Family Planning and Fertility: Estimating Program Effects using Cross-sectional Data

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PRELIMINARY

Abstract

This paper uses a novel method of identifying the effects of a family planning program, when there is endogenous program placement and only cross-sectional data are available. It focuses on the differential effects of health facilities, standard family planning and community based reproductive health programs. We find that access to family planning reduces the age specific fertility by about 0.5 children for women younger than 30, while there is less of an effect for older women. This effect is statistically significant and in line with what other studies have found. Corresponding to the reduction we also find a significantly lower probability of having had a birth within the last twelve months. Clearly, this reduction is not overly large when compared to the high total fertility rate in Ethiopia. We do, however, find other positive effects of access to family planning program. Firstly, women are generally older when they have their first child in areas with family planning service, which may have a beneficial effect on child health and the health of the mother. Secondly, it appear that the risk of an unwanted pregnancy decreases, especially for older women, then there is access to familiy planning.

Keywords: Family planning, Community based reproductive health, program evaluation, Ethiopia

JEL codes:

1 Introduction

This paper examines how the effectiveness of program interventions can be evaluated when the available data are less than ideal. The example we use is the effect of the provision of family planning service on fertility in Ethiopia. [on Ethiopia and fertility]

One of the main problems in evaluating the impact of a program intervention is that the government, or more general the responsible organisation, is likely to respond to characteristics of an area when deciding whether to implement a program there, some of which may be unobservable to the researcher. Say a government is interested in reducing fertility. One possible policy is place family planning programs in the areas with the highest fertility. Assuming that the program does reduce fertility, then naively comparing areas with and without family planning program may not show any effect of the program depending on the fertility patterns before the program and the size of the effect. A good illustration of these problems can be found in Pitt, Rosenzweig, and Gibbons (1993); they show that not taking account of the non-random placement of programs leads to substantial biases in the estimated program effects. [quote numbers on bias]

The most straight-forward way of overcoming the problem of non-random placement is to randomize the allocation of the programs and then compare the outcomes of interest between the treatment and control areas [general reference on experiments?]. Probably the best known example of a family

planning program is the experiment in Matlab, Bangladesh. It began in 1978 and assigned about half of the villages to receive a very intensive family planning program, while the other half continue to be served by the standard government family planning program. Phillips, Simmons, Koenig, and Chakraborty (1988) found that fertility was 24 percent lower in the villages that had received the intensive family planning program than in the other villages. Pritchett (1994), however, argued that these results reflect a level of program intervention and intensity which is unlikely to be sustainable. The program was exceedingly expensive with the cost of the program being in the order of 35 times the normal cost of running a standard government family planning program per woman reached.[1] A more recent study of the Matlab family planning program is Joshi and Schultz (2005). They analyse the same 141 villages in Matlab, Bangladesh from 1974 to 1996 and find that village and individual data show a decline in fertility of about 15 percent in the program villages compared with the control villages.

While experiments appear to offer an attractive means to avoiding the problems of non-random placements there are a number of drawbacks to this approach. Firstly, given the substantial lag in fertility decisions an experiment would have to run for a substantial period of time before one was able to assess the effect on fertility. Any short-run effects may simply reflect changes in spacing-pattern rather than actual changes in the overall number

[1]Pritchett (1994) calculates that each averted birth cost USD 180 in 1987, which was equivalent to 120 percent of Bangladeshs GDP per capita at the time.

of children. Secondly, it is not clear to what extent an experiment in, say, Bangladesh can inform the creation of programs in Ethiopia given the substantial differences in the structure of the economies and the issues facing the population. Finally, in many areas family planning programs have been in existence for a substantial period of time and not using the information that can be derived from these programs is unattractive for mainly program providers.

An alternative approach to an experiment is the use of longitudinal data. If these are available it is in principle straight forward to estimate the effect of a program using fixed effects estimation, which removes the problem of unobservable characteristics influencing the program placement. There are, however, two cave-ats to this approach. Firstly, there must be a sufficient number of areas which acquire a program between the (minimum) two data points. Secondly, the time period between the surveys must be long enough for the program to have an effect. If these conditions are not fulfilled it is difficult to identify the program effects with any precision. [additional problems with fixed effects - see angeles98] Two example of studies that have used longitudinal data to identify program effects are Rosenzweig and Wolpin (1986) for the Laguna province in the Philippines and Pitt, Rosenzweig, and Gibbons (1993) for Indonesia. Both show that the cross-sectional estimates show substantial bias compared with the fixed effects estimates. Only Pitt, Rosenzweig, and Gibbons (1993) directly examine the effect of family planning programs on fertility. They find that although there does appear to be

a negative effect, although it is very imprecisely estimated. In Rosenzweig and Wolpin (1986) the family planning programs do have a significant and positive effect on child health as measured by both (standardised) weight and height.

For the above reasons and the scarcity of available experimental or longitudinal data researcher are often faced with using cross-sectional data for analysing interesting questions when analysing program effects. Two recent examples, which use very different approaches to overcome the problem of non-random program placements, are Angeles, Guilkey, and Mroz (1998) and Miller (2005). [Describe Angeles, Guilkey, and Mroz (1998) method - essentially fancy IV, but instruments not very attractive] Although the method in Angeles, Guilkey, and Mroz (1998) is not strictly speaking a standard instrumental variable approach the underlying idea behind their method is very similar. First, they estimate the selection process used to determine program placement. Second, they estimate the program effects using a semi-parametric, random-effects estimator which allows for correlation between unobservables that influence program placement and the outcomes of interest. Identification comes from variables that influence program placement, but which are unrelated to the individual fertility decision. [limitation of their study: choice of "instruments" likely affect both placement and fertility] They find, using data from Tanzania, that family planning programs do have a negative effect on fertility, although this effect varies with the type of and distance to outlet and how old a woman was when the program was

introduced. They find, using simulations, that a woman exposed to family planning would have 4.13 children instead of 4.71 children in the absence of family planning interventions. This results, however, masks differences between the different types of outlets; health centers are substantially more effective than hospital and dispensaries.

Miller (2005), in contrast to Angeles, Guilkey, and Mroz (1998), does not use an instrumental variable approach. Instead, he argues that the haphazardly implementation of the family planning program, PROFAMILIA, in Colombia essentially implies that non-random program placement in not an issue. [estimates program placements?] One potential problem with this approach is that even if (available) observables do not affect placement, it is still possible that unobservables do, in which case the results are subject to bias. Interestingly, the results Miller (2005) corresponds closely to those of Angeles, Guilkey, and Mroz (1998). He finds that PROFAMILIA has led to a reduction in lifetime fertility on the order of half a child. Furthermore, it appears to have a led to a substantial postponement of first birth, which in turn have led to higher education for young women. Miller (2005) finds, however, that only around 10 percent of the sharp decline in fertility in Colombia can be explained by the family planning programs.

This paper examines under which assumptions identification can be achieved when only cross-sectional data are available. We do this using the basic framework laid out in Menon and Pitt (2001), who suggested that area characteristics can be used as instrument for the placement decision.

2 Family Planning in Ethiopia

[make sure to describe health facilities, family planning services and CBRH programs and types of each]

The government of Ethiopia adopted a population policy in 1993 with an overall objective of harmonizing the country's population growth rate with that of the economy, specifically to achieve a TFR of 4 children per women by 2015. One of the major strategies has been to expand access to family planning programs so that by 2015 contraceptive prevalence would reach 44 percent (Transitional Government of Ethiopia 1993).

Ethiopia has historically have had a very low level of contraceptive use. According to the first ever-national survey on fertility and family planning in 1990, only four percent of the women in their reproductive ages were using some family planning methods, of which less than three percent were using modern contraceptives (CSA, 1993). In 2000 the CPR for currently married women had increased to six percent (Central Statistical Authority [Ethiopia] and ORC Macro 2001).

