From health service delivery to family planning: the changing impact of health clinics on fertility in rural Iran

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Abstract

Family planning after the Islamic Revolution of 1979 has followed an unusual path. After a decade of pro-natal policies, in 1989 the government reversed itself and launched an ambitious program to control population growth. During the pro-natal phase the government invested heavily in a network of health clinics that focused on providing mother and child care, but not family planning. After the policy reversal, it used the same network to begin active delivery of family planning services. In the subsequent 15 years the average number of birth per rural woman dropped from more than 7 to replacement level. We evaluate the impact of the health clinics on rural fertility, distinguishing between their effect when they delivered only health services and when they also provided family planning. Previous studies of program impact have been unable to disentangle the effects of family planning and health delivery on fertility. Since the two effect can go in opposite directions, these studies may underestimate the impact of family planning on fertility. We use the exogenous variation in the timing of construction of health clinics across rural Iran to identify their impact on fertility. We also use the policy reversal in 1989 to delineate the function of the clinics in each year of its operation – that is, health vs. health and family planning. We match this information with the birth histories of individual women recorded in the 2000 Iran Demographic and Health Survey. We measure exposure to health clinics by the number of clinics per 1000 women of child bearing age in each district. We then estimate the impact of the clinics during their different phases on the probability of births using a discrete-time hazard model of the first through the third birth. Our findings indicate that the impact of health clinics on the hazard of first birth was positive before policy reversal and none afterwards. For the second and third births we do not see any positive effect before family planning, but we do find a clear negative effect after family planning went into effect.

JEL classification: J13, I18

Key words: Family Planning, Fertility, Impact Evaluation, Hazard Model, Iran

1 Introduction

Iran's fertility decline in the 1990s is something of a record in the annals of demographic transition. In its recent survey of world fertility decline, the *Economist* noted that Iran's fertility decline is "about as fast as it can happen." Although urban fertility is now below replacement, the more impressive aspect of Iran's transition is fertility decline in rural areas. Whereas attempts to lower rural fertility before the revolution had failed (Aghajanian 1995), after the revolution the drop in rural fertility broke the world record: in the span of 15 years the average number of children fell fertility fell from about 8 to 2 births.

This impressive decline in fertility in Iran is usually identified with the family planning program launched in 1989 (Abbasi-Shavazi et al. 2009). Mehryar et al. (2001) attribute the decline, which they call a 'miracle', to this program. Before then, having discontinued the Shah's program,[1] the government had shown no interest in family planning, and adopted pro-natal policies that promoted larger families. Following the surprising results of the 1986 census that revealed a record rate of population growth of 3.9 percent since 1976 (3.6 percent not including Afghan and Iraqi refugees) the government reversed its pronatal policies and adopted family planning. The baby boom occurring around the time of the revolution in 1979 had caused unusually large cohorts of children entering primary school in the mid 1980s, forcing schools into two and three shifts. The timing of the family planning program and the turnabout from pro- to anti-natal policies in 1989 was also influenced by the fact that the war had ended the year before, shifting the government's attention to millions of youth in need of schooling and in search of jobs. The family planning program was thus an integral part of the reconstruction effort pursued by the Rafsanjani adminstration that took power in 1989. Rural areas figured prominently in the reconstruction effort, because of their support for the war effort and because their disadvantaged position symbolized the Shah's policies (Salehi-Isfahani 2009a; Salehi-Isfahani 2009b). In 1985, as part of its rural development strategy, the government had begun the rural Health Network System (HNS), which expanded the construction of rural health houses rapidly around the country, and was later used as the institutional and physical base for the family planning program. In this paper we evaluate the impact of this program on rural fertility.

Understanding the role of health clinics in the spectacular decline in rural fertility in Iran is important as this program gains respect as a model for other developing countries (Boonstra 2001). The evidence of the causal impact of Iran's program on rural fertility is still being accumulated. Salehi-Isfahani et al. (2010) employ a difference-in-differences method to measure the impact of the program and find that less than 20% of the decline in rural fertility can be attributed to the presence of rural health clinics. Their evidence shows that less than 20 percent of the rural decline can be accounted for the construction of rural health clinics. While their methodology is strong in terms of identification, their measure of fertility, the village-level child-woman ratio, is an imprecise measure of fertility because it is susceptible

[1] For a description of this program, see Moore (2007); for its effect on fertility, see (Raftery et al. 1995).

to changes in child mortality and migration.

In this paper we use micro data from the 2000 Iran Demographic and Health Survey (IDHS) to examine the response of women of given characteristics – e.g., age, education, and number of previous live births – to exposure to the program. In particular, we are interested in how access to health houses (availability of birth control), schools, and other village infrastructure has affected the timing of births of different parities and women of different ages and education. Our work builds on the village level study of Salehi-Isfahani et al. (2010) by identifying the impact of the family planning program at the individual level and by parity, thus giving us a more precise notion of program impact. Our findings support their general results, that the expansion of family planning services contributed to lower fertility in rural Iran. In addition, we are able to show that the effect of the program varied by parity and the characteristics of women.

To identify program effect, we take advantage of the geographic spread of health houses across rural areas. Concern for endogenous placement arises from the tendency of administrators to give priority to areas in greater need of program services. Although Iran's program did not have this particular bias –areas with lower fertility received their clinic earlier– it was not totally random either. As Salehi-Isfahani et al. (2010) show, Iran's family program proceeded from areas with better local infrastructure, such as roads, electricity and water, to less developed areas. To control for placement endogeneity, we use fixed effects at the district level, which removes the effect of all time-invariant factors including those unobservables which affected both placement and fertility.

