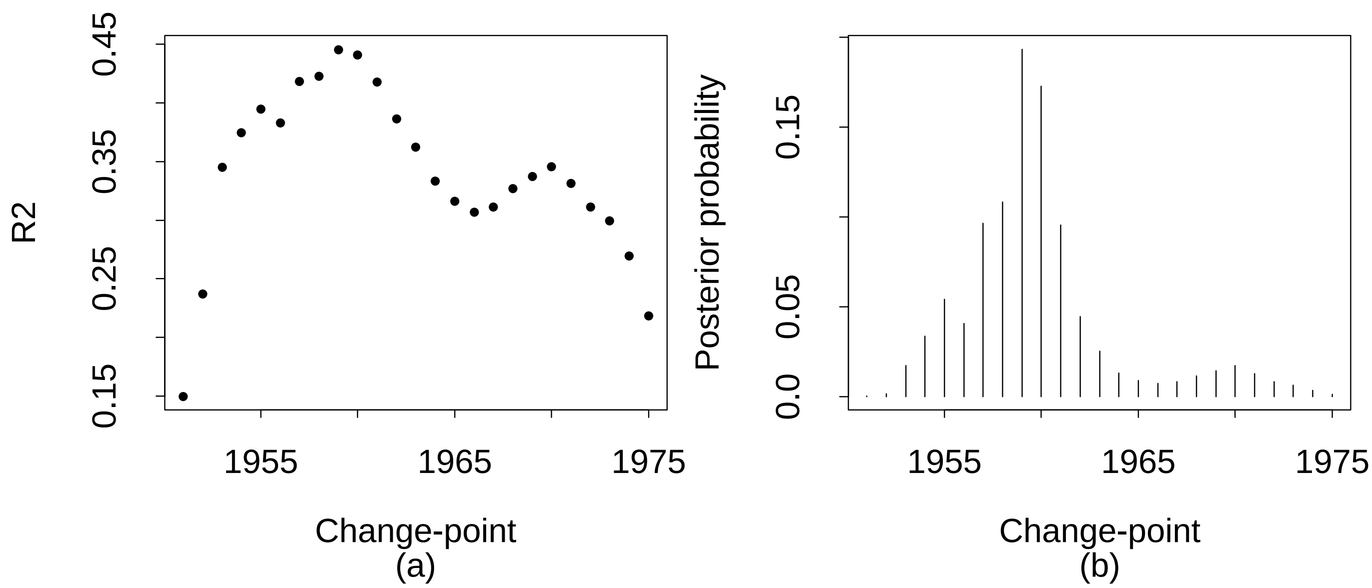

Figure 7: Exploratory change-point regression results: (a) R^2 for the linear change-point model for each possible change-point; (b) Approximate posterior probability that the change happened at year t_0, for each t_0.

than that following the first birth, while with each subsequent birth the average length of the following interval increased by about 5%.[8]

Analysis of the Period Effect

We first fitted model 11 of Table 2, in which there was a dummy variable for each year from 1953 onwards; the estimates are shown in Table 4. There is strong evidence for a change-point, and the most likely year for it is 1959 (Figure 7); with posterior probability about 67% it occurred in the period 1957–1961. Figure 8(a) shows the estimated period effects, their approximate 95% confidence intervals and the fitted change-point regression line. The line fits the period effects well, lying within or very close to all the confidence intervals; there are no outliers and there is no evidence of nonlinearity or serial correlation.

We then regressed the estimated period effect on variables that represent the competing theories. Demand theory says that modernization increases the direct cost of children by raising the amount of formal education they receive to meet the greater need for skilled

living was $e^{0.77} = 2.16$.

[8]The ratio of the fertility rate for the first interval to that for the second is $e^{0.22-(-0.08)} = 1.35$, and the average length of an interval is the reciprocal of the fertility rate. The ratio of the fertility rate for the kth interval to that for the $(k+1)$th interval (for $k \geq 2$) is $e^{0.08} = 1.08$.

