Family Planning and Rural Fertility Decline in Iran: A Study in Program Evaluation *

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Abstract

During the first few years of the Islamic Revolution Iranian fertility was on the rise, in part because of the revolutionary government's pro-natal policies. In a policy reversal, in 1989 the government launched an ambitious and innovative family planning program specifically aimed at rural families. By 2005, the program had covered more than 90 percent of the rural population and the average number of births per rural woman had declined to near replacement level from about 8 birth in the mid 1980s. In this paper we ask to what extent this decline was the result of the family planning program. We use the timing of establishment of rural health houses to identify the effect of the program on change in village-level fertility. Our results indicate only a moderate effect of the program on rural fertility. Fertility decline in villages that received health services earlier was only slightly greater than those that received it later. Our regression results indicate that other factors, such as initial literacy and availability of schools may have played a larger role in fertility decline than family planning.

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1 Introduction

The question of the role of state-provided family planning programs in fertility transition has long interested demographers, economists and policy makers. Economists stress the role of demand for children, and hence factors that determine it, such as infant mortality and education, as more important than provision of family planning services (Schultz 1994; Schultz 2007). There are few rigorous evaluations of family planning programs in developing countries. Joshi and Schultz (2007) exploit the experimental design of the Matlab program in Bangladesh to estimate a decline of 15 percent in fertility over more than a decade. In a non-experimental setting, Angeles et al. (2005a) and (2005b), and Miller (2005) estimate the effect of family planning programs in Peru and Columbia using geographic variation in program implementation. This paper contributes to this literature by presenting an evaluation of the impact of Iran's family planning program.

During the last two decades Iran's fertility declined from one of the world's highest to replacement level. In a span of 15 years the total fertility rate (TFR) dropped by about five births reducing fertility in Iran to replacement level (Abbasi-Shavazi and McDonald 2006; Abbasi-Shavazi et al. 2007; Hosseini-Chavoshi et al. 2006). At the same time, Contraceptive Prevalence Rates (CPR) increased from 54 percent in urban areas and 20 percent in rural areas in 1976 to 77 and 67, placing Iranian families among the highest users of contraceptives in the developing world (Mehryar et al. 2001). The existing descriptive literature on Iran's fertility decline credits this spectacular decline to an innovative and ambitious family planning program launched in 1989, immediately after the end of the war with Iraq, that represented a reversal of the Islamic government's pro-natal stance during its first ten years (Aghajanian 1995, Ladier-Fouladi 1996, Hoodfar and Assadpour 2000, Abbasi-Shavazi and McDonald 2006, Mehryar et al. 2001). While early on the leader of the Islamic Revolution, Ayatollah Khomeini, had declared birth control legitimate, the government's policy was pro-natal and suspended, if not actively discouraged, the Shah's family planning program. This policy seemed appropriate from the government's point view as long as the war with Iraq was raging (1980-1988) and large numbers of young fighters were being recruited for the war effort. But, by 1989, when the war had ended, the results of the 1986 census had shown that during the preceding decade population growth had accelerated to 3.9% per year, and primary schools were moving to two and three shifts to accommodate the baby boom of the early 1980s, family planning once again became official policy.

The effect of the policy reversal was the greatest on rural families because in urban areas private sector continued to supply birth control devices through prices were higher as their subsidy had been removed (Hoodfar and Assadpour 2000). In rural areas, where government run health houses had a monopoly on the distribution of birth control devices, access dropped off sharply once the national family planning program was shut down.

The new revived program focused on rural areas, where fertility had shown no sign of decline. It had a strong information campaign, which was particularly effective because it was backed by the clergy. But its operation relied on the health infrastructures that has been gradually built up as part of the rural Reconstruction Crusade. Within a few years the program started to show results, as rural fertility started to fall, from 8.4 birth per woman in 1985 to 2.4 in 2002 (see also Figure 1). Contraceptive Prevalence Rate increased from about 20% in 1970s to 67% in 2000. Infant Mortality Rate declined from 92 per 1000 in 1980 to 32 in 2004. The program's success has drawn international attention in part because of its innovative structure and in part because it occurred in an Islamic state famous for its strong adherence to a pro-natal and conservative Islamic ideology (Obermeyer 1995). The program has been labeled an "Iranian miracle" by Mehryar et al. (2001), as a model for developing countries Boonstra (2001), and has influenced the design of programs elsewhere (for example, in Pakistan).

Despite the international acclaim, there is no published study that provides evidence of a causal link between Iran's family planning program and the decline in fertility. This paper presents an evaluation for this program in the rural areas of Iran. The rural component of the program is of special interest for two reasons. First, the decline in fertility was most spectacular in rural areas, where previous attempts had failed (Aghajanian 1995). Total fertility fell by nearly four fold in less than two decades, from 8 to 2 average births per woman from the late 1980s to 2005. Second, the program was most innovative in its rural component. During this period, more than 90 percent of rural families came under the coverage of the Health Network System (HNS), which is a network of 18,000 Health Houses serving more than 22 million rural people. The construction of rural health facilities began before the Revolution of 1979, but really accelerated in the mid 1980s, closely timed with fertility decline (see Figure 5 for the pace of construction of the the Health Houses).

But the apparent close timing of fertility decline and the program's initiation does not prove causation. To establish a causal role for the program one must be able to control for changes in demand factors that could account for why women and families decided to use the program's services when it was offered in the 1990s. Iran had a history of offering family planning with very modest effect–almost no effect in rural areas. An analysis of the moderate fertility decline before the Revolution by Raftery, Lewis, and Aghajanian (1995) found in favor of the role of demand for children over ideation that might have resulted from family planning.

There are other, more fundamental reasons for why fertility would decline in the 1990s as fast as it did besides ideation. Economists, who are often most skeptical of claims that attribute fertility decline to family planning, emphasize the role of household characteristics, such as education and women's opportunity cost of time, in fertility determination (Becker 1992; Schultz 1988; Schultz 1994). Women's education had been on the rise for some time, in both rural and urban areas, and could thus account for increased demand for contraception offered by the program. Reduced form models of fertility for Iran confirm the role of these factors. The number of children ever born is negatively influenced by women's education and positively by family income (Salehi-Isfahani 2001). Thus the increase in education and falling income in the 1980s could explain why families were more eager to adopt family planning when it was offered in 1989 than they had been in the 1970s (see Figure 2 for fluctuations in per capita incomes). Infant mortality had been on steady decline that had started in the 1950s. Figure 3 shows that mortality decline in Iran was on a downward trend very similar to Turkey, another large Middle Eastern country that did not have a similar family planning program but experienced fertility decline in the same order of magnitude as Iran, albeit at a more gradual pace.

