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

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February 2011

*We would like to thank Pathfinder International - Ethiopia for use of the data and Yared Mekennon for supervising the collection of the facility survey. We would also like to thank Yoram Barzel, Alan de Brauw, Seik Kim, Shelly Lundberg, David Ribar, and seminar participants at the University of Washington for useful comments and suggestions. The views and findings expressed here are those of the authors and should not be attributed to the World Bank or any of its member countries.

**Abstract**

This paper uses a novel set of instruments to identify the effects of a family planning program when there is potentially non-random program placement and only cross-sectional data are available, a situation common in many developing countries. The instruments are based on the idea that areas compete for resources and that the relative ranking of characteristics across areas is not correlated with the outcomes of interest. Using data from Ethiopia we find that access to family planning substantially reduces the number of children ever born for women without education; the reduction is especially pronounced for women younger than 20 and older than 30. Completed fertility, measured as children ever born for women aged 40 to 45, falls by more than one birth with access to family planning. These effects are statistically significant and substantially larger than previous studies have found. For women who have gone to school there is no evidence of an impact of family planning on fertility. Based on a relative small reduction in child mortality we argue that the effect on fertility is due to family planning access and not the impact of the concurrent presence of health facilities. Finally, family planning access reduces unwanted fertility, especially for older women.


Keywords: Family planning, fertility, program evaluation, Ethiopia

JEL codes:

# 1 Introduction

Many countries, especially in Africa, still have high fertility rates. This has potentially significant implications for women's and children's health and economic development. Motivated by these concerns, policy discussions often focus on the role of family planning programs in helping individuals manage and implicitely lower their fertility. The effectiveness of family planning programs is, however, still an under-researched question. Despite the lack of evidence, there appears to be a consensus in economics that family planning programs are ineffective.[1] This is partly because of the lack of convincing evidence that these programs reduce fertility and partly because standard models of fertility decisions suggest that many people in developing countries have little incentive to reduce the number of children when children are potentially productive on the family farm and when the cost of women's time is low.

There are a number of reasons why there is little convincing evidence on the effectiveness of family planning programs. First, studies of family planning programs have often covered periods of rapid economic development and fertility decline, making it difficult to isolate the effects of family planning programs. Secondly, there is little emphasis on how family planning affects women of different education levels. Evidence from the USA shows that better-educated women are not more efficient users of modern contraceptives than less-educated women, but the better-educated women are more likely to know how to use and more efficient at using "ineffective" contraceptive methods such as withdrawal or rhythm (Rosenzweig and Schultz 1989). This suggests that the lower a woman's education level, the more likely she is to benefit from access to modern methods.

Finally, when an organisation decides where to place programs it is likely to respond to area characteristics. Some of these characteristics may be unobservable to the researcher and correlated with the outcomes of interest. This correlation can lead to biased estimates of program effectiveness (Pitt, Rosenzweig and Gibbons 1993). It is therefore important to find a method to address non-random program placement, but the nature of fertility decisions poses obstacles. Suppose a

[1] Instead there is an emphasis on factors that influence fertility demand such as household poverty and girls' schooling.

government aims to reduce fertility. Two cases illustrate the problems of non-random program placement. In the first case, the government places programs in areas that are more "receptive" to reducing fertility. Simply comparing fertility in areas with and without family planning will then overestimate the impact of expanding the program. In the second case, the government places programs in the high fertility areas. If information on prior fertility is not available comparing fertility across areas will underestimate the effectiveness of the program. As these examples show, without information on the placement process it is difficult to assess the direction of the potential bias.

The most straight-forward way of overcoming non-random placement is to randomize the allocation of programs and compare the outcomes of interest between the treatment and control areas (Duflo and Kremer 2005). Although experiments appear to offer an attractive means of avoiding issues of non-random placement, they are subject to a number of drawbacks when examining the effectiveness of family planning programs. First, because of the cumulative nature of fertility, an experiment has to run for a substantial period of time before one can assess the effect on fertility. Any observed short-run effects may simply reflect changes in spacing-patterns rather than changes in the overall number of children. Modern contraceptives offer more control over the timing of births and even if completed fertility decreases, fertility for certain age groups may increase. This makes short-term changes unreliable indicators of the final number of children. Secondly, experiments are prone to problems like short-term health scares such as the one experienced by an experiment in Zambia (Ashraf, Field and Lee 2009). Other methods are also affected by this, although the longer the period covered and the broader area coverage is, the less the problem will be. Thirdly, it is not clear to what extent an experiment in, say, Bangladesh can inform family planning programs in Ethiopia given the substantial differences in the structure of the economies, cultural context, and the issues facing the population. Finally, in many settings family planning programs have been in existence for a substantial period of time and it is obviously cost-effective to try to use information that can be derived from these programs.

An alternative to a randomized design is to use longitudinal data. If these data are available, program effects can be estimated using fixed effects to remove unobservable characteristics that influence program placement and fertility. There are two caveats to this approach. First, there must be a sufficient number of areas that receive 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.[2]

For the reasons above and the scarcity of available experimental and longitudinal data covering long enough periods of time, researchers are often faced with using cross-sectional data for analysing program effects. This paper uses cross-sectional data linked with information on area characteristics to evaluate Ethiopia's family planning program. During field work we asked Ethiopian NGOs responsible for the introduction of community based reproductive health (CBRH) agents what factors influenced their decisions on where to place new programs. Two factors stood out: accessibility and the extent to which the area was considered "receptive" to the family planning idea. The important difference between these factors is that accessibility is, in principle, measurable whereas receptiveness to family planning is generally unobserved by the researchers. We do not claim that the Ethiopian government distributes family planning programs according to the same criteria as the NGOs, but the example illustrates that there may be unobserved factors that influence both whether to place a program in an area and whether women in the area will use the services.

To address non-random program placement in this setting, one can estimate the program placement decision model and use predicted placement to evaluate the effects of the program. Identification comes from variables that are argued to influence program placement but not women's fertility decisions. The challenge is that many of the obvious candidates for variables that affect program placement also affect fertility either directly or through other pathways such as child mortality. An example of a variable that affects both program placement and fertility is how urbanised an area is. Cost of children may be higher in more urban areas reducing fertility and at the same time it may be less costly for the government to place programs in areas there are more urban because of

[2]There are also additional problems with using fixed effects, such as measurement error bias. For a discussion of this and other problems in the study of family planning see, for example, Angeles, Guilkey and Mroz (1998).

easier access. The direction of the effect of urbanisation on probability of having a program is less important than the fact that urbanisation substantially impact whether a program will be placed in an area. That rules out using urbanisation directly as an identifying variable.

The identification strategy introduced here is based on limited resources and, therefore, competition between areas for these resources. To fix ideas assume that there are only three areas, A, B and C, and that the three areas compete for resources from the government. Using the urbanisation example, we expect that the urbanisation of area A will affect fertility in area A, but the degree of urbanisation of areas B and C will have little or no effect on fertility in area A. Because the three areas compete for resources the *relative* degree of urbanisation may, however, affect the program placement decision. A straight-forward way to capture competition and the role of relative characteristics is to convert variables that are expected to be important in determining placement into rankings and use the ranking as identifying variables.[3] Imagine that urbanisation ranks the three areas such that A is greater than B and B greater than C and that the higher rank an area has the more likely it is to receive a program. Identification is achieved because the rank an area receives is predominantly dependent on other areas' absolute value of the ranked variable. Specifically, assume that the underlying value for area B increases. Unless it increases enough to surpass area A the ranking will not change even though the increase in the value of the ranked characteristics may directly affect fertility.

There are two major advantages to this approach. First, the instruments are easy to create from readily available secondary data like a census or, possibly, even from the primary data set itself. Secondly, the instruments are intuitive in that they mimic expectations about the underlying resource allocation process. In other words, ranks likely reflect what policy makers care about when distributing programs but are not directly related to fertility. Furthermore, the process is

[3] Menon and Pitt (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 the averages to the overall (national) average, but the drawback of this is that it requires a weighting of the characteristics based, for example, on distance between the areas. This weighting is essentially set outside the model by the researcher. It is possible to assign a unit weight to all characteristics and achieve identification, but as one increases the number of areas in the survey the matrix will eventually become of non-full rank.

agnostic about what ranks actually determine placement.