Table 4: The estimated period effect and its predictors.

Year	Period Effect	Standard Error	% Primary Participation	% Secondary Participation	Gross Domestic Product	Family Planning Program
1953	0.13	0.10	26	7		0
1954	0.00	0.09	26	7		0
1955	0.14	0.09	28	7		0
1956	−0.20	0.08	30	8		0
1957	0.18	0.08	33	9		0
1958	−0.06	0.08	35	10		0
1959	0.21	0.07	38	11	304	0
1960	0.19	0.07	40	11	321	0
1961	0.14	0.07	42	11	334	0
1962	0.03	0.06	45	12	355	0
1963	0.11	0.06	46	13	381	0
1964	−0.02	0.06	49	14	412	0
1965	0.00	0.06	51	15	463	0
1966	−0.04	0.06	55	19	508	0
1967	−0.00	0.06	56	19	567	1
1968	0.11	0.06	58	22	635	28
1969	0.08	0.06	60	24	712	48
1970	0.16	0.06	60	26	802	67
1971	0.05	0.06	62	35	903	83
1972	−0.03	0.06	65	37	1056	96
1973	0.04	0.06	67	40	1178	94
1974	−0.01	0.06	75	43	1281	93
1975	−0.16	0.06	79	46	1296	92
1976	0.00		84	50	1296	104
1977	−0.32	0.06				

NOTE: Gross Domestic Product is measured in Billions of Rials at constant 1959 prices. Family Planning Program is measured by the number of contraception acceptors per 1,000 women (Nortman and Hofstatter, 1978).

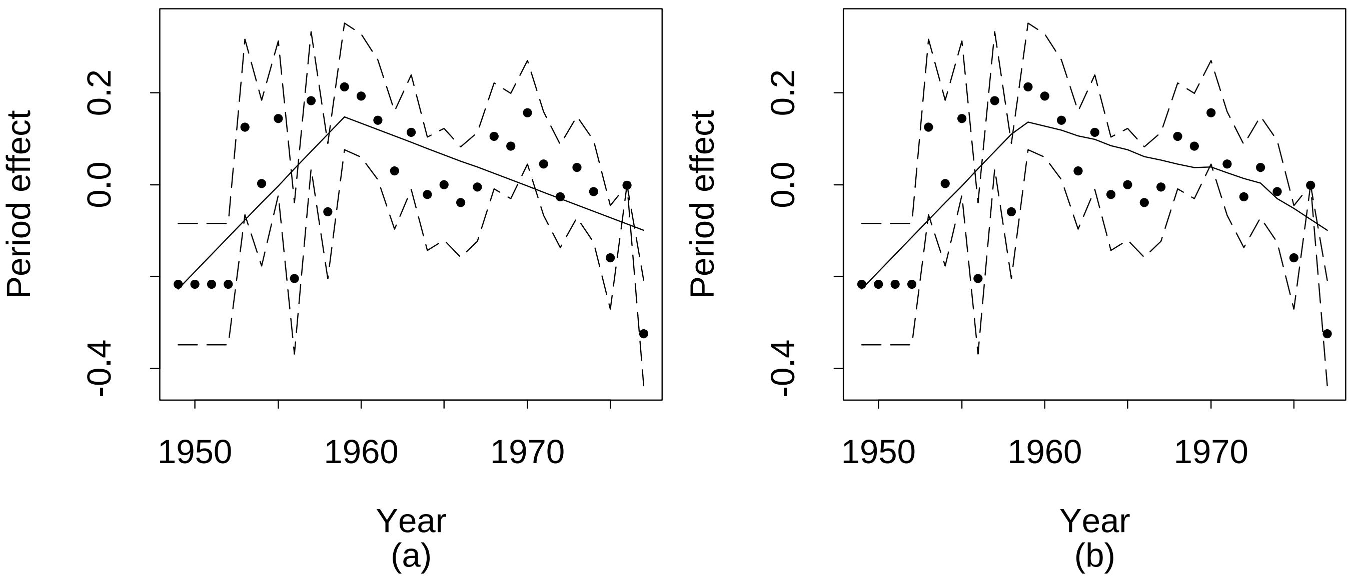

Figure 8: Period effect regression results: (a) Period effects (dots), their 95% confidence intervals (dashed lines) and the linear change-point model fit (solid line); (b) Pre-1959: linear fit; post-1959: primary education participation regression.