There is also evidence that the post-Revolution fertility decline started in the mid 1980s *before* the mandate of the Health Network System had been to include family planning in 1989 (Abbasi-Shavazi and McDonald 2006). Finally, the same pressures generated by the fertility boom of the early years of the Revolution (1979-1984) that had prompted the government to reverse its position on family planning may have also persuaded individual families to limit their fertility. A similar argument has been made in the case of Taiwan where fertility decline appears to have preceded family planning and was more closely correlated with mortality decline (Li 1973). In light of these observations, as well as the fact that Iran's program has been hailed as a model for other developing countries, a rigorous analysis of the effects of Iran's program is warranted.

There are several process evaluations of Iran's family planning program that demonstrate the program's effectiveness in service delivery but fall short of evaluating its impact. To evaluate its impact is to compare the actual outcomes in terms of fertility decline for women who were exposed to the program services with what they would have experienced had they not been exposed. This study proposes a method of doing such a counterfactual analysis. It is hard to deny that Iran's family planning program was influential in reducing rural fertility because of its large scope and the fact that in 1989 it moved contraception from a position of official opposition or, at best, benign neglect to one of active endorsement and support. It stands to reason that lowering the psychic and monetary cost of contraception should have some effect on fertility. What we do not know and wish to find out in this study is the degree to which the program or other factors were responsible for rural fertility decline.

2 Program description

Iran's present rural Health Network System was started in 1984 with a law that mandated the Ministry of Health and Medical Education (MOHME) to build the country's rural health infrastructure (Hosseini-Chavoshi et al. 2007). Starting in the capital city of each province, the Ministry set up a rural Health Center to oversee the operation of several health Houses each in a "Main" village serving about 1500 households. Health Houses were typically staffed with two *behvarz*, health workers, recruited from the village and trained for one year. Health Houses in Main villages served several Satellite villages that were nearby directly and those in outer settlements with mobile units. Figure 4 shows the relationship within the Network.

The initial focus of the HNS, before family planning became official policy in 1989, was the health of mother and child. This feature may have helped establish the trust of the rural families in that the government's intention was to improve their lives rather than merely limit their numbers. Recruitment and training of local health workers also added to local trust. As a result, by the time the national communications campaign for family planning was in full swing, most rural residents had come to believe the second part of its main slogan — fewer children, better life.

The program adopted an active system of delivery of services. If a woman did not visit the Health House within a year, the *behvarz* would pay her a visit to collect new information and provide needed services. The data obtained from individual women is entered into a statistical database known as *Zij*, which is now a huge data base containing every rural woman's health history.

Figure 5 shows the distribution of Health Houses by year of establishment. There were very few villages with Health Houses in the early 1970s. The last two years before the Revolution, 1977-78, saw an expansion of the rural health network, which continued at a slower pace after the Revolution until 1985, when the law went into effect and the number of Health Houses built each year more than doubled. The peak rate of construction was reached in 1989, when family planning was added to the HNS's mandate. By then roughly half of the Health Houses were already in existence. We exploit the fact that half of the villages had access to the HNS at the time of policy reversal as part of our identification strategy. By 2004, there were 16,560 Health Houses staffed by 26,403 health workers (*behvarz*) and linked to 2321 rural Health Centers and serving about 55,000 villages. By then the program's coverage had reached about 90% of the country rural population (20.4 million individuals living in 4.2 million households).

2.1 Program placement

An important feature of our identification strategy is the placement of the Health Houses across the country and over time. While placement was not random, we believe that it was not compensatory in the sense of villages with lower health and higher fertility receiving programs earlier. According to interviews with MOHME officials in charge of the program, the mandate to MOHME in 1984 was to begin the implementation of the heath network in one district in each of the 25 provinces (now 30 provinces) and then expand to other districts within each province, eventually covering all districts (about 180 then and 360 now). According to these officials, placement was mainly influenced by the capability of local administrators (provincial governor, mayors and town councils), and the availability of educated potential health workers (initially minimum of primary education, later lower secondary). The principal concern in estimating program impact is to make sure that program placement was not endogenous to the outcome being measured. In our case, we are particularly interested to know if villages that received the program early were not those with higher fertility. From the account of interviews regarding placement of Health Houses, it is likely that localities with higher education (and therefore likely lower fertility) would receive the program earlier.

In Iran the largest variation in rural health and fertility is between provinces rather than inside the same province. As a result, this particular strategy created some degree of independence of program placement from local conditions at the initial phase. In 1996, seven years after the family planning program had been adopted nationally, the birth rate in the more developed Esfahan province was less than half that of the least developed Sistan and Baluchestan (Abbasi-Shavazi and McDonald (2006); see also Figure 6 for variation in the child-woman ratios across districts in Iran). Yet, fertility decline has occurred widely across Iran, indicating the influence of common factors that may have helped reduce fertility, among them possibly family planning.

Within each province selection of districts may have introduced some endogeneity because the initial districts were picked based on criteria that could be related to health and fertility. One criterion was availability of local educated young men and women (with primary education in the early years and high school later) who could be trained as Health Workers. Another was the quality of the local administration – whether or not the district governor was competent and willing to cooperate with setting up the facilities. It is thus possible that districts chosen earlier, presumably those with greater supply of educated young people and higher quality administrations, also enjoyed greater health and lower fertility. We test for the factors that influenced placement using probit regressions for the year in which villages were brought into the HNS. The results for placeman in 1986 and 1989 are presented in Table 3. The probability of being in the HNS before, say, 1989 is negatively related to fertility and positively related to literacy rates and the presence of schools in the village. These estimates corroborate the anecdotal evidence we obtained during our interviews to the effect that programs were placed first in areas with better administrative infrastructure and better education.

3 Data

Our unit of observation is a village designated as a "Main village" by MOHME. We obtained information on the year of establishment for 16715 "Main" villages that had a Health House by 2005. The Health Houses in these village cover more than 90% of the rural population, but they are less than 30% of all villages in Iran. In addition, there are another 60,000 smaller hamlets and collection of houses. Most of these units are served by the Health Houses in our sample. So, our test is about change in fertility in the "main" villages rather than all villages and rural settlements in Iran.

