Essays on the Economics of Fertility

by

Johannes Frederick Norling

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Economics)
in the University of Michigan
2016

Doctoral Committee:

Professor David A. Lam, Co-Chair
Associate Professor Martha J. Bailey, Co-Chair
Professor Barbara A. Anderson
Associate Professor C. Hoyt Bleakley

ACKNOWLEDGMENTS

I am grateful to the members of my dissertation committee – David Lam, Martha Bailey, Barbara Anderson, and Hoyt Bleakley – for their generous guidance. I also thank my parents, Susan and Fred; my brother, Henry; my students and neighbors in Dzolo Gbogame; and my fellow graduate students Aaron Flaaen, Evan Herrnstadt, Max Kapustin, Justin Ladner, and James Wang. Finally, I thank my wife, Gretchen, for her wisdom and kindness.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

In several countries, girls are more likely than boys to be aborted, to die in infancy, or to have younger siblings, all of which signal that parents want sons. However, standard techniques for measuring sex preferences fail to detect more subtle forms of sex preferences, especially when preferences are heterogeneous within a population. The first chapter of this dissertation introduces a new framework for estimating heterogeneity in sex preferences using birth history records. The framework selects among many possible combinations of preferences over the sex and number of children to best match observed childbearing. Empirical estimates indicate that sex preferences are more widespread than previously reported and exhibit substantial heterogeneity within regions. In Africa, this heterogeneity is associated with agricultural traditions that favor men or women.

During the apartheid era, all South Africans were formally classified as white, African, coloured, or Asian. Starting in 1970, the government directly provided free family planning services to residents of townships and white-owned farms. The second chapter of this dissertation demonstrates that, relative to African residents of other regions of the country, the share of African women that gave birth in these townships and white-owned farms declined by nearly one-third during the 1970s. Deferral of childbearing into the 1980s partially explains this decline, but lifetime fertility fell by one child per woman.

The third chapter of this dissertation provides new evidence that family planning programs are associated with a decrease in the share of children and adults living in poverty. The chapter uses publicly-available census data to study the relationship between U.S. family planning programs in the late 1960s and early 1970s and short and longer-term poverty rates. Cohorts born after federal family planning programs began were less likely to live in poverty in childhood and in adulthood.

CHAPTER I

Measuring Heterogeneity in Preferences over the Sex of Children

1.1 Introduction

Amartya Sen famously estimated that “more than 100 million women are missing” (Sen 1990). Due to abortion of girls, infanticide, and neglect, many of these women go missing at very young ages (Bongaarts and Guilmoto 2015). Parents that want a son can also simply continue bearing children until they have a son. Doing so concentrates girls in larger families in which resources are spread more thinly across many children (Jensen 2002). In China, India, and several other countries in Asia, son preference leaves girls outnumbered and disadvantaged from a young age (Guilmoto 2012, World Bank 2015).

Widespread son preference is less common outside of Asia. Parents in the United States and several other countries tend to want a balance of sons and daughters, but in much of Africa and Latin America parents do not overwhelmingly want sons, daughters, or a balance of the two (Ben-Porath and Welch 1976, Arnold 1997, Angrist and Evans 1998, Bongaarts 2013). Standard techniques for measuring sex preferences cannot identify whether even shares of parents in these regions prefer sons and daughters or parents generally do not care about the sex of their children (Haughton and Haughton 1998). Such a distinction is crucial for understanding how gender, which is fundamental to many areas of economic and social activity (Munshi and Rosenzweig 2006, Mammen 2008, Alesina et al. 2013, Goldin 2014), motivates childbearing decisions around the world.

This paper introduces a revealed preference framework that, for the first time, measures heterogeneity in sex preferences within a population using a collection of birth histories. The framework has three steps. First, I develop a model of childbearing in which parents care about the share of children that are boys and the total number of children. The model yields a set of possible childbearing strategies that govern the decision to have another child after each possible sequence of sons and daughters. Second, for a couple following each strategy, I calculate the likelihood that the couple stops childbearing after every possible sequence of sons and daughters. Third, I identify the combinations of strategies that best match an observed distribution of sequences of sons and daughters in completed families.

The new framework quantifies the range of preferences over sex and number of children that are consistent with an observed population. Crucially, the framework also measures the importance of the sex of children relative to the number of children. This relative importance determines how a couple weighs potentially competing objectives over the sex and number of their children. For example, a couple may want one child and prefer only sons, but whether the couple has a second child after a first-born daughter depends on the relative importance of having a small family versus having a son. If the couple would always stop after one child regardless of the child's sex, then the couple's desire for a son has no bearing on its fertility decisions. Sex preferences matter only if the sex of previous children influences the decision to have another child.

Estimates using the new framework suggest that sex preferences are more widespread and heterogeneous than previously reported. Using several large-scale birth history surveys from Africa, Asia, and the Americas, the new framework estimates that, for at least 40 percent of couples in each of these regions, the sex of previous children influences the decision to have additional children. In Asia, son preference clearly dominates and at least half of parents want sons. In Africa and the Americas, many parents want sons and many want daughters.

Inheritance rules and other cultural characteristics contribute to widespread son preference in Asia (Das Gupta et al. 2003). Greater heterogeneity in sex preferences in Africa and the Americas suggests variation within these regions in the conditions that shape sex preferences. Africa comprises hundreds of ethnic groups that have a variety of male or female-favoring traditional practices and cultural norms (Murdock 1959, Murdock 1967). Estimates using the new framework identify pockets of son preference among ethnic groups in which land is traditionally inherited through the father's line, agriculture is traditionally performed primarily by men, and the plow is traditionally used in agriculture. Daughter preference is more common where inheritance of land follows matrilineal ties and women complete most agricultural tasks.

Standard approaches for measuring sex preferences during childbearing model sex preferences according to stopping rules, in which a couple has a minimum number of children and then continues bearing children until it has a target number of sons or daughters or until it reaches a maximum number of children (Sheps 1963, Keyfitz 1977, Seidl 1995, Jensen 2002, Basu and de Jong 2010). These rules permit sex preferences to only inflate fertility: without sex preferences, each couple would not exceed their minimum number of children. For this reason, weakened sex preferences are thought to yield declines in overall fertility levels (Mutharayappa et al. 1997). The new framework in this paper more flexibly allows sex preferences to either inflate or deflate fertility levels: just as some couples may have additional children in order to have a son or daughter, other couples may stop childbearing early if they reach a particularly desirable combination of sons and daughters. These two effects on fertility roughly offset in aggregate, and I estimate that eliminating all sex preferences would change overall fertility levels around the world by less than 0.2 children per couple. Although sex preferences are widespread and govern many parents' childbearing decisions, these estimates suggest that they do not drive overall fertility levels.

I follow standard convention and refer to desire for sons or daughters as sex preferences. These preferences may result from a more fundamental optimization among the various tastes, incentives, and constraints that determine whether parents want sons or daughters. Although I show that agricultural traditions in Africa are associated with son and daughter preference, I do not attempt to fully disentangle all components of sex preferences in this paper. Additionally, men and women may have substantially different sex preferences (Robitaille 2013, Ashraf et al. 2014), but large-scale birth history surveys are generally collected from women alone. I do not address inter-partner bargaining over childbearing decisions in this paper and I refer to preferences as belonging to couples. Finally, it is not possible to recover a couple's preferences from its sequence of sons and daughters: when the sex of children is random, couples with the same preferences can have different sequences of sons and daughters, and couples with different preferences can have the same sequence (Haughton and Haughton 1998). Only the distribution of preferences across a group of couples is discernible.

1.2 Sex Preferences and Parity Progression

The likelihood that a conceived child is a boy can vary by ancestry and environmental conditions, but there remains no widely agreed-upon and adopted method by which parents can influence the sex of a fetus, and in all populations the natural likelihood that a conceived child is a boy is about 0.51 (Novitski and Sandler 1956, James 1971, Pickles et al. 1982, James 1990, Bongaarts 2013). However, ultrasound and amniocentesis technologies allow parents to identify the sex of a fetus and make sex-selective abortion possible. The share of births that are boys remained at or below 0.519 in all countries before 1980, but has since risen above 0.519 in Armenia, Azerbaijan, China, Georgia, India, Pakistan, South Korea, and Vietnam, suggesting substantial selective abortion of girls (World Bank 2015). Girls in many of these countries are also more likely than boys to die in childhood (Arnold 1997, Bongaarts and Guilmoto 2015). Because no country exhibits corresponding selection against boys, the study of sex preferences during childbearing is overwhelmingly the study of son preference.

Outside of Asia, the sex ratio at birth generally remains at the natural level. Particularly in Sub-Saharan Africa, abortion is heavily stigmatized and infanticide is historically less common than in Asia (Maharaj and Cleland 2006, Kumar et al. 2009). However, even where sex-selective abortion is rare, sex preferences may influence whether a couple continues childbearing after each son or daughter is born. Many surveys ask parents to report whether they want another child or are using contraception, and these decisions signal sex preferences when they vary according to the sex of previous children (Bongaarts 2013, Milazzo 2014). However, surveys generally record these decisions over a limited time frame, such as since the birth of a parent's most recent child. Many more surveys record the order and sex of all of a parent's live births. These birth history surveys offer the most comprehensive account of a parent's childbearing career. In this paper, I focus on inferring sex preferences using these sequences of sons and daughters.

Sex preferences shape the distribution of children across families. For example, consider a population with son preference in which all couples continue childbearing until they have a son or until they have two children. If every birth is a boy with likelihood one-half, then half of couples have a first-born son and stop, one-quarter have a daughter and then a son, and one-quarter have two daughters. Several characteristics of this distribution are commonly cited as signals that parents prefer sons (Park 1983, Yamaguchi 1989, Seidl 1995, Clark 2000, Jensen 2002, Conley and Glauber 2006, Basu and de Jong 2010, Chaudhuri 2012). Table 1.1 calculates standard measures of sex preferences for several hypothetical populations. Column 1 presents these measures for the hypothetical population with son preference. No boy in this hypothetical population has a younger sibling while two-thirds of girls have a younger sibling. Boys have one-third of a sibling on average while every girl has one sibling. The overall sex ratio remains one boy for every girl, but three-quarters of last-born children are boys and the average share of sons per family is five-eighths. Parity progression ratios, which measure the share of couples with a particular sequence of children that have another child, are greater for couples with one daughter than for couples with one son, suggesting that parents are generally not satisfied with having only a daughter.