labor, and reduces the benefits by making children less available and less useful for work. This happened in a dramatic way in Iran, where primary educational participation went from 25% to 80% in just twenty years. Demand theory would therefore predict a strong association between fertility decline and primary school participation. The same is true of secondary school enrollments, but to a lesser extent because that change affected less people. Demand theory also says that modernization increases the opportunity cost of children by providing other goods on which to spend money. We used Gross Domestic Product (GDP) as a (somewhat imprecise) measure of this effect.

There were two major observable ideational changes. The official Family Planning Program started in 1967, and we measured its effect by the number of users as a proportion of the relevant population, which grew rapidly over the following ten years. The Family Protection Act became law also in 1967, and we represented it by a variable that was equal to 1 in years when it was in effect, and 0 when it was not.

Table 5 shows that primary educational participation is the best single predictor of the period effect, followed by secondary participation and GDP, but that the Family Planning Program and the Family Protection Act have little explanatory power.[9] When added to

[9] Model 10 of Table 5, which includes both primary participation and the Family Planning Program, seems to fit better, but this is not a real effect as the sign of the Family Planning Program is in the wrong direction.

Table 5: Exploratory regression models for the period effect, 1959–1976.

#	*Model*	p	R^2	BIC
1.	Linear trend (YEAR)	1	.40	−6.2
2.	Gross domestic product (GDP)	1	.33	−4.4
3.	Primary participation (PRIM)	1	.44	−7.6
4.	Secondary participation (SEC)	1	.34	−4.5
5.	Family planning program (FPP)	1	.17	−0.5
6.	Family protection act (FPA)	1	.11	0.8
7.	PRIM + YEAR	2	.46	−5.2
8.	PRIM + GDP	2	.49	−6.4
9.	PRIM + SEC	2	.50	−6.8
10.	PRIM + FPP	2	.59	−10.1
11.	PRIM + FPA	2	.56	−9.0

primary participation, no other variable explained much and the model with primary participation as the only predictor fits well (Figure 8(b)).

Table 6 shows the fits of various event history models in which the period effect is modeled as a function of substantive variables. A comparison of models 1, 2, 3 and 4 confirms that the period effect is well represented by a piecewise linear function with a change-point in 1959. Models 5 and 6 support the exploratory regression results about the predictive power of primary participation, while model 7 confirms that the Family Planning Program had no additional effect. Models 8 and 9 confirm that a change-point in 1959 fits better than one in either 1957 or 1961. Table 7 shows the estimates for the preferred model in Table 6.

Compositional and Child Mortality Effects

Couples that are more educated tend to have less children, and urban women tend to have less children than rural women. Modernization increases the average educational level of the adult population and also leads to a flight from the land, and we would expect this alone to lead to a reduction in fertility. We refer to this as the *compositional* effect. We know that this does not completely explain the fertility decline, because the period effect exists even when education and place of residence are controlled for. But *how much* of the fertility decline is due to the compositional effect?

This anomaly disappears in the confirmatory event history modeling (see Table 6 below). A similar comment holds for the Family Protection Act variable.

Table 6: Event history models for the period effect. All models include age, duration, parity 1, parity, woman's education, husband's education, size of place of residence and child mortality. The period effect is replaced by the variables shown. The preferred model is shown in bold.