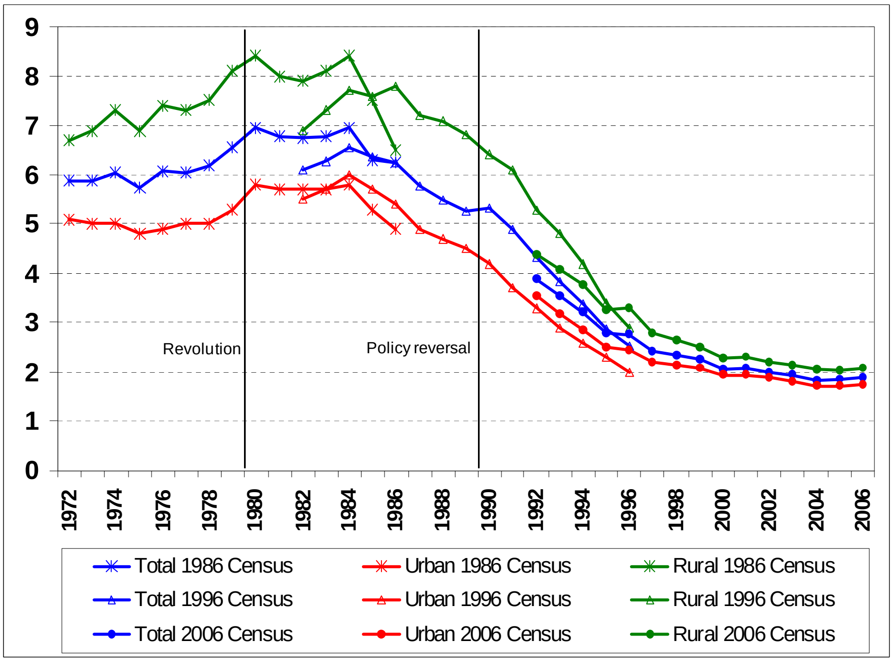
We use micro data derived from Iran's 2000 Demographic and Health Survey (IDHS) to estimate a hazard model of birth by parity. IDHS includes data on about 114,000 women of childbearing age, of whom 54,000 are rural. We are able to link a particular birth for each woman to the level of program exposure at her district of residence at the time of birth. We measure exposure to the program by the number of health clinics per 1000 women of childbearing age (each health house is designed to serve approximately 1500 women).

In the rest of this paper we first review the evidence for fertility transition, showing the extent of rural fertility decline and its timing. We then describe Iran's family planning program in more details. In section 4 we present the methodology used in this study, especially how we deal with the issue of identification of program effect. In section 5 we introduce the data we use in this study. Section 6 presents the results of discrete-time hazard regressions of births by parity and section 7 is the conclusion.

2 Fertility transition

A well-established literature, reviewed in Abbasi-Shavazi et al. (2009), shows that fertility transition in Iran began sometime in the mid 1980s and was completed less than two decades later. Estimates of the fertility transition in rural Iran have been derived from census data by Abbasi-Shavazi and McDonald (2006), which is reproduced in Figure 1. Two interesting observations can be made with the help of this graph. First, the decline in rural fertility has been faster than urban fertility, so that the gap in fertility between the two areas was all but closed by 2006. In a period of about 15 years the average number of birth per rural woman, the total fertility rate (TFR), declined from more than 7 to about 2, compared to a decline of about 4 births for urban women. The fact that such an impressive decline has occurred in Iran's rural areas, where families are more conservative and less educated, is probably the reason why most observers have assumed a causal link between the rural program and fertility decline. There are certain aspects of the family planning program that were national in impact, such as the removal of the implicit child subsidies, and there are aspects that are specific to rural areas, most importantly, active delivery. The distinction between active and passive service delivery is based on whether the clinics offer the series to those who seek the service or whether health workers seek out individual women. In rural Iran, health workers based in the clinics visited each woman of child bearing age at least once a year to take note of her health and reproductive history (Abbasi-Shavazi et al. 2009). The narrowing of the fertility gap may be attributed to these aspects of the program but not to the shared aspects.

Figure 1: Total Fertility Rates, 1972-2006



Source: Abbasi-Shavazi, McDonald, and Hosseini-Chavoshi (2009)

Second, as Figure 1 shows, fertility decline in both rural and urban areas began before the introduction of family planning. This suggests that other factors besides the family planning program were acting on fertility at the time. In 1989 there were several changes taking place simultaneously that could have affected fertility.

The rationing of basic goods introduced during the war which had benefited larger families were on their way out. There was talk of ending of other subsidies, mainly in schooling and health, for higher parity children. By 1993, a law limited the benefits from various government programs to three children (Roudi-Fahimi 2002). Educational opportunities in rural areas were expanding, raising the expectation of higher returns to schooling for the rural population, which could limit the desire for larger families (Becker 1992).