We were able to match 15,071 villages with village-level demographic and facilities data such as schools, electricity, piped water, etc. We use the demographic data extracted from the censuses of 1986, 1996, and 2006 to calculate our measure of the fertility outcome as the ratio of children 0-4 to women 15-49, the child-woman ratio (CWR), for each village. CWR is a measures fertility in the previous five years, so in 1986 it actually measures fertility during 1981-86. This does not present a problem for us since the change in fertility from this period to 1991-96 still provides a good measure of change in fertility during a period of rapid expansion of the rural health network. CWR is not the ideal measure of fertility because it is a measure of surviving children and is therefore affected by infant mortality.[1] In populations with the same life expectancy TFR can be derived from CWR but not if mortality varies (Rele 1967). Since we are comparing CWR's in two points in time, if the distribution of the error induced by differences in child mortality across the country remains constant during 1986-96, the errors will cancel out. If, on the other hand, changes in child mortality are systematic, bias may result. For example, villages integrated into the health network may experience a greater decline in mortality, so more of their births survive to be counted, in which case their CWR would underestimate the extent of decline in fertility. This induces a positive correlation between family planning services and change in CWR, which will bias the results in the direction of finding less impact from family planning than it is actually the case.

We do not have data on child mortality at the village level so we cannot determine the extent to which the distribution of CWRs accurately reflects the distribution of fertility across villages. However, we have this information at the rural district level. Child CWR and TFR at the district level are highly correlated. affected by differences in are reflecting the district level. We use district level infant mortality rates in our regressions in an attempt to control of differences in the level of infant mortality. deal with this problem we include infant

We were able to obtain information about the presence of schools and basic services for about 14,500 villages in our sample from the Ministry of Agriculture and Rural Reconstruction. For each census year we are able to tell whether the villages in our sample had schools (primary, lower- or upper-secondary), electricity, piped water, a mosque, public bath, and the like.

After eliminating villages with unreliable data, we are left with a working sample of 14,139 villages for 1986-1996 and 13,795 villages for all three years. Table 1 presents the summary statistics for the sample as a whole. Mean village population is 854, and the range is very wide, from 6 to more than 10,000. Average literacy rate is 47%, 95% of the villages had a primary school, 29% middles school and only 2% a high school.

Average child-woman ratio (CWR) is 725 children 0-4 old per 1000 women 15-49, and the range is from 31 to 3000. These outlier values of CWR arise because some villages are quite small making it possible to have extreme values of the CWR. In our empirical analysis we experiment with dropping the outliers to see if the results change, but since the sample is large, they do not matter. Apart from this, there is quite a bit of variation in fertility across the country that should help to identify program effect (Figure 6). The distributions of CWRs by census year are shown in Figure 7. There is a clear shift to the left in the distribution of CWR in each ten year period.

[1]It is also affected by mortality of women 15-49, but the variation in the mortality of this demographic group is much less than infant mortality.

4 Identification

Two features of Iran's rural family planning program offer strategies for identification of program impact. One is the considerable geographic variation in the spread of services in villages during 1985-2000, which seems uncorrelated with demand for contraception services and can therefore potentially identify program impact. Numerous studies take advantage of geographic variation in program placement to evaluate their impact (Duflo 2000, 2001, Breierova and Duflo 2004, Angeles, Guilkey, and Mroz 2005a and 2005b, and Miller 2005).

Another feature is the sudden policy reversal in 1989 from pro- to anti-natal, which essentially divides the target rural population into two treatment and comparison groups. In the treatment group are those families who in 1989 resided in villages already served by the rural Heath Network (but no family planning) and were therefore exposed to family planning services immediately after 1989. The comparison group consists of those who were not yet integrated into the Health Network System and were therefore not exposed to family planning.

In what follows we present results of three sets of regressions with different identification.

4.1 A difference-in-difference estimator

In this section we report on a difference-in-difference estimator based on fertility change in villages between the two census periods of 1986 and 1996. This method aims to identify the average treatment effect from the difference in the rate of fertility decline between a group of villages that between 1986 and 1996 went from being outside the HNS to being inside. We call this group the Program (or treatment) group. Our Comparison (or control) group consists of those villages that did not have a Health House in neither year.

The DID estimator is valid if the potential treatment effect for program and comparison groups are the same (Heckman, LaLonde, and Smith 1999). That is,

$$E(Y_{0t} - Y_{0t'}|D = 1) = E(Y_{0t} - Y_{0t'}|D = 0), \quad (1)$$

where Y_{0t} and $Y_{0t'}$ are the outcomes of interest in two periods of time, and D is the program dummy variable. In our case Y is the no-program child-woman ratios in the cross section data of 1986 and 1996, and D takes the value of one if the village has a Health House in year t and zero otherwise. Since outcomes are only observed in one state for each individual (or village), assumption (1) is not directly testable. For program villages ($D = 1$) we do not observe $Y_{it'}$.

This assumption requires that program and comparison villages have the same trend in the absence of the program. If program villages are randomly placed, this assumption would hold. As we argued earlier, in Iran program placement was not random, but neither was it directly based on the outcome variable (fertility). We find that its placement is related to observable village characteristics, such as schooling, which we can control for in the DID regression.

The DID estimator can be implemented with this equation:

$$Y_{it} = \alpha + \beta D_{it} + \gamma Year_t + \delta(D_{it} * Year_t) + X_{it}\psi + \epsilon_{it} \quad (2)$$

where Y_{it} is the child-woman ratio of village i in year t, D is a dummy variable which takes the value of one if the village has a Health House in year t, and X is a vector of controls that affect Y. The value of β is an estimate of the difference between Program and Comparison villages, γ is the common time trend, and δ is the program effect (the DID estimator).

As noted earlier, the main concern with the this identification strategy is that program placement may be endogenous; for example, if the villages covered early are systematically different from those that receive the services later. In particular, if these differences are not due to observable factors, such as education, and cannot be included in X, the dummy variable D may be correlated with the error term ϵ_{it}.

This would be the case if, for example, program placement had been compensatory in the sense that villages with lower health or higher fertility were included first, or if people had migrated to these areas to take advantage of the program (Rosenzweig and Wolpin 1986, 1988; Schultz 1988). Only studies that take advantage of an experimental design can claim true randomness in assigning women to treatment and control groups and thus offer a clean test of program effect (Sinha 2005). Others must rely on ways to reduce the bias resulting from endogenous program placement.