Of these statistics, parity progression ratios best measure sex preferences when not all couples have the same preference. In population 2 in Table 1.1, all couples have daughter preference and keep childbearing until they have a daughter or until they have three children. In population 3, 60 percent of couples come from population 1 and have son preference, and the remaining 40 percent come from population 2 and have daughter preference. Boys and girls in this mixed population are equally likely to have a younger sibling and the share of last-born children that are boys is one-half, both of which fail to indicate son or daughter preference. Boys have more siblings on average than do girls, suggesting that parents want daughters, but the average share of sons per family is greater than one-half, suggesting that parents want sons. Parity progression ratios better explain the mixture of preferences in this population: couples with one daughter are more likely than couples with one son to have a second child, while couples with two sons are most likely to have a third child, suggesting that son preference dominates among parents deciding whether to have a second child and daughter preference dominates among parents deciding whether to have a third child.

In actual populations, parity progression ratios exhibit substantial variation. For the main empirical analyses in this paper, I compile birth histories collected by the following seven large surveys: China's 1988 Fertility Survey (the "Two-per-thousand" survey), Demographic and Health Surveys, India's 1982 Rural Economic and Demographic Survey, Japanese General Social Surveys, United States Integrated Fertility Survey Series, Multiple Indicator Cluster Surveys, and World Fertility Surveys (see Table 1.2). As depicted in Figure 1.1, these surveys offer substantial coverage in Africa, Asia, North America, and South America. The sample is restricted to women aged 40 and above to plausibly identify completed families. As given in Table 1.3, parity progression ratios on each continent vary among women with the same number of children. For example, 86.7 percent of women in North America with two sons have a third child, which is 1.5 percentage points higher than women with two daughters, 2.2 percentage points higher than women with a son and then a daughter, and 2.9 percentage points higher than women with a daughter and then a son.

The goal of this paper is to explain the childbearing behavior that drives observed variation in parity progression ratios within populations. First, to gauge whether sampling error alone can explain observed variation, I use a binomial test of the null hypothesis that all couples in a population with the same number of children are equally likely to have another child. For example, as given in Table 1.3, 95.5 percent of women observed in Asia with one son have a second child, and 95.8 percent of women with one daughter have a second child. Table 1.4 demonstrates that, if all women observed in Asia were equally likely to have a second child, the likelihood is less than 0.001 that at most 95.5 percent of women with one son would have a second child. Likewise, the likelihood is less than 0.001 that at least 95.8 percent of women with one daughter would have a second child. Sampling error alone similarly cannot explain observed variation in parity progression ratios in Asia after two children and after three children. In Africa and the Americas, sampling error could explain variation in parity progression after the first child but not after the second and third child. As given in Figure 1.2, the same binomial test indicates that sampling error alone cannot account for observed variation in parity progression ratios after the first, second, or third child in most of the 94 countries in the compiled dataset.

Because sampling error alone cannot explain all of the observed variation in parity progression ratios, at least some parents on each continent must make childbearing decisions that depend on the sex of previous children. As given in Table 1.3, couples in Asia that have only daughters are more likely to have another child than are couples with the same number of children that have only sons. However, not all couples stop after having a son. For example, 21.2 percent couples in Asia with three sons have another child. Similarly, in each of the other three continents, parity progression is greatest for couples with only sons or only daughters, but substantial shares of couples that already have a son and daughter go on to have another child.

This observed variation in parity progression ratios suggests that sex preferences in actual populations are more heterogeneous than in the simulated populations in Table 1.1. Table 1.3 does not clearly signal whether a minority of parents have strong sex preferences or a majority of parents have relatively weaker sex preferences. Especially outside of Asia, some couples may not care about the sex of children while others prefer sons, daughters, or a balance of sons and daughters. Some couples may want many children while others want just one or two. As noted by Ben-Porath and Welch (1976, page 292), "If populations are heterogeneous … observed patterns will be blurred."

In the next section, I introduce a new framework for measuring this heterogeneity. Standard techniques calculate single statistics from the distribution of sequences of children across families – statistics that reliably signal sex preferences only when most parents have the same preferences. The new framework instead starts by specifying a set of possible preferences that parents can have, and then identifies the combinations of preferences that best explain the entire distribution of sequences of children across completed families in an observed population. Although point identification of sex preferences is generally not possible, the new framework identifies meaningfully narrow bounds on preferences that indicate that many parents in Africa and the Americas prefer sons while many others prefer daughters.

1.3 A New Framework for Measuring Heterogeneity in Sex Preferences

This section introduces a three-step framework for measuring heterogeneity in sex preferences during childbearing. First, I define a set of possible childbearing strategies. Second, I calculate the likelihood that a couple following each strategy has each possible sequence of sons and daughters. Third, I identify the combinations of strategies that best explain the observed distribution of sequences of sons and daughters in a population.

A childbearing strategy is a rule governing the decision to have another child after every possible realization of sons and daughters. For example, a couple has one child, has a second child only if the first-born child is a daughter, and never has a third child. This strategy fits within a stopping rule model of childbearing in which a couple has a minimum number of children and then continues bearing children until it has a target number of sons or daughters or until it reaches a maximum number of children. Stopping rules only permit sex preferences to inflate fertility above the minimum, which is the number of children the couple would have absent any son or daughter targets (McClelland 1979).

This section develops an alternative model of childbearing in which preferences over the ideal share of children that are boys and ideal number of children determine childbearing strategies. The model highlights the tradeoff between sex and number of children. While trying to improve upon an undesirable combination of sons and daughters, a couple may have more than its ideal number of children. Alternatively, a couple with a particularly desirable combination of sons and daughters may stop childbearing before reaching its ideal number of children. The model therefore more flexibly permits sex preferences to inflate or deflate fertility. Table 1.5 demonstrates that the model nests common stopping rules.

The new framework assumes that the likelihood that each birth is a boy is stochastic and the same across all couples. Sex-selective abortion violates this assumption, and I exclude from the compiled dataset women who were of childbearing age after 1980 and live in a country in which sex-selective abortion has been widespread. Couples may also vary in their natural likelihoods of having a boy, but this variation is small (James 2009). For the main results, I assume that each child is a boy with likelihood 0.51, and I demonstrate the robustness of the empirical estimates to changes in this assumption.

1.3.1 Define a Set of Possible Childbearing Strategies

I assume that all couples have the same number of childbearing periods, T, and face the same likelihood that each child is a boy, l. In each period, a couple tries or does not try to have a child. These two options approximate the range of effort that couples may actually exert to become or avoid becoming pregnant. The couple then has a son, a daughter, or no child (there are no twin births). All couples have the same likelihood of conception when trying to get pregnant, p, and when not trying, q. All conceived children are carried to full term. Therefore, a couple that tries to get pregnant has a son with likelihood pl, a daughter with likelihood $p(1–l)$, and no child with likelihood $1–p$. A couple that does not try to get pregnant has a son with likelihood ql, a daughter with likelihood $q(1–l)$, and no child with likelihood $1–q$. Later, I discuss sensitivity of the main estimates to specifications of these parameters.

After the last childbearing period, a couple receives additively-separable utility from the share of children that are sons and the total number of children. The couple cares only about their total numbers of sons and daughters, not the order in which they were born. The couple has three preferences: ideal share of children that are sons, r^*, ideal number of children, c^*, and importance of the sex of children relative to the number of children, α. I consider a discrete number of possible values for these preferences: $r^* \in \{0, 0.1, 0.2, \ldots, 1\}$, $c^* \in \{0, 1, 2, \ldots, T\}$, and $\alpha \in \{0, 0.1, 0.2, \ldots, 1\}$.

A couple may not be able to simultaneously reach its ideal share of children that are boys and ideal number of children. The relative importance of the sex of children determines how the couple trades off these competing goals and captures the degree to which sex preferences affect childbearing decisions. A couple may consider only the number of children (α=0), only the sex of children (α=1), or both ($0<\alpha<1$) when deciding whether to have additional children. Sequential childbearing decisions are therefore fundamentally economic, balancing competing desires (the sex and number of children) under constraints (a finite number of childbearing periods and the randomness of the sex of each child).

A couple's childbearing decisions are governed by the following Bellman equation:

$$\mathrm{V}(s, d, T-t) = \mathrm{Max}\{EV_{\mathrm{try}}, EV_{\neg\mathrm{try}}\}, \text{ where} \tag{1}$$

$$EV_{\mathrm{try}} = plV(s+1, d, t+1) + p(1-l)V(s, d+1, t+1) + (1-p)V(s, d, t+1)$$

$$EV_{\neg\mathrm{try}} = qlV(s+1, d, t+1) + q(1-l)V(s, d+1, t+1) + (1-q)V(s, d, t+1)$$

$$V(s, d, T+1) = \begin{cases} -\alpha\left(\frac{s}{s+d} - r^*\right)^2 - (1-\alpha)(s+d-c^*)^2 & \text{if } s+d>0 \\ -\alpha \qquad\qquad\quad - (1-\alpha){c^*}^2 & \text{if } s=d=0. \end{cases}$$

In every childbearing period $t = 1, 2, \ldots, T$, the couple tries or does not try to have a child in order to maximize expected utility at the end of its childbearing career (period T+1). If trying and not trying to have a child yield the same expected utility, the couple tries to have a child. The decision in each period depends on the number of sons, s, and daughters, d, to which the couple has already given birth. The couple receives bliss-point utility in period T+1 equal to the sum of the squared difference between the actual and ideal share of children that are boys and the squared difference between the actual and ideal number of children. The importance of the sex of children relative to the number of children, α, weights these two terms.

1.3.2 For Each Strategy, Calculate the Likelihood of Each Sequence of Children

Equation 1 is solved using backward induction. In period T, a couple tries to have a child if and only if the expected utility from trying to having a child weakly exceeds the expected utility from not trying to have a child. When facing the same choices in period T–1, the couple knows, for each possible outcome, what its decision will be in period T. Similar calculations govern decisions in all earlier periods. The set of decisions after all possible realizations of sons and daughters constitutes a childbearing strategy.

For example, assume that a couple faces two childbearing periods and an even chance that each child is a boy (T=2, l=½), has perfect control over conception (p=1, q=0), and cares only that all children are sons (α=1, r^*=1, c^* does not matter and can take any value). In the first period, the couple has a child. If the first-born child is a son, additional children cannot raise and might reduce the share of children that are sons, so the couple does not have a second child. If the first-born child is a daughter, a second child cannot reduce and might raise the share of children that are sons, so the couple has a second child. Therefore, with likelihood l the couple has a son, with likelihood $(1–l)l$ the couple has a daughter and then a son, and with likelihood $(1–l)(1–l)$ the couple has two daughters. The couple has no chance of having any other sequence of children.