Our focus in the empirical section of this paper is on married women. In principle, family planning programs influence both the prevalence of marriage as well as marital fertility. However, in Iran, there are strong social and legal taboos against relations between men and women outside marriage. So, we expect that a large part of the program effect is to be searched among married women. Abbasi-Shavazi et al. (2009) show that of the decline of 3.71 births during 1986-96, 3.11 births, or 84 percent, was due to decrease in marital fertility. The implication of this for our results is that we do not expect family planning to have had a strong effect on the timing of the first birth (see section 6).

Iran's program appears to have affected higher order births only (Abbasi-Shavazi et al. 2009). In Iran, especially in rural areas, marriage is a rite of passage to adulthood, which is completed with the birth of the first. In Figure 2 we present the average number of years a couple wait between marriage and first birth, first and second, and second and third birth. The waiting time to first birth does not show a particular trend; in particular there is no increase after family planning went into effect. The time to second and third birth show a distinct upward trend, consistent with the decline in fertility over time. In our empirical results we allow for differences in program effect by parity.

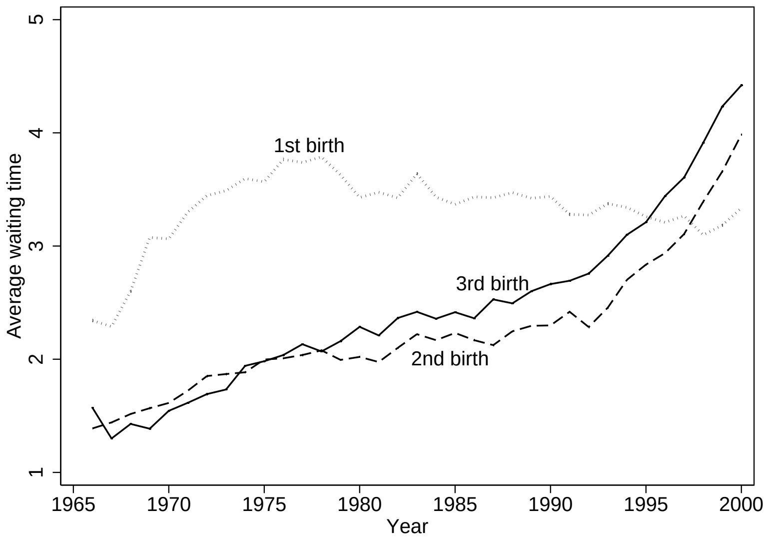


Figure 2: Average waiting time by parity

3 Family Planning program

Health care and family planning are delivered to Iran's rural areas through the Health Network System (HNS), at the core of which are rural health clinics.[2] Health house construction in rural areas started in early 1970s with few health built before the revolution. Figure 3 shows the pace of the construction of rural health houses in Iran. The network expanded gradually before the revolution but the major jump in health house construction happened in 1985 after that ministry of health was mandated by legislature to improve the rural health infrastructure, and reached its pick in 1989, when the family planning program became law. By 2005, about 90% of the country's rural population (20.4 million individuals living in 4.2 million households) had been covered by the program [3]. The construction program implemented in one district in each of the provinces and then expanded to other districts within each province. The selection was not random and according to officials in charge of the program placement was influenced by the local infrastructure and the availability of educated potential health workers Salehi-Isfahani et al. (2010). These local characteristics have also a direct impact on the fertility decision of women residing in that area. We control for these district level characteristic and also imply a fixed effect estimator to deal with the problem of non-random placement. See Section 4 for more details.

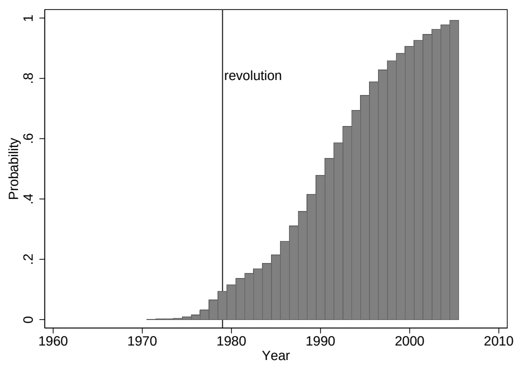


Figure 3: Timing of health house establishment

An important feature of Iran's rural health program is that health houses existed for a number of years before family planning was introduced, so we are able to estimate the effect of exposure to health houses in two distinct periods, with and without family planning services. We believe that this unique feature of Iran's program adds to the strength of identification. We thus distinguish between the periods before and after 1989, when health houses started provide family planning

[2]We use the terms health clinics and health houses interchangeably. For descriptions of the HNS see Roudi-Fahimi (2002), Abbasi-Shavazi et al. (2009) and Salehi-Isfahani et al. (2010).

[3]From total of 15,000 health clinics, 8% were built before revolution, 30% since revolution until policy reversal at 1989, 33% since the start of family planning program lunch until 1995, and 17% from 1995 to 2000

services. To further understand how the effect of health houses has changed over time, we split each period (before and after 1989) into two. The base period (1966-78), which serves as the reference period in the estimation, is before the revolution, when the family planning under the Shah was still in effect (Moore 2007). The circumstances surrounding rural family planning differs after the revolution from the earlier period in two ways. First, during this period the government suspended the existing family planning and adopted pronatal policies with economic incentives through rationing of basic necessities that treated children equal to adults, and state encouragement of larger families. Second, during this period the revolutionary government began a rural reconstruction effort which included massive investments in rural infrastructure, especially in health house construction. About 45 percent of all the health houses in existence by the year 2000 were constructed during this period. The important difference between this period and the two following periods is that before 1989 the mandate of the rural health delivery system did not include family planning.