We first implement this test for two specific groups of villages, those without a Health House in 1986 and 1996 (program group) and those without in 1986 but with a Health House in 1996 (comparison). According to this definition, approximately 25% of the villages were in the comparison group (2434 villages) and the rest (7164 villages) were program. Table 2 presents the summary statistics for this regression. The two groups of villages are similar in population size (688 and 742, respectively) and CWR, which is slightly higher for the comparison group (1.01) compared to program (0.94). Consistent with their lower CWR, program villages have on average a higher literacy rate and a greater proportion have schools than comparison villages.

The regression results for equation (3) are presented in Table 4. The average difference between program and comparison villages (row 1) is rather small and gets even smaller as we add controls that are known determinants of fertility. This is the only coefficient that changes much as we add more regressors. The common time trend is a reduction of 0.43 in the CWR, about fifty percent decline, and does not change from one specification to another. The coefficient of interest (program effect) is -0.032 (also constant across regressions), which is significant but small relative to the average decline in child woman ratio. Program villages on average experienced a decline if 0.47 compared to 0.44 for comparison villages. This difference is quite modest and indicates that stronger forces operating in both groups of villages were driving rural fertility down during the 1986-1996 period.

Adding controls for schooling, religion, and infrastructure does not change this finding. The presence of primary, middle and high school are all significant and, as expected, negatively related to fertility. These variables may be endogenous to some degree (villages with lower fertility are more likely to acquire schools), so these effects may be biased. Villages with mosques and those with majority shia populations also had on average lower fertility. Villages with access to electricity had lower fertility but those with piped water in column (4) have *higher* fertility. We believe that this may be due to the fact that availability of clean water has a more direct effect in lowering mortality which then raises the child woman ratio for a given level of fertility. When we control for district-level fixed effects (column 5), which removes differences in mortality at the district level, which may be a substantial part of the variation in health condition, the coefficient of piped water is becomes negative and significant. In addition to removing the effect of variables common health conditions, fixed effects regressions control for cultural norms that affect individual responses to the family planning program as well as the quality of family planning services that we believe very between districts rather than within districts. Since we do not have information about the quality of services offered in the NHS, these results offer a glimpse of how important quality variation may be in determining program effect. The fact that the size and sign of the coefficients of comon time trend and program effect remain unchanged in the fixed effects regressions indicates that the unobserved district level variables are not important in the determination of these two effects.

4.2 A difference-in-difference estimator for policy reversal

Does it matter if we take the year of policy reversal (1989) as the basis for the DID estimation? This DID estimator compares fertility indicators before and after 1989 for a slightly different definitions of program and comparison villages. In this case we can make a stronger case for the exogeneity of the placement of Health Houses. The argument is based on the fact that villages that received a Health House before 1989 did so independently of their demand for family planning services (and presumably fertility) because at the time family planning was not government policy and therefore not a part of the NHS mandate. Thus between 1985-89 many rural Health Houses operated and offered maternal and child health services but not family planning services.[2] In 1989, when the government made its sudden turnabout on population policy and Health House services expanded to include family planning, there were over 8000 Main villages, half of the total, that were able to take advantage of the new services immediately while others had to wait for one or more years before getting theirs. We believe that this observation forms a reasonable basis for identification of program impact. The difference between this model and the preceding model is in the increased confidence in the exogeneity of program placement.

About 11,808 villages in the sample (71%) fall into the program group (had a Health House by 1989) and the remaining 4,914 are comparison. Average CWR for the program group was 0.97 in 1986 and 0.51 in 1996, and for the comparison group 1.01 and 0.57, respectively. Both groups experienced sharp declines in fertility, but again the evidence in Table 5 indicates that the difference in the decline was not

[2]In visits to several Health Houses we came across one village (Firouzkooh, near Tehran) where health workers recalled giving advice on family planning and services to those who requested it. So, the policy reversal was not as drastic for all villages as one might assume.

large. This table presents the results of estimating equation 3 with the a slightly different definition for the Health House dummy variable. There is no noticeable difference between these results and the comparable results for the previous model in Table 4. One reason for the similarity between these two sets of results may be that fertility decline for those villages that received their Health House between 1986 and 1989 is the same. This implies that actual program impact, for what it was worth, may have occurred after 1989, when family planning was added to the HNS mission. We learn more about this issue in the next section when we consider the effect of the length of exposure to the program and can distinguish between the years that Health Houses were present (since establishment) and the years they offered active family planning services (since 1989 or establishment whichever is shorter).

4.3 The effect of exposure to the program

This last observation raises the question that exposure to the HNS may matter and more so for the years after the policy reversal in 1989. To test for this conjecture, we replace the dummy variable with the years of exposure as the basis for the evaluation of program impact. This is our third and final identification strategy.

We define exposure as the difference between the census year in which we observe the fertility outcomes (1996 or 2006) and the year of establishment of the Health House. This allows us to distinguish between the effect of the years in the Health Network before and after the policy reversal, which provides a test for the difference in the effects of having a Health House with and without the family planning component. The regression equation is now changed to

$$Y_{it'} = \alpha + \alpha' Y_{it} + \beta E_{i86} + \beta' E_{i89} + X_{it}\psi + \epsilon_i \tag{3}$$

where t' is 1996 or 2006.

The results of the regression of CWRs in 1996 and 2006 on the CWR in 1986 along with a set of other exogenous variables are presented in Table 6. Exposure has a small but significant negative effect on CWR in 1996 (and even smaller in 2006), but in columns 2 and 4, where we put the years of program exposure before and after policy reversal in the regression separately, we note that the former has no effect on CWR. This result indicates that, for what it was worth, the mother and child well-being functions of the Health Houses before family planning went into effect does not seem to have had much effect on fertility.

5 Conclusion

During the 1990s rural fertility in Iran declined sharply. At the same time an innovative family planning program, known as the rural Health Network System, was gradually extended across 60,000 villages in Iran. This paper takes advantage of the timing of when villages were integrated into Iran's Health Network System to identify the impact of the country's family planning program on fertility. Between 1986 and 1996 about 8000 Health Houses were built serving about 1.2 households. We measure fertility at the village level in two points in time, in census years 1986 and

1996, and develop a difference-in-difference (DID) estimator that compares decline in the village-level child-woman ratios between those villages with no Health House in either point in time and those that received one by 1996. The DID estimator shows a very weak program effect, indicating that other factors played an important role in the sharp decline in fertility in rural Iran during this period. In particular, we find that the level of infrastructure — electricity and schools — influenced the child woman ratio.