#	Period Effect: Pre-1959	Period Effect: Post-1959	χ^2	p	BIC
1.	Dummies	Dummies	14592	37	−14176
2.	Linear	Linear	14523	15	−14354
3.	Dummies	Linear	14545	21	−14309
4.	Linear	Dummies	14570	32	−14210
5.	**Linear**	**PRIM**	**14527**	**15**	−14358
6.	Linear	FPP	14514	15	−14346
7.	Linear	PRIM + FPP	14529	16	−14349
8.	Linear to 1957	PRIM from 1957	14526	15	−14357
9.	Linear to 1961	PRIM from 1961	14520	15	−14351

Table 7: Estimates for the preferred model in Table 6.

Variable	Without Heterogeneity β	Without Heterogeneity t	With Heterogeneity β	With Heterogeneity t	95% Interval Lower	95% Interval Upper
Intercept	−2.68	−8.4	−2.36	−14.7	−2.67	−2.18
Age (linear)	−0.41	−17.9	−0.35	−12.2	−0.41	−0.30
Age (quadratic)	−0.31	−17.9	−0.31	−17.6	−0.35	−0.28
Duration 0	−2.23	−33.3	−2.42	−26.3	−2.61	−2.26
Duration 1	0.47	9.5	0.32	4.2	0.20	0.46
Duration 2	1.31	26.6	1.20	16.9	1.08	1.33
Duration 3+	2.55	25.9	2.39	18.0	2.18	2.63
Parity 1	0.24	7.7	0.22	7.1	0.15	0.28
Parity	−0.05	−8.0	−0.09	−7.1	−0.10	−0.07
Pre-1959 linear trend	0.03	6.2	0.03	29.5	0.03	0.04
Post-1959 primary participation	−0.42	−5.1	−0.43	−6.6	−0.55	−0.30
1977	−0.23	−4.6	−0.24	−5.0	−0.33	−0.14
Woman's education	−0.17	−10.1	−0.19	−9.1	−0.23	−0.15
Husband's education	−0.05	−4.7	−0.06	−4.9	−0.08	−0.03
Size of place of residence	−0.06	−8.8	−0.07	−7.6	−0.09	−0.05
Child mortality	−0.74	−30.4	−0.75	−32.9	−0.80	−0.70

Table 8: Contributions to the fertility decline of population composition in terms of education and place of residence, and of child mortality. All models include age (A), duration (D), parity (P) and period effect (Y).

	Post-1959 Estimate in Model $ADPY+$		% of Period Effect Due to V	
V	V	$WHSM-V$	Lower	Upper
None	.82	.42		
Woman's education (W)	.62	.48	7	25
Husband's education (H)	.66	.43	2	20
W + H	.59	.58	20	28
Size of place of residence (S)	.83	.37	0	0
Child mortality (M)	.56	.64	27	32

We have also seen that death of a child leads to a large increase in fertility in the following interval, and that infant mortality declined considerably over the period of our study. This alone would reduce fertility to some extent, but once again we have seen that it does not completely explain the observed fertility decline. How much of the fertility decline is due to the decrease in child mortality?

Table 8 shows by how much the post-1959 primary enrollment coefficient (i.e. the period effect) goes down when these other variables are introduced. When only age, duration, parity and period are in the model, the post-1959 primary enrollment coefficient is 0.82,[10] and when woman's education, husband's education, place of residence and child mortality are introduced, this goes down to 0.42. Thus, these variables together account for about 50% of the decline.

It is of interest to see how that 50% breaks down between the four variables. The most common way to do this is to introduce the four variables one by one in a predetermined order and then see by how much the post-1959 primary enrollment coefficient goes down for each one. This is unsatisfactory, however, because it depends on the order in which the variables are introduced, which here would be somewhat arbitrary. Instead, we show in Table 8 by how much a variable reduces the post-1959 primary enrollment coefficient if it is introduced first and if it is introduced last, using this to define a range.