We divide the post 1989 period when family planning went into effect into two five year periods, 1989-1994 and 1995-2000. Our interest in doing so is to capture the effect of the increased national information campaign for smaller families, which may have had its own effect on incentives for smaller families separate from the services provided by the local clinics. Not only the state propaganda against large families intensified as the years went by, the government made its intentions to penalize large families official by enacting a law in 1993 that prevented the government from providing subsidies to the fourth and higher parity children.

4 Empirical model

Estimation of the program effect is complicated by the fact that distribution of health houses across the country was not completely random, even though placement did not favor high fertility areas, as programs are likely to do (Salehi-Isfahani et al. 2010). Local infrastructure and availability of qualified health workers played an important role in the placement decision, thus introducing factors in the decision to build a health house that are also correlated with fertility. For instance, paved roads, electricity, and the presence of educated women who would staff the health clinic, were obviously important considerations in building a health house in a particular location. The likely effect of these observable infrastructure factors on placement is not detrimental because we can account for them by conditioning the probability of birth on the characteristics of the district of residence. There are also unobservable factors, such as social norms that influence individual choice in adoption of contraceptive use, that can affect the administration's decision to implement the program in an area. The influence of unobservable factors on placement can be viewed as an omitted variable problem. Omitting the characteristics which affect placement from the fertility equation, leads to estimation bias (Strauss and Thomas 1995). The standard practice to deal with time-invariant unobserved factors is use fixed-effects estimator to difference them out from the regression (Rosenzweig and Wolpin 1986; Pitt and Gibbons 1993; Gertler and Molyneaux 1994; Angeles et al. 2005). A drawback of the fixed-effects procedure is that it also eliminates time-invariant observable factors, so it could be inefficient.

We use a duration model to estimate the effect of access to health houses on fertility. Our outcome of interest is the probability of a birth in each year since marriage or a previous birth. In order to estimate this probability we construct birth histories for individual women using retrospective information in IDHS. Our unit of observation is thus woman-year, for which we know whether or not a birth occurs. We do this separately for each parity (or birth order). For the first birth, we follow each woman from the time of marriage until she gives birth to her first child, and for the second birth from the time of the first birth, and so on. For some women and some parities we do not observe a birth occurring before the survey year but one could have occurred after that, so the interval is open. The hazard regression method we employ is designed to deal with these censored observations. We choose to define the unit of time as a year rather than a month because we do not have confidence on accurate reporting of month of birth for older children. This allows us to use logistic regression, which is the common method for estimating discrete-time hazard models.

The binary birth outcome each year is modeled as a function of own age and education and husband's education, as well as community characteristics, such as access to electricity, piped water, schools, etc. We estimate the following logistics equation:

$$ln\left[\frac{P(B_{ijt}=1|X_{ijt},COV_{jt},Z_{jt},\mu_j)}{P(B_{ijt}=0|X_{ijt},Cov_{jt},Z_{jt},\mu_j)}\right]=$$
$$\sum_{k=1}^{3}\tau_k T_k+\delta COV_{jt}+\beta[Cov_{jt}*\sum_{k=1}^{3}T_k]+X_{it}\alpha+Z_{jt}\gamma+\mu_j+\sum_{p=1}^{5}\psi_p S_p+\epsilon_{ijt},$$

where the dependent variable, B_{ijt}, takes the value of 1 if the woman i in district j gives birth at year t, and 0 otherwise. T_k's are three dummy variables indicating the period during which the birth occurs. The reference period is 1966-78 (the pre-revolution period), the dummy variables represent periods 1979-88, 1989-1994, and 1995-2000. The latter two periods are when family planning was in effect. COV_{jt} is the the measure of health house coverage at time t in district j and reports the number of health houses per 1000 rural women in each district at each year. We also interact COV_{jt} with the period dummies, T_k, to examine the change in the effect of coverage over time. We expect the effect of health houses to vary depending on the period. Program impact will be reflected in the difference between the coefficients interaction terms before and after the start of family planning.

X_{ijt} are personal characteristics, such as age and education, which directly impact the fertility decision. We also account for household wealth using an index based on ownership of various assets. We use the method of principal component analysis suggested by (Filmer and Pritchett 1998; Rutstein and Johnson 2004) to combine 15 asset indicators for private cars, TV, radio, refrigerator, and the like, into a single measure of household wealth.[4] X_{ijt} also includes a variable indicat-

[4]The complete list of assets is: number of rooms per household member, car, motorcycle, TV,

ing whether the woman has moved in the past five years, which we use to identify migrants, and whether or not the previous birth child had died, which help us differentiate between regular births and replacement births.

Z_{jt} are time varying local characteristics, such as schools, electricity, and piped water. Time-invariant local characteristics such as religious and cultural norms are captured by μ_j. The hazard of birth at each point in time depends on previous spells. A standard way to deal with the problem of time dependency in duration models is to use spell dummies (Jenkins 2005), which which mark each period starting from the time when the previous event occurs until the next event. The coefficient of these dummy variables represent the shape of baseline hazard function[5] in the discrete time duration model. S_p's represent spell dummies in our model. Their coefficient can also be interpreted as the baseline hazard for each parity (see Figure 5). Temporal dependence also affect the standard errors from a normal logit or probit (Beck et al. 1998; Poirier and Ruud 1988). We correct the standard errors by using robust standard errors clustered on the each woman.