Imperfect control over conception is the only reason to defer childbearing. For example, assume that a couple faces two childbearing periods and an even chance that each child is a boy (T=2, l=½), can get pregnant when trying but faces some chance of accidentally becoming pregnant when not trying (p=1, $0<q<1$), and wants one child regardless of its sex (α=0, c^*=1, r^* does not matter). A couple that tries to have a child in the first period will always succeed. Because the couple has reached its ideal number of children, the couple stops trying to have children, but with likelihood q the couple accidentally has another child in the second period. If the couple instead waits until the second period to try to have a child, with likelihood q the couple has a child in the first period, and then again with likelihood q the couple has a child in the second period. In this case, the couple has two children with likelihood q^2. Because $q^2<q$,

waiting to try to conceive lessens the risk of having two children. Knowing that it can always have a child if it wishes to, the couple defers trying to have a child until the second period.

Parents may actually defer childbearing for education, employment, marriage, and other reasons. Women who have their first child late in their fecund years may in fact have perfect control over conception, but the model introduced in Section 1.3.1 interprets this deferral as resulting from concern over the likelihood of conception. For each combination of preferences, the model generates an expected distribution over the full sequence of periods in which a boy, girl, or no child is born. To avoid misinterpreting the timing of births, I collapse this distribution to the sequence of sons and daughters, as given in Table 1.6. Shorter spacing after the birth of daughters signals that parents in some countries are eager to have sons. Because girls are breastfed for less time than boys, shorter spacing can reduce the chance that girls survive infancy (Jayachandran and Kuziemko 2011). Collapsing to the sequence of sons and daughters avoids misinterpreting the timing of childbearing, but at a cost of ignoring information about spacing between births.

1.3.3 Identify the Combinations of Strategies that Best Explain an Observed Population

Given T childbearing periods, there are N=121(T+1) possible strategies (defined by each combination of preferences r*, c*, and α) and $M=2^{T+1}-1$ possible sequences of sons and daughters. **A** is an $M \times N$ matrix in which each element a_{mn} is the likelihood that a couple with combination of preferences n has order of children m. **D** is an $M \times 1$ matrix in which each element d_m is the share of couples with sequence of children m in an observed population. For example, consider a large population in which half of couples have a single son, one-quarter have a daughter and then a son, and one-quarter have two daughters. Assuming two childbearing periods, an even chance that each child is a son, and perfect control over conception (T=2, l=½, p=1, q=0), Table 1.7 defines **A** and **D**.

The goal of this section is to determine the share of couples with each combination of preferences that best explains an observed distribution of sequences of children. If all couples follow the final strategy listed in **A** in Table 1.7 (r*=1, c*=2, α=1), then half of couples will have one son, one-quarter will have a daughter and then a son, and one-quarter will have two daughters. This distribution exactly matches the actual observed distribution of sequences of children, **D**. However, if all couples follow the next-to-last strategy listed in **A** (r*=1, c*=2, α=0.9), the resulting population will also exactly match the observed population. Figure 1.3 describes the combinations of strategies that each exactly match the observed population. The dots in panels (b) through (f) each represent a population in which all parents have the same preferences. In each of these populations, the expected distribution of sequences of children exactly matches the observed population. For example, the final strategy listed in **A** in Table 1.7 (r*=1, c*=2, α=1) exactly matches the observed population and is given by the dot in the upper-right corner of panel (f).

Each vertex of the three-dimensional object in panel (g) corresponds to a dot in panels (b) through (f) and is a unique combination of preferences that, in expectation, exactly matches the observed population. Because any population that consists of combinations of couples following any of these unique strategies also exactly matches the observed population, the polyhedron in panel (g) is a convex set of all possible combinations of average values of r*, c*, and α that exactly match the observed population. Each of the polygons in panels (c) through (f) provide slices of the polyhedron in panel (g), holding average r* constant.

This example is a specific case when at least one combination of preferences yields a predicted distribution over all possible sequences of sons and daughters that exactly matches the observed distribution of children in completed families. In the more general case when no strategy exactly matches the observed population, it is not possible to create a polyhedron, as in panel (g), formed by vertices that represent single strategies. The edges of the convex hull may be determined by an infinite number of combinations of preferences. In this section, I develop a two-stage procedure for calculating bounds on the average values of preferences without determining the entire convex hull, and later I adapt the procedure to estimate additional summary measures.

The first stage identifies the smallest difference between observed and predicted populations:

$$\begin{aligned} \underset{\mathbf{S}_{N\times 1}}{\text{Min}} \quad & \mathbf{W}_{1\times M}^{\mathrm{T}} \left| \mathbf{D}_{M\times 1} - \mathbf{A}_{M\times N}\mathbf{S}_{N\times 1} \right| \\ \text{s.t.} \quad & \mathbf{0}_{N\times 1} \leq \mathbf{S}_{N\times 1} \\ & \mathbf{1}_{1\times N}\mathbf{S}_{N\times 1} = 1. \end{aligned} \tag{2}$$

The candidate share, **S**, is an N×1 matrix in which each element s_n is the estimated share of couples with combination of preferences n. Minimum value function 2 (which I refer to as equation 2) chooses a candidate share that minimizes the sum of absolute deviations between the observed population, **D**, and the predicted population, **AS**, subject to the constraints that the shares of parents with each combination of preferences are non-negative and sum to 1. Each deviation is weighted according to an M×1 matrix **W**. Throughout this paper I assign equal weight to all orders of children (**W**=**1**). Equation 2 identifies the smallest possible sum of absolute deviations between the observed and predicted populations, $e^{\min}=\mathbf{W}^{\mathrm{T}}|\mathbf{D}-\mathbf{AS}|$. I use the sum of absolute deviations so that this minimized sum can enter as a linear constraint in the second stage.

The second stage calculates bounds on average values of each preference across all candidate shares that best match the observed population:

$$\begin{aligned} \min_{\mathbf{S}_{N\times 1}} \quad & \mathbf{F}^{\mathrm{T}}_{1\times N}\mathbf{S}_{N\times 1} \\ \text{s.t.} \quad & \mathbf{0}_{N\times 1} \leq \mathbf{S}_{N\times 1} \\ & \mathbf{1}_{1\times N}\mathbf{S}_{N\times 1} = 1 \\ & \mathbf{W}^{\mathrm{T}}_{1\times M}|\mathbf{D}_{M\times 1} - \mathbf{A}_{M\times N}\mathbf{S}_{N\times 1}| = e^{\min}. \end{aligned} \tag{3}$$

F is a N×1 matrix in which each element f_n is a characteristic of strategy n. For example, if each f_n equals the ideal share of children that are boys in corresponding strategy n, then equation 3 chooses a candidate share that minimizes $\mathbf{F}^{\mathrm{T}}\mathbf{S}$, the average ideal share of children that are boys across all strategies. In addition to the same proportionality constraints as in equation 2, equation 3 requires that the sum of absolute deviations using the chosen candidate share equals the minimized sum of absolute deviations from the first stage. I use the linear programming simplex algorithm to solve equations 2 and 3.

The minimized value of $\mathbf{F}^{\mathrm{T}}\mathbf{S}$ from equation 3 provides the minimum average ideal share of children that are sons across all combinations of strategies that best explain the observed population. Similarly, setting each element of **F** to equal the ideal number of children or relative importance of the sex of children in the corresponding strategy permits calculations of the minimum average values of these preferences across all combinations of strategies that best explain the observed population. Finally, multiplying **F** by –1 and rerunning equation 3 yields the maximum average value of these preferences, $-\mathbf{F}^{T}\mathbf{S}$.

Figure 1.4 provides the estimated bounds on the average values of the three preferences for each of the simulated populations in Table 1.1, calculated assuming three childbearing periods, an even chance that each child is a boy, and perfect control over conception (T=3, l=½, p=1, q=0). Panel (a) indicates that the average ideal share of children that are boys is at least 0.6 in population 1, is at most 0.2 in population 2, and is between 0.1 and 0.75 in population 3. (Again, because of collinearity of strategies, it is possible to bound but not point identify preferences.) The distribution of sequences of children in completed families shapes these estimated bounds. For example, half of couples in population 1 have just one son but no couple has just one daughter, suggesting that parents are satisfied with sons but not with daughters. These estimates are consistent with parity progression ratios that suggest son preference in population 1, daughter preference in population 2, and no clear overall son or daughter preference in population 3.

Panel (b) of Figure 1.4 indicates that the average ideal number of children could be between 0 and 1 in population 1, between 0 and 3 in population 2, and between 0 and 1.8 in population 3. The upper bound on this range is lowest in population 1 because there are three childbearing periods yet no couple has more than two children, indicating unwillingness to have a third child in order to have a son. In contrast, some couples in population 2 and population 3 do have three children.

Panel (c) of Figure 1.4 indicates that, on average, the relative importance that couples place on the sex of children is between 0.8 and 0.9 in population 1, between 0.9 and 1 in population 2, and between 0.5 and 0.95 in population 3. Although it is not possible to identify whether parents in population 3 generally prefer sons or daughters, these estimates demonstrate that parents in population 3 care about the sex of their children. Within each population, the range of possible values in panel (c) shapes the bounds on estimates in panels (a) and (b). For example, if all parents in population 2 care only about the sex of their children, then their preferences over ideal number of children do not matter and can range anywhere from zero to three. If all parents instead care about both the sex and number of children, the bounds on average ideal number of children that best explains observed childbearing narrow.

1.4 Main Results: Estimates of Preferences Using the New Framework

I solve equation 1 using the following quantities: eight childbearing periods, a likelihood of 0.51 that each child is a boy, a likelihood of 0.9 that a couple conceives when trying to get pregnant, and a likelihood of 0.1 that a couple conceives when not trying to get pregnant (T=8, l=0.51, p=0.9, q=0.1). Childbearing is limited to eight periods to facilitate computation of equations 1 through 3. Larsen (2005) reports that approximately 90% of women in northern Tanzania are able to get pregnant within two years when trying. However, access to contraception and other factors that influence control over conception can vary across populations, across couples within a population, and over time for individual couples (Henry 1961, Di Renzo et al. 2007, Clifton 2010). Section 4.2 examines the sensitivity of the empirical estimates to the specification of these parameters.