Table 8 indicates that the decrease in child mortality accounted for a little over one-quarter of the fertility decline, while the increase in level of (parents') education accounted

[10]The minus signs are removed here, and the discussion is in terms of the absolute value of the coefficient.

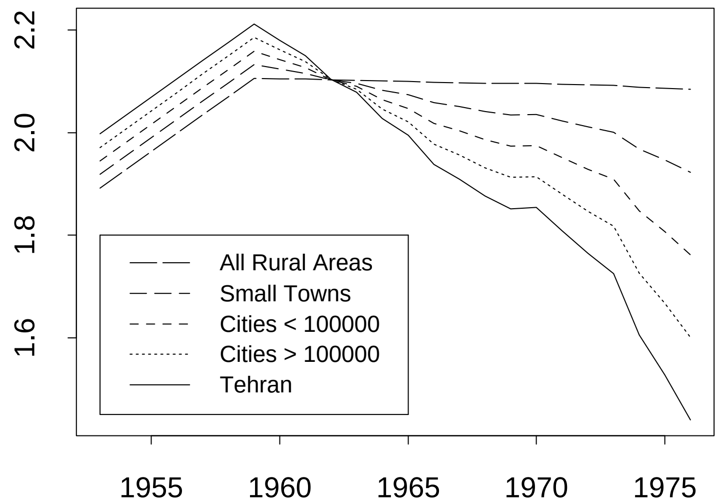

Figure 9: Interaction between period and size of place of residence: The period effect estimated from Table 9 for each of the five levels of size of place of residence.

for a little less. Urbanization did not contribute to the fertility decline.

Interaction Effects

To examine possible interactions, we fit a model with all two-way interactions between the variables duration, parity, size, education and the period effect, and then used a backwards elimination procedure to choose the best subset.[11] The resulting model had $L^2 = 14854$, $p = 25$ and $BIC = -14573$, and the estimates are shown in Table 9.

The fertility decline was large in Tehran, corresponding to a reduction of about four children in the marital TFR, but in rural areas and small towns the decline was very small (Figure 9). In smaller cities the decline was substantial but less than in Tehran.

The fertility decline was the same for women of all educational levels, but its extent did depend on their husband's education (Figure 10).[12] For women with the same educational level, the decline for husbands with some higher education was about 0.8 greater (on the logit scale) than that for husbands with no education; this translates into a difference in TFR of about four children. In the pre-transition period, husband's education had no effect

[11] We also tried adding any three-way interactions that were justified by the hierarchy principle and that improved the model, but in fact there were none.

[12] Although the woman's education and that of her husband were highly correlated, there was enough educational heterogamy to allow us to make such distinctions quite clearly.

Table 9: Estimates for the preferred model with interactions.