Placement is related to observed and unobserved local characteristics. We will control for the observable part. However, μ_j includes unobservable factors that affect both placement and fertility decisions. To the extent that placement of health houses is not random, μ_j will be correlated with the random disturbance (ϵ_{ijt}), which causes estimation bias. To address this problem, we use fixed-effects to difference out μ_j from the regression. We implement this by putting a dummy variable for each of the j districts. The advantage of this approach is that it takes out all unobservable time-invariant characteristics, but at the cost of also losing the observed ones.

5 Data

The individual level data for this study are from Iran's Demographic and Health Survey of 2000 (IDHS). IDHS is a nationally representative survey of 113,913 households in 28 provinces (plus city of Tehran). In each province, 4000 households (2000 in rural and 2000 in urban areas) selected and 90,201 ever-married women 10-49 were interviewed. In this study, the sample is restricted to the rural areas (43,279 ever-married women age 15-49)[6]. IDHS contains detailed information on fertility, family planning practices, socioeconomic characteristics of women 10-49, and also the district of residence.[7]

Unfortunately, as noted earlier, the district of residence is the smallest unit of location that can be found in IDHS and the village of residence cannot be identified. Thus, all the community characteristics should be calculated in district level. A

radio, refrigerator, telephone, bicycle, electricity, piped water, natural gas, central heating, shower, latrine, and hygienic toilet.

[5]Baseline hazard function shows the value of hazard when other explanatory variables are assumed zero.

[6]From the total number of 43,813 rural women aged 10-49, we dropped 173 observations whose age were less than 15. We also dropped 365 observations whose age at marriage was missing or incorrect (age at marriage less than 10 years old).

[7]For further details on the survey see (Aghajanian and Mehryar 1999).

retrospective birth history is constructed based on the woman's marriage and children's birth year. For each woman, we construct a woman-year series of observation including information for every year from the year of marriage until the survey year, 2000. The dependent variable is a dummy variable which indicates whether the woman gave birth in a particular year. We use this retrospective information on timing of birth to implement a discrete time hazard model of fertility.

Information on program placement includes data on year of health house establishment for 15,070 villages in which at least one health clinic were present by 2005. To obtain community characteristics, such as the presence of schools, mosque, electricity, and piped water, we use data on village facilities over time.[8] Since district is the smallest geographical decision that can be identified from the IDHS, we turned the village characteristics to district level by defining the total number of villages in a district which uses that service (electricity, piped water) or facility (middle school, mosque) per 1000 rural residents of district. The district rural population comes from 1986 census. Health house coverage is calculated in district level and shows the number of health houses per 1000 rural women aged 15-49. Our working sample consists of 43,279 ever-married women aged 15-49 in 2000 living in 193 districts.

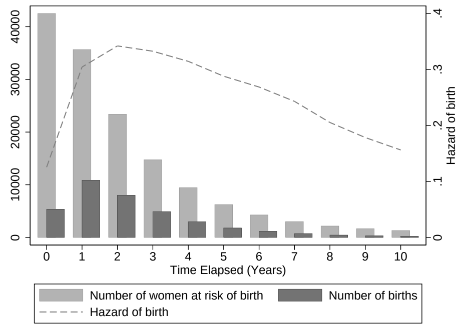
The dependent variable is an indicator variable showing whether a woman has given births in a particular year. There are 676,994 woman-years in the retrospective data set, with a total of 161,902 births. Using the retrospective information on the timing of different births, we will implement a discrete hazard model in which each year-specific hazard rate depends on time variant explanatory variables. Figure 5 shows the number of women at risk of birth (risk pool) and number of birth occurred at each spell year for each parity. The second y-axis in these graphs report the hazard, which is simply the ratio of these two numbers at each spell year.

The individual level variables include education, age, husband's education at year 2000, year dummies and the time since last birth (or time since marriage for the first birth).

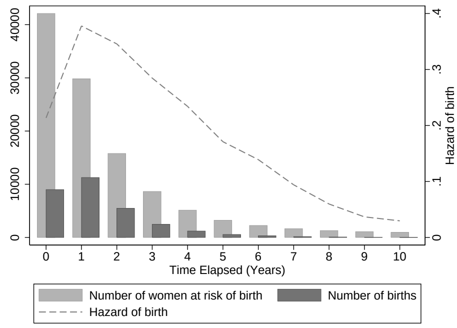
Education is included in the model using a set of dummy variables for three education categories; illiterate, primary, and secondary levels. These dummies are created by assuming that the women entered school at age 6 and remained there until the reported highest level of education was obtained. As noted earlier, spell dummies were included to take into account the temporal dependence of hazard function. We set as reference category for spell dummies the year of marriage or of a birth. We clock the hazard for five periods after the event.