The paper makes three contributions to the literature. First, it uses the new set of instruments described to estimate program placement effects and identify the effect of family planning on fertility. Second, it shows how the effect of access to family planning is critically dependent on the education level of women. Third, whereas the scant evidence we have comes from very ambitious, costly program (Matlab) or dynamic macro-economic settings (Indonesia and Colombia), discussed in the next section, this paper presents results for the effect of family planning in a situation where there has been relatively low economic growth over the period in question.[4]

We find that access to family planning in Ethiopia has a statistically significant and economically large impact on fertility of women with no schooling. (about 65% of women 30 years or older in the 2007 Census). The reductions in fertility are concentrated among the youngest women and the oldest women indicating that access to family planning leads to a postponement of birth among younger women and a reduction in completed fertility. The reduction in completed fertility at more than 1 child is large compared to other studies. There are no discernible effects of family planning on fertility for women who have ever attended school. Using data on child mortality, timing of first birth and unwanted fertility, we argue that the reduction in fertility is due to access to family planning and not to improvement in child health and survival coming from the health facilities in which the family planning services are offered. Finally, we find that failing to take account of non-random program placement results in a downward bias in the estimated effectiveness of family planning, although the results nonetheless still show a statistically significant and substantial impact.

# 2 Literature Review

Probably the best-known example of a family planning program experiment comes from Matlab, Bangladesh. It began in 1978 when about half of the villages in the region were assigned a very

[4]Ethiopia's GNI per capita in PPP went from just over USD 300 in 1980 to USD 480 in 2003.

intensive family planning program and the other half continued to be served by the standard government family planning program. Fertility was 24 percent lower in the villages that received the intensive family planning program compared to the villages that received only the standard family planning program (Phillips, Simmons, Koenig and Chakraborty 1988). It has, however, been argued that these results reflect a level of program intervention and intensity unlikely to be sustainable because the program was exceedingly expensive; per woman reached the program cost 35 times more than the standard government family planning program (Pritchett 1994). Each averted birth cost USD 180 in 1987, equivalent to 120 percent of Bangladeshs GDP per capita at the time. More recent work on using the same villages in Matlab from 1974 to 1996 finds a decline in fertility of about 15 percent in the program villages compared with the control villages (Sinha 2005; Joshi and Schultz 2007).

Longitudinal data has been used to identify family planning program effects in the Philippines and Indonesia (Rosenzweig and Wolpin 1986; Pitt et al. 1993; Gertler and Molyneaux 1994). For Indonesia, Pitt et al. (1993) found that family planning programs had a negative effect on fertility, although it is very imprecisely estimated, whereas Gertler and Molyneaux (1994) found that family planning programs were responsible for only 4 to 8% of the decline in fertility from 1982 to 1987.[5] In the Philippines family planning prgrams had a significant and positive effect on child health as measured by both (standardised) weight and height. Cross-sectional estimates showed substantial bias compared with the fixed effects estimates.

Cross-sectional data has also been used to estimate the effect of family planning programs. One approach, used for evaluating the effect of Columbia's family planning program, Profamilia, assumed that the process of allocating programs is to all extent and purposes arbitrary (Miller 2010). Profamilia is found to reduce lifetime fertility by around half a child, which means that the family planning program is responsible for only 10 percent of the the sharp decline in fertility in Colombia over the period when the program was implemented. It does, however, appear that Profamilia led to a substantial postponement of first birth and that, in turn, led to higher education

[5] Gertler and Molyneaux (1994) do, however, argue that the rapid decline was only possible because of already-existing access.

levels for young women. A potential problem is that even if (available) observables do not affect placement, unobservables characteristics may still impact placement, resulting in bias.

Closer to the method used here is an evaluation of family planning programs in Tanzania (Angeles et al. 1998). There family planning was found to have a negative effect on fertility, although the effect varies with the type and distance to outlet and age of the woman when the program was introduced. A woman exposed to family planning through her fertile lifespan is predicted to have 4.13 children compared with 4.71 children in the absence of family planning programs. Identification comes from variables that are proported to influence program placement, but are unrelated to the individual fertility decision. The main issue is that some of the variables used to identify placement (such as child mortality levels and the presence of other family planning services) are likely to be correlated with unobservable variables that influence both placement and fertility decisions.

# 3 Family Planning in Ethiopia

Ethiopia is a classic example of a high fertility country (World Bank 2007). Its current total fertility rate, the predicted number of children a woman will have over her reproductives ages, is estimated at 5.4. During the period 1990 to 2005 Ethiopia's total fertility rate declined by about one child and the use of contraceptives tripled from 5 percent to 15 percent, with a most of the increase coming from modern methods, especially injectable contraceptives (Central Statistical Authority [Ethiopia] and ORC Macro 2006). Population growth resulting from such high fertility is believed to come at a high cost to living standards. The average land holding per rural person was estimated at only 0.21 ha in 1999, down from 0.5 ha in the 1960s. This, couples with lack of agricultural productivity growth, has contributed to a (rapidly growing) core group of five to seven million who are chronically food insecure. Spatial resettlement of about two million people from the highlands to the lowlands, adopted as one of a series of policy measures by the Coalition for Food Security Commission to tackle the problem of chronic food insecurity in many highland weredas, is unlikely to provide a sustainable solution in light of the estimated annual increase of Ethiopias population by two million people.

In 1993 the government of Ethiopia adopted a population policy; the overall objective was to harmonize the country's population growth rate with that of the economy, specifically to achieve a total fertility rate of 4 children per women by 2015. One of the major strategies in the policy aimed 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 had a very low level of contraceptive use and has one of the lowest contraceptive prevalence rates in Sub-Saharan Africa. According to the first-ever national survey on fertility and family planning in 1990 only 4 percent of women of reproductive age were using some family planning methods and less than 3 percent were using modern contraceptives (Transitional Government of Ethiopia 1993). Results from the 2005 Demographic and Health Survey (DHS) 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).[6] The Ethiopia DHS 2005 shows that the most commonly used modern methods are injectable contraceptives at 10 percent and oral contraceptives at 3 percent. The other modern methods are used substantially less: condoms, female sterilization, IUD and any traditional method accounted for less than 1 percentage point each.

# 4 Data and Estimation Strategy

We use three data sources to evaluate the impact of the availability of contraception on fertility. The first is a contraceptive use survey collected under the auspices of Pathfinder International

[6]Other studies have found use rates in line with the DHS number or higher (Pathfinder International Ethiopia 2004; Essential Services for Health in Ethiopia 2005). 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 showed prevalence rates for modern contraceptives to be 14 percent, 16 percent and 14 percent in the Amhara, Oromia and SNNP regions. 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 a 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) (Pathfinder International Ethiopia 2004).

– Ethiopia (Pathfinder International Ethiopia 2005). The second is a health facility survey we collected to augment the Pathfinder survey. Finally, we supplement our study with data from the 1994 census of Ethiopia.

The Pathfinder survey was collected in September 2004 and covered the four largest regions: Amhara, Oromia, SNNPR and Tigray.[7] The Pathfinder survey's objective was to provide information on the level of knowledge, attitude and practice of family planning. The survey used a stratified multi-stage sampling design in four regions combined with urban-rural residence for each region. Weredas (districts) constituted the primary sampling units and a total of 58 weredas were sampled. A total of 176 communities (PA/kebeles), 113 rural and 63 urban, were surveyed in these 58 districts. Weights are provided to make the sample representative at for the 4 regions and for each of the strata. We use these weights for all descriptive and regression analyses as well as take into account the sampling design.

We conducted the Wereda Health Facility and CBRH (WHFC) survey in July 2005 to collect information on health facilities, family planning services and Community Based Reductive Health (CBRH) programs available in the 58 Pathfinder districts. The information came from health departments or social sector departments. In each weredas general questions were asked regarding the entire wereda and detailed questions were asked about the communities covered by the Pathfinder Survey.

It was not possible to identify 5 communities that are therefore dropped, leaving 171 communities. After data collection uncertainty arose about whether some of the urban communities surveyed in the facility survey were the same as in the Pathfinder survey and to be cautious we therefore drop an additional 26 communities. Furthermore, 9 communities are dropped because essential information are missing from the facility survey, including the presence of health facilities and when they were introduced. Finally, 16 additional communities were dropped because we were not able to find census data for the areas or because other important information was missing.

[7]The four regions cover 86 percent of Ethiopia's population. Ethiopia is divided into 9 regions, with each regions further divided into zones and there are currently 68 zones in Ethiopia. Each zone is divided into weredas (or woredas, also sometimes called districts) and each wereda is divided into a combination of Kebeles (urban areas) and Peasant Associations (PAs) in rural areas. Kebeles and PAs are the smallest administrative unit of local government.

Our final sample consists of 109 communities covering a total of just over 2,700 women, of which just over 2,000 remain after excluding never married and never partnered women.