	Without Heterogeneity		With Heterogeneity			
					95% Interval	
Variable	β	t	β	t	Lower	Upper
Intercept	−2.83	−8.8	−2.73	−71.3	−2.80	−2.66
Age (linear)	−0.41	−17.8	−0.38	−12.7	−0.44	−0.32
Age (quadratic)	−0.30	−17.4	−0.30	−17.1	−0.34	−0.27
Duration 0	−2.79	−26.2	−2.97	−22.6	−3.21	−2.73
Duration 1	0.50	9.4	0.37	8.2	0.28	0.44
Duration 2	1.34	25.4	1.24	33.2	1.17	1.31
Duration 3+	2.36	19.2	2.23	25.2	2.00	2.38
Parity 1	0.15	4.5	0.12	3.5	0.06	0.20
Parity	−0.06	−10.2	−0.10	−8.9	−0.11	−0.07
Pre-1959 linear trend	0.04	6.5	0.04	31.4	0.04	0.04
Post-1959 primary participation	−0.05	−0.5	0.02	0.2	−0.14	0.22
1977	−0.25	−4.8	−0.27	−5.4	−0.36	−0.17
Woman's education	0.06	1.2	0.06	1.8	−0.02	0.12
Husband's education	0.05	2.3	0.06	2.9	0.03	0.10
Size of place of residence	0.03	2.3	0.03	2.8	0.01	0.05
Child mortality	−0.75	−30.8	−0.76	−34.9	−0.81	−0.72
Duration 0 * Woman's education	−0.37	−3.3	−0.38	−3.6	−0.58	−0.19
Duration 1 * Woman's education	−0.33	−5.8	−0.35	−8.5	−0.42	−0.26
Duration 2 * Woman's education	−0.29	−5.2	−0.30	−9.2	−0.37	−0.24
Duration 3+ * Woman's education	−0.64	−5.6	−0.67	−9.5	−0.80	−0.52
Duration 0 * Parity	0.15	8.3	0.16	7.7	0.12	0.19
Parity 1 * Woman's education	0.23	8.2	0.24	7.5	0.17	0.30
Post-1959 * Duration 3+	1.34	4.7	1.39	5.8	0.93	1.87
Post-1959 * Size of place of residence	−0.41	−8.7	−0.43	−9.1	−0.52	−0.33
Post-1959 * Husband's education	−0.34	−5.2	−0.40	−8.5	−0.48	−0.29
Size of place of residence * Husband's education	−0.02	−3.8	−0.02	−4.0	−0.04	−0.01

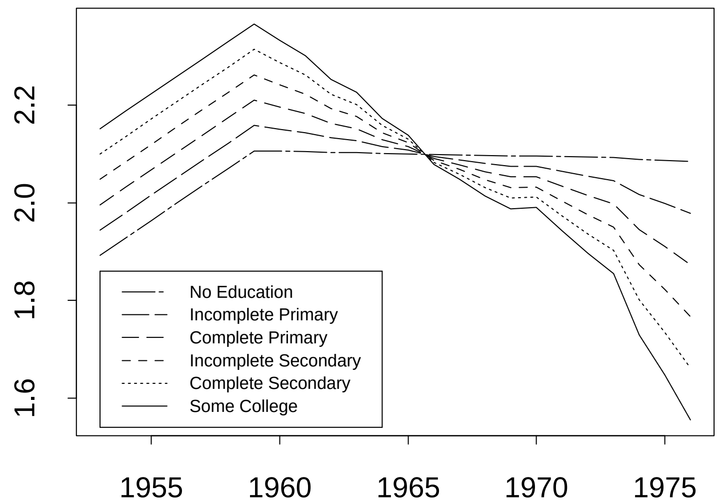

Figure 10: Interaction between period and husband's education from Table 9: Period effect for each level of husband's education.

on fertility, but as the transition proceeded, its effect grew, to become almost as large as that of the woman's own education. This may explain the conflicting results in the literature about whether husband's education has an effect on fertility (Sorenson, 1989).

The interactions give some idea of whether the fertility decline was due to stopping or spacing of births. There is no evidence that the extent of the decline differed by parity, and the average birth interval increased as fertility declined. Thus the decline seems to have consisted of increased spacing at all parities, rather than of parity-specific stopping. Of course, women may have had the *intention* of stopping, and our results merely reflect that that was not what actually happened in most cases. This is in line with the more general WFS results of Hobcraft (1987), who argues that the stopping versus spacing debate is a vacuous one.

Discussion

Demand or Ideation?

Marital fertility in Iran increased during the 1950s and started to decline around 1959, a few years after massive economic growth began around 1955. The decline continued until 1977, the year in which the IFS was carried out. It was largely an urban decline, amounting to about four children per married woman in Tehran, somewhat less in smaller cities, and very little in rural areas. It closely paralleled the large increase in primary school participation. More than one-quarter of the decline can be attributed to the reduction in child mortality, a key mechanism of demand theory. There is no evidence that the Family Planning Program or the Family Protection Act, both instituted in 1967, accelerated the decline; certainly neither caused its onset.