I limit the sample of women aged 40 and above introduced in Section 1.2 to women that gave birth eight or fewer times and do not have any twin births. For countries in which the share of births that are boys has ever exceeded 0.519 since 1980 (Armenia, Azerbaijan, China, Georgia, India, Pakistan, South Korea, and Vietnam), I exclude women that reached age 40 after 1980. I calculate the distribution of sequences of children on each continent using weights that accompany each survey, with each survey's weight rescaled to have a mean value of one.

1.4.1 Estimated Bounds on Average Values of Preferences

The dark rectangles in panel (a) of Figure 1.5 provide estimated bounds on the average ideal share of children that are boys on each continent, calculated using the new framework. The light rectangles provide 95-percent confidence intervals around the unknown true average value, calculated using subsampling following Romano and Shaikh (2008) with 1,000 subsamples. The coefficient of determination next to each continent's name is calculated according to McKean and Sievers (1987). These estimates indicate that the average ideal share of children that are boys is between 0.25 and 0.9 in Africa, between 0.52 and 0.97 in Asia, between 0.2 and 0.8 in North America, and between 0.3 and 0.8 in South America. The estimates in panel (b) indicate that the average ideal number of children is roughly five in Africa, just above four in Asia, and less than four in the Americas. (Again, younger women that live in high-sex ratio countries are excluded from these estimates. Because these women are concentrated in Asia and generally have few children, the actual average ideal number of children across all women in Asia is likely much less than four.) The estimates in panel (c) indicate that the average relative importance of the sex of children is between about 0.2 and 0.8 in Africa and the Americas and between 0.4 and 0.85 in Asia. The coefficients of variation indicate that the framework explains 94 percent of observed variation in sequences of children across families in Africa, Asia, and North America, and 95 percent of observed variation in South America.

Variation in parity progression ratios, and corresponding variation in the distribution of sequences of children in completed families, drives these estimates. As discussed in Section 1.2, this variation indicates that the sex of previous children is associated with the choice to have additional children. For this reason, the new framework estimates that the average relative importance of the sex of children is greater than zero on all continents. As given in Table 1.3, couples in Asia are most likely to have another child when all previous children are girls. For example, couples with three daughters are 9 percentage points more likely to have another child than are couples with three sons (76 percent compared to 67 percent). Because no other continent exhibits correspondingly stark parity progression ratios in favor of one sex, only in Asia does the new framework conclude that parents on average favor a particular sex.

1.4.2 Robustness of Estimates to Specification of Model Parameters and Sample Definition

Figure 1.6 demonstrates the sensitivity of estimated bounds on average values of preferences in Africa to choice of model parameters. The solid rectangles provide the identified set under the main specification, and the hollow rectangles under alternative specifications. As the number of childbearing periods permitted rises and women with greater numbers of children are included in the sample, the average ideal number of children increases and the bounds on sex preferences narrow. As the assumed likelihood that each birth is a boy rises, the upper and lower bounds on average ideal share of children that are boys fall slightly, but the bounds on the average ideal number of children and the average relative importance of the sex of children remain roughly the same. For various specifications of the increment between each possible r^* and between each possible α, sex preferences also remain roughly consistent. In all cases, the specification used in the main results best explains observed childbearing (coefficient of determination equal to 0.94).

Figure 1.7 demonstrates that estimated bounds on average preferences vary substantially across different assumed specifications of control over conception. The bounds are widest when the likelihood of conception when trying to get pregnant is low (p=0.8 or p=0.7) or when the likelihood of conception when not trying to get pregnant is low (q=0). The bounds are narrower and remain roughly stable using larger values of these parameters. As in Figure 1.6, the parameters used in the main specification (likelihood of conception 0.9 when trying to get pregnant and 0.1 when not trying to get pregnant) best explain observed childbearing in Africa (coefficient of determination equal to 0.94). Figure 1.7 therefore suggests that parents face a small likelihood of infecundity and a small likelihood of accidentally becoming pregnant. This imperfect control over conception introduces some randomness into actual sequences of sons and daughters. A model that assumes perfect control over conception cannot account for this randomness and struggles to explain observed childbearing. By allowing for imperfect control over conception, the new framework better explains observed variation in sequences of sons and daughters across families.

Figure 1.8 demonstrates that the estimated bounds on average preferences remain stable as the minimum age at observation rises from 40 to 44. Estimates are also stable across currently and previously-married women, but widen considerably among never-married women. Finally, the main sample retains all live births, and estimates vary only slightly across samples that exclude children who died before one month of age, before their first birthday, before their fifth birthday, or before the birth of their next sibling. However, the coefficient of determination rises slightly as deceased children are excluded.

1.4.3 Additional Summary Measures of Sex Preferences

Section 3.3 presents a two-stage optimization procedure for estimating bounds on the average ideal share of children that are boys, the average ideal number of children, and the average relative importance of the sex of children across all couples. This section adapts the procedure to consider four additional summary measures: *Prevalence*, equal to the share of couples that place any importance on the sex of children (α>0); *WantBalance*, equal to the share of couples want a balance of sons and daughters ($r^*=½$); *WantSons*, equal to the share of couples that want more than half of their children to be sons ($r^*>½$); and *WantDaughters*, equal to the share of couples that want more than half of their children to be daughters ($r^*<½$). These summary measures are calculated using alternative specifications of **F** in equations 2 and 3. For example, to estimate the prevalence of sex preferences, each element of **F** equals 1 if the corresponding strategy places any weight on the sex of children ($\alpha>0$) and equals 0 otherwise.

The binomial test in Section 1.2 demonstrates that sex preferences are discernible on all four continents, but the test cannot identify the share of parents that make childbearing decisions that depend on the sex of previous children. As presented in panel (a) of Figure 1.9, the new framework estimates that the prevalence of sex preferences is at least 0.4 on all continents. For at least 40 percent of parents, the sex of previous children influences future childbearing decisions. In Asia, Africa, and the Americas, sex preferences are widespread and not concentrated among a small group of parents.

Panel (c) of Figure 1.9 indicates that at least half of couples in Asia prefer sons to daughters, confirming earlier studies that document extensive son preference in Asia. Elsewhere, sex preferences are heterogeneous. As given in panel (b), at most about 60 percent of couples in Africa and the Americas want a balance of sons and daughters. As given in panels (c) and (d), the identified bounds on the shares of couples that prefer sons and prefer daughters are wide, but the lower bounds are substantially greater than zero: at least 15 percent of couples in these continents prefer sons, and at least 10 percent prefer daughters. Together, these estimates suggest that many parents outside of Asia prefer sons to daughters and many others prefer daughters to sons.

1.4.4 Comparison between Estimated and Reported Sex Preferences

Preferences estimated using the new framework can be compared with attitudinal surveys that elicit stated preferences. Many Demographic and Health Surveys ask women to report the number of sons and number of daughters they would choose if they could return to the start of their childbearing careers (Arnold 1997). Using a sample of women that both provide birth histories and report their ideal numbers of sons and daughters, Figure 1.10 compares estimated bounds on average values of preferences, given by hollow rectangles, and average reported preferences, given by dark circles. Panel (a) suggests that parents generally over-report desire for a balance of sons and daughters. On each continent, the upper bound on the estimated share of parents that want an even balance of sons and daughters ($r^*=\frac{1}{2}$) is below the share of women that report wanting an even balance of sons and daughters. For example, the new framework estimates that at most 52 percent of couples in Africa want a balance of sons and daughters, yet 60 percent of women in Africa report wanting a balance of sons and daughters.

Panel (b) of Figure 1.10 suggests that women under-report the strength of their preferences. Bounds on the strength of sex preferences are again estimated using equations 2 and 3, with each element of **F** set to equal the magnitude of the difference between the ideal share of children that are boys and one-half, $|r^*-\frac{1}{2}|$, in the corresponding strategy. The estimated lower bound on the strength of preferences is at least 0.2 on all continents, substantially greater than the average reported magnitude of 0.09 in Africa and Asia and 0.14 in the Americas.

One potential explanation for the disparity between reported and estimated preferences is that the reported preferences in Figure 1.10 are collected from women alone while actual childbearing reflects a combination of women's and men's preferences. However, reported son preference in India is often as strong or stronger among women than among men (Robitaille 2013). As discussed by Bongaarts (2013), sensitive questions that directly elicit sex preferences are particularly prone to misreporting. Additionally, these attitudinal surveys do not address the sequential nature of childbearing. A couple's decision to have another child depends not only on its ideal composition of sons and daughters but also on the relative undesirability of other combinations of sons and daughters.

1.5 Traditional Agricultural Practices and Sex Preferences in Africa

Previous studies find evidence of substantial son preference in Democratic Republic of the Congo, Egypt, Nigeria and a few other countries in Africa (Bongaarts 2013, Milazzo 2014). However, most countries in Africa do not exhibit clear son preference or clear daughter preference (Arnold 1997). The bounds on the average ideal share of children that are boys in panel (a) of Figure 1.5 confirm this general conclusion, but the additional summary measures in Figure 1.9 suggest that there is substantial heterogeneity: many parents in Africa choose to have another child depending on the sex of previous children, with some parents preferring sons and others preferring daughters.

This section measures sex preferences by ethnic group affiliation. Africa comprises hundreds of ethnic groups. The anthropologist George Murdock drew from thousands of reports and other documents to generate a map of historical ethnic group boundaries in Africa and a database of pre-colonial characteristics of many of these groups (Murdock 1959, 1967). Economists have used this information to study the development of institutions in Africa and their relationship with economic growth (Fenske 2009, Bolt 2010, Nunn and Wantchekon 2011, Michalopoulos and Papaioannou 2014). Alesina et al. (2013) use Murdock's database to show that, consistent with the Boserup hypothesis that plow-based cultivation gives men an advantage in agricultural production, areas in which the plow was traditionally used in agriculture tend to have more male-favoring gender norms today.

Alesina et al. (2013) do not address sex preferences during childbearing, but others have examined the relationship between traditional cultural characteristics and desire for sons in Asia. Das Gupta et al. (2003) find that son preference is widespread where inheritance passes through patrilineal ties and a bride's family pays a dowry at marriage. Although dowry is rarely paid in Africa, there is substantial variety, even across ethnic groups located in the same country, in whether inheritance of land traditionally follows patrilineal or matrilineal ties and whether men or women traditionally perform most agricultural tasks. For example, among the Ewe of Ghana, Togo, and Benin, patrilineal heirs inherit land. Among the Ashanti of Ghana, matrilineal heirs inherit land. In Kenya, men traditionally perform most agricultural tasks in Boran regions, while women do so in Kamba areas (Murdock 1959, 1967).