## 4.1 Estimation Strategy

Our approach is to first estimate the determinants of the decision on whether to place a program $P$ in area $k$ and then to estimate the program effect on the individual outcome $y_i$. The system of equations is then:

$$P_k = X_k\alpha_1 + Z_k\alpha_2 + \nu_k, \quad (1)$$

$$y_i = X_k\beta_1 + X_i\beta_2 + P_k\beta_3 + \varepsilon_i, \quad (2)$$

where $X_k$ is a vector of exogenous variable that are area specific, $Z_k$ is a vector of area specific exogenous variables that affect program placement but do not affect the individual fertility decision, and individual characteristics are captured by $X_i$. Whether a program is available in the area, $P_k$, is the main variable of interest and $\beta_3$ measures the program's impact on the outcome of interest. The main outcome of interest is number of children ever born. In addition, we estimate the effects of family planning on various measures of mortality, timing of first birth, recent birth or pregnancy and whether last birth or pregnancy was wanted. Unfortunately, lack of birth histories in the data means that we cannot examine how the timing of births respond to family planning.

Using a modified two-stage method, $\beta_3$ can be estimated under relatively relaxed conditions (Wooldridge 2002, Chapter 18). 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 for $P_k$, $\mathbf{X_k}$ 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.

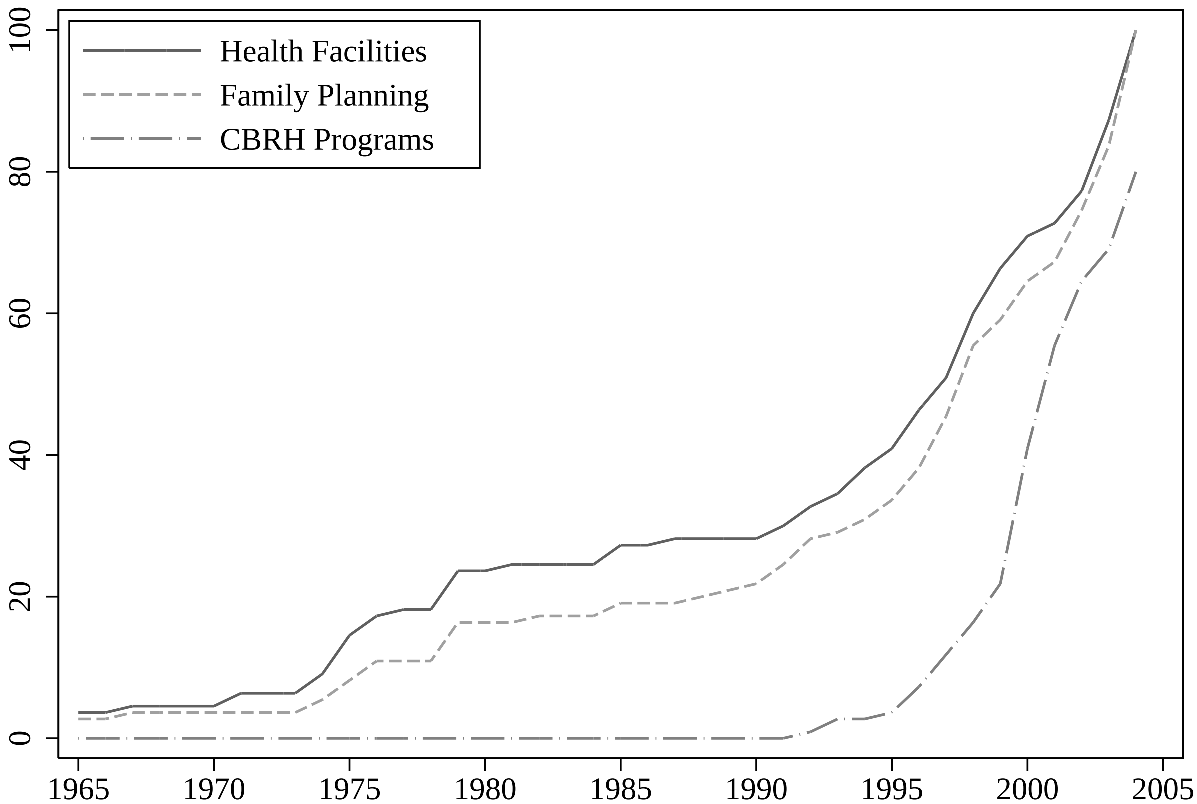
In addition to the instrumental variable results, we also present OLS results, where Equation (2) is estimated under the assumption that there is no correlation between program placement and unobserved area characteristics. All regressions take account of the multi-stage sampling design and apply sample weights. Access to family planning is measured for each of the 109 communities in which women in the sample reside and standard errors would be biased downwards if no correction is applied to account for this clustering (Moulton 1990). Standard errors for both OLS and IV regressions are therefore clustered at the community level.

## 4.2 Family Planning Programs

The three main facilities or programs that might influence individual fertility decisions are health facilities, family planning services and CBRH programs. For all sample communities we have information on whether a health facility is available, when the facility opened, whether family planning services are offered at the health facility and, if so, the year it began offering family planning services. There are health facilities that do not offer family planning, but family planning is never offered outside of health facilities during the period we study.

A community is considered to have access to family planning if there is either a facility with family planning in the community or the community is less than 40 kilometers to the closest facility with family planning. Although the distance may appear long, most women only visit the family planning program every three months, either to pick up more pills or renew the injection. Furthermore, there is only one community where there is 40 km to the closest family planning program and the second-longest distance is 30 km. For urban communities the maximum distance to the closest facility is 3.5 kilometers. The average distance from those communities that did not have a health facility with family planning is around 10 kilometers. To determine when women in a rural community had access to family planning we use the year family planning services were first offered in that administrative area. For urban areas we use the year the closest health facility began offering family planning services whether or not the health facility is located in the urban area or a neighbouring area.

The definition of access leads to two potential issues. First, it is not possible to estimate the extent to which distance to a family planning program is an important factor in use. Although our conversations with providers indicates that many of their clients do, indeed, travel substantial distances to receive family planning services, increasing distances must at some point lower use rates. In that case, our definition of access will tend to bias downward the estimated effect of access. Secondly, we only have information on access to the closest family planning program. Some areas may be coded as only having had family planning services for a relatively short period if a new health center recently opened in the area, even though the neighbouring area already offered family planning services. Similarly, it is possible that changes in facility type might not be reflected in the start date, i.e. a change from clinic to center that results in access to a wider set of services. These issues are also likely to result in a downward bias of the estimated effect of access.




Source: The World Bank Wereda Health Facility and CBRH survey.

Figure 1: Percent Communities with access to Health Facilities, Family Planning or CBRHA

Figure 1 shows the development in access to health facilities, family planning services and CBRH programs over time.[8] We focus on the effects of having access to family planning services

[8]The introduction of CBRH program is an interesting development, but happened too recently and to too many

in 1990, when approximately 20 percent of all communities in the sample had access to a family planning program. The prevalence of programs was essentially constant the decade before 1990. A majority of the women who had access in 1990 therefore have been exposed to the program for almost 25 years at the time of the survey allowing sufficient time to identify long-term effects on fertility. There was a substantial expansion in access to health facilities and family planning programs after 1990 with coverage going from 50 to 100 percent over from 1997 to 2005. The effect of the increase in program coverage is to bias downward the estimated the effect of the program.

Table 1 shows the descriptive statistics for the dependent variable and the explanatory variables used for estimating program placement. There are two categories of explanatory variables. First, variables that affect both placement and the individual decisions. Secondly, the instruments that are assumed to only affect the program placement.

The first set of variables are variables expected to affect the placement decision that may also affect individual fertility decisions. The district level variables are the total area of the district, the average yearly rainfall and its square and the elevation of the district and its square. At the community level the variables include a dummy for whether is it an urban area (or in other words, whether it is a kebele), and a dummy for whether there is a market in the 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).

We use the rank of variables as instruments in the placement decision estimation. Each variable is ranked with 1 assigned to the smallest value and ties are assigned the same value, so that the sum of the ranks is preserved. That is, for a given variable an observation's rank is 1 plus the number of values that are lower than that observation's value. Five variables are ranked at the zonal level for the 36 zones in the sample and one variable is ranked within zones. For zones, the ranked variables are the size of the population, the degree of urbanisation (measured as the percent of the

areas simultaneously to allow for an analysis of long-term effects on fertility. Access to health facilities and family planning services track closely making it impossible to estimate whether there is an independent effect of access to health facilities.