Our results refer specifically to the construction of Health Houses and inclusion in the rural health network. It is important to point out that the family planning program had other components that may have had their effect independent of whether a village was in or out of the HNS. Most important was the signal sent by the policy reversal, namely that government support for large families were to be cut in future. Shortly after the policy reversal the rationing of many basic commodities which depended on the number of children in a family were removed. At some point the government threatened to take all subsidies for the fourth child, including free tuition from elementary to university. Finally, the propaganda campaign stressed the tradeoff between the number of children and investment in each child. This may have signalled government commitment to child education and higher returns to child education, and therefore higher returns to child education, thus increasing at the margin the cost of an additional child. The founder of the Islamic Republic, Ayatollah Khomeini, repeatedly stressed that the Revolution belonged to the poor and the disinherited (*mostazafin*), many of whom lived in rural areas. Consistent messages about empowering the rural poor in Iran's new Islamic society, coupled with the promise of health and family planning services may have been sufficient in convincing rural families to change their childbearing strategy from high fertility and low investment in children to low fertility and high investment even before the actual services arrived.

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Figures

Figure 1: Total Fertility Rates, 1972-2006

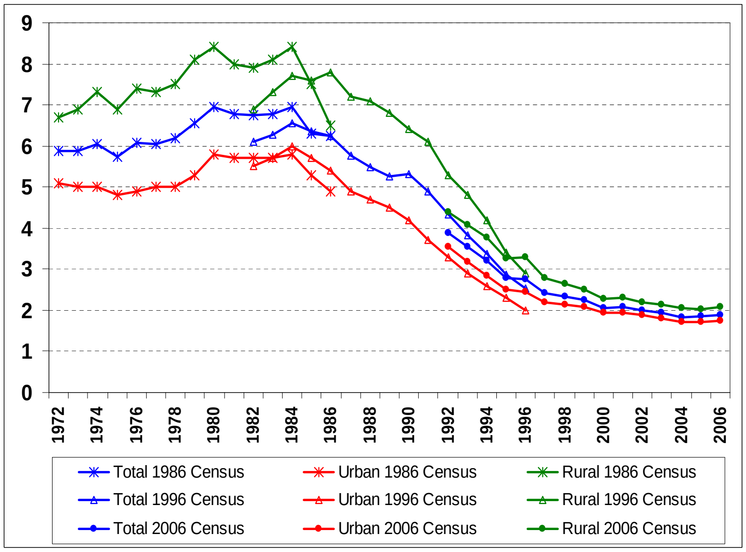
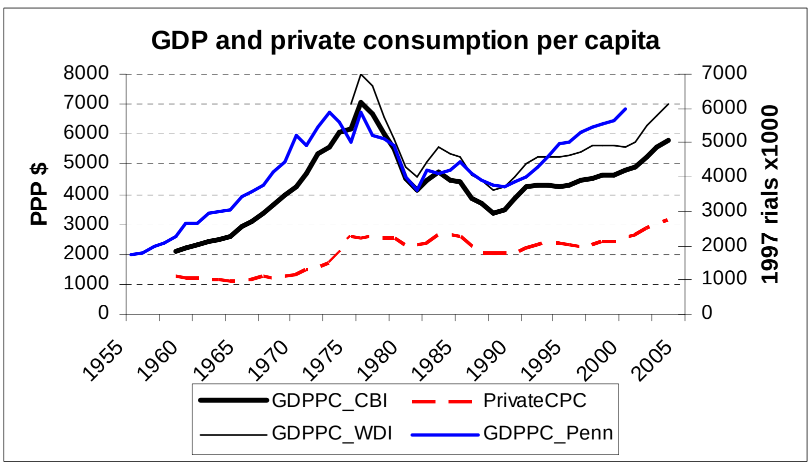


Figure 2: Iran's main macroeconomic indicators, 1955-2005



Source: World Bank World Development Indicators database, The Central Bank of IR Iran, and Penn World Tables.