Recently, however, a number of surveys indicate that the use of family planning method has significantly increased since the 2000 DHS. The Essential Services for Health in Ethiopia (ESHE) conducted three region-wide surveys in SNNP, Oromia and Amhara regions between 2003 and 2004. The studies documented rates of 16 percent, 19 percent and 16 percent in the Amhara, Oromia and SNNP regions, respectively. The corresponding

prevalence for modern contraceptives was 14 percent, 16 percent and 14 percent in the three regions, respectively. The average modern contraceptive prevalence rate for the three regions combined was 15 percent (Essential Services for Health in Ethiopia 2005). In September 2004, Pathfinder International Ethiopia conducted another survey on family planning and fertility in Amhara, Oromia, SNNP and Tigray regions. The use of modern methods was the highest in Oromia (24 percent) followed by Tigray (20.4 percent), Amhara (20.5 percent) and SNNP region (17.1 percent). The overall contraceptive prevalence for the four regions combined was 21 percent (Pathfinder International Ethiopia 2004).

Preliminary results from DHS 2005 show that 15 percent of married women use some method of contraception and that the majority of them rely on a modern method (Central Statistical Authority [Ethiopia] and ORC Macro 2005). Hence, use of modern contraceptive methods has more than doubled from 6 percent of currently married women in the 2000 DHS to 14 percent in the 2005 DHS. This is in line with what is reported in Essential Services for Health in Ethiopia (2005), but it appears that Pathfinder International Ethiopia (2004) substantially overestimate the increase in contraceptive use which is probably due to the oversampling of areas where Pathfinder is active. It is worth noting that in spite of the increase in contraceptive use the TFR has only fallen 0.1 between the two DHS surveys (5.5 to 5.4).

Ethiopia has one of the lowest contraceptive prevalence rates in Sub-

Saharan Africa. Given that even the countries that have done well are far from the 44 percent prevalence rate which is the goal for Ethiopia it seems unlikely that the 44 percent goal can be reached by 2015, unless there are substantially investments made in family planning programs.

In terms of the effect of increasing contraceptive use Malawi is instructive. She has seen a pattern which, to some extent, mirrors what Ethiopia is currently seeing. In 1992 the use of modern contraceptives stood at 7 percent, while it had increased to 26 percent by 2000. Despite this large increase in contraceptive use Malawi saw only a 0.4 reduction in the TFR (from 6.7 to 6.3 children) over the same time period.

Regional variation is clearly apparent in the preliminary results of the 2005 DHS. The use of modern contraceptive is 45 percent in Addis Ababa and 3 percent in the Somali Region. The three big regions, namely Oromia, Amhara and Southern Nations Nationalities Peoples (SNNP), which constitutes over 70 percent of the country's population, have contraceptive prevalence r ates of 13.6, 16.1 and 11.9 percent, respectively.

There are also significant urban/rural, and poor/rich differences in contraceptive use. While CPR is 46.7 percent in urban areas, it is only 10.9 percent in rural areas. Unfortunately, data on the distribution by rich and poor is not yet available for the 2005 DHS, but in the 2000 DHS the differentials between the rich and poor were enormous, with 29 percent of rich women and only 2 percent of poor women using any method of contraception.

The 2005 Ethiopia DHS show that the most commonly used modern

methods are injectables (10 percent) and the pill (3 percent). The other modern methods are used substantially less; those are condom (0.1 percent), female sterilization (0.1 percent), IUD (0.2 percent) and any traditional method (0.8 percent). These numbers are based on Table 4 in Central Statistical Authority [Ethiopia] and ORC Macro (2005) and are very imprecise given rounding errors. For comparison the numbers for the 2000 DHS were injectables (3.1 percent), followed by the pill (2.5 percent), condom (0.3 percent), female sterilization (0.3 percent), IUD (0.1 percent) and any traditional method (1.7 percent). It means that over 80 percent of contraceptive prevalence in that year was accounted for by the injectables and pills.

It is widely held that most family planning clients in Ethiopia prefer injectables to other methods because of its convenience as it is taken as a single shot to provide protection for three months. On the other hand, there are a number of deterrents to the uptake of long-term methods in the country. For example, an assessment of the reasons for the low use of IUD in Ethiopia concluded that inadequate information about the method, lack of access and unfounded rumors about the side effects of the method were the most important barriers to use the method (Pathfinder International Ethiopia 2003).

What is interesting is that lack of knowledge does not seem to be a major impediment to use. Among the reasons for not using contraceptives 12.5 percent mention lack of knowledge about methods, while 16.7 mention lack of knowledge about a source of contraceptives. A substantially number of

women are not using because of fertility related reasons, which includes everything from not having sex to breastfeeding. Of more interest is that a relatively large number mention health concerns (including possible side effects) among the reasons for not using contraceptives. This is clearly one area where more information might be beneficial.

The MOH guideline for the provision of contraceptives states that a range of family planning methods are available to family planning clients in order to insure method mix in the country. Despite this, contraceptives shortage is often reported in the country. The 2002 national family planning program assessment indicated that although there had been increasing efforts to enhance the availability and accessibility of contraceptive methods in the country, the efforts seemed to capitalize on only condoms, pills and injectables. The poor contraceptives logistics management system often blamed for the lack of continuous supply of family planning commodities in the country. In particular, shortage of transportation and storage facilities are the major barriers to insure continuous availability of contraceptives in the country (Mekonnen 2005). Without improvements in these areas it is very unlikely that the stated goal of a CPR of 44 percent will be reached by 2015.

3 Estimation Strategy

During conversations with NGOs responsible for the introduction of community based reproductive health (CBRH) agents we asked them which factors

influenced their decisions on where to place new programs.[2] The main factors were access to a family planning clinic in the area, since the agents can only distribute a limited set of contraceptives, and accessability to the area. There were, however, also a third important factor, which is also the most interesting one: The extent to which an area was "receptive" to the family planning idea. This "receptiveness" was often infered from discussions with the local community leaders, rather than being determined from a survey of the potential users. The important difference between the two first factors and the third is that the former are, in principle, measurable, while the latter is generally unobservable.

Although we do not claim that the Ethiopian administration distributed health facilities and family planning program according to the same critia as the NGOs it illustrate that it likely that we are, in fact, dealing with two (related) decisions: Where to place family planning programs and whether to use the services offered if one is available. These two decisions are, of course, made by different agents; the government decides where to place the programs, while the individual woman/family decides whether to use the programs. The main issue is that the there may be unobservable factors which influence both whether to place a program in an area and whether women in the area will use the services. These factors need not be directly related to the desire to use family planning services. A government may, for example, favour areas or ethnic groups what supports it. As long as these

[2]We return to the effectiveness of the CBRH programs below.

areas or groups respond differently to the implementation of the program we need to find a way to avoid any bias that might result from these unobservable characteristics.

We first estimate the determinants of the decision on whether to place a program P in area k and secondly the program effect on the individual decision y_{ik}. The system of equations is then

$$P_k = \boldsymbol{X}_k\alpha_1 + \boldsymbol{Z}_k\alpha_2 + \nu_k, \quad (1)$$

$$y_{ik} = \boldsymbol{X}_k\beta_1 + \boldsymbol{X}_i\beta_2 + P_k\beta_3 + \epsilon_{ik}, \quad (2)$$

where $\boldsymbol{X}_k$ is a vector of exogenous variable that are area specific, $\boldsymbol{Z}_k$ is a set of area specific exogenous variable that affect program placement but do not affect the individual fertility decision, the individual characteristics are captured by $\boldsymbol{X}_i$ and finally, the main variable of interest is P_i which measures the program's impact on the outcome of interest. As discussed by Wooldridge (2002, Chapter 18) β_3 can be estimated under relatively relaxed conditions using a modified two stage method. The first stage estimates the determinants of the placement decision. In the second stage the individual decision equation is estimated by IV using the *fitted probabilities* from the first stage, $\mathbf{X_k}$ and $\mathbf{X_i}$ as instruments. An attractive feature of this approach is that the results are robust even if the placement equation is not correctly specified.