Table 1: Descriptive Statistics for Program Placement

| | Mean | Standard Error | Min | Max |
|---|---|---|---|---|
| **Dependent Variable** | | | | |
| Family planning program in 1990 (ratio) | 0.19 | 0.39 | 0.00 | 1.00 |
| **Zone characteristics** | | | | |
| Percent with no education in zone | 79.20 | 5.94 | 30.07 | 94.83 |
| Percent with 1-6 years of education in zone | 11.62 | 5.24 | 2.05 | 37.45 |
| Percent with 7-8 years of education in zone | 2.39 | 1.24 | 0.20 | 10.70 |
| **District characteristics** | | | | |
| Total area (square km/100) | 14.53 | 9.57 | 0.00 | 53.81 |
| Avg. yearly rainfall (mm/100) | 11.91 | 4.05 | 4.46 | 20.48 |
| Avg. yearly rainfall squared $(\text{mm}/100)^2/100$ | 1.58 | 1.02 | 0.20 | 4.19 |
| Elevation (m/100) | 19.68 | 4.25 | 8.65 | 29.26 |
| Elevation squared $(\text{m}/100)^2/100$ | 4.05 | 1.65 | 0.75 | 8.56 |
| **Community characteristics** | | | | |
| Urban (rate) | 0.04 | 0.19 | 0.00 | 1.00 |
| Market in area (rate) | 0.35 | 0.48 | 0.00 | 1.00 |
| Road access - all year (rate) | 0.41 | 0.49 | 0.00 | 1.00 |
| Road access - dry season (rate) | 0.39 | 0.49 | 0.00 | 1.00 |
| Population / 1000 | 3.23 | 5.28 | 0.35 | 96.94 |
| **Ranking of Zones (Nationally)** | | | | |
| Zone population rank | 21.76 | 9.37 | 1.00 | 36.00 |
| Zone urbanisation rank | 19.08 | 8.76 | 1.00 | 36.00 |
| Zone percent with no education rank | 18.88 | 9.31 | 1.00 | 36.00 |
| Zone Percent with 1-6 years of education rank | 17.21 | 9.73 | 1.00 | 36.00 |
| Zone Percent with 7-8 years of education rank | 18.59 | 9.46 | 1.00 | 36.00 |
| **Ranking of Communites (Within Zones)** | | | | |
| Community population rank | 2.27 | 1.40 | 1.00 | 10.00 |
| Number of communities | | 109 | | |

**Notes.** Estimated means and standard errors based on sample frame and weights. The ranking of zones is based on the available sample, with 1 assigned to the smallest value and ties are assigned the same value, so that the sum of the ranks is preserved. For communities the ranking is based on the sample available within a zone.

population who live in urban areas) and the percentage of adults with various levels of education (none, primary or 1-6 years, and 7-8 years). These ranks are all based on data from the 1994 Census. The means of the rankings are not all equal to 19 because not all zones have the same number of communities and because weights are applied to calculate the means. The communities are ranked within each zone by their population size. The maximum number of communities within a zone is ten, while for five zones there is only one community in the survey. Although it would be advantageous to have more information at the community level, the set of possible variables is limited by the lack of information available at that level from published census reports.

## 4.3 Individual Data

As discussed early, we posit that the impact of family planning on fertility is highly dependent on a woman's schooling. The lower a woman's education, the more likely she is to benefit from access to family planning services (Rosenzweig and Schultz 1989). This is especially so in Ethiopia where injectable contraceptives are the main method. Injectable contraceptives are ideal for women without education because they do not require any user action except the visit to a family planning clinic every 3 months.[9] In addition to the expected larger effect of family planning for women with no education, the age profile of fertility and the effect of other factors on fertility are likely to be different across education groups. Instead of trying to correctly specify how age and other factors affect fertility across education groups, the main sample consists of all women who have ever been married or lived together with a man and who have no education. Among the original sample, 65% of women never attended school. Table 2 shows the descriptive statistics for the individual level data.[10]

The main dependent variable is the number of children a woman had given birth to at the time of the survey (children ever born) which averages just over 4. The large number of births reflects the high fertility rate in Ethiopia, especially considering that the average age of the women in the sample is just over 28 years.[11]

Age is captured using five year age groups with the excluded category being aged 15-19. With the high population growth rate in Ethiopia younger cohorts are larger than older cohorts, but the percentage that have married or lived with a partner is smaller for young women compared to older women explaining the lower percentages of the two youngest age groups (15-19 and 20-24) in the sample. Just over half of the women are Orthodox Christian, a quarter are Muslim and the last

[9]This also makes them attractive for women who do not want to reveal to their partner that they are using contraceptives (Ashraf et al. 2009).

[10]The descriptive statistics for the full sample is available on request.

[11]For comparison the equivalent number for Guatemala is 2.8 and Guatemala has one of the highest total fertility rates in Latin America (Pörtner 2008).

Table 2: Descriptive Statistics for Women
Ages 15-45 With No Schooling

| | Mean | Standard Error | Min | Max |
|---|---|---|---|---|
| Children even born | 4.14 | 2.73 | 0.00 | 13.00 |
| Age 20-24 | 0.17 | 0.37 | 0.00 | 1.00 |
| Age 25-29 | 0.21 | 0.41 | 0.00 | 1.00 |
| Age 30-34 | 0.20 | 0.40 | 0.00 | 1.00 |
| Age 35-39 | 0.18 | 0.38 | 0.00 | 1.00 |
| Age 40-45 | 0.17 | 0.38 | 0.00 | 1.00 |
| Orthodox | 0.54 | 0.50 | 0.00 | 1.00 |
| Muslim | 0.26 | 0.44 | 0.00 | 1.00 |
| **Community characteristics** | | | | |
| Total area (square km/100) | 15.51 | 10.10 | 0.00 | 53.81 |
| Avg. yearly rainfall (mm/100) | 11.97 | 4.25 | 4.46 | 20.48 |
| Avg. yearly rainfall squared $(mm/100)^2/100$ | 1.61 | 1.05 | 0.20 | 4.19 |
| Elevation (m/100) | 19.36 | 4.18 | 8.65 | 29.26 |
| Elevation squared $(m/100)^2/100$ | 3.92 | 1.62 | 0.75 | 8.56 |
| Urban (rate) | 0.04 | 0.20 | 0.00 | 1.00 |
| Market in area (rate) | 0.35 | 0.48 | 0.00 | 1.00 |
| Road access - all year (rate) | 0.41 | 0.49 | 0.00 | 1.00 |
| Road access - dry season (rate) | 0.41 | 0.49 | 0.00 | 1.00 |
| Percent with no education in zone | 79.97 | 6.40 | 30.07 | 94.83 |
| Percent with 1-6 years of education in zone | 11.17 | 5.42 | 2.05 | 37.45 |
| Percent with 7-8 years of education in zone | 2.28 | 1.27 | 0.20 | 10.70 |
| Population / 1000 | 3.08 | 4.90 | 0.35 | 96.94 |
| Access to family planning (rate) | 0.18 | 0.38 | 0.00 | 1.00 |
| Observations | | 1326 | | |

**Notes.** Estimated means and standard errors based on sample frame and weights.

mainly other Christian. The remaining variables are community characteristics used for the first stage.

Because there is no information on migration of women the definition of access to family planning implicitly assume that a woman has spent her entire life in the area where she was found during the survey. Given the relocation policy in Ethiopia this might be a problematic assumption, but in the absence of additional information other assumptions would be just as arbitrary. Finally, the survey did not ask for birth histories. It is therefore not possible to directly examine how the timing of births responds to the introduction of family planning.

# 5 Results

Table 3 presents the results from the determinants of placement estimation. The dependent variable is whether a given community was within 40 kilometers of the nearest family planning program in 1990.[12] Most of the variables have the expected signs. Areas that have a market are statistically significantly more likely to also have access to family planning services. Furthermore, urban areas and areas with easier access, as measured by whether there is road access by car either all year or during the dry season, are more likely to have a program, although the effects are not statistically significant.

The main variables of interest are the rank variables that identify program placement. All instruments are individually statistically significant or close to. Zones with larger population and more urbanised are statistically significantly more likely to have access to a family planning program. Within a zone, communities with relatively smaller population are more likely to have access to family planning programs. For education policy makers appear to target zones with a relatively larger share of people with between 1 and 6 years of education. The effects of the two other education ranking, no education and 7 to 8 years of education, are negative. One interpretation of the education rank variables is that the government was actively trying to place family planning programs in areas where the population is less educated but not overwhelmingly lacking in education. Presumably those with more education are likely to live in areas where there are other means of obtaining family planning services or have lower desired fertility. The F-test for all instruments being jointly equal to zero is 6.14. Despite the low number of observations, the F-test indicates that the instruments perform well.

[12]The first stage results for other cut-off years are available on request. Using immediately surrounding years do not substantially change the results.