Figure 3: Decline in fertility and child mortality in Iran and Turkey

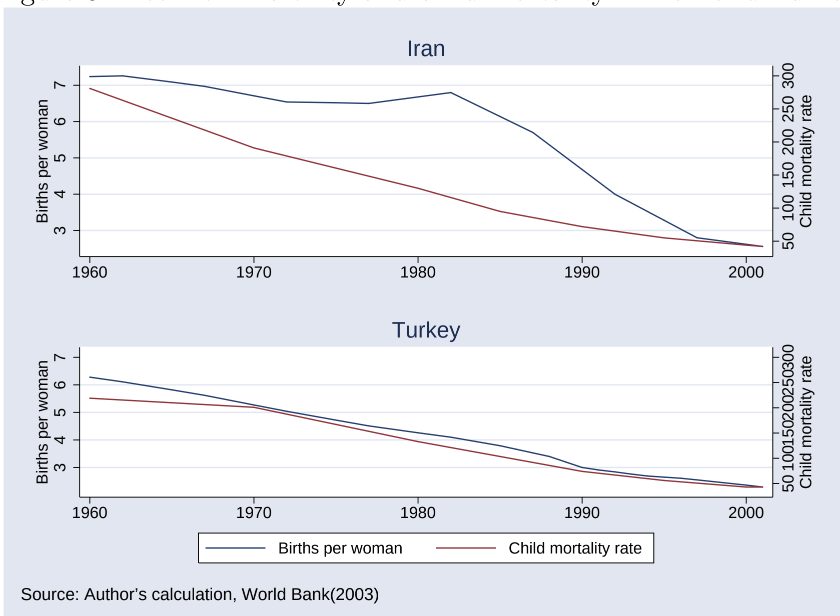


Figure 4: The Role of Health Houses in Iran's Rural Health Network System

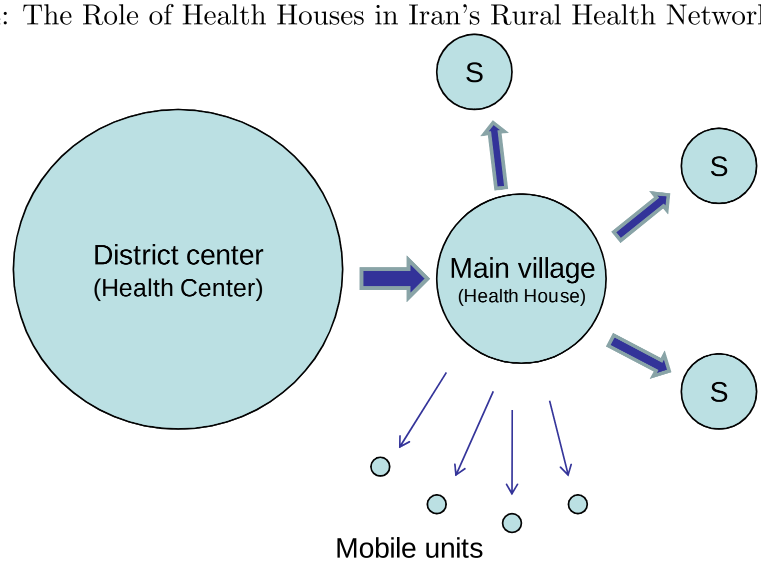
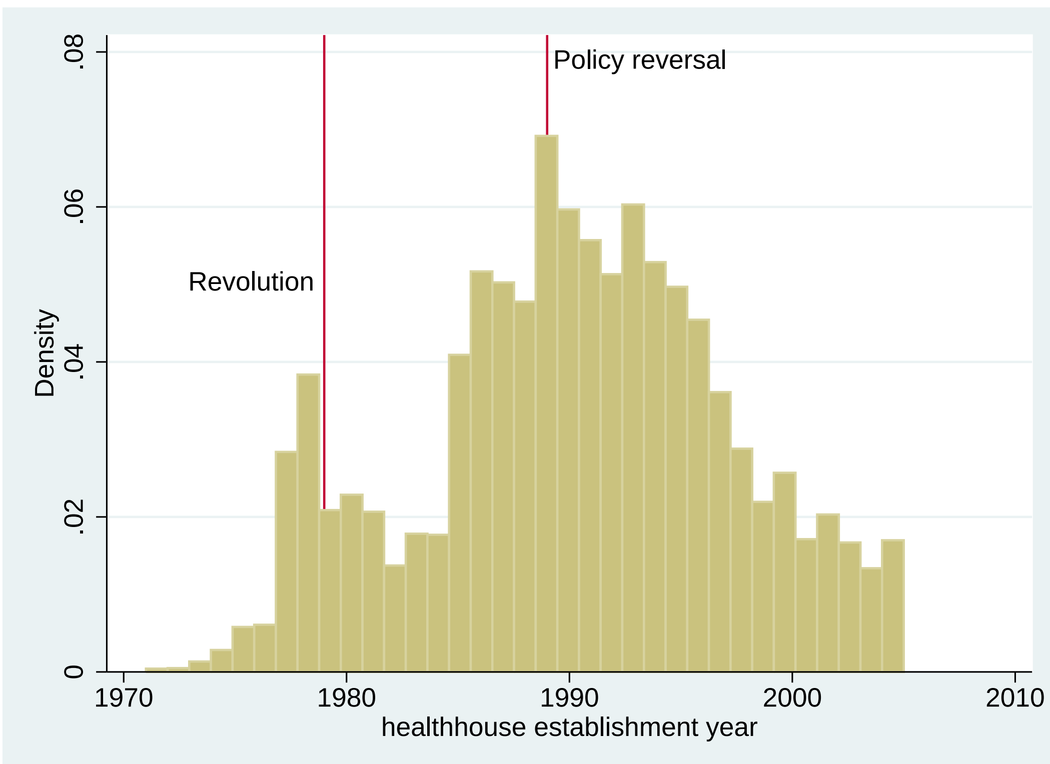