Many Demographic and Health Surveys that collect birth histories also report the location of each cluster of respondents. Figure 1.11 provides the distribution of these clusters by ethnic group characteristic, as determined using Murdock (1959, 1967). The top row presents the location of respondents living in areas where inheritance of land traditionally passes through patrilineal ties, agriculture is traditionally performed primarily by men, and the plow is traditionally used in agriculture. These characteristics all imply incentives for having sons. The bottom row provides the location of respondents living in areas with traditional characteristics that imply incentives for having daughters. Historical use of the plow is concentrated in North

Africa and Ethiopia, but the other two characteristics exhibit substantial variation, particularly within West, Central, and East Africa.

These traditional agricultural practices are associated with sex preferences during childbearing. Figure 1.12 presents estimated bounds on the share of couples that want more sons than daughters minus the share that want more daughters than sons, with couples grouped according to agricultural tradition. Again, these estimates are calculated using the procedure in Section 1.3.3, with each element of **F** set equal to 0 if the corresponding strategy represents balance preference ($r^*=½$), 1 if the strategy represents son preference ($r^*>½$), and –1 if the strategy represents daughter preference ($r^*<½$). Where inheritance of land traditionally follows patrilineal ties, agriculture is traditionally performed primarily by men, or the plow is traditionally used in agriculture, couples today generally prefer sons. Where agricultural traditions favor women, couples generally prefer daughters.

Variation in the distribution of sequences of children in completed families drives these estimates. For example, where inheritance traditionally passes through patrilineal ties, 5.8 percent of couples stop after having two daughters and 7.1 percent stop after having two sons. Where inheritance follows matrilineal ties, the shares are reversed: 7.1 percent of couples stop after having two daughters but just 6.4 percent stop after having two sons. Although the identified sets for each pair of estimates in Figure 1.12 overlap and it is not possible to rule out that the direction of sex preferences is the same in each pair, these estimates suggest that agricultural traditions are associated with sex preferences today. Diversity in incentives for having sons and daughters crosses country borders and is consistent with variation in whether parents want sons or daughters.

1.6 Effect of Sex Preferences on Fertility Levels

High fertility can have several adverse consequences. Having many children raises the chance that a woman will die during childbirth, a risk that is exacerbated by a high likelihood of maternal death per childbirth in many countries that also have high fertility rates (Stanton et al. 2000). Parents with many children tend to invest less in each child's education, leading to poorer labor market achievement for these children in adulthood (Lloyd and Brandon 1994, Pop-

Eleches 2006). Rapid population growth unaccompanied by technological development can also place Malthusian pressure on food resources (Galor and Weil 2000, Hansen and Prescott 2002).

Mutharayappa et al. (1997), Bhat and Zavier (2003), and others propose that weakening sex preferences may foster declines in fertility by giving parents less incentive to have many children. This conclusion stems from the stopping rule model of sex preferences, in which parents exceed their desired minimum number of children only to have a target number of sons or daughters. By lowering or removing these targets, overall fertility should fall. Freedman and Coombs (1974) criticize this prediction on the grounds that it does not allow parents to stop early upon reaching a particular combination of sons and daughters.

The bliss-point model of childbearing in Section 1.3.1 more flexibly allows parents to also fall short of their ideal number of children. For example, among couples following the strategy represented by the final column of **A** in Table 1.7 ($r^*=1$, $c^*=2$, $\alpha=1$), half have two children but the rest have only one child, which is less than their ideal number of two total children. If these couples instead did not care about the sex of children, they would all have two children. Eliminating sex preferences would therefore cause half of these couples to have one additional child. Similar calculations for other strategies show that, if all couples no longer cared about the sex of their children, some would have additional children, some fewer, and some the same number.

Panels (a) and (b) of Figure 1.13 present estimated bounds on the expected change in overall fertility under two separate counterfactual scenarios: all couples want a balance of sons and daughters ($r^*=½$), and all couples care only about their number of children ($\alpha=0$). These calculations are performed according to the procedure in Section 1.3.3. For example, to calculate the expected change in children per couple if all couples want a balance of sons and daughters, each element of **F** is set equal to the expected change in fertility if a couple following the corresponding strategy retains the same ideal number of children and relative importance of the sex of children (c^* and α) but wants half of children to be sons ($r^*=½$). In each scenario, the average number of children per couple would change by at most 0.2. These estimates suggest that, although encouraging parents to have balanced or weakened sex preferences could substantially raise or lower fertility for many individual couples, in aggregate these changes would have little effect on overall fertility levels.

Panel (c) of Figure 1.13 presents estimated bounds on the change in children per couple if all couples want one less child than before (c^*–1). On all continents, fertility would fall by between 0.6 and 0.75 children per couple. The magnitude of the decline is less than one because some couples already want zero children. Imperfect control over conception also tempers the decline: parents that want fewer children spend more childbearing periods trying not to get pregnant, but during these periods they still run a risk of conception. Additionally, among parents that care mostly or entirely about the sex of their children, a desire for one less child will have little effect on childbearing decisions. However, the predicted decline of roughly two-thirds of a child per couple is still substantial. Together, the three panels of Figure 1.13 suggest that sex preferences alone do not shape overall fertility levels. Policies aimed at reducing each couple's ideal number of children would more effectively lower aggregate fertility.

1.7 Conclusion

Son preference is widespread in many countries in Asia. Although parents in much of the rest of the world do not overwhelmingly want sons or daughters, parity progression ratios and sequences of sons and daughters exhibit substantial variation within regions. In this paper, I introduce a new framework for measuring the heterogeneity in childbearing strategies that generates this variation. The framework identifies the combinations of preferences over sex and number of children that best explain observed sequences of sons and daughters in completed families. I estimate that at least 40 percent of parents in Africa, Asia, and the Americas make childbearing decisions that depend on the sex of previous children. Substantial shares of parents do not want a balance of sons and daughters, and the direction of these preferences overwhelmingly favors sons only in Asia.

These findings provide a richer account of the role of gender in childbearing decisions. Differential treatment of and opportunities for boys and girls is widespread (Arnold 1997), but the study of sex preferences during childbearing has focused largely on Asia and a handful of countries outside of Asia where parents overwhelmingly want sons or want a balance of sons and daughters. The new framework in this paper reveals that, in much of the world, sex preferences are widespread and heterogeneous. Some parents want sons, others daughters, and others a balance of sons and daughters. By calculating bounds on sex preferences – bounds that are meaningfully narrow – this paper connects the study of sex preferences with a growing literature on partial identification in economics, reviewed by Tamer (2010).

Heterogeneity in sex preferences within a population implies heterogeneity in the underlying tastes, incentives, and constraints that shape sex preferences. I show that variation in agricultural traditions in Africa is associated with whether parents tend to prefer sons or daughters today. These traditions follow ethnic group boundaries that cross country borders. Household surveys are generally conducted at the country level, but these findings indicate that alternative groupings of parents can identify greater homogeneity in preferences.

Finally, estimates using the new framework suggest that, although widespread, sex preferences do not shape overall fertility levels. Sex preferences lead some couples to have more than their ideal number of children and others to stop childbearing early. Although individual couples may substantially exceed or stop short of their ideal number of children, these effects balance out in aggregate, and weakening or eliminating sex preferences would only slightly change overall fertility levels. Factors that reduce the number of overall children that parents want to have, such as lower infant mortality or improved economic opportunities for women, may offer more effective policy levers for reducing fertility.

1.8 Works Cited

Alesina, Alberto, Paola Giuliano, and Nathan Nunn. 2013. "On the Origins of Gender Roles: Women and the Plough." *Quarterly Journal of Economics*, 128(2): 469–530.

Angrist, Joshua, and William Evans. 1998. "Children and Their Parents' Labor Supply: Evidence from Exogenous Variation in Family Size." *American Economic Review*, 88(3): 450–477.

Arnold, Fred. 1997. *Gender Preferences for Children*. DHS Comparative Studies No. 23. Calverton, Maryland: Macro International Inc.

Ashraf, Nava, Erica Field, and Jean Lee. 2014. "Household Bargaining and Excess Fertility: An Experimental Study in Zambia." *American Economic Review*, 104(7): 2210–2237.

Basu, Deepankar, and Robert de Jong. 2010. "Son Targeting Fertility Behavior: Some Consequences and Determinants." *Demography*, 47(2): 521–536.

Ben-Porath, Yoram, and Finis Welch. 1976. "Do Sex Preferences Really Matter?" *Quarterly Journal of Economics*, 90(2): 285–307.

Bhat, Mari, and Francis Zavier. 2003. "Fertility Decline and Gender Bias in Northern India." *Demography*, 40(4): 637–657.

Bolt, Jutta. 2010. "Explaining Long-Run Economic Development in Africa: Do Initial Conditions Matter?" Ph.D. dissertation, University of Groningen

Bongaarts, John, and Christophe Z. Guilmoto. 2015. "How Many More Missing Women? Excess Female Mortality and Prenatal Sex Selection, 1970–2050." *Population and Development Review*, 41(2): 241–269.

Bongaarts, John. 2013. "The Implementation of Preferences for Male Offspring." *Population and Development Review*, 39(2): 185–208.

Chaudhuri, Sanjukta. 2012. "The Desire for Sons and Excess Fertility: A Household-Level Analysis of Parity Progression in India." *International Perspectives on Sexual and Reproductive Health*, 38(4): 178–186.

China Fertility Survey. 1988. Ten percent sample of the Two-per-thousand survey.

Clark, Shelley. 2000. "Son Preference and Sex Composition of Children: Evidence from India." *Demography*, 37(1): 95–108.

Clifton, V. L. 2010. "Review: Sex and the Human Placenta: Mediating Differential Strategies of Fetal Growth and Survival." *Placenta*, 31(3): S33–S39.

Conley, Dalton, and Rebecca Glauber. 2006. "Parental Educational Investment and Children's Academic Risk: Estimates of the Impact of Sibship Size and Birth Order from Exogenous Variation in Fertility." *Journal of Human Resources*, 41(4): 722–737.

Das Gupta, Monica, Jiang Zhenghua, Li Bohua, Xie Zhenming, Woojin Chung, and Bae Hwa-Ok. 2003. "Why is Son Preference so Persistent in East and South Asia? A Cross-country Study of China, India and the Republic of Korea." *Journal of Development Studies*, 40(2): 153–187.