What does this tell us about the debate between demand and ideational theories? The Iranian fertility decline closely followed the predictions of the demand theory of Easterlin and Crimmins (1985). It is less clear what ideation theory predicts, but it certainly predicts that the establishment of the Family Planning Program and the passing of the Family Protection Act would at least accelerate, and probably cause the onset of, fertility decline. However, not only did the 1967 events not trigger the fertility decline (the timing precludes this), but there is no evidence that they accelerated it at all. Thus the Iranian fertility decline seems better described by demand than by ideation theories.

Several of our other results support this general conclusion. The fertility decline was preceded by a fertility increase, precisely as predicted by demand theory, but not by ideation theory. Ideational changes tend to affect the young more than their elders (Ryder, 1965), and so one would expect an ideational effect to manifest itself partly as a cohort effect. However, the Iranian fertility decline was a period effect and not a cohort effect, affecting childbearing women of all ages equally. This is in line with demand theory, which says that fertility behavior is largely determined by *current* costs and benefits, rather than by attitudes that change slowly over the life course. There were similar results for most other WFS countries (Hobcraft, 1987). The fact that it is place of current rather than childhood residence that counts also points in the same direction.

The decline affected women of all educational levels equally, but it was greater among women whose *husbands* were more educated (after controlling for their own educational level). This may be because husband's education is a good proxy for husband's occupational status and hence for the socioeconomic standing of the household. Households with higher socioeconomic standing tend to participate more fully in modernization and hence to have a greater fertility decline, as predicted by demand theory. If the decline were driven primarily by the transmission of ideas, one would expect more educated women to be more affected than less educated women, which was not the case.

One of our main findings is that fertility decline in Iran closely paralleled the expansion of mass primary education. This is essentially the theory of Caldwell (1980, 1982), which our results both support and allow us to refine. It is important to distinguish between the effects of mass education on current fertility, and on the subsequent fertility of students in the school system. The former are mainly demand-related, while the latter are essentially ideational. The former are measured in our study by current enrollments, while the latter are measured by the parents' education. The former lead to an immediate fertility decline, while the latter have a delayed effect.

Caldwell postulated five mechanisms through which mass education causes fertility decline; three of these are demand-related and two are ideational. So how can we assert that the Iranian fertility decline was in line with demand rather than ideation theories? The three demand-related mechanisms are the reduction of the child's potential as a worker, increased schooling costs and the fact that schooling causes the child to be more dependent. These all relate to mass schooling of the *children*, and imply an immediate effect on fertility, which is precisely what we observed.

The ideational mechanisms are cultural change and the introduction of Western values. Both of these are postulated to affect the fertility of students once they grow up, and hence to have a delayed effect on fertility. Our results indicate that only about one-quarter of the fertility decline was due to the increase in *parents'* level of education (Table 8). The Egyptian study of Faust *et al.* (1991) suggests that even this small and delayed ideational effect of mass education may be moot. They found that, far from introducing Western values, the Egyptian school system actually reinforces Islamic family values, although it is essentially a Western-style system. They also found that schools and teachers have little influence on students in terms of role modeling. By contrast, they found that the demand-related mechanisms did operate as Caldwell had postulated.

The Lack of Effect of the Family Planning Program

Our finding that the Family Planning Program did not initiate, or even accelerate, the fertility decline appears at first sight to run counter to many cross-national cross-sectional studies that have found an association between fertility decline and family planning effort (Freedman and Berelson, 1976; Mauldin and Berelson, 1978; Tsui and Bogue, 1978; Cutright and Kelly, 1981; Menard, 1983, 1985, 1986, 1987, 1990; Tolnay and Chistenson, 1984; Tolnay and Rodeheaver, 1988).