The major difficulty is finding a set of "instruments" that can be used to

identify β_3 in (2). A promising possibility is to use relative characteristics of different areas as suggested in Menon (2001). To fix ideas assume that there are only two areas, A and B, and that these two areas compete for resources from the government. We might expect the average education of women in area A to affect fertility in area A, but the average education of women in area B should not affect fertility in area A. Since the two areas compete for resources we do, however, expect that the relative distribution of education will affect the program placement decision. The government could, for example, be more inclined to place a family planning program in the area with lower average education.

Menon (2001) used average characteristics of areas, such as education level, for their instruments. A potential issue with this approach is that if network effects are important these averages might not serve as valid instruments. One could use the ratio of these averages to the overall (national) average. The main drawback of this approach is, however, that it requires a weighting of the characteristics based, for example, on distance between the areas. Furthermore, this weighting is essentially a set outside the model by the researcher. It is possible to assing a unit weight to all characteristics and achieve identification, but if one increases the number of areas in the survey the matrix will eventually become of non-full rank. An alternative is to use the ranking of various variables which are a priori believed to be important in determining the placement decision. The benefit of this approach is that it does not require weighting and that it makes intuitive sense. We use this

method here.

4 Data and Variables

This section first describes the data sources used. Secondly, we discuss the definition of the variables used for the estimation of the determinants of the program placement decision and their descriptive statistics. Finally, we do the same for the individual decisions.

We use three data sources. The first is a contraceptive use survey collected under the auspice of Pathfinder International Ethiopia, the second is a facility survey collected by the World Bank to match the Pathfinder survey and finally we supplement with data drawn from the 1994 census of Ethiopia. We describe each in turn.

The Pathfinder survey was collected in September 2004 from the four largest regions: Amhara, Oromia, SNNPR and Tigray. The objective was to provide information on the current level of knowledge, attitude and practice of family planning. The survey used a stratified multistage sampling design with four regional states combined with urban-rural residence for each of the regions. In each, the survey provided a representative sample. weredas constituted the primary sampling units and a total of 58 weredas were sampled. A total of 176 PA/kebeles (113 rural and 63 urban) was included in the study.[3] Weights are provided to make the sample representative at the na-

[3]Pathfinder International Ethiopia (2005) provides more information on the survey.

tional level. We use these weights for all descriptive and regression analyses as well as take into account the sampling method.[4]

The Wereda Health Facility and CBRH (WHFC) survey of weredas was conducted in July 2005 with the intent to collect information on health facilities, family planning services and Community Based Reductive Health (CBRH) programs available in Ethiopia. The WHFC was designed to be used in conjunction with existing household survey data on fertility and reproductive health issues, specifically the Pathfinder Survey and therefore covered the 58 weredas surveyed by Pathfinder. The information came from health departments or social sector departments and n each of the sampled weredas general questions were asked regarding the whole wereda while detailed questions were asked of the PA/kebele in the wereda covered by the Pathfinder Survey. That is, the WHFC did not collect information specific to all PAs/kebele in the wereda.

Unfortunately, it was not possible to locate all PA/kebeles which led to five PA/kebeles being dropped. Furthermore, after data collection was done there was some uncertainty about whether the towns surveyed in the facility survey were the same as in the Pathfinder survey. Hence, 26 additional kebeles were dropped. Furthermore, 9 PA/kebeles were dropped before essential information were missing, specifically relating to the presence of health facilities and their introduction. Finally, additional PA/kebeles were dropped because it proved either impossible to find census data for the areas or because

[4]This is done using Stata's svy commands.

other important information was missing. The sample used here consists of 50 wereda and 125 PA/kebele covering a total of just over 2700 women.

4.1 Placement of Programs

The three main facilities or programs that might influence individual fertility decisions are health facilities, family planning services and CBRH programs. The main variable of interest here is obviously access to family planning. For all kebeles and PAs we have information on whether a health facility is available and if so when the facility was opened. Furthermore, we know if the family planning services are offered at the health facility and when it first offered family planning services. A PA/kebele is coded as having access to a health facility or family planning program if there is either one in the PA/kebele or there is less than 40 kilometers to the closest one. Note that kebeles are essentially districts of a town and identifying placement within a town is beyond the capability of our data and is also of less interest since most of these towns are small and travel within them should be relatively easy. The maximum distance to the closest facility in the case where a kebele does not have family planning services but where another kebele within the town had is 3.5 kilometers. For comparision the maximum travel distance to the closest health facility or family planning program for the rural Peasant Associations is 40 kilometers.[5] While this might appear to be a relative

[5]There is only one PA/kebele where there is 40 km to the closest family planning program and the second-longest distance is 30 km.

long distance the average distance at the time of the survey for those PAs that do not have health facilities is only around 10 kilometers. Furthermore, most people would only need to go the family planning program about three months, either to pick up more pills or renew the injection. Figure 1 shows the development in access to health facilities, family planning services and CBRH programs over time.

[Figure 1 about here.]

Of interest is not only if there is a health facility with family planning in the immediate area but also for how long family planning has been available. We therefore estimate the determinants of whether family planning was available at a given point in time. Those are 1992 and 1997 (which are 1985 and 1990 in Ethiopian calendar). For Peasant Associations we use the year family planning services was offered in that administrative area. For kebeles we use the year the closest health facility began offering family planning services whether or not the health facility is located in the kebele or a neighbouring kebele. The motivation for this difference is that kebeles are essentially districts of a town and identifying placement within a town is beyond the capability of our data and is also of less interest since most of these towns are small and travel within them should be relatively easy. These two years are chosen to allow the program to have an effect on fertility, while still being relatively recent. If we chose a year closer to the survey date it is likely that we would see a lower effect of the program since it would not

have had time to affect most of the people in the survey. Unfortunately, we do not have birth histories, which means that we cannot examine how the timing of births responds to the introduction of family planning.

One issue with this definition is that including family planning programs that are not in the pa/kebele for which we have information makes the estimation of the placement decision less precise, but the alternative, which is to ignore family planning programs outside the PA/kebele is likely to substantially bias downward the results of the fertility estimation. Another potential issue is that family planning services might have been available earlier in a neighbouring administrative area, but we unfortunately do not have information about this. Similarly it is that possible changes in facility type might not be reflected in start date (i.e. change from clinic to center). It is therefore possible that some areas are coded as only having a had family planning services for a relatively short period since a new health center has just opened in the area, even though the neighbouring area offered family planning services for longer.

[Table 1 about here.]

Table 1 shows the descriptive statistics for the two dependent variables and the explanatory variables. The explanatory variables can be divided into two categories. Firstly, those that affect both placement and the individual decisions. Secondly, the "instruments" or variables that are assumed to only affect the program placement.

As mentioned above we use rank variables as the main instruments in the placement decision estimation, with higher rank equal to a larger value of the underlying variable. The variables are ranked at two levels. Firstly, they are ranked between the 37 zones in the sample. Scondly, within zones the PA/kebeles are ranked. For zones the variables are the rank of the size of the population, rank of the degree of urbanisation (measured as the percent of the population who live in urban areas), the rank of the proportion of orthodox and the rank of the proportion of muslim between the areas and the rank of percentage of adults with various levels of education (1-3 years, 4-6 years, 7-8 years and 9 and above, and non-regular). These ranks are all based on data from the 1994 Census. Furthermore, the zones are also ranked based on their distance to Addis Ababa. This distance is calculated as the mean of the distances from the weredas within each zone, which were collected in the WHFC survey. The reasons that the means of the rankings are not all equal to 19 are that not all zones have the same number of PA/kebeles and that weights are applied to the calculate the means. The PA/kebeles are ranking within each zone by their population size. The maximum number of PA/kebeles within a zone is eleven, while for five zones there is only one PA/kebele in the survey. While it would be advantageous to have more information at the PA/kebele level the number of variables possible is limited by the lack of information at that level in the census.