Migration presents a problem for our estimation. Women who move between rural districts or between rural and urban areas may have had access to different faculties, including family planning services, than their current place of residence indicates. IDHS contains only limited information on immigration. Only for women who have moved in the last five years, the survey reports the number of years of residence in the same village. For these women, we also know where they came from (whether they have moved from rural/urban areas of the same province or

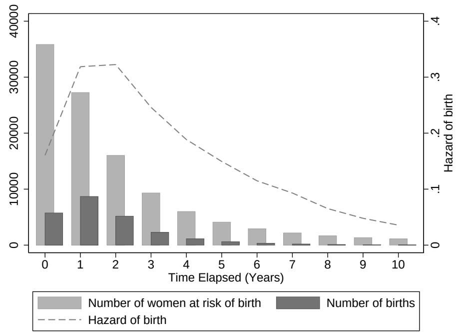
[8]These data are not available only for the following years: 1950, 1966, 1973, 1976, 1981, and 1986. To construct community characteristics for the entire period of interest, from 1966 to 2000, we se the value of these variables for later years to the latest value available.



(a) 1st birth



(b) 2nd birth



(c) 3rd birth

Figure 4: Hazard rates for different parities

another province). Fortunately, only about 11.6 percent of women in the sample had moved in the last five years, and of these only about half had moved from an urban area. Since access to education, health and family planning services differ more between rural and urban areas than between rural areas, it is the latter group that really concern us. Very likely these women had better access to family planning services where they came from, and perhaps continued to have the same level of access after they moved to the rural district. We control for this characteristic in our estimation and find that the hazard of birth for those who moved in the last five years are significantly lower than those who did not move. This is true for all different parities.

Table 1 presents descriptive statistics for the variables included in the empirical model. The left section of the table reports woman's characteristics at the survey year, 2000. From the total of 43,279 ever married women of in our sample, nearly half (45%) are illiterate, 37% have completed their primary education and one in five of them (about 20%) have secondary and higher education. About all of them have attained the their highes level of education at the year of survey and no longer are at school. Most of the women in our sample are currently married, and from those 96% have been married only once. Women's age ranges from 15 to 49 with the average of 32 years old. The average age of marriage which is the age at which they are introduced to our sample in 17 years old. The right section of this table shows the summary statistics for the restructured data set in which the unit of observation is woman-year. This sample includes information on 676,994 woman-years of which 22% are for the first birth, 17% the second birth, and 17% for the third birth. More than half of the observations in this sample represent illiterate women, 30% those with completed primary education, and less than 10% with secondary and higher education. Husbands are generally more educated with about 20% having more education than their wives.

As noted earlier the variable coverage is a measure of district exposure to health clinics. It reports the number of health clinics in district per 1000 rural women (aged 15-49). This average of this measure for our woman-year sample is about 2 health clinics per 1000 women. We also calculated local characteristics in district level. These measures show the total number of villages in a district (per 1000 individual) with electricity, piped water, middle school, and mosque. The asset index, which is combined ownership indicator varies between -5 to +5 with the average of about -1.

The survey does not report educational attainment of women at the time of each birth. To construct a time varying variable for years of schooling, we follow Angeles et al. (2005) by assuming that each woman entered school at age 6 and gained one year of schooling each year until she graduated. For instance, a woman who completed primary education (5 years of schooling) is recorded as having 3 years of education by age 9, 4 years by age 10, and 5 years from age 11 onwards. All but 1% of the married women in our sample have completed their education. Using the reported highest attainment from the survey does not change the results significantly.

6 Estimation Results

Tables 2 report the estimation results using logit. Columns 1-3 present the simple logit results, in which we control for both individual and community characteristics. These results are likely to be inconsistent since they are affected by endogeniety of placement. Columns 4-6 of the same table report the results of the fixed-effects model, using 193 district-level dummy variables which remove the effect of unobservable community characteristics which affected both placement and fertility decisions.

Because the same woman is observed multiple times, we report Huber-White standard errors which correct for the correlation between observations for the same woman. The number of observations we report in these tables refer to the number of woman-years for each parity. We report our results by parity order, for birth 1 through 3. For higher birth orders we have fewer observations and face greater censoring, so we limit our analysis to these three births.

We discuss our findings with reference to the fixed effects estimates, which are our consistent estimates and are therefore preferred. The coefficient of the period dummies capture the decline in fertility over time. The hazard of first birth after the revolution has increased relative to before, but there is not change after that. In other words, the post-revolution periods all show a decline in the waiting time between marriage and the first birth, which may reflect increased emphasis on motherhood and family formation after the Islamic Revolution. Whatever impact the change in the social atmosphere of the country brought for fertility does not seem to go beyond the first birth. The hazard of the second and third birth do not change in period 1 relative to the base period. This is consistent with the hypothesis put forward by (Salehi-Isfahani and Murphy 2004) who argue that the baby boom of the early years of the revolution was the result of a change in tempo rather than completed fertility.

The hazard of the second and third births decline in periods 2 and 3, reflecting the sharp drop in fertility after family planning went into effect. However, to see the impact of exposure to the program on fertility we need to look to the coefficients of coverage and its interaction with period dummies for second and third births.

The effect of coverage for each period is the sum of the coefficient of coverage in the base period plus the coefficient of the relevant interaction term. The results show that the main distinction in terms of coverage is between periods 2 and 3, when family planning was in effect, compared to periods 1 and 2, when they were not. In particular, we do not notice any difference in the impact of exposure to rural clinics between the pre-revolution period and the pro-natal post-revolution period.

Thus while the null hypothesis that health clinics had no effect on fertility cannot be rejected for the pro-natal period, it can be at the 5% level of significance for the second and third period. These results indicate that coverage was only effective when the function of the rural clinics changed from health only to health and family planning.