Table 3: First Stage Probit – Determinants of Family Planning Program Placement

| Variable | Program available in 1990 |
|---|---|
| Total area of district | −0.021 |
| | (0.027) |
| Rainfall (mm/100) | −0.717** |
| | (0.338) |
| Rainfall squared $(\text{mm}/100)^2/100$ | 3.715** |
| | (1.478) |
| Elevation (m/100) | 0.999** |
| | (0.425) |
| Elevation squared $(\text{m}/100)^2/100$ | −3.050*** |
| | (1.134) |
| Urban area | 0.474 |
| | (0.989) |
| Market in PA/kebele | 0.994*** |
| | (0.368) |
| Road access - all year | 0.296 |
| | (0.558) |
| Road access - dry season | −0.120 |
| | (0.540) |
| Percent with no education in zone | −0.018 |
| | (0.165) |
| Percent with 1-6 years of education in zone | −1.601*** |
| | (0.393) |
| Percent with 7-8 years of education in zone | 3.427*** |
| | (1.003) |
| PA/kebele population / 1000 | 0.063 |
| | (0.044) |
| Constant | 0.745 |
| | (14.332) |
| **Ranking of Zones** | |
| Total population | 0.155*** |
| | (0.032) |
| Urbanisation | 0.085*** |
| | (0.026) |
| Percent with no education | −0.126 |
| | (0.078) |
| Percent with 1-6 years of education | 0.785*** |
| | (0.180) |
| Percent with 7-8 years of education | −0.579*** |
| | (0.139) |
| **Ranking of PA/kebeles within Zone** | |
| Total population | −0.511*** |
| | (0.163) |
| All ranks equal to zero F(6,96) | 6.14*** |
| Observations | 109 |

**Notes.** * sign. at 10%; ** sign. at 5%; *** sign. at 1%. Weighted probit with robust clustered standard errors in parentheses estimated using Stata's svy command. Dependent variable is whether a family planning program was available within 40 km of community in 1990.

## 5.1 Effect on Fertility

Table 4 presents the results for the effect of access to family planning in 1990 on the number of children ever born.[13] Models I and II assume that program placement is exogenous and estimate the effect of family planning using OLS. Models III and IV treat program placement as endogenous and use the predicted probability of access to a family planning program from Table 3 as instrument.[14] Models I and III estimate the average effect of access to family planning services on children ever born across all women in the sample. Because the effect of access is likely to vary by age, Models II and IV include interactions between family planning access and the five year age group dummies.

Table 4: Effect of Family Planning Access on
Number of Children Ever Born for Women Without Schooling

| | Children Ever Born | | | |
|---|---|---|---|---|
| | OLS | | Instrumental Variable[a] | |
| | Model I | Model II | Model III | Model IV |
| Family planning | $-0.687^{***}$ | | $-0.892^{***}$ | |
| | (0.215) | | (0.323) | |
| Family planning × age 15-19 | | $-0.656^{**}$ | | $-1.052^{**}$ |
| | | (0.288) | | (0.412) |
| Family planning × age 20-24 | | $-0.219$ | | $-0.281$ |
| | | (0.254) | | (0.465) |
| Family planning × age 25-29 | | $-0.302$ | | $-0.899^{**}$ |
| | | (0.236) | | (0.448) |
| Family planning × age 30-34 | | $-0.919^{**}$ | | $-0.925$ |
| | | (0.395) | | (0.590) |
| Family planning × age 35-39 | | $-0.928^{***}$ | | $-0.700^{*}$ |
| | | (0.339) | | (0.418) |
| Family planning × age 40-45 | | $-0.932^{*}$ | | $-1.269^{**}$ |
| | | (0.487) | | (0.604) |

**Notes.** * sign. at 10%; ** sign. at 5%; *** sign. at 1%. Robust standard errors clustered at PA level in parentheses. Family planning indicates whether there was a family planning within 40 km in 1990. Additional variables not shown are region dummies, ethnic group dummies, five year age group dummies, dummies for religion, area of wereda, rainfall and rainfall squared of wereda, dummy for urban area, dummy for market in area, and dummies for road access all year and road access only during dry season. Number of observations for all models is 1340. Results for including other explanatory variables are in Table A-1.
[a] Weighted IV estimation using Stata's svy command with family planning access treated as endogenous. In Model III the predicted probability of a family planning program in the area is the instrument. In Model IV the predicted probability of program in area interacted with age dummies are the instruments.

The average effect of access to family planning on children ever born is negative and strongly

[13] Table A-1 shows the full results.

[14] Choosing a different cut-off year does not substantially change the results for years immediately around 1990. The results for other years are available on request.

statistically significant for both OLS and IV. The OLS estimate indicates that providing family planning reduces the number of children ever born by 0.7 children. Taking account of program placement leads to an even larger estimated impact of access to family planning with fertility falling by 0.9 children. Given the sample's average the effect is equivalent to an approximately 20 percent reduction in the number of children born per woman. A possible interpretation the IV estimate being larger than the OLS estimate is that among areas with similar observable characteristics, the government targeted areas with higher fertility first when introducing the program.

The results for access interacted with age groups are less precise than the average effects although most are still statistically significant. The OLS results show that the reduction in number of children is 0.6 for the youngest age group, aged 15-19, smaller and not statistically significant for women between 20 to 29 and then large and statistically significant at just below 1 for women aged 30 to 45. Except for women aged 35 to 39, the IV effects are larger than the OLS effects. For women less than 20 years old taking account of program placement almost doubles the effect of family planning on number of children; the IV result indicates that family planning access decreases the number of children by 1 for the youngest women. In other words, young women substantially delay their child bearing when they have access to family planning. For the oldest age group, women aged 40 to 45, the IV results are also larger than the OLS results. Because few women have children after passing 45 years of age the estimated effect for the oldest age group is a good indicator of the impact of family planning access on completed fertility. According to the IV results access to family planning decreases completed fertility by 1.2 children among women without education. To place this in perspective, women who late received access to family planning will have approximately 5.7 children by the time they end child bearing, whereas women with access for most of their fertile period will have approximately 4.5 children.

For women who have passed first grade or above there is no impact of access to family planning on fertility.[15] OLS results show that the average effect for women with 1 to 5 years of education is 0.1 and the average effect for women with 6 to 12 years of education is 0.05. Using the IV results

[15]Table A-2 presents results for the sample of all women.

the effect for women with 1 to 5 years of education is 0.04 and for women with 6 to 12 years of education the effect is 0.4. Neither result is statistically significant. Using the same age groups as above for the two education groups leads to no consistent results.

## 5.2 Family Planning or Health Facilities?

An important question is whether the effects on fertility arise from access to family planning services or the concurrent health facilities. Access to health facilities are unlikely to directly reduce fertility but we would expect that health facilities reduce child mortality. A reduction in expected child mortality would in turn allow parents to achieve a desired number of surviving children with fewer births (Sah 1991; Schultz 1997; Wolpin 1997).

In Ethiopia government family planning programs are offered only at health facilities and not as standalone clinics. As Figure 1 shows there is a close correspondence between the presence of health facilities and family planning programs; in 1990 18 percent of women had access to family planning and a health facility while an additional 6 percent had access to only a health facility. The low number of women with access to health facilities only makes it impossible to estimate the effects of access to only health facilities with any degree of confidence. Substituting health facility for family planning service in the models above lead to smaller and less statistically significant effects using OLS.[16] The smaller OLS estimates is a first indication that the effect on fertility is mainly due to access to family planning at facilities and not access to health facilities alone.

Given the close connection between access to health facilities and family planning estimating the effects of health facilities on child mortality does not help to isolate the effect of health facilities on fertility for two reasons. First, if family planning reduces fertility there will be fewer children who can die and more resources will be available to the children born. Secondly, even in the absence of a reduction in fertility, access to family planning can improve the survival chances of children by allowing parents to better space births. In other words, if we observe a reduction in

[16] The IV estimations the first stage for health facilities performs worse than for the family planning with the F-statistics for the instruments jointly equal to zero close to 3. Results for both OLS and IV are available on request.