The remaining variables for the first stage are variables that are likely to affect the placement decision, but might also have an effect on the individual

decisions. At the zonal level is the actual distance to Addis Ababa the only variable.[6] At wereda level we have the average yearly rainfall and its square plus the total area of the wereda. Finally, at the PA/kebele level we have a dummy for whether is it an urban area (or in other words, whether it is a kebele), and the distance to the closest town and the distance squared (with the distance being set to zero if it is a urban area). The accessibility of the area is captured by two variables: Whether the area can be reached by car all year or only during the dry season (the excluded category is no road access).

4.2 Individual Fertility Decision

Table 2 shows the variables and their descriptive statistics for the second stage estimations. The dependent variable is the number of children born at the time of the survey, which is on average 3.4. Considering that the average age of the women interviewed is just over 28 years this is a relatively high number of children, which reflects the very high fertility rate in Ethiopia.[7]

Beside the variables that are also part of the first stage estimation there are six variables, which are individual specific. Beside age and age squared (divided by 100), there are four dummy variables. The first two are for whether the person has between one and five years of education and whether the woman has graduated primary school and/or gone to school further. The last two are dummies for whether she is orthodox or muslim. Since the

[6] See above for the definition of the variable.

[7] For comparison the equivalent number for Guatemala is 2.8 and Guatemala has has one of the highest total fertility rate in Latin America (Pörtner 2006).

average education level is low, especially in the rural areas, we use a different grouping that than of the first stage to prevent too small cell sizes.

[Table 2 about here.]

There is unfortunately no information on the migration of the women which makes it difficult to determine for how long she has been exposed to family planning. Hence, we essentially assume that the woman has spent her entire life in the area where she was found during the survey. This is obviously not a very attractive assumption, given the relocation policy in Ethiopia and marriage migration, but without any additional information most other assumption will be just as arbitrary or even more. One alternative would be to count exposure from the time of marriage, essentially assuming that the women moved to the area when she was married.

5 Results

In this section we first examine the determinants of where family planning programs are introduced. This is the first step of the two-stage method described above. We then turn to the effect of the availability of family planning on the number of children. Finally, we investigate what drives the effect of family planning on fertility.

5.1 Placement of Programs

Table 3 presents the results from the determinants of placement estimations. We focus on the results for 1992 since that is around the time where there is a substantial expansion in access to health facilities and family planning programs, while the prevalence was essentially constant for the decade before that. Hence, most of those women who had access in 1992 were likely to have had access for a substantial amount of time before 1992.[8]

[Table 3 about here.]

Most of the variables have the expected signs and are statistically significant. Urban areas and areas that have a market are more likely to also have access to family planning services. In the same vein, the more urbanised a zone is the higher is the likelihood that a given PA/kebele has less than 40 kilometers to the closest family planning program. Furthermore, areas with easier access, as measured by whether there is road access by car, also have statistically significant effects for both all year access and dry season access (with no road being the excluded variable).

For the rank variables most of them are again statistically significant.[9] The larger the population of a zone is the more likely it is that there is family planning program accessible, although the effect is of the opposite sign for

[8]The results are broadly similar for the two years and although the svyivreg does not produce standard R-square statistics the same regressions, with weights, have an adjusted pseudo R-square of 0.65.

[9]Recall that a higher rank is equivalent to a larger underlying variable.

the size of the population at the PA/kebele level.[10] Interestingly, the two education ranking that have *positive* effects on placement are the percentage of adults with between four and six years of education and the percentage of adults without any education. One interpretation of the education rank variables are that the government is the government is actively trying to place family planning programs in areas where the population is relatively less educated, presumably because those with more education are likely to live in areas where there are other means of obtaining family planning services.

Contrary to expectations the distance to Addis Ababa does not seem to have a statistically significant effect on the placement of programs. Neither the standard variable or the ranking have any substantial effect on the probability of a family planning program being present. The same is the same for the distance to town and its squared. Possible reasons for why the latter two variables are not statistically significant can be the definition of access to family planning and that distance in itself might not matter so much as how easy it is to get to an area, which is already captured by the urban variables and the road access variables. Furthermore, neither of the two variables that capture the religious make-up of an area have any statistically significant effect.

[10]It is worth noting that the actual size of the wereda has a negative and stastically significant effect.

5.2 Effect of Programs on Fertility

Table 4 shows the results for two different specifications for each of the two cut-off years. Models I and III include the endogenous variable capturing whether family planning services are available, while the two other models furthermore includes the interactions between the availability of family and age, age squared, having one to five years of education and having six years or more of education.[11] As discussed above the instrument for the presence of a family planning program is the prediced probability of an area having a program based on the first stage regressions. The instruments for the interactions are the predicted probability interacted with the variable in question.

[Table 4 about here.]

The main parameters of interest are the family planning ones. The first impression is that most of these variables are not significant and the one which is statistically significant has the wrong sign. This, however, is not the full story. It is true that in Models I and III family planning does not have much of an effect of the number of children born and is far from being statistically significant, but these specifications ignore that not all age groups are likely to respond to family planning programs the same way. As mentioned above it is likely that most women who had access to a family planning program in 1992 also had access to the program in the ten years

[11] For comparison Table 5 show the equivalent results when the endogeneity of program placement is not taken into account.

prior. That, however, still leave a substantial number of women who were well into their reproductive ages by the time the family planning programs were introduced.

[Figure 2 about here.]

Figures 2 show the marginal effects of access to family planning services by age together with the 90 percent confidence interval (calculated using the delta method) from Models II and IV. For the 1992 estimation we find that there is a statistically significant negative effect of access to family planning services until around age 27. After age 27 the effect is still negative, although it is no longer statistically significant. This is in line with the idea, discussed in Angeles, Guilkey, and Mroz (1998), that what is important is whether family planning was available before age 15, although it is clearly possible that for the older women the programs came too late to have much of an effect on their fertility. For the ages where the effect of family planning is significant the presence of a program is associated with a reduction in the number of children born of about 0.5.

Interestingly, many of the background variable are not statistically significant, although they generally behave as expected. Among those that are statistically significant are the education dummies. More educated women tend to have fewer children and this effect is stronger the more education they have received. The same goes for women who live in urban areas or in areas with a market, although none of these effect are significant.

5.3 Explaning the Effect of Family Planning

While it is clear that there is a negative effect on number of children born for those who have been exposed to a family planning program for for a substantial period of time, it is not clear exactly how this effect comes about. The remainder of this section is therefore dedicated to examining in more detail how family planning affects the fertility decisions and alternative explanation for the lower fertility in areas with family planning.

The first question is whether the effect really comes from family planning or whether it is due to the health facilities that are alway present at the same time. As can be seen from Figure 1 above for the years that we are examining there is a close correspondance between health facilities and family planning programs. In fact, the two are so that estimations show little difference between the effect of family planning and the effect of having a health facility available. The main way that a health facility could reduce fertility would be through a reduction in child mortality, which in turn would lead to fewer births needed to achieve a certain number of children. One could argue that we could look at the effect of health facilities on child mortality to see whether there is a substantial effect. The issue here is, however, that we can only have mortality information from women who have had children already. Hence, if the women who are least likely to use family planning are also the most likely to suffer the death of a child then an estimation of the effect of health facilities will be biased upwards and this bias can be substantial.[12]

[12]We do, in fact, find that the effect of health facilities on child mortality is positive,

While it is not possible to directly separate the effect of family planning and health facilities we can examine other behaviour that can be argued to be mainly influence by family planning rather than access to health facilities. There are three questions in the Pathfinder survey which is especially of interest here: The age of the mother at first birth, whether she has had a birth within the last year and whether the last birth was wanted.