Figure 5: The distribution of Health Houses by year of establishment



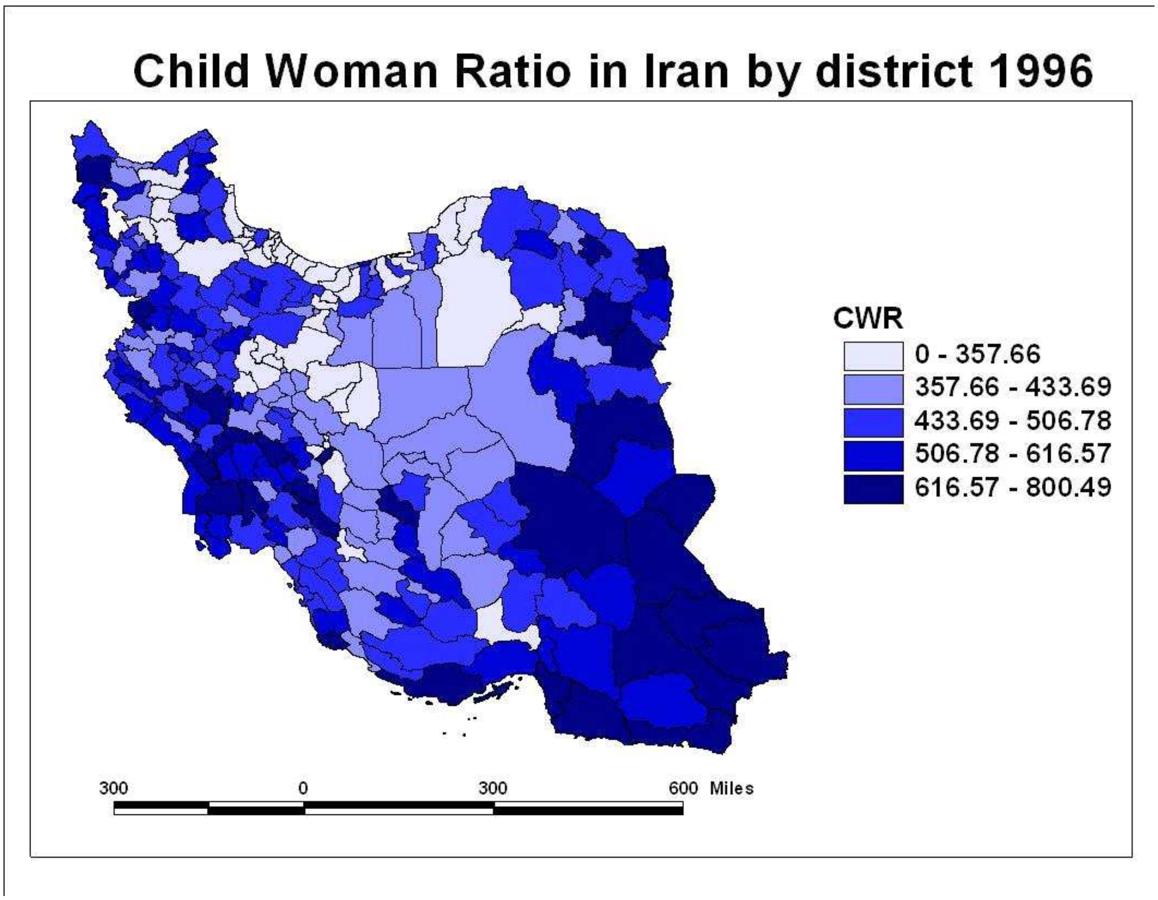


Figure 6: Child-woman ratios at the district level, 1996

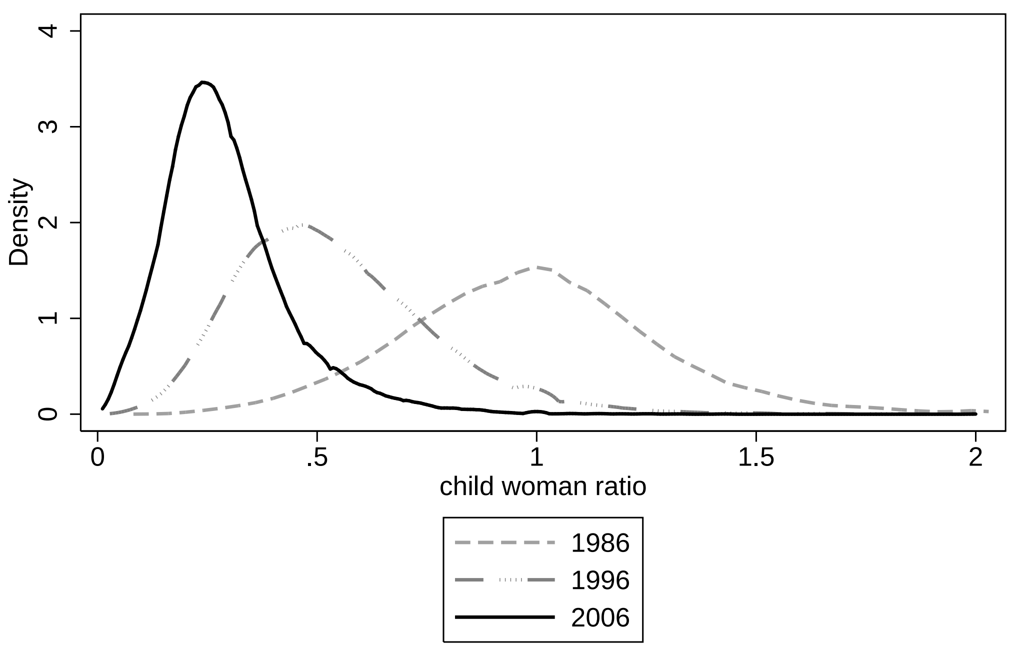


Figure 7: The distributions of village-level child-woman ratios by census year

Tables

Table 1: Summary Statistics for the Full Sample

Variable	Mean	Std. Dev.	Min.	Max.	N
Population	859	763.834	6	10136	27018
Children (0-4)	128.363	124.485	1	2119	27018
Women (15-49)	186.9	170.172	1	2501	27018
Child woman ratio	0.724	0.311	0.031	2.169	27018
Literacy	0.474	0.158	0.004	0.857	27003
Proportion with primary school in 1986	0.951	0.217	0	1	27018
Proportion with middle school in 1986	0.289	0.453	0	1	27018
Proportion with high school in 1986	0.024	0.153	0	1	27018
Proportion with mosque in 1986	0.852	0.355	0	1	27018
Proportion with Shia majority in 1986	0.86	0.347	0	1	27018
Proportion with electricity in 1986	0.543	0.498	0	1	27018
Proportion with piped water in 1986	0.59	0.492	0	1	27018

Notes: N is the number of villages in the sample which includes the 1986 and 1996 samples.

Table 2: Summary Statistics for Comparison and Program Groups

	Mean				Std. Dev.			
	Comparison		Program		Comparison		Program	
Year	1986	1996	1986	1996	1986	1996	1986	1996
Total population	693	747	806	826	759	873	655	706
Child (aged 0-4) population	136	94	152	94	153	106	128	85
Female (aged 15-49) population	137	173	161	194	152	206	132	167
Child woman raito	1.01	0.57	0.96	0.50	0.23	0.20	0.23	0.18
Literacy	0.31	0.54	0.36	0.58	0.14	0.12	0.12	0.10
Villages with primary school in 1986	0.91	-	0.95	-	0.29	-	0.22	-
Villages with middle school in 1986	0.12	-	0.24	-	0.32	-	0.43	-
Villages with high school in 1986	0.01	-	0.02	-	0.10	-	0.13	-
Villages with mosque in 1986	0.78	-	0.85	-	0.42	-	0.35	-
Villages with shia majority in 1986	0.80	-	0.85	-	0.40	-	0.36	-
Villages with electricity in 1986	0.43	-	0.51	-	0.50	-	0.50	-
Villages with piped water in 1986	0.53	-	0.57	-	0.50	-	0.49	-
# of observations	2,434		7,164					

Table 3: Program placement: the relationship between village characteristics and having a Health House

	(1)	(2)
1986 child woman ratio	-0.095	-0.093
	(0.018)**	(0.020)**
Literacy	0.580	0.722
	(0.040)**	(0.044)**
Dummy for primary school in 1986	0.067	0.082
	(0.018)**	(0.020)**
Dummy for middle school in 1986	0.187	0.248
	(0.011)**	(0.011)**
Dummy for high school in 1986	-0.005	0.039
	(0.024)	(0.031)
Dummy for mosque in 1986	0.005	-0.012
	(0.012)	(0.013)
Dummy for shia majority in 1986	0.040	-0.025
	(0.012)**	(0.014)
Log of population	0.016	0.014
	(0.006)**	(0.007)*
Observations	14138	14138

Notes: Coefficients are marginal effects. Dependent variable in column 1 is presence of a Health House in 1986 and in column 2 presence in 1989. Standard errors in parentheses: * significant at 5%; ** significant at 1%.