Table 5: Effect of Family Planning Access on Mortality of Children for Women Without Schooling

| | OLS | | Instrumental Variable[a] | |
|---|---|---|---|---|
| | Model I | Model II | Model III | Model IV |
| | | Any Children Died | | |
| Family planning | 0.008 | | −0.008 | |
| | (0.050) | | (0.079) | |
| Family planning × age 15-19 | | −0.094 | | −0.111 |
| | | (0.088) | | (0.138) |
| Family planning × age 20-24 | | 0.013 | | 0.060 |
| | | (0.055) | | (0.097) |
| Family planning × age 25-29 | | −0.000 | | 0.012 |
| | | (0.075) | | (0.098) |
| Family planning × age 30-34 | | 0.007 | | −0.073 |
| | | (0.084) | | (0.117) |
| Family planning × age 35-39 | | 0.010 | | 0.019 |
| | | (0.098) | | (0.141) |
| Family planning × age 40-45 | | 0.036 | | −0.005 |
| | | (0.086) | | (0.130) |
| | | Number of Dead Children | | |
| Family planning | −0.094 | | −0.110 | |
| | (0.097) | | (0.163) | |
| Family planning × age 15-19 | | −0.215 | | −0.284 |
| | | (0.168) | | (0.259) |
| Family planning × age 20-24 | | −0.122 | | −0.154 |
| | | (0.097) | | (0.189) |
| Family planning × age 25-29 | | 0.023 | | −0.053 |
| | | (0.136) | | (0.171) |
| Family planning × age 30-34 | | −0.274* | | −0.090 |
| | | (0.156) | | (0.330) |
| Family planning × age 35-39 | | −0.264 | | −0.269 |
| | | (0.231) | | (0.315) |
| Family planning × age 40-45 | | 0.155 | | 0.024 |
| | | (0.270) | | (0.367) |
| | | Share of Children that Died | | |
| Family planning | −0.002 | | 0.011 | |
| | (0.019) | | (0.031) | |
| Family planning × age 15-19 | | −0.072* | | −0.096 |
| | | (0.042) | | (0.074) |
| Family planning × age 20-24 | | −0.015 | | −0.010 |
| | | (0.026) | | (0.050) |
| Family planning × age 25-29 | | −0.002 | | 0.026 |
| | | (0.026) | | (0.033) |
| Family planning × age 30-34 | | −0.010 | | 0.003 |
| | | (0.035) | | (0.057) |
| Family planning × age 35-39 | | −0.018 | | −0.003 |
| | | (0.037) | | (0.049) |
| Family planning × age 40-45 | | 0.042 | | 0.046 |
| | | (0.043) | | (0.061) |

**Notes.** * sign. at 10%; ** sign. at 5%; *** sign. at 1%. Robust standard errors clustered at PA level in parentheses. Family planning indicates whether there was a family planning within 40 km in 1990. Additional variables not shown are region dummies, ethnic group dummies, five year age group dummies, dummies for religion, area of wereda, rainfall and rainfall squared of wereda, dummy for urban area, dummy for market in area, and dummies for road access all year and road access only during dry season. Number of observations for all models is 1242. Complete results including other explanatory variables are available on request.

[a] Weighted IV estimation using Stata's svy command with family planning access treated as endogenous. In Model III the predicted probability of a family planning program in the area is the instrument. In Model IV the predicted probability of program in area interacted with age dummies are the instruments.

child mortality there is no guarantee that the reduction will be the result of access to health facilities because access to family planning programs and health facilities are so closely connected.

Despite these issues, the size of reduction in child mortality is interesting both in its own right and because it can still provide an indication of the relative importance of health facilities and family planning. Table 5 presents the estimated effects of access to family planning on three measures of child mortality: whether any of a woman's children have died, the number of children who have died, and the share of children who have died.[17] For the sample of women who have had children, close to 30 percent have had at least one child die, the average number of children who died is 0.57 and 10 percent of children children born have died.[18]

None of the average effects are statistically significant, although negative as expected, except for the OLS estimate of any children died. The reductions in whether a woman has had at least one child die by age group are small, statistically insignificant and many are of the wrong sign. For the number of children that have died, there are statistically significant and negative effects of family planning for women younger than 25, whereas the effects for older women are not significantly significant. Likewise for the share of children who have died, where the only statistically significant effect is for women younger than 20. For older women the effects are small and not statistically significant, although negative (except for women age 40 to 45). The small effects on child mortality and that the effects are concentrated among the youngest women indicate that the reduction in fertility is unlikely to come from access to health facilities. A more convincing explanation is that family planning services reduced fertility and that combined with health facilities in turn lead to lower mortality.

A different approach to determining if health facilities or family planning services are responsible for the reduction in fertility is to examine three outcomes that are mainly influenced by family planning rather than health facilities: age at first birth, recent birth or pregnancy, and unwanted births or pregnancies. Even if lower mortality leads to lower desired fertility, it is, for example, harder to avoid unwanted births or pregnancies unless one has regular access to family planning services. To capture the timing of first birth, the dependent variable is coded one for women who

[17]The corresponding results using health facility access are available on request, but lead to qualitatively similar results.

[18]It should be kept in mind that this includes mortality after age 5 and the sample consists solely of women with no schooling.

Table 6: Effect of Family Planning Access on
Timing of First Birth for Women Without Schooling

| | Was 18 Years or Older at First Birth | | | |
|---|---|---|---|---|
| | OLS | | Instrumental Variable[a] | |
| | Model I | Model II | Model III | Model IV |
| Family planning | 0.049 | | 0.035 | |
| | (0.058) | | (0.082) | |
| Family planning × age 20-24 | | −0.061 | | −0.405 |
| | | (0.140) | | (0.250) |
| Family planning × age 25-29 | | 0.047 | | 0.099 |
| | | (0.086) | | (0.148) |
| Family planning × age 30-34 | | 0.038 | | 0.093 |
| | | (0.111) | | (0.191) |
| Family planning × age 35-39 | | 0.120 | | 0.125 |
| | | (0.084) | | (0.123) |

**Notes.** * sign. at 10%; ** sign. at 5%; *** sign. at 1%. Linear probability model with robust standard errors clustered at PA level in parentheses. Family planning indicates whether there was a family planning within 40 km in 1990. Additional variables not shown are region dummies, ethnic group dummies, five year age group dummies, dummies for religion, area of wereda, rainfall and rainfall squared of wereda, dummy for urban area, dummy for market in area, and dummies for road access all year and road access only during dry season. Number of observations for all models is 1024; sample consists of women without education who are between 20 years and 39 years of age. Complete results including other explanatory variables are available on request.
[a] Weighted IV estimation using Stata's svy command with family planning access treated as endogenous. In Model III the predicted probability of a family planning program in the area is the instrument. In Model IV the predicted probability of program in area interacted with age dummies are the instruments.

are either 18 years or older and have not yet had a child or had their first birth after age 18, otherwise the variable is coded zero. We restrict the sample to women 20 to 39 years of age because very few women 40 or older were exposed by the program early enough for it to have an effect on this outcome. Table 6 presents the results of the linear probability model. For OLS the average effect is small and positive but not statistically significant. The OLS results by age groups are mostly negative despite the expected sign being positive, but again not statistically significant. The IV results are positive with the exception of women aged 20 to 24 for whom the effect is negative and unrealistically large. A potential issue is that a relatively large share of women report being 18 or older when they had their first child and there is surprisingly little variation across age groups, which is likely to be the result of recall error. For women 20 to 24, 58 percent report being 18 or older at their first birth and the same is the case for women age 35 to 39.

Table 7 presents the estimated impact of access to family planning on whether a woman has either had a birth within the last 12 months or is currently pregnant. For both OLS and IV the average effect is negative and statistically significant. The IV results indicate that a woman with

Table 7: Effect of Family Planning Access on
Recent Birth or Pregnancy for Women Without Schooling

| | Birth within last 12 months or currently pregnant | | | |
|---|---|---|---|---|
| | OLS | | Instrumental Variable[a] | |
| | Model I | Model II | Model III | Model IV |
| Family planning | −0.063* | | −0.071 | |
| | (0.034) | | (0.059) | |
| Family planning × age 15-19 | | 0.095 | | 0.173 |
| | | (0.151) | | (0.170) |
| Family planning × age 20-24 | | 0.189** | | 0.304* |
| | | (0.074) | | (0.173) |
| Family planning × age 25-29 | | −0.110* | | −0.030 |
| | | (0.065) | | (0.156) |
| Family planning × age 30-34 | | −0.114 | | −0.140 |
| | | (0.075) | | (0.107) |
| Family planning × age 35-39 | | −0.168** | | −0.301*** |
| | | (0.075) | | (0.086) |
| Family planning × age 40-45 | | −0.029 | | −0.056 |
| | | (0.056) | | (0.077) |

**Notes.** * sign. at 10%; ** sign. at 5%; *** sign. at 1%. Linear probability model with robust standard errors clustered at PA level in parentheses. Family planning indicates whether there was a family planning within 40 km in 1990. Additional variables not shown are region dummies, ethnic group dummies, five year age group dummies, dummies for religion, area of wereda, rainfall and rainfall squared of wereda, dummy for urban area, dummy for market in area, and dummies for road access all year and road access only during dry season. Number of observations for all models is 1021; sample consists of women without education who are between 20 years and 39 years of age. Complete results including other explanatory variables are available on request.
[a] Weighted IV estimation using Stata's svy command with family planning access treated as endogenous. In Model III the predicted probability of a family planning program in the area is the instrument. In Model IV the predicted probability of program in area interacted with age dummies are the instruments.

access to family planning is more than 10 percent less likely to have had a birth within the last 12 months or be currently pregnant compared to a woman without access to family planning. The average effect masks substantial differences across age groups. For women younger than 25 access to family planning increases the chance of a recent birth or pregnancy; the OLS effect for women 20 to 24 is statically significant. For older women the effect of access is negative and generally statistically significant. The IV results show large reductions in the probability of a recent birth or pregnancy with women 30 to 34 are 18 percent less likely and women 35 to 39 are 35 percent less likely with access to family planning.