We begin with whether the respondent has had a birth within the last 12 months. Figure 3 shows the marginal effect of access to family planning services on the probability of having a birth within the last year.[13] For essentially all women there is a significant negative effect of access to family planning on the probability of having a birth during the last year for the 1992 cut-off point, while there is no significant effect for the 1997 cut-off. It appears that especially the very young seen a large reduction in their probability of having a birth in the last 12 month. This combined with the results above suggests that access to family planning works (partly) by postponing the age of first, although whether the end result is a lower completed level of fertility is difficult to establish.

[Figure 3 about here.]

We can check whether there is, in fact, an increase in the age of first birth with the introduction of family planning by using the question on age at first

although consistently statistically insignificant.

[13] As for Figure 2 the 90 percent confidence interval is calculated using the delta method. Furthermore, the estimation are done using a linear probability model and are available upon request from the corresponding author.

birth. The results are presented in Figure 4. There is, however, a significant cave-at to these results due to the censoring problem. Women who have not yet had a birth are coded as having a birth as their current age (no matter what that might be).[14] Hence, there is likely to be a substantial down-wards bias in the effect of family planning on the age of first birth. This helps explain why the effect is positive but generally statistically insignificant.

[Figure 4 about here.]

Finally, one of the attractions of providing family planning is that is potentially provides women with more control which is welfare improving, even in the cases where it does not reduce fertility. To avoid the same problems as for age of first birth, we invert the question to whether a woman has had an unwanted pregnancy (i.e. family planning should ideally have a negative effect).[15] Figure 5 shows the results for the two cut-off years. For 1992 there is generally a reduction in unwanted pregnancies, although the effect is only statistically significant for the older group. Hence, even though we do not find a significant reduction in fertility among the older group of women they also benefit from access to family planning through improved control over when their children are born. Ideally we would like to examine the effect of access to family planning on spacing of children, but that is unfortunately not possible using this data set since there are no birth histories.

[14]Note that simply excluding those who have not yet had a birth lead to potentially even more bias, especially among the youngest.

[15]As before the estimation is done using a linear probabilty model and the results are available upon request.

[Figure 5 about here.]

6 Conclusion

Despite a substantial interest in family planning programs there is relatively little research on their effectiveness. Given the long lag between implementation and effect likely with family planning programs researchers are generally forced to use survey data instead of standard experimental data.[16] This reliance on survey data requires methods for dealing the problem of potentially endogenous program placement. This paper uses a novel set of instruments to estimate the effects of access to family planning on fertility and other related outcomes in Ethiopia.[17]

We find that access to family planning reduces the age specific fertility by about 0.5 children for women younger than 30, while there is less of an effect for older women. This effect is statistically significant and in line with what other studies have found.[18] Clearly, this reduction is not overly large when compared to the high total fertility rate in Ethiopia. We do, however, find other positive effects of access to family planning program. Firstly, women are generally older when they have their first child in areas with family planning service, which may have a beneficial effect on child health and the health of the mother. Secondly, it appear that the risk of

[16] The main exception to this is the case of Matlab discussed above.

[17] The suggestion of this particular class of instrument was first made in Menon (2001).

[18] Corresponding to the reduction we also find a significantly lower probability of having had a birth within the last twelve months.

an unwanted pregnancy decreases, especially for older women, then there is access to familiy planning.

One generally problem with analysing the effectiveness of family planning provision is the lack of good data sources. What is especially a problem is the scarcity of information on facilities. Although we do have more information than most surveys, there are still much to be done on this front. Having a facility survey which covers all surrounding PA/kebeles and which could be matched with the 2005 Ethiopian DHS would be a major improvement and would be sure to add substantially to our (as yet) limited knowledge of the effects of family planning programs.

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[Table 5 about here.]

[Figure 6 about here.]

Table 1: Descriptive Statistics for Program Placement

	Mean	Standard Error
Dependent Variables		
Family planning program before 1992	0.2336	0.0426
Family planning program before 1997	0.3554	0.0501
Zone variables		
Distance to Addis Ababa	454.2581	16.5798
Wereda variables		
Average yearly rainfall	1183.686	39.5751
Average yearly rainfall^2/1000	1566.474	102.2593
Total area	14.3627	0.9935
PA/kebele variables		
Urban area	0.0728	0.0011
Market in area	0.3609	0.0494
Distance to town	16.0870	1.4786
Distance to town^2	455.9426	113.4497
Road access - all year	0.4275	0.0497
Road access - dry season	0.3748	0.0495
Ranking of Zones (Nationally)		
Total population	22.3255	0.8780
Distance to Addis Ababa	18.5170	0.9225
Urbanisation	19.2924	0.7473
Percent orthodox	19.8486	0.7815
Percent muslim	19.0513	0.8849
Percent with 1-3 years of education	17.0105	0.5651
Percent with 4-6 years of education	18.0898	0.7110
Percent with 7-8 years of education	18.6943	0.7616
Percent with 9 or more years of education	19.6805	0.8580
Percent with non-regular education	19.7868	0.8524
Ranking of Towns/PA (Within Zones)		
Total population	2.3355	0.1258

NOTE: Estimated means and standard errors based on sample frame and weights

Table 2: Descriptive Statistics for Individuals

	Mean	Standard Error
Number of children born	3.3857	0.1063
Age	28.5881	0.2848
$Age^2/100$	8.9398	0.1696
Education (1-5 years)	0.1622	0.0109
Education (6 or more years)	0.1993	0.0216
Orthodox	0.5870	0.0309
Muslim	0.2213	0.0342
Zone distance to Addis Ababa	450.2821	17.688
Market in PA/kebele	0.3737	0.0512
Area of wereda	14.5495	1.0110
Average yearly rainfall	1187.446	39.7080
Average yearly $rainfall^2/1000$	1570.506	99.2742
Lives in urban area	0.0738	0.0042
Distance to town	16.1036	1.5865
Distance to $town^2$	467.5753	125.1523
Road access - all year	0.4221	0.0502
Road access - dry season	0.3872	0.0510
Family planning program before 1992	0.2395	0.0445
Family planning program before 1997	0.3545	0.0507
Predicted FP program before 1992	0.2374	0.0316
Predicted FP program before 1997	0.3567	0.0294

NOTE: Estimated means and standard errors based on sample frame and weights

Table 3: Probit – Family Planning Program in PA/kebele

Variable	Begun before	
	1992	1997
Distance to Addis	0.0006	0.0036
	(0.0049)	(0.0044)
Market in PA/kebele	0.8373**	0.6547**
	(0.3398)	(0.3034)
Size of wereda	−0.1041**	−0.0912***
	(0.0410)	(0.0319)
Rainfall	−0.0074**	−0.0086***
	(0.0031)	(0.0027)
Rainfall^2	0.0034**	0.0035***
	(0.0013)	(0.0011)
Urban	2.7216***	1.1004
	(0.8787)	(0.6819)
Distance to town	0.0701	0.0132
	(0.0573)	(0.0551)
Distance to town^2	0.0000	0.0012
	(0.0012)	(0.0012)
Accessible all year	1.2127*	0.6168
	(0.6543)	(0.5359)
Accessible dry season	1.0008*	0.3995
	(0.5090)	(0.4588)
Ranking of Zones		
Population	0.1427***	0.0413*
	(0.0332)	(0.0248)
Distance to Addis	−0.0309	−0.0942
	(0.0868)	(0.0797)
Urbanisation	0.1510***	0.0292
	(0.0464)	(0.0285)
Percent Orthodox	0.0181	−0.0041
	(0.0360)	(0.0323)
Percent Muslim	−0.0446	−0.0468
	(0.0350)	(0.0283)
Percent primary (1-3)	−0.2785***	−0.1453***
	(0.0644)	(0.0504)
Percent primary (4-6)	0.6090***	0.2921***
	(0.1338)	(0.0995)
Percent JS (7-8)	−0.3328***	−0.1088
	(0.1100)	(0.0776)
Percent SS and above	−0.2197**	−0.1110*
	(0.0961)	(0.0650)
Percent non regular	−0.0492*	0.0041
	(0.0255)	(0.0222)
Ranking of PA/kebeles within Zone		
Population	0.2446*	0.0738
	(0.1292)	(0.1049)
Constant	1.4692	4.7609**
	(2.6124)	(2.2502)
Observations	125	125