Di Renzo, Gian Carlo, Alessia Rosati, Roberta Donati Sarti, Laura Cruciani, and Antonio Massimo Cutuli. 2007. "Does Fetal Sex Affect Pregnancy Outcome?" *Gender Medicine*, 4(1): 19–30.

Fenske, James. 2009. "Does Land Abundance Explain African Institutions?" Yale University, Department of Economics, Working Paper No. 74.

Freedman, Ronald, and Lolagene C. Coombs. 1974. *Cross-Cultural Comparisons: Data on Two Factors in Fertility Behavior*. New York: Population Council.

Galor, Oded, and David N. Weil. 2000. "Population, Technology, and Growth: From Malthusian Stagnation to the Demographic Transition and Beyond." *American Economic Review*, 90(4): 806–828.

Goldin, Claudia. 2014. "A Grand Gender Convergence: Its Last Chapter." *American Economic Review*, 104(4): 1091–1119.

Guilmoto, Christophe Z. 2012. *Sex Imbalances at Birth: Current Trends, Consequences, and Policy Implications*. Bangkok, Thailand: UNFPA Asia and the Pacific Regional Office.

Hansen, Gary D., and Edward C. Prescott. 2002. "Malthus to Solow." *American Economic Review*, 92(4): 1205–1217.

Haughton, Jonathan, and Dominique Haughton. 1998. "Are Simple Tests of Son Preference Useful? An Evaluation Using Data from Vietnam." *Journal of Population Economics,* 11(4): 495–516.

Henry, Louis. 1961. "Some Data on Natural Fertility." *Biodemography and Social Biology*, 8(2): 81–91.

Institute of Regional Studies at Osaka University of Commerce. 2000–2010. “Japanese General Social Surveys.” Available at <http://www.icpsr.umich.edu>, accessed July 17, 2015.

International Statistics Institute. 1974–1981. “World Fertility Surveys.” Available at <https://opr.princeton.edu/archive/wfs>, accessed July 11, 2015.

James, William H. 1971. “Cycle Day of Insemination, Coital Rate, and Sex Ratio.” *Lancet,* 297(7690): 112–114.

James, William H. 1990. “On the Magnitude of Variation in the Human Sex Ratio at Birth.” *Current Anthropology*, 31(4): 419–420.

James, William H. 2009. “Variation in the Probability of a Male Birth Within and Between Sibships.” *Human Biology,* 81(1): 13–22.

Jayachandran, Seema, and Ilyana Kuziemko. 2011. “Why Do Mothers Breastfeed Girls Less than Boys? Evidence and Implications for Child Health in India.” *Quarterly Journal of Economics,* 126(3): 1–54.

Jensen, Robert. 2002. “Equal Treatment, Unequal Outcomes? Generating Sex Inequality through Fertility Behavior.” Unpublished document, J. F. Kennedy School of Government, Harvard University, Cambridge MA.

Keyfitz, Nathan. 1977. *Introduction to the Mathematics of Population with Revisions*. Reading, Massachusetts: Addison-Wesley.

Kumar, Anuradha, Leila Hessini, and Ellen M.H. Mitchell. 2009. “Conceptualising Abortion Stigma.” *Culture, Health, & Sexuality*, 11(6): 625–639.

Larsen, Ulla. 2005. “Research on Infertility: Which Definition Should We Use?” *Fertility and Sterility*, 83(4): 846–852.

Lloyd, Cynthia B, and Anastasia J. Gage-Brandon. 1994. “High Fertility and Children’s Schooling in Ghana: Sex Differences in Parental Contributions and Educational Outcomes.” *Population Studies,* 48(2): 293–306.

Maharaj, Pranitha, and John Cleland. 2006. “Condoms Become the Norm in the Sexual Culture of College Students in Durban, South Africa.” *Reproductive Health Matters*, 14(28): 104–112.

Mammen, Kristin. 2008. “The Effect of Children’s Gender on Living Arrangements and Child Support.” *American Economic Review: Papers and Proceedings*, 98(2): 408–412.

McClelland, Gary. 1979. "Determining the Impact of Sex Preferences on Fertility: A Consideration of Parity Progression Ratio, Dominance, and Stopping Rule Measures." *Demography,* 16(3): 377–388.

McKean, Joseph W., and Gerald L. Sievers. 1987. "Coefficients of Determination for Least Absolute Deviation Analysis." *Statistics & Probability Letters*, 5(1): 49–54.

MeasureDHS. 1985–2015. "Demographic and Health Surveys." Available at <http://dhsprogram.com>, accessed September 14, 2015.

Michalopoulos, Stelios, and Elias Papaioannou. 2014. "National Institutions and Subnational Development in Africa." *Quarterly Journal of Economics*, 129(1): 151–213.

Milazzo, Annamaria. 2014. "Son Preference, Fertility and Family Structure: Evidence from Reproductive Behavior among Nigerian Women." World Bank Policy Research Working Paper 6869.

Munshi, Kaivan, and Mark Rosenzweig. 2006. "Traditional Institutions Meet the Modern World: Caste, Gender, and Schooling Choice in a Globalizing Economy." *American Economic Review,* 96(4): 1225–1252.

Murdock, George. 1959. *Africa: Its Peoples and their Culture History*. New York: McGraw-Hill.

Murdock, George. 1967. "Ethnographic Atlas: A Summary." *Ethnology*, 6(2): 109–236.

Mutharayappa, Rangamuthia, Minja Kim Choe, Fred Arnold, and T. K. Roy. 1997. "Son Preference and Its Effect on Fertility in India." National Family Health Survey Subject Reports, Number 3.

National Council of Applied Economic Research. 1982. "Rural Economic and Demographic Survey." Available at <http://adfdell.pstc.brown.edu/arisreds_data>, accessed July 14, 2015.

Novitski, E., and L. Sandler. 1956. "The Relationship between Parental Age, Birth Order, and the Secondary Sex Ratio in Humans." *Annals of Human Genetics,* 21(2): 123–131.

Nunn, Nathan, and Leonard Wantchekon. 2011. "The Slave Trade and the Origins of Mistrust in Africa." *American Economic Review,* 101(7): 3221–3252.

Park, Chain Bin. 1983. "Preference for Sons, Family Size, and Sex Ratio: An Empirical Study in Korea." *Demography,* 20(3): 333–352.

Pickles, A. R., R. Crouchley, and R. B. Davies. 1982. "New Methods for the Analysis of Sex Ratio Data Indepdendent of the Effects of Family Limitation." *Annals of Human Genetics*, 46(1): 75–81.

Pop-Eleches, Cristian. 2006. "The Impact of an Abortion Ban on Socioeconomic Outcomes of Children: Evidence from Romania." *Journal of Political Economy*, 114(4): 744–773.

Robitaille, Marie-Claire. 2013. "Determinants of Stated Son Preference in India: Are Men and Women Different?" *Journal of Development Studies*, 49(5): 657–669.

Romano, Joseph, and Azeem Shaikh. 2008. "Inference for Identifiable Parameters in Partially Identified Econometric Models." *Journal of Statistical Planning and Inference*, 138(9): 2786–2807.

Seidl, Christian. 1995. "The Desire for a Son is the Father of Many Daughters." *Journal of Population Economics*, 8(2): 185–203.

Sen, Amartya. 1990. "More than 100 Million Women are Missing." *The New York Review of Books*, 37(20): 61–66.

Sheps, Mindel. 1963. "Effects on Family Size and Sex Ratio of Preferences Regarding the Sex of Children." *Population Studies*, 17(1): 66–72.

Smock, Pamela, Peter Granda, and Lynette Hoelter. 1955–2002. "Integrated Fertility Survey Series, Release 7." Available at <http://www.icpsr.umich.edu>, accessed July 13, 2015.

Stanton, Cynthia, Noureddine Abderrahim, and Kenneth Hill. 2000. "An Assessment of DHS Maternal Mortality Indicators." *Studies in Family Planning*, 31(2): 111–123.

Tamer, Elie. 2010. "Partial Identification in Econometrics." *Annual Review of Economics*, 2(1): 167–195.

UNICEF. 2006–2014. "Multiple Indicator Cluster Surveys." Available at <http://mics.unicef.org>, accessed August 23, 2015.

World Bank. 2015. "World DataBank." Available at <http://databank.worldbank.org>, downloaded April 3, 2015.

Yamaguchi, Kazuo. 1989. "A Formal Theory for Male-Preferring Stopping Rules of Childbearing: Sex Differences in Birth Order and in the Number of Siblings." *Demography*, 26(3): 451–465.

Table 1.1: Standard Measures of Sex Preferences in Simulated Populations

		Population 1 All couples stop after 1st son and have up to 2 children	**Population 2** All couples stop after 1st daughter and have up to 3 children	**Population 3** 60% of couples from population 1, 40% from population 2
Share of boys with a younger sibling		0.00	0.86	0.38
Share of girls with a younger sibling		0.67	0.00	0.38
Average number of siblings of boys		0.33	1.71	0.94
Average number of siblings of girls		1.00	0.57	0.81
Share of all children that are boys		0.50	0.50	0.50
Share of last-born children that are boys		0.75	0.13	0.50
Average share of sons per family		0.63	0.33	0.51
Parity progression ratios				
1st child	*2nd child*			
Boy	–	0	1	0.4
Girl	–	1	0	0.6
Boy	Boy	–	1	1
Boy	Girl	–	0	0
Girl	Boy	0	–	0
Girl	Girl	0	–	0

Notes: The distribution of sequences of children in completed families is calculated assuming a likelihood of one-half that each birth is a boy. In population 1, one-half of parents have a first-born son and stop, one-quarter have a daughter and then a son, and one-quarter have two daughters. In population 2, one-half of parents have a first-born daughter and stop, one-quarter have a son and then a daughter, one-eighth have three sons, and one-eighth have two sons and then a daughter. In population 3, 30 percent of couples have one son, 20 percent have one daughter, 10 percent have a son and then a daughter, 15 percent have a daughter and then a son, 15 percent have two daughters, 5 percent have three sons, and 5 percent have two sons and then a daughter. Among parents that start with each given sequence of sons and daughters, parity progression ratios measure the share that have at least one more child.