Finally, Table 8 shows the effects of family planning on the last birth or current pregnancy being unwanted. Control over fertility provides possibly the most direct evidence on whether family planning or health facilities are responsible for the reduction in fertility. To capture control over fertility, women without children are coded as not having had a unwanted birth or pregnancy;

Table 8: Effect of Family Planning Access on
Unwanted Fertility for Women Without Schooling

| | Last/Current Pregnancy Unwanted | | | |
|---|---|---|---|---|
| | OLS | | Instrumental Variable[a] | |
| | Model I | Model II | Model III | Model IV |
| Family planning | −0.071 | | −0.051 | |
| | (0.046) | | (0.071) | |
| Family planning × age 15-19 | | −0.073 | | −0.104 |
| | | (0.104) | | (0.130) |
| Family planning × age 20-24 | | −0.039 | | −0.001 |
| | | (0.071) | | (0.130) |
| Family planning × age 25-29 | | −0.079 | | −0.034 |
| | | (0.071) | | (0.132) |
| Family planning × age 30-34 | | 0.034 | | 0.083 |
| | | (0.083) | | (0.120) |
| Family planning × age 35-39 | | −0.142** | | −0.124 |
| | | (0.061) | | (0.094) |
| Family planning × age 40-45 | | −0.113 | | −0.140 |
| | | (0.073) | | (0.107) |

**Notes.** * sign. at 10%; ** sign. at 5%; *** sign. at 1%. Linear probability model with robust standard errors clustered at PA level in parentheses. Family planning indicates whether there was a family planning within 40 km in 1990. Additional variables not shown are region dummies, ethnic group dummies, five year age group dummies, dummies for religion, area of wereda, rainfall and rainfall squared of wereda, dummy for urban area, dummy for market in area, and dummies for road access all year and road access only during dry season. Number of observations for all models is 1340. Complete results including other explanatory variables are available on request.

[a] Weighted IV estimation using Stata's svy command with family planning access treated as endogenous. In Model III the predicted probability of a family planning program in the area is the instrument. In Model IV the predicted probability of program in area interacted with age dummies are the instruments.

women who have not had any children have presumably been able to avoid a pregnancy exactly because of access to family planning. The average effects indicate that longer expose to family planning reduces the risk of an unwanted birth or pregnancy but the effects are not statically significant. The results by age group show that mainly older women benefit from family planning in terms of avoiding unwanted fertility. For both women aged 35 to 39 and 40 to 45 there is a substantial reduction in the probability of last birth or current pregnancy being unwanted with the effects statistically significant for women 35 to 39 for the OLS results and for women 40 to 45 for the IV model. That there is a reduction in unwanted fertility among older part of the sample indicates that the reductions in fertility is likely due to family planning access and not health facilities.

# 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 researchers are generally forced to use survey data instead of ideal experimental data. The reliance on survey data requires methods for dealing with the problem of potentially non-random program placement. This paper uses a novel set of instruments to estimate the effects of access to family planning on fertility and related outcomes in Ethiopia. The advantages of the instruments, ranking of area characteristics, are twofold. First, they are easy to understand and likely to reflect what policy makers care about while not being directly related to fertility. Secondly, they are easy to create from readily available secondary data like a census or even from the primary data set itself.

Access to family planning substantially reduces the number of children born for women without education. Most of the reduction is concentrated among the youngest and the oldest women. Women younger than 20 with long-term access to family planning have one child fewer than those without access to family planning indicating postponements of births. The reduction in completed fertility, captured by the number of children born to women aged 40 to 45, is almost 1.2 children. This effect is more than twice as larger as found in other studies. There are two likely explanations for this. First, Ethiopia's fertility is high compared to other study countries such as Columbia. Secondly, the role of women's educational attainment is important when examining the effectiveness of family planning; family planning significantly reduces fertility for women with no education, but there is no effect of family planning among women who have gone to school and not properly accounting for this will bias downwards the estimated effect. In addition, many of the women who did not have access to family planning in 1990 will subsequently receive access. The results therefore likely underestimate the true effect of exposure to family planning programs.[19]

Although family planning programs are always offered in conjunction with health facilities we argue that the presence of health facilities is unlikely to explain the reduction in fertility. If

[19] There is unfortunately little scope for determining how severe the underestimation is because the Pathfinder data does not collect birth histories.

health facilities explained the reduction we would expect them to work mainly through reductions in child mortality. We do find reductions in child mortality, but the size of the reductions and their distribution across age groups makes the reductions more likely to be the result of reduced fertility than a strong impact of health facilities. Furthermore, women with access to family planning are less like to have their first birth before they turn 18. Women are also less likely to have had a recent birth or pregnancy and the last birth or pregnancy is more likely to be wanted for older women with access to family planning. All of these results indicate it is not the health facility but rather the access to family planning that is the dominant explanation for the reduction in fertility.

The age pattern of the effects on fertility is evidence of a strong compression of the timing of births with access to family planning. One might a priori expect a uniform reduction in births across age or that the cumulative effect would become larger with increasing age. Instead there are large reductions for women younger than 20 and women older than 30. Because the outcome is cumulative births, the women with access to family planning must have had more children in their twenties than those without access to family planning.[20]

The compression of births is important for three reasons. First, it is another indication that family planning rather than health facilities is responsible for the reduction in fertility. Without access to modern contraceptives the main way to reduce fertility is to ensure that the space between births is as long as possible. Only with added control over the timing of births and completed fertility would it be optimal for a woman to have children more closely spaced. With modern contraceptives it is possible to control the timing of births and stop child bearing completely when desired. Secondly, with closer spacing of children women can spend more time in the labour market thereby increasing the amount of resources available to the household. Finally, the compression of births into a shorter period of time allows women to investment more in human capital.

The reduction in births with access to family planning in Ethiopia, although large compared to

[20]Women aged 15 to 19 are estimated to have 1 birth less with access compared to without access. Women aged 20 to 24 with access have only 0.5 births less than those without access. In other words, compared to those without access to family planning, women with access have, on average, given birth to 0.5 children *more* from turning 20 until they turn 25. Say, a woman without family planning have 1 child between 15 and 19 and an additional 1.5 child between 20 and 25, then a woman with access will have 0 children between 15 and 19 and 2 children between 20 and 25.

previous studies, is not sufficient to reduce fertility to replacement level. The results here indicates that the reduction in fertility is mainly due to the avoidance of unwanted births, especially births early and late in a woman's fertile years. Our estimated effect of family planning does not take into account that a potentially important impact of family planning access is that it allows young women to continue going to school longer than they would otherwise be able to. The resulting increase in schooling will in turn lead to a even larger reduction in fertility and better health for both mother and children. Family planning may not be a panacea for rapid population growth but it does substantially reduce fertility and, maybe even more importantly, it provides women with increased control over the timing of births. Clearly providing access to family planning is an effective means of improving the welfare of women.