NOTE: * sign. at 10%; ** sign. at 5%; *** sign. at 1%
Robust clustered standard errors in parentheses.

Table 4: Effect of Family Planning on Fertility (Endogenous Placement)

	Before 1992		Before 1997	
	Model I	Model II	Model III	Model IV
Family planning	−0.2215	−0.6138	−0.0792	−1.9480
	(0.2436)	(1.6274)	(0.4371)	(1.9862)
Family planning × age		−0.0085		0.1307
		(0.1198)		(0.1468)
Family planning × age^2		0.0430		−0.2150
		(0.2049)		(0.2521)
Family planning × 1-5 years education		0.5350		−0.1094
		(0.3613)		(0.4523)
Family planning × 6+ years education		0.7391 ∗ ∗		0.3550
		(0.3353)		(0.3712)
Age	0.4308∗∗∗	0.4300∗∗∗	0.4293∗∗∗	0.3856∗∗∗
	(0.0356)	(0.0440)	(0.0352)	(0.0630)
Age^2	−0.3339∗∗∗	−0.3384∗∗∗	−0.3315∗∗∗	−0.2604 ∗ ∗
	(0.0610)	(0.0737)	(0.0607)	(0.1055)
Education (1-5 years)	−0.5131∗∗∗	−0.6407∗∗∗	−0.5177∗∗∗	−0.4731 ∗ ∗
	(0.1152)	(0.1458)	(0.1142)	(0.2091)
Education (6+ years)	−0.7612∗∗∗	−0.9357∗∗∗	−0.7588∗∗∗	−0.8881∗∗∗
	(0.1044)	(0.1468)	(0.1119)	(0.1868)
Orthodox	−0.3157∗	−0.3287∗	−0.3161∗	−0.3018
	(0.1881)	(0.1841)	(0.1865)	(0.1824)
Muslim	0.0787	0.0626	0.0793	0.0795
	(0.1969)	(0.1967)	(0.1981)	(0.1941)
Distance to Addis	−0.0001	−0.0002	−0.0001	−0.0002
	(0.0004)	(0.0004)	(0.0005)	(0.0005)
Market in area	−0.0598	−0.0641	−0.0851	−0.0903
	(0.1251)	(0.1264)	(0.1442)	(0.1424)
Size of wereda	0.0036	0.0039	0.0044	0.0037
	(0.0067)	(0.0068)	(0.0078)	(0.0079)
Rainfall (avg)	−0.0005	−0.0005	−0.0005	−0.0006
	(0.0009)	(0.0010)	(0.0014)	(0.0014)
Rainfall^2	0.0002	0.0002	0.0002	0.0003
	(0.0004)	(0.0004)	(0.0006)	(0.0006)
Urban	−0.2492	−0.2289	−0.3099	−0.3020
	(0.1903)	(0.1897)	(0.2126)	(0.2137)
Distance town	0.0004	0.0035	−0.0005	0.0008
	(0.0113)	(0.0115)	(0.0120)	(0.0122)
Distance town squared	−0.0001	−0.0001	−0.0001	−0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Accessible all year	0.0474	0.0572	0.0497	0.0480
	(0.1779)	(0.1767)	(0.1781)	(0.1788)
Accessible dry season	0.3637 ∗ ∗	0.3790 ∗ ∗	0.3501∗	0.3403∗
	(0.1836)	(0.1833)	(0.1812)	(0.1827)
Constant	−4.4774∗∗∗	−4.4093∗∗∗	−4.4782∗∗∗	−3.7982∗∗∗
	(1.0794)	(1.0355)	(1.3259)	(1.3549)
Observations	2707	2707	2707	2707
Adj. R-squared	0.60	0.60	0.60	0.60

Note: * significant at 10%; ** significant at 5%; *** significant at 1%
Robust standard errors in parentheses
Additional variables are region dummies and ethnic group dummies.

Table 5: Effect of Family Planning on Fertility (Exogenous Placement)

		Before 1992		Before 1997	
Family planning		−0.1979	−1.4012	0.0037	−0.6920
		(0.1473)	(1.0956)	(0.1201)	(1.0236)
Family planning ×			0.0861		0.0600
Age			(0.0787)		(0.0724)
Family planning ×			−0.1600		−0.1239
Age^2			(0.1329)		(0.1232)
Family planning ×			0.3156		0.2150
1-5 years edu			(0.2747)		(0.2481)
Family planning ×			0.4628 ∗ ∗		0.2337
6 plus years edu			(0.2039)		(0.2010)
Age	0.4291∗∗∗	0.4306∗∗∗	0.4151∗∗∗	0.4291∗∗∗	0.4113∗∗∗
	(0.0351)	(0.0352)	(0.0397)	(0.0351)	(0.0445)
Age^2	−0.3311∗∗∗	−0.3336∗∗∗	−0.3049∗∗∗	−0.3311∗∗∗	−0.2938∗∗∗
	(0.0605)	(0.0605)	(0.0683)	(0.0604)	(0.0767)
Education (1-5 years)	−0.5183∗∗∗	−0.5137∗∗∗	−0.5931∗∗∗	−0.5183∗∗∗	−0.5968∗∗∗
	(0.1143)	(0.1153)	(0.1249)	(0.1144)	(0.1334)
Education (6+ years)	−0.7521∗∗∗	−0.7602∗∗∗	−0.8814∗∗∗	−0.7518∗∗∗	−0.8368∗∗∗
	(0.1049)	(0.1043)	(0.1255)	(0.1044)	(0.1328)
Orthodox	−0.3201∗	−0.3162∗	−0.3236∗	−0.3203∗	−0.3192∗
	(0.1873)	(0.1887)	(0.1864)	(0.1875)	(0.1862)
Muslim	0.0826	0.0791	0.0630	0.0827	0.0750
	(0.1950)	(0.1960)	(0.1950)	(0.1950)	(0.1943)
Distance to Addis	−0.0001	−0.0001	−0.0002	−0.0001	−0.0002
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Market in area	−0.0981	−0.0639	−0.0699	−0.0986	−0.1120
	(0.1200)	(0.1173)	(0.1184)	(0.1172)	(0.1183)
Size of wereda	0.0054	0.0038	0.0039	0.0055	0.0055
	(0.0071)	(0.0071)	(0.0070)	(0.0074)	(0.0074)
Rainfall (avg)	−0.0003	−0.0005	−0.0006	−0.0003	−0.0004
	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)
$Rainfall^2$	0.0002	0.0002	0.0003	0.0002	0.0002
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Urban	−0.3344∗	−0.2582	−0.2434	−0.3355∗	−0.3230∗
	(0.1864)	(0.1878)	(0.1869)	(0.1872)	(0.1868)
Distance town	−0.0013	0.0002	0.0017	−0.0013	−0.0006
	(0.0122)	(0.0115)	(0.0115)	(0.0120)	(0.0120)
Distance town square	−0.0001	−0.0001	−0.0001	−0.0001	−0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Accessible all year	0.0469	0.0474	0.0699	0.0468	0.0599
	(0.1749)	(0.1773)	(0.1732)	(0.1752)	(0.1724)
Accessible dry season	0.3495∗	0.3622 ∗ ∗	0.3710 ∗ ∗	0.3494∗	0.3518 ∗ ∗
	(0.1801)	(0.1810)	(0.1766)	(0.1803)	(0.1775)
Constant	−4.6318∗∗∗	−4.4939∗∗∗	−4.3003∗∗∗	−4.6389∗∗∗	−4.3417∗∗∗
	(1.1119)	(1.1021)	(1.0491)	(1.1122)	(1.1000)
Observations	2707	2707	2707	2707	2707
Adj. R-squared	0.60	0.60	0.60	0.60	0.60