The effect of coverage on the first birth is only evident for the first two periods: it is positive for the base period, which may indicate increase in fertility as a result of improved health conditions due to the presence of a health house. The effect of coverage on the hazard of the first birth disappears for the subsequent periods.

The estimates of the coefficients of individual and community characteristics are consistent with previous studies in the literature. The effects of the woman's own education and her husband on the hazard of birth are as expected and as predicted by the literature on economics of fertility (Willis 1973; Martin and Juarez 1995; Schultz 1994; Schultz 2001). Increase in the woman's own education decreases the hazard of birth for all parities. Having a secondary education has a rather large impact on the hazard of birth compared to primary education. However, less than 10 percent of women-years are with secondary level of education.

Her husband's education has a generally positive effect on the hazard of birth, except for secondary education and for the third birth. From these results, it seems that husband's education is acting more as an indicator of household wealth than opportunity cost of children.

We also control for household assets (excluding homes, but including the number of rooms, car, and key appliances), which, like husband education, has a positive effect on the hazard of first birth. However, the effect is not significant for the second birth and turns negative for the third. This suggests that, in rural Iran, the first child is a normal good, so that it is more likely to occur in more wealthy couples.

The effect of age on fertility is non-linear, but increasing for the entire child bearing ages. This finding is most likely due to the fact that women who marry very young wait longer to have their first birth compared to those who marry later.

The effect of district-level characteristics on the hazard of birth in columns 4-6. The most robust effect is from the presence of a middle school, which makes sense since it is related to women's education as well as placement of health houses (Salehi-Isfahani et al. 2010). Interestingly, the effect of piped water is positive, indicating perhaps that, *ceteris paribus*, better health conditions increase fertility. Electricity shows no clear pattern. It only shows negative impact for second birth. The presence of a mosque shows a negative effect for the first birth and insignificant for higher order births. Initially we put mosque in the regression expecting it to indicate religiosity, and be positively correlated with fertility. It is likely that having a mosque, or rather the resources to build and maintain one, is correlated with variables related to economic development, which negatively affect fertility.

The last set of estimates are the coefficients of temporal dummy variables. As noted earlier, these coefficients can be interpreted as the baseline hazard function (see Figure 5). The hazard of each birth are highest in the second and third year and decline later. The estimated coefficients of the control variables are the estimated shifts of the baseline hazards.

7 Conclusion

The dramatic decline in fertility in rural Iran, and its coincidence with the implementation of a nationwide family planning, has led to speculations about cause and effect. There is considerable interest among policy makers in developing countries to learn how the shift in rural Iran from one of the highest fertility levels to replacement level in less than two decades took place. Among the innovative features of Iran's program is the construction of rural health clinics that provided active delivery of family planning services to all women in a geographic area. In this paper we take advantage of the variation in exposure to this program due to the timing of the construction of these clinics across Iran to measure the impact of the program. We matched data on the birth histories of about 50,000 rural women obtained from Iran's 2000 DHS with information about the coverage of rural clinics in their district of residence.

Since the placement of the program was not entirely exogenous and variables such as the level of education and availability of basic services (roads, electricity, and piped water) in a rural area influenced when a clinic was established there, we have to account for these factors. We do this in two ways, by controlling for those variables that we can observe and by using fixed effects at the district level that help eliminate all time-invariant unobserved variables that affect program placement.

We use a proportional hazard model to estimate the effect of exposure to family planning on the probability of births of different parities. We show that the program had a limited impact on the timing of the first birth, but that it delayed the occurrence of the second and third births. We distinguish between the impact of the clinics during their different phases of operation. We show that in the 1980s, when they did not offer family planning and focused on mother and child health care, exposure to the clinics was associated with an increase in the hazard of the first birth, no change in the hazard of the second birth, and a small decline in the third.

However, during the periods in which they offered active family planning services, they had a strong negative effect on the hazard of the second and third birth.

Table 1: Descriptive Statistics

Women characteristics at survey year (2000)			Woman-year sample (1966-2000)		
Variable	Mean	Std. Dev.	Variable	Mean	Std. Dev.
Education			**Education**		
Illiterate	0.45	0.50	Illiterate	0.61	0.49
Primary	0.37	0.48	Primary	0.31	0.46
Secondary	0.18	0.38	Secondary	0.09	0.28
Husband's education			**Husband's Education**		
Illiterate	0.30	0.46	Illiterate	0.42	0.49
Primary	0.41	0.49	Primary	0.40	0.49
Secondary	0.29	0.45	Secondary	0.18	0.38
No. of marriages			Coverage	1.83	1.68
1	0.96	0.19			
+2	0.04	0.19	**Community characteristics**		
			Middle school	0.19	0.33
Marriage status			Electricity	0.82	1.89
Married	0.96	0.19	Pipedwater	0.86	3.02
Divorced/Widowed	0.04	0.19	Mosque	1.20	2.87
Age	32.02	9.08	Wealth index	-0.98	1.65
Age at first marriage	17.44	3.72	Moved in the last 5 years	0.07	0.26
Currently student	0.01	0.10	Previous child born dead	0.06	0.25
Household size	5.84	2.56			
Immigration status (last 5 years)					
Moved from urban	0.06	0.24			
Moved from rural	0.06	0.23	**Number of woman-year spells**		
Did not move	0.88	0.32	1st birth	153,397	
			2nd birth	119,491	
Number of women	43,279		3rd birth	115,496	
Number of districts	193		Total	676,994	