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# A Appendix

Table A-1: Estimated Effect of Family Planning Access on Children Ever Born for Women Without Schooling

| | OLS | | IV[a] | |
|---|---|---|---|---|
| | Model I | Model II | Model III | Model IV |
| Age 20-24 | 1.054*** | 1.010*** | 1.041*** | 0.953*** |
| | (0.148) | (0.166) | (0.147) | (0.164) |
| Age 25-29 | 2.538*** | 2.473*** | 2.544*** | 2.521*** |
| | (0.156) | (0.184) | (0.158) | (0.195) |
| Age 30-34 | 3.862*** | 3.906*** | 3.867*** | 3.848*** |
| | (0.164) | (0.176) | (0.164) | (0.193) |
| Age 35-39 | 5.112*** | 5.163*** | 5.117*** | 5.054*** |
| | (0.191) | (0.205) | (0.192) | (0.227) |
| Age 40-45 | 5.757*** | 5.819*** | 5.772*** | 5.837*** |
| | (0.234) | (0.264) | (0.236) | (0.274) |
| Orthodox | −0.321 | −0.318 | −0.320 | −0.328 |
| | (0.267) | (0.268) | (0.267) | (0.269) |
| Muslim | 0.131 | 0.136 | 0.143 | 0.127 |
| | (0.240) | (0.240) | (0.238) | (0.240) |
| Total area | 0.008 | 0.007 | 0.008 | 0.007 |
| | (0.009) | (0.009) | (0.010) | (0.010) |
| Avg. yearly rainfall (mm/100) | −0.180 | −0.185 | −0.206 | −0.213 |
| | (0.132) | (0.130) | (0.132) | (0.132) |
| Avg. yearly rainfall$^2$/100 | 0.716 | 0.737 | 0.830 | 0.852 |
| | (0.537) | (0.529) | (0.546) | (0.546) |
| Elevation (m/100) | 0.030 | 0.034 | 0.045 | 0.046 |
| | (0.136) | (0.136) | (0.139) | (0.139) |
| Elevation$^2$/100 | −0.023 | −0.036 | −0.067 | −0.073 |
| | (0.332) | (0.330) | (0.336) | (0.337) |
| Urban | 0.343 | 0.272 | 0.433 | 0.396 |
| | (0.328) | (0.300) | (0.352) | (0.338) |
| Market in area | −0.044 | −0.036 | −0.023 | −0.027 |
| | (0.154) | (0.152) | (0.159) | (0.157) |
| Road access - all year | 0.129 | 0.141 | 0.113 | 0.113 |
| | (0.214) | (0.208) | (0.219) | (0.218) |
| Road access - dry season | 0.269 | 0.266 | 0.249 | 0.241 |
| | (0.219) | (0.216) | (0.219) | (0.218) |
| Percent with no education in zone | −0.082 | −0.082 | −0.090 | −0.094* |
| | (0.056) | (0.056) | (0.055) | (0.056) |
| Percent with 1-6 years of education in zone | −0.088 | −0.089 | −0.093 | −0.098 |
| | (0.069) | (0.069) | (0.068) | (0.070) |
| Percent with 7-8 years of education in zone | −0.086 | −0.072 | −0.105 | −0.106 |
| | (0.181) | (0.181) | (0.178) | (0.181) |
| PA/kebele population / 1000 | −0.030** | −0.029** | −0.030** | −0.030** |
| | (0.012) | (0.012) | (0.012) | (0.012) |
| Family planning | −0.687*** | | −0.892*** | |
| | (0.215) | | (0.323) | |
| Family planning × age 15-19 | | −0.656** | | −1.052** |
| | | (0.288) | | (0.412) |
| Family planning × age 20-24 | | −0.219 | | −0.281 |
| | | (0.254) | | (0.465) |
| Family planning × age 25-29 | | −0.302 | | −0.899** |
| | | (0.236) | | (0.448) |
| Family planning × age 30-34 | | −0.919** | | −0.925 |
| | | (0.395) | | (0.590) |
| Family planning × age 35-39 | | −0.928*** | | −0.700* |
| | | (0.339) | | (0.418) |
| Family planning × age 40-45 | | −0.932* | | −1.269** |
| | | (0.487) | | (0.604) |
| Constant | 9.689 | 9.601 | 10.402* | 10.898* |
| | (6.379) | (6.268) | (6.277) | (6.326) |
| $R^2$ | 0.500 | 0.502 | 0.500 | 0.500 |
| Observations | 1326 | 1326 | 1326 | 1326 |

**Notes.** * sign. at 10%; ** sign. at 5%; *** sign. at 1%. Robust standard errors clustered at community level in parentheses. Family planning indicates whether there was a family planning within 40 km in 1990. Additional variables not shown are region dummies and ethnic group dummies.

[a] Weighted IV estimation using Stata's svy command with family planning access treated as endogenous. In Model III the predicted probability of a family planning program in the area is the instrument. In Model IV the predicted probability of program in area interacted with age dummies are the instruments.

Table A-2: Estimated Effect of Family Planning Access
on Children Ever Born using All Education Groups

| | OLS | | | | Instrumental Variable[a] | | | |
|---|---|---|---|---|---|---|---|---|
| | Model I | Model II | Model III | Model IV | Model V | Model VI | Model VII | Model VIII |
| Family planning | −0.394** | −0.620*** | | | −0.505 | −0.739** | | |
| | (0.169) | (0.211) | | | (0.306) | (0.332) | | |
| Family planning | | 0.763** | | | | 0.883 | | |
| × 1-5 years of education | | (0.340) | | | | (0.541) | | |
| Family planning | | 0.505** | | | | 0.534 | | |
| × 6-12 years of education | | (0.237) | | | | (0.345) | | |
| Family planning × age 15-19 | | | −0.257 | −0.600** | | | −0.754** | −0.889** |
| | | | (0.277) | (0.291) | | | (0.337) | (0.389) |
| Family planning × age 20-24 | | | −0.348 | −0.116 | | | −0.479 | −0.055 |
| | | | (0.215) | (0.236) | | | (0.394) | (0.440) |
| Family planning × age 25-29 | | | −0.038 | −0.255 | | | −0.394 | −0.731 |
| | | | (0.183) | (0.233) | | | (0.383) | (0.455) |
| Family planning × age 30-34 | | | −0.700** | −0.829** | | | −0.369 | −0.694 |
| | | | (0.298) | (0.395) | | | (0.492) | (0.613) |
| Family planning × age 35-39 | | | −0.459* | −0.855** | | | −0.276 | −0.535 |
| | | | (0.272) | (0.342) | | | (0.357) | (0.424) |
| Family planning × age 40-45 | | | −0.735 | −0.883* | | | −1.060* | −1.162* |
| | | | (0.455) | (0.495) | | | (0.612) | (0.621) |
| Family planning × Age 15-19 | | | | 0.820 | | | | 0.317 |
| × 1-5 years of education | | | | (0.604) | | | | (0.566) |
| Family planning × Age 20-24 | | | | −0.647* | | | | −0.913* |
| × 1-5 years of education | | | | (0.343) | | | | (0.487) |
| Family planning × Age 25-29 | | | | 0.914 | | | | 0.728 |
| × 1-5 years of education | | | | (0.558) | | | | (0.953) |
| Family planning × Age 30-34 | | | | 0.580 | | | | 2.069* |
| × 1-5 years of education | | | | (0.756) | | | | (1.147) |
| Family planning × Age 35-39 | | | | 1.256* | | | | 1.017 |
| × 1-5 years of education | | | | (0.698) | | | | (0.815) |
| Family planning × Age 40-45 | | | | 1.248 | | | | 6.137 |
| × 1-5 years of education | | | | (1.039) | | | | (5.441) |
| Family planning × Age 15-19 | | | | 0.722 | | | | 0.519 |
| × 6-12 years of education | | | | (0.447) | | | | (0.599) |
| Family planning × Age 20-24 | | | | −0.255 | | | | −0.485 |
| × 6-12 years of education | | | | (0.320) | | | | (0.491) |
| Family planning × Age 25-29 | | | | 0.067 | | | | 0.754 |
| × 6-12 years of education | | | | (0.347) | | | | (0.593) |
| Family planning × Age 30-34 | | | | 0.221 | | | | 0.158 |
| × 6-12 years of education | | | | (0.575) | | | | (0.853) |
| Family planning × Age 35-39 | | | | 1.639** | | | | 1.541 |
| × 6-12 years of education | | | | (0.743) | | | | (1.240) |
| Family planning × Age 40-45 | | | | 2.204 | | | | −2.325 |
| × 6-12 years of education | | | | (1.390) | | | | (5.092) |
| Observations | 2051 | 2051 | 2051 | 2051 | 2051 | 2051 | 2051 | 2051 |

**Notes.** * sign. at 10%; ** sign. at 5%; *** sign. at 1%. Robust standard errors clustered at PA level in parentheses. Family planning indicates whether there was a family planning within 40 km in 1990. Additional variables not shown are region dummies, ethnic group dummies, five year age group dummies, dummies for religion, area of wereda, rainfall and rainfall squared of wereda, dummy for urban area, dummy for market in area, and dummies for road access all year and road access only during dry season.

[a] Weighted IV estimation using Stata's svy command with family planning access treated as endogenous. Instrument for Model V is the predicted probability of a family planning program in the area. Instruments for Model VI are predicted probability of program in area and its interaction with dummies for the two education levels. Instruments for Model VII are predicted probability of program in area interacted with age dummies. Instruments for Model VIII are predicted probability of program in area interacted with age dummies and age dummies interacted with dummies for the two education levels.