NOTE: * significant at 10%; ** significant at 5%; *** significant at 1%
Robust standard errors in parentheses

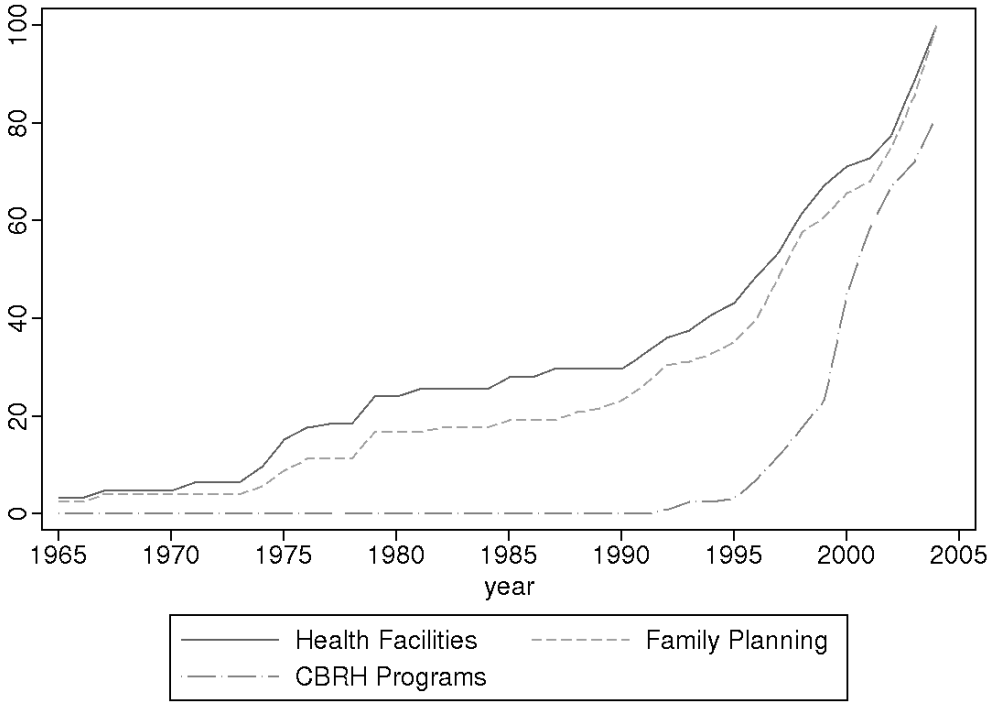
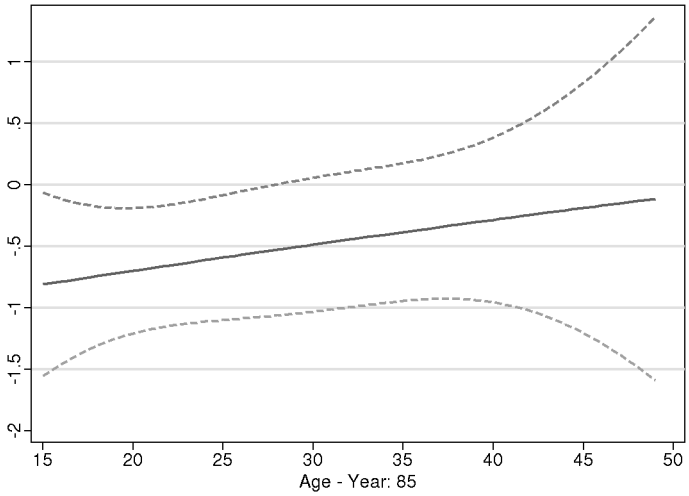
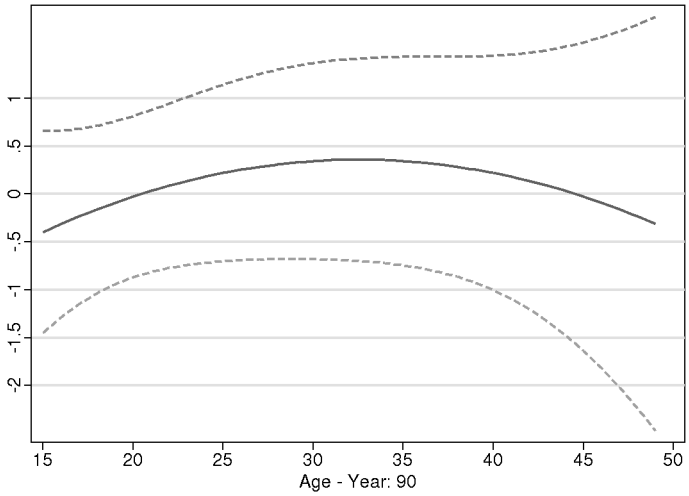


Figure 1: Precent PA/kebeles with access to health facilities, family planning or CBRHA

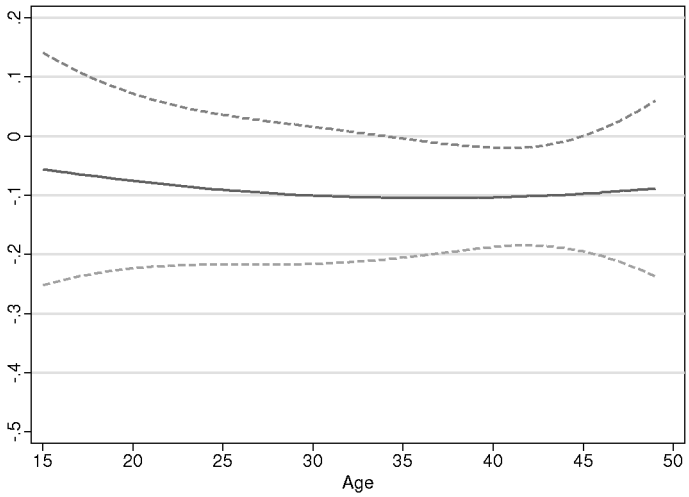


(a) By Age for 1992

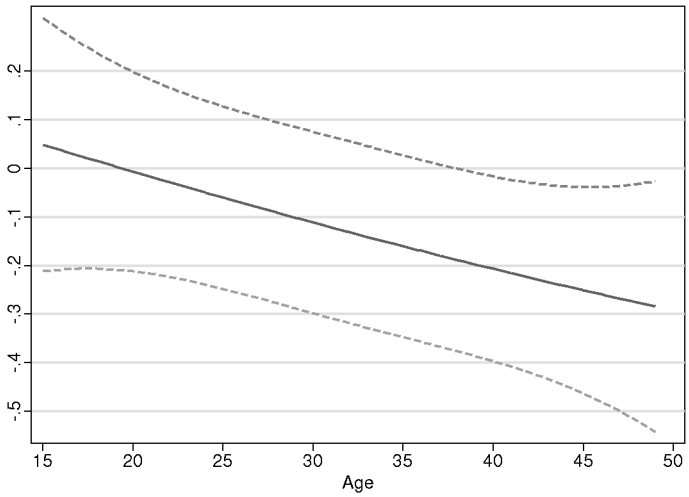


(b) By Age for 1997

Figure 2: Marginal Effect of Family Planning on Fertility by Age (Endogenous Placement)