However, these authors assumed that family planning effort was both temporally and causally prior to fertility decline, an assumption that is open to question. Demeny (1979a,b) pointed out that fertility decline *preceded* family planning effort in several countries such as

Taiwan, and we have shown this to be the case in Iran also. Davis (1967) and Hernandez (1981, 1984) contended that family planning programs are effective only where substantial socioeconomic transformations have already increased the motivation for family limitation. Kelly and Cutright (1983) argued that fertility decline is causally prior to family planning effort, on the grounds that fertility decline is an indicator of the demand for contraception, which family planning programs are then established to meet. Our results for Iran are consistent with this argument, although they do not prove its validity. Of course, the Iranian fertility decline was still at an early stage in 1977, and it is possible that the Family Planning Program could have had a substantial effect later on.

Note that our result is not inconsistent with those of the authors who found cross-national associations between fertility decline and family planning effort, since both occurred in Iran within a fairly short time of each other. However, our longitudinal study reveals the temporal ordering of the two events in a way that the cross-sectional studies cannot, and so sheds some light on the direction of causality between the two (if any).

In practical terms, how can we explain the finding that the Family Planning Program did not accelerate the fertility decline? The Family Planning Program emphasized use of the pill, and our data show it to have been successful in one sense: 85% of the women interviewed reported having heard of the pill, 37% reported ever having used it, and 19% of the currently married women who were not pregnant reported using the pill at the time of the survey (Aghajanian, 1992). However, our data provide no evidence of any association between pill use and lower fertility for individual women.[13] Anecdotally, interviewers reported seeing piles of unused boxes of pills in the homes of women who reported having used this method.

Perhaps the following is a clue. Two-thirds of current contraceptive users in rural areas were using the pill, while for urban areas it was only 40%. Withdrawal was the best-known and most used method apart from the pill, and this was used by one-third of urban contraceptive users but by only 16% of rural users. Thus, where fertility was really declining (in urban areas), withdrawal was being widely used, while in rural areas, where the fertility decline was very small, the pill was the main method and withdrawal was little used. It follows that the fertility decline that we observed may have been due, at least in part, to the use of withdrawal rather than modern methods. The fact that the decline consisted of spacing rather than stopping of births, and that fertility was still quite high at the end

[13]This statement is based on analyses not reported here, which consisted of estimating event history models in which ever use of the pill was included as an independent variable. It was true both on average overall, and for each parity individually.

of our period, even in Tehran, makes this hypothesis somewhat plausible. A full answer to this question would require birth-interval-specific data on contraceptive use, including correctness of pill use, which we do not have. Even this might not be enough, however, as the fuller Korean WFS data shows (Bumpass, Rindfuss and Palmore, 1986).

The Effect of Birth Order

In one important respect, our results for Iran are not the same as those reported for other WFS countries. Hobcraft (1987) reported a lack of association between fertility behavior and parity beyond the second birth, once other factors are controlled for. By contrast, the strong significance of the "Parity" coefficient in Tables 3, 7 and 9 above indicates that there was a clear association between fertility behavior and parity in Iran, consisting of a gradual decline of fertility with increasing parity of about 8% per birth. This is a relatively subtle effect in that the differences between neighboring parities are small, but it is clear and important. Our finding may be due to the power of our methodology, in which case it may also be present, albeit so far undetected, in other WFS data sets. On the other hand, it may be a result that is unique to Iran.

Trends Since the Islamic Revolution

In 1979, shortly after the IFS, the Islamic Revolution took place. The 1986 Census showed that the average birth rate was actually higher in 1976–1986 than in 1966–1976, so that the demographic transition that started before the Islamic Revolution stalled after it, or perhaps was even reversed (Aghajanian, 1991). This is the only example of a stalled or reversed demographic transition that we know of. There are many possible reasons for this, such as the closing of the family planning clinics by the new regime, the repeal of the Family Protection Act and the institution of strict rationing during the Iran-Iraq war in which the amount of food increased with the number of children. Some of the possible reasons are economic and some are ideational; further work is need to explain this reversal of fertility decline.

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