Table 2: Estimates from standard logit and fixed-effects regressions

	Simple logit			Fixed-effects logit		
	1st birth	2nd birth	3rd birth	1st birth	2nd birth	3rd birth
	(1)	(2)	(3)	(4)	(5)	(6)
Time periods (1966-1978 excluded)						
Pro-natal period (1979-1988)	0.280**	0.020	-0.071*	0.298**	0.032	-0.054
	(0.021)	(0.028)	(0.031)	(0.023)	(0.031)	(0.033)
FP period I (1989-1994)	0.366**	-0.310**	-0.412**	0.358**	-0.294**	-0.338**
	(0.032)	(0.039)	(0.043)	(0.035)	(0.056)	(0.049)
FP period II (1995-2000)	0.367**	-1.117**	-1.428**	0.333**	-1.086**	-1.357**
	(0.041)	(0.048)	(0.057)	(0.045)	(0.059)	(0.066)
Coverage	0.183**	0.072	0.093	0.246**	0.092	0.075
	(0.043)	(0.058)	(0.055)	(0.045)	(0.062)	(0.060)
(Pro-natal period)*coverage	-0.150**	-0.033	-0.081	-0.180**	-0.067	-0.106
	(0.044)	(0.059)	(0.056)	(0.045)	(0.062)	(0.059)
(FP period I)*coverage	-0.155**	-0.089	-0.119*	-0.203**	-0.125*	-0.155**
	(0.044)	(0.059)	(0.057)	(0.045)	(0.063)	(0.060)
(FP period II)*coverage	-0.197**	-0.114	-0.120*	-0.244**	-0.158*	-0.153*
	(0.044)	(0.059)	(0.058)	(0.046)	(0.063)	(0.061)
Age						
age	-0.152**	-0.069**	-0.077**	0.003	0.009	-0.005
	(0.002)	(0.003)	(0.003)	(0.008)	(0.007)	(0.007)
age sqrd	0.002**	0.001**	0.001**	-0.001**	-0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education (illiterate excluded)						
primary	-0.146**	-0.216**	-0.336**	-0.115**	-0.186**	-0.301**
	(0.018)	(0.020)	(0.021)	(0.018)	(0.021)	(0.022)
secondary	-0.122**	-0.627**	-0.860**	-0.118**	-0.598**	-0.803**
	(0.025)	(0.028)	(0.034)	(0.026)	(0.029)	(0.035)
Husband's education (illiterate excluded)						
primary	-0.009	0.103**	0.060**	0.006	0.107**	0.067**
	(0.018)	(0.021)	(0.021)	(0.018)	(0.022)	(0.021)
secondary	-0.010	0.058*	-0.108**	-0.008	0.049	-0.108**
	(0.023)	(0.026)	(0.028)	(0.023)	(0.026)	(0.029)
Wealth index	0.060**	-0.004	-0.026**	0.049**	0.004	-0.008
	(0.005)	(0.006)	(0.006)	(0.005)	(0.006)	(0.007)
Moved in the last 5 years	-0.091**	-0.256**	-0.252**	-0.101**	-0.247**	-0.212**
	(0.022)	(0.026)	(0.033)	(0.023)	(0.027)	(0.034)
Mortality of previous child		1.673**	0.383**		1.707**	0.392**
		(0.058)	(0.038)		(0.057)	(0.038)
District level characteristics						
Middle school	-0.043	-0.336**	-0.359**	-0.821**	-0.949**	-0.545**
	(0.072)	(0.073)	(0.077)	(0.123)	(0.149)	(0.155)
Electricity	-0.031**	-0.022*	-0.009	-0.006	-0.053*	0.021
	(0.010)	(0.009)	(0.009)	(0.022)	(0.027)	(0.028)
Piped water	0.054**	0.058**	0.055**	0.169**	0.236**	0.103**
	(0.009)	(0.009)	(0.010)	(0.025)	(0.031)	(0.033)
Mosque	-0.036**	-0.012	-0.015	-0.084**	0.006	-0.039
	(0.007)	(0.009)	(0.009)	(0.016)	(0.021)	(0.021)
Spell duration dummies (duration 0 is excluded)						
1 year	0.972**	0.967**	1.015**	1.020**	0.976**	1.027**
	(0.018)	(0.018)	(0.021)	(0.019)	(0.019)	(0.021)
2 years	1.197**	1.018**	1.202**	1.239**	1.026**	1.220**
	(0.020)	(0.023)	(0.024)	(0.020)	(0.023)	(0.025)
3 years	1.185**	0.857**	0.960**	1.219**	0.868**	0.983**
	(0.023)	(0.031)	(0.031)	(0.024)	(0.031)	(0.032)
4 years	1.141**	0.621**	0.703**	1.161**	0.636**	0.735**
	(0.027)	(0.042)	(0.041)	(0.028)	(0.042)	(0.041)
+5 years	0.610**	-0.953**	-0.534**	0.649**	-0.886**	-0.466**
	(0.027)	(0.054)	(0.053)	(0.028)	(0.053)	(0.052)
Log likelihood	-79,506	-56,939	-50,342	-78,109	-56,556	-49,953
Pseudo R^2	0.17	0.21	0.23	0.18	0.21	0.24
Observations	147864	116766	113100	147864	116766	113100

Standard errors in parentheses
* significant at 5%; ** significant at 1%

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