Table 1.2: Birth History Sources

Country	Sources	Women
Africa		
Angola	DHS(2011)	936
Benin	DHS(1996,2001,2006,2011) WFS(1981)	8,504
Burkina Faso	DHS(1992,1998,2003,2010)	7,272
Burundi	DHS(1987,2010)	1,979
Central African Rep.	DHS(1994)	886
Cameroon	DHS(1991,1998,2004,2011) WFS(1978)	7,167
Chad	DHS(1996,2004)	2,182
Comoros	DHS(1996,2012)	1,179
Congo	DHS(2005)	979
Congo, Dem. Rep.	DHS(2007,2013)	4,504
Cote d'Ivoire	DHS(1994,1998,2011) WFS(1980)	3,975
Egypt	DHS(1988,1992,1995,2000,2003,2005,2008) WFS(1980)	27,925
Ethiopia	DHS(1992,1997,2003)	7,235
Gabon	DHS(2000,2012)	2,472
Ghana	DHS(1988,1993,1998,2003,2008) MICS(2011) WFS(1979)	7,757
Guinea	DHS(1999,2005,2012)	4,433
Kenya	DHS(1988,1993,1998,2003,2008) WFS(1977)	7,289
Lesotho	DHS(2004,2009) WFS(1977)	3,403
Liberia	DHS(1986,2006,2008,2013)	4,463
Madagascar	DHS(1992,1997,2003,2008)	6,700
Malawi	DHS(1992,2000,2004,2010) MICS(2006,2013)	14,785
Mali	DHS(1987,1995,2001,2006,2012)	8,466
Mauritania	MICS(2011) WFS(1981)	2,938
Morocco	DHS(1987,1992,2003) WFS(1980)	7,546
Mozambique	DHS(1997,2003,2011)	5,648
Namibia	DHS(1992,2000,2006,2013)	5,316
Niger	DHS(1992,1998,2006,2012)	5,353
Nigeria	DHS(1990,1999,2003,2008,2010,2013)	18,220
Rwanda	DHS(1992,2000,2005,2007,2010)	8,262
Sao Tome & Principe	DHS(2008)	506
Senegal	DHS(1986,1992,1997,2005,2008,2010,2012) WFS(1978)	12,182
Sierra Leone	DHS(2008,2013)	3,864
Somalia	MICS(2006)	849
South Africa	DHS(1998)	2,221
South Sudan	MICS(2010)	1,150
Sudan	MICS(2010) WFS(1978)	2,979
Swaziland	DHS(2006) MICS(2010)	1,602
Tanzania	DHS(1991,1996,1999,2004,2009)	6,759
Togo	DHS(1988,1998)	1,880
Tunisia	DHS(1988) MICS(2011) WFS(1978)	4,625
Uganda	DHS(1988,1995,2000,2006,2009,2011)	5,591
Zambia	DHS(1992,1996,2001,2007)	4,074
Zimbabwe	DHS(1988,1994,1999,2005,2010) MICS(2009,2014)	8,951

Table 1.2 (Continued): Birth History Sources

Country	Sources	Women
Asia		
Armenia	DHS(2000,2005,2010)	5,430
Azerbaijan	DHS(2006)	2,327
Bangladesh	DHS(1993,1996,1999,2004,2007,2011) WFS(1975)	14,665
Cambodia	DHS(2000,2005,2010)	11,301
China	CFS(1988)	155,474
India	DHS(1992,1998,2005) REDS(1982)	62,591
Indonesia	DHS(1987,1991,1994,1997,2002,2007) WFS(1976)	42,878
Iraq	MICS(2006,2011)	13,301
Japan	JGSS(2000,2001,2002,2005,2006,2008,2010)	9,522
Jordan	DHS(1990,1997,2002,2007,2009,2012)	13,732
Kazakhstan	DHS(1995,1999)	2,088
Korea	WFS(1974)	1,544
Kyrgyzstan	DHS(1997,2012)	2,559
Laos	MICS(2011)	4,622
Malaysia	WFS(1974)	1,756
Maldives	DHS(2009)	1,740
Nepal	DHS(1996,2001,2006,2011) MICS(2014) WFS(1976)	11,841
Pakistan	DHS(1990,2006,2012) WFS(1975)	8,547
Philippines	DHS(1993,1998,2003,2008,2013) WFS(1978)	17,646
Sri Lanka	WFS(1975)	1,911
Syria	WFS(1978)	1,072
Tajikistan	DHS(2012)	1,932
Thailand	DHS(1987)	1,651
Timor-Leste	DHS(2009)	2,494
Turkey	DHS(1993,1998,2003) WFS(1978)	6,597
Uzbekistan	DHS(1996)	761
Vietnam	DHS(1997,2002)	3,384
Yemen	DHS(1991) MICS(2006) WFS(1979)	2,764
Europe		
Albania	DHS(2008)	2,300
Moldova	DHS(2005) MICS(2012)	3,742
Ukraine	DHS(2007)	2,028
North America		
Costa Rica	WFS(1976)	874
Dominican Rep.	DHS(1986,1991,1996,1999,2002,2007,2013) WFS(1975)	16,886
Guatemala	DHS(1987,1995,1998)	3,830
Haiti	DHS(1994,2000,2005,2012) WFS(1977)	7,665
Honduras	DHS(2005,2011)	7,503
Jamaica	WFS(1975)	666
Mexico	DHS(1987) WFS(1976)	2,989
Nicaragua	DHS(1997,2001)	4,437
Panama	WFS(1975)	769
Trinidad & Tobago	DHS(1987) WFS(1977)	1,420
United States	IFSS(1970,1973,1976,1982,1988,1995,2002)	9,280

Table 1.2 (Continued): Birth History Sources

Country	Sources	Women
Oceania		
Fiji	WFS(1974)	1,056
South America		
Bolivia	DHS(1989,1993,1998,2003,2008)	11,780
Brazil	DHS(1986,1991,1996)	4,394
Colombia	DHS(1986,1990,1995,2000,2004,2009) WFS(1976)	28,337
Ecuador	DHS(1987) WFS(1979)	1,753
Guyana	DHS(2009) WFS(1975)	2,007
Paraguay	DHS(1990) WFS(1979)	1,814
Peru	DHS(1986,1991,1996,2000,2003,2009,2010,2011,2012) WFS(1977)	46,803
Venezuela	WFS(1977)	358

Sources: China Fertility Survey (CFS; a 10 percent sample of the 1988 “Two-per-thousand” survey), Demographic and Health Survey (DHS; MeasureDHS 1985–2015), India Rural Economic and Demographic Survey (REDS; National Council of Applied Economic Research 1982), Japanese General Social Survey (JGSS; Institute of Regional Studies at Osaka University of Commerce 2000–2010), United States Integrated Fertility Survey Series (IFSS; Smock, Granda, and Hoelter 1955–2002), Multiple Indicator Cluster Surveys (MICS; UNICEF 2006–2014), and World Fertility Survey (WFS; International Statistics Institute 1974–1981). Only surveys that meet the following conditions are included: surveys that have national coverage; surveys that collect complete birth histories; surveys in which less than 1 percent of women report a total number of children that differs from that given in their birth history; and surveys in which less than 1 percent of women report births out of order. The sample excludes birth histories that do not report the order and sex of each of a woman’s children. The final column provides the number of women aged 40 and above observed in each country. The Japanese General Social Surveys (JGSS) are designed and carried out at the Institute of Regional Studies at Osaka University of Commerce in collaboration with the Institute of Social Science at the University of Tokyo under the direction of Ichiro Tanioka, Michio Nitta, Hiroki Sato and Noriko Iwai with Project Manager, Minae Osawa. The project is financially assisted by Gakujutsu Frontier Grant from the Japanese Ministry of Education, Culture, Sports, Science and Technology for 1999–2003 academic years, and the datasets are compiled with cooperation from the SSJ Data Archive, Information Center for Social Science Research on Japan, Institute of Social Science, and the University of Tokyo.

Table 1.3: Parity Progression Ratios in Observed Populations

1st child	2nd child	3rd child	Africa	Asia	North America	South America
Boy	–	–	0.963	0.955	0.930	0.922
Girl	–	–	0.962	0.958	0.928	0.917
Boy	Boy	–	0.940	0.857	0.867	0.828
Boy	Girl	–	0.933	0.853	0.845	0.798
Girl	Boy	–	0.935	0.852	0.838	0.809
Girl	Girl	–	0.942	0.904	0.852	0.833
Boy	Boy	Boy	0.909	0.788	0.795	0.758
Boy	Boy	Girl	0.896	0.759	0.757	0.735
Boy	Girl	Boy	0.897	0.760	0.777	0.744
Boy	Girl	Girl	0.907	0.812	0.779	0.747
Girl	Boy	Boy	0.900	0.761	0.777	0.754
Girl	Boy	Girl	0.905	0.813	0.771	0.746
Girl	Girl	Boy	0.904	0.784	0.772	0.746
Girl	Girl	Girl	0.916	0.871	0.785	0.771

Notes: Among parents age 40 and above that start with each given sequence of sons and daughters, parity progression ratios measure the share that have at least one more child. Source: See Table 1.2.

Table 1.4: Binomial Test of Equal Parity Progression Ratios in Asia

1st child	2nd child	3rd child	(1) Number of respondents that reach given sequence	(2) Number of respondents that progress beyond given sequence	(3) Parity progression ratio	(4) Parity progression ratio if even across parity	(5) Binomial test p-value: n=(1) k=(2) p=(4)	(6) Minimum p-value, by parity
Boy	–	–	204,015	194,873	0.955	0.957	<0.001	<0.001
Girl	–	–	186,781	178,991	0.958		<0.001	
Boy	Boy	–	100,518	86,129	0.857	0.865	<0.001	<0.001
Boy	Girl	–	94,355	80,446	0.853		<0.001	
Girl	Boy	–	92,153	78,516	0.852		<0.001	
Girl	Girl	–	86,838	78,459	0.904		<0.001	
Boy	Boy	Boy	44,341	34,953	0.788	0.792	0.015	<0.001
Boy	Boy	Girl	41,788	31,728	0.759		<0.001	
Boy	Girl	Boy	41,324	31,414	0.760		<0.001	
Boy	Girl	Girl	39,122	31,748	0.812		<0.001	
Girl	Boy	Boy	40,607	30,902	0.761		<0.001	
Girl	Boy	Girl	37,909	30,834	0.813		<0.001	
Girl	Girl	Boy	40,617	31,859	0.784		<0.001	
Girl	Girl	Girl	37,842	32,967	0.871		<0.001	

Notes: This table demonstrates how the binomial tests in Section 1.2 are calculated. The compiled dataset described in Table 1.2 contains 406,130 women aged 40 and above living in Asia that provide birth histories. Each row of this table represents a unique sequence of sons and daughters. Column 1 provides the number of women that reach each given sequence, column 2 the number that progress beyond each sequence, and column 3 the corresponding parity progression ratio. Column 4 presents the parity progression ratio if all women with the same number of total children had been equally likely to have another child. For example, of the 390,796 women that have one child, 373,864, or 95.7 percent, have a second child. Column 5 presents the one-tailed p-values from a binomial test in which the number of trials is given by column 1, the number of successes is given by column 2, and the assumed true probability of success is given by column 4. For example, if the 204,015 women that have a boy all have another child with likelihood 0.957, 195,176 would be expected to have a second child and the likelihood is less than 0.001 that 194,873 or fewer will in fact have a second child. Column 6 identifies the smallest p-value by parity. For all parities, these smallest p-values are less than 0.001, suggesting that sampling error alone cannot account for the variation in parity progression ratios in Asia.