Table 4: The difference-in-difference estimator for change in fertility 1986-1996

	(1)	(2)	(3)	(4)	(5)
Difference between groups	-0.043	-0.030	-0.023	-0.020	-0.012
(Program dum=1)	(0.005)**	(0.005)**	(0.005)**	(0.005)**	(0.004)**
Common time trend	-0.434	-0.434	-0.434	-0.434	-0.434
(Period dum=1)	(0.006)**	(0.006)**	(0.006)**	(0.006)**	(0.005)**
Program effect	-0.032	-0.032	-0.032	-0.032	-0.032
(Program dum*Period dum=1)	(0.007)**	(0.007)**	(0.007)**	(0.007)**	(0.006)**
Primary school in 1986		-0.046	-0.003	-0.001	-0.023
		(0.006)**	(0.006)	(0.006)	(0.006)**
Middle school in 1986		-0.084	-0.066	-0.056	-0.044
		(0.004)**	(0.004)**	(0.004)**	(0.003)**
High school in 1986		-0.083	-0.080	-0.071	-0.048
		(0.012)**	(0.012)**	(0.012)**	(0.010)**
Mosque in 1986			-0.089	-0.082	-0.014
			(0.004)**	(0.004)**	(0.005)**
Shia majority in 1986			-0.090	-0.082	-0.038
			(0.004)**	(0.004)**	(0.005)**
Electricity in 1986				-0.057	-0.031
				(0.003)**	(0.003)**
Piped water in 1986				0.007	-0.009
				(0.003)*	(0.003)**
Constant	1.008	1.060	1.159	1.165	1.080
	(0.004)**	(0.007)**	(0.008)**	(0.008)**	(0.008)**
Observations	19196	19196	19196	19196	19196
R-squared	0.55	0.57	0.59	0.60	0.71

Note: Robust standard errors in parentheses; * significant at 5%; ** significant at 1%; Col(1)-Col(4) regular OLS model; Col(5): district level fixed effect model

Table 5: The difference-in-difference estimator for policy reversal in 1989

	(1)	(2)	(3)	(4)	(5)
Difference between groups	-0.037	-0.027	-0.020	-0.018	-0.010
(Program dum=1)	(0.006)**	(0.006)**	(0.006)**	(0.005)**	(0.005)*
Common time trend	-0.434	-0.434	-0.434	-0.434	-0.434
(Period dum=1)	(0.006)**	(0.006)**	(0.006)**	(0.006)**	(0.005)**
Program effect	-0.030	-0.030	-0.030	-0.030	-0.030
(Program dum*Period dum=1)	(0.007)**	(0.007)**	(0.007)**	(0.007)**	(0.006)**
Primary school in 1986		-0.049	-0.006	-0.003	-0.029
		(0.008)**	(0.008)	(0.008)	(0.008)**
Middle school in 1986		-0.082	-0.063	-0.053	-0.043
		(0.004)**	(0.004)**	(0.004)**	(0.003)**
High school in 1986		-0.089	-0.086	-0.075	-0.045
		(0.012)**	(0.012)**	(0.013)**	(0.011)**
Mosque in 1986			-0.089	-0.082	-0.014
			(0.005)**	(0.005)**	(0.005)**
Shia majority in 1986			-0.089	-0.080	-0.032
			(0.004)**	(0.004)**	(0.007)**
Electricity in 1986				-0.057	-0.031
				(0.003)**	(0.003)**
Piped water in 1986				0.004	-0.008
				(0.003)	(0.003)**
Constant	1.008	1.062	1.160	1.167	1.082
	(0.005)**	(0.009)**	(0.010)**	(0.010)**	(0.011)**
Observations	16566	16566	16566	16566	16566
R-squared	0.55	0.56	0.58	0.59	0.70

Note: Robust standard errors in parentheses; * significant at 5%; ** significant at 1%; Col(1)-Col(4) regular OLS model; Col(5): district level fixed effect model

Table 6: The effect of exposure to the family planning program on child-woman ratios in 1996 and 2006

	cwr 1996			cwr 2006		
	(1)	(2)	(3)	(4)	(5)	(6)
Child woman ratio in 1986	0.332	0.331	0.253	0.113	0.113	0.061
	(0.006)**	(0.006)**	(0.006)**	(0.004)**	(0.004)**	(0.004)**
Exposure	-0.002			-0.001		
	(0.000)**			(0.000)**		
Exposure before 1989		0.001	0.001		0.001	0.000
		(0.000)**	(0.000)**		(0.000)**	(0.000)
Exposure after 1989		-0.007	-0.008		-0.003	-0.002
		(0.001)**	(0.000)**		(0.000)**	(0.000)**
Primary school in 1986	-0.042	-0.039	-0.045	-0.018	-0.017	-0.016
	(0.006)**	(0.006)**	(0.006)**	(0.004)**	(0.004)**	(0.004)**
Middle school in 1986	-0.031	-0.030	-0.023	-0.011	-0.012	-0.008
	(0.003)**	(0.003)**	(0.003)**	(0.002)**	(0.002)**	(0.002)**
High school in 1986	-0.005	-0.007	0.007	0.003	0.002	0.008
	(0.009)	(0.009)	(0.008)	(0.006)	(0.006)	(0.005)
Mosque in 1986	-0.039	-0.038	-0.027	-0.011	-0.010	-0.019
	(0.004)**	(0.004)**	(0.004)**	(0.003)**	(0.003)**	(0.003)**
Shia majority in 1986	-0.091	-0.093	-0.042	-0.073	-0.073	-0.028
	(0.004)**	(0.004)**	(0.005)**	(0.003)**	(0.003)**	(0.003)**
Electricity in 1986	-0.056	-0.056	-0.036	-0.010	-0.010	-0.005
	(0.003)**	(0.003)**	(0.003)**	(0.002)**	(0.002)**	(0.002)**
Piped water in 1986	-0.011	-0.011	-0.010	-0.006	-0.007	-0.005
	(0.003)**	(0.003)**	(0.003)**	(0.002)**	(0.002)**	(0.002)**
Constant	0.393	0.405	0.421	0.278	0.295	0.298
	(0.009)**	(0.009)**	(0.010)**	(0.006)**	(0.007)**	(0.007)**
Observations	12476	12476	12476	12476	12476	12476
R-squared	0.39	0.39	0.54	0.18	0.19	0.40

Note: Standard errors in parentheses; Dependent variable in Col(1)-Col(3):
child woman ratio of 1996; Dependent variable in Col(1)-Col(3): child woman ratio of 1996;
Col(3), Col(6): district level fixed effect model;* significant at 5%; ** significant at 1%