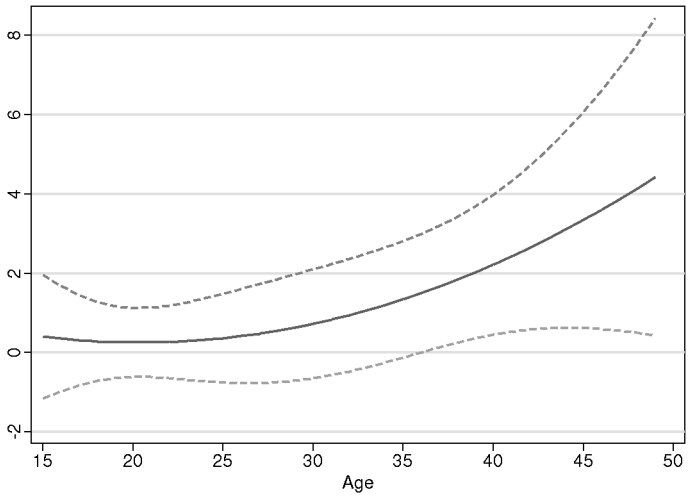


(a) By Age for 1992

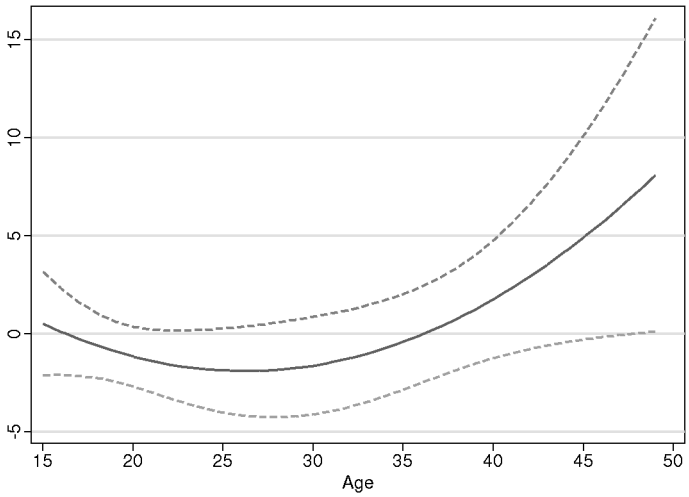


(b) By Age for 1997

Figure 3: Marginal Effect of Family Planning on Birth within Last Year

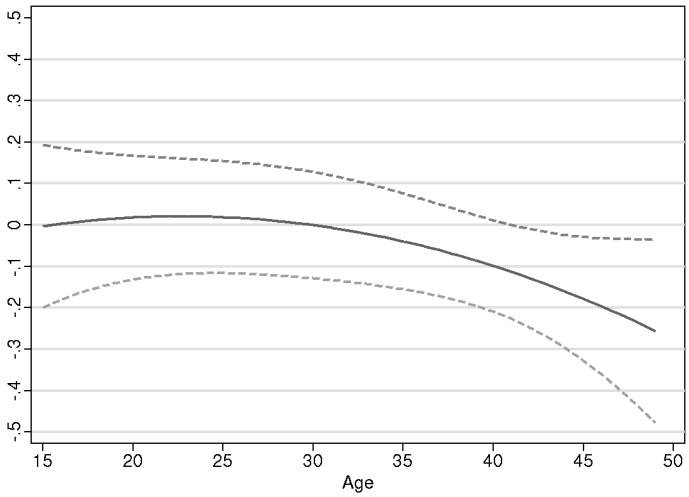


(a) By Age for 1992

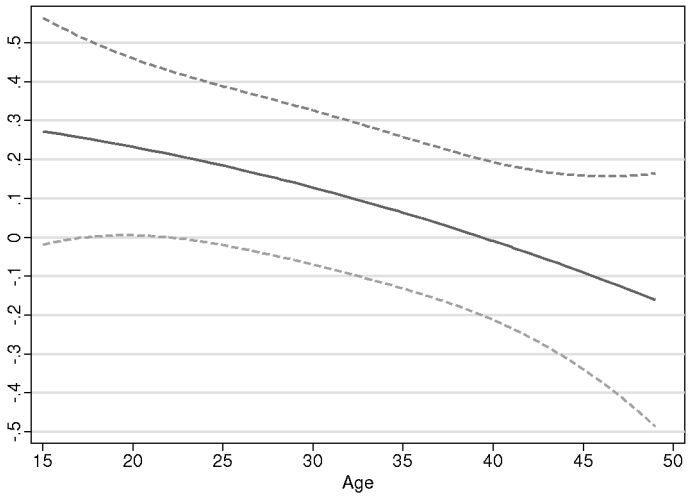


(b) By Age for 1997

Figure 4: Marginal Effect of Family Planning on Age of First Birth

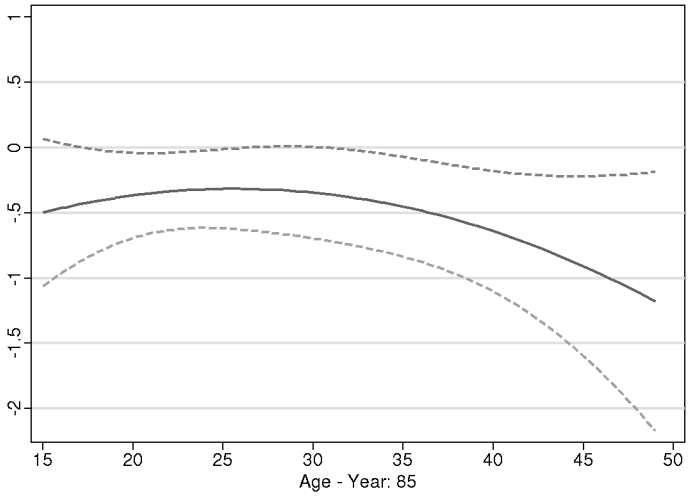


(a) By Age for 1992

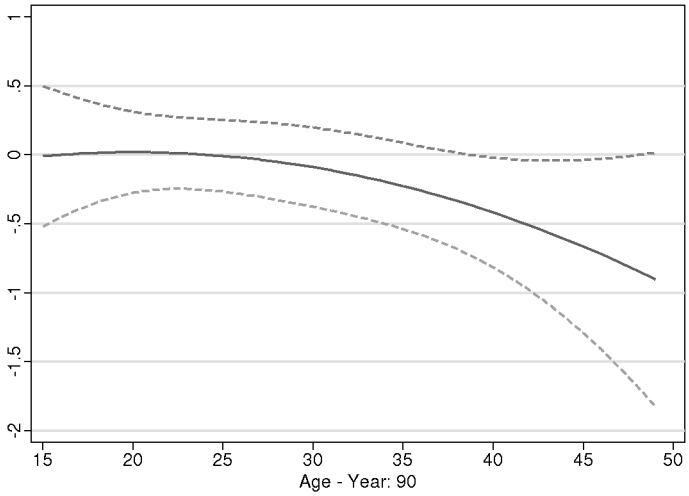


(b) By Age for 1997

Figure 5: Marginal Effect of Family Planning on whether Last Birted Wanted



(a) By Age for 1992



(b) By Age for 1997

Figure 6: Marginal Effect of Family Planning on Fertility by Age (Exogenous Placement)