Table 1.5: Correspondence between Stopping Rules and Bliss-point Utility Model

				Son preference	Daughter preference	Balance preference	No preference
			Stopping rule				
			Min. children:	1	1	1	2
			Max. children:	2	2	3	2
			Stop after:	1st son	1st daughter	1 son and 1 daughter	
			Bliss-point preferences				
			Childbearing periods, T	2	2	3	2
			Ideal share of children that are boys, r^*:	1	0	0.5	0
			Ideal number of children, c^*:	2	2	2	2
Observed sequence of children			*Relative importance of The sex of children, α:*	1	1	1	0
1st child	2nd child	3rd child					
Boy	–	–		½			
Girl	–	–			½		
Boy	Boy	–			¼		¼
Boy	Girl	–			¼	¼	¼
Girl	Boy	–		¼		¼	¼
Girl	Girl	–		¼			¼
Boy	Boy	Boy				⅛	
Boy	Boy	Girl				⅛	
Boy	Girl	Boy					
Boy	Girl	Girl					
Girl	Boy	Boy					
Girl	Boy	Girl					
Girl	Girl	Boy				⅛	
Girl	Girl	Girl				⅛	

Notes: This table demonstrates that the bliss-point utility model introduced in Section 1.3.1 explains several standard stopping rules. Each column reports a childbearing strategy, and each row presents the likelihood that a parent following that strategy has the indicated sequence of children under the assumption that each child is a son with likelihood one-half and parents have perfect control over conception. For example, a couple following the son-preferential stopping rule in column 1 has a son with likelihood one-half, a daughter and then a son with likelihood one-quarter, and two daughters with likelihood one-quarter. A couple following the bliss-point preferences strategy in column 1 has the same expected distribution over possible sequences of children. For columns 1, 2, and 4, two childbearing periods are assumed. For column 3, three childbearing periods are assumed.

Table 1.6: Collapse of Childbearing into Sequence of Sons and Daughters

(a) **Original**				(b) **Collapsed by sequence of sons and daughters**		
Period #1	Period #2	Likelihood		Child #1	Child #2	Likelihood
No child	No child	0	→	–	–	0
No child Son	Son No child	$(1-q)l$ $ql(1-q)$	→	Son	–	$(1-q)l + ql(1-q)$
No child Daughter	Daughter No child	$(1-q)(1-l)$ $q(1-l)(1-q)$	→	Daughter	–	$(1-q)(1-l) + q(1-l)(1-q)$
Son	Son	$qlql$	→	Son	Son	$qlql$
Son	Daughter	$qlq(1-l)$	→	Son	Daughter	$qlq(1-l)$
Daughter	Son	$q(1-l)ql$	→	Daughter	Son	$q(1-l)ql$
Daughter	Daughter	$q(1-l)q(1-l)$	→	Daughter	Daughter	$q(1-l)q(1-l)$

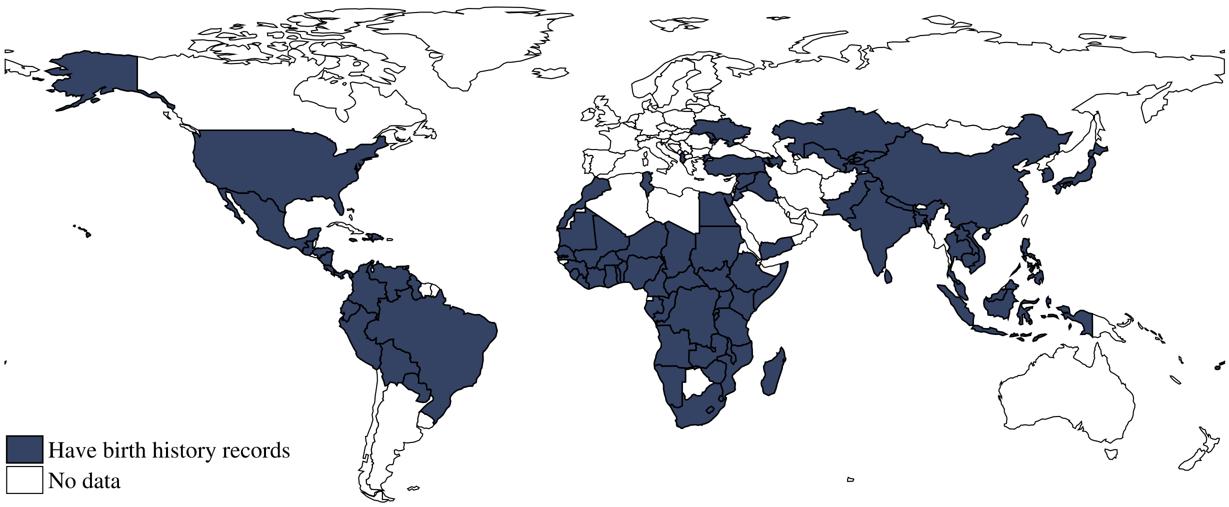
Notes: Panel (a) presents the likelihood that a couple has each possible sequence of childbearing periods with no child, a son, and a daughter, given that the couple wants one child regardless of its sex (α=0, c^*=1, r^* does not matter), has perfect control over conception when trying to get pregnant (p=1), and can accidentally conceive when not trying to get pregnant ($0<q<1$). Each child is a boy with likelihood l. The couple's childbearing decisions are governed by equation 1 and discussed in Section 1.3.2. The couple does not try to get pregnant in the first period, and then only tries to get pregnant in the second period if the first period did not yield a child. Panel (b) collapses these likelihoods by each unique sequence of sons and daughters, ignoring the timing of each birth. Empirical estimates in Sections 1.4 through 1.6 use these collapsed sequences.

Table 1.7: Structure of Matrices Used in Section 1.3

		Share in population		Likelihood of each sequence of children given each combination of preferences							
			Ideal share of children that are boys, r^*:	0.0	0.0	···	0.5	···	1.0	1.0	
1st	2nd		Ideal number of children, c^*:	0	0	···	1	···	2	2	
child	child		Relative importance of the sex of children, α:	0.0	0.1	···	0.5	···	0.9	1.0	
–	–	0		1	1	···	0	···	0	0	
Boy	–	½		0	0	···	½	···	½	½	
Girl	–	0		0	0	···	½	···	0	0	
Boy	Boy	0		0	0	···	0	···	0	0	
Boy	Girl	0		0	0	···	0	···	0	0	
Girl	Boy	¼		0	0	···	0	···	¼	¼	
Girl	Girl	¼	**D**	0	0	···	0	···	¼	¼	**A**

Notes: See Section 1.3.3.

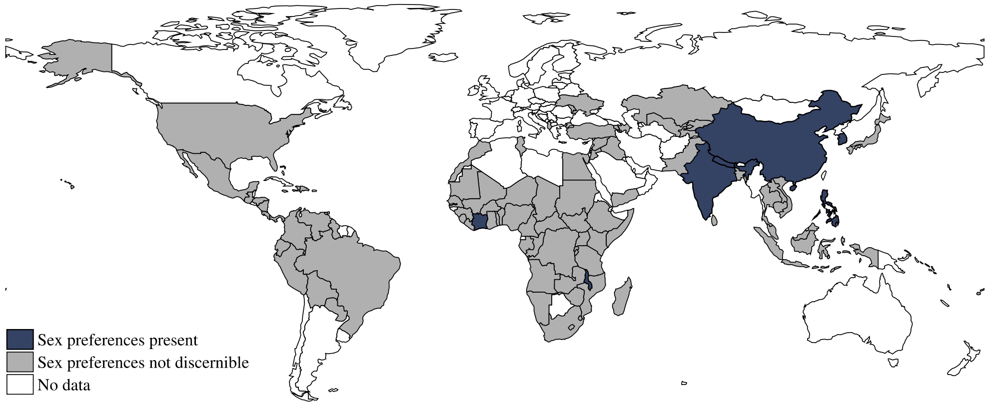
Figure 1.1: Countries Represented in the Final Dataset



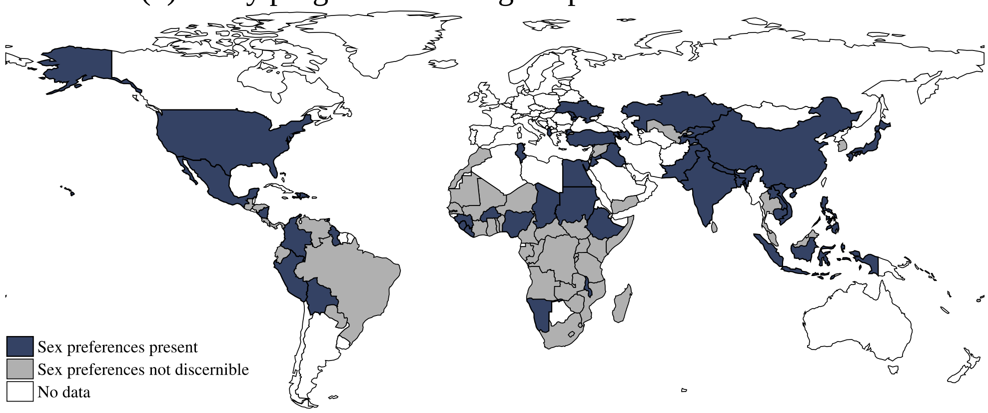
Source: See Table 1.2.

Figure 1.2: Countries in Which Parity Progression Ratios Indicate Sex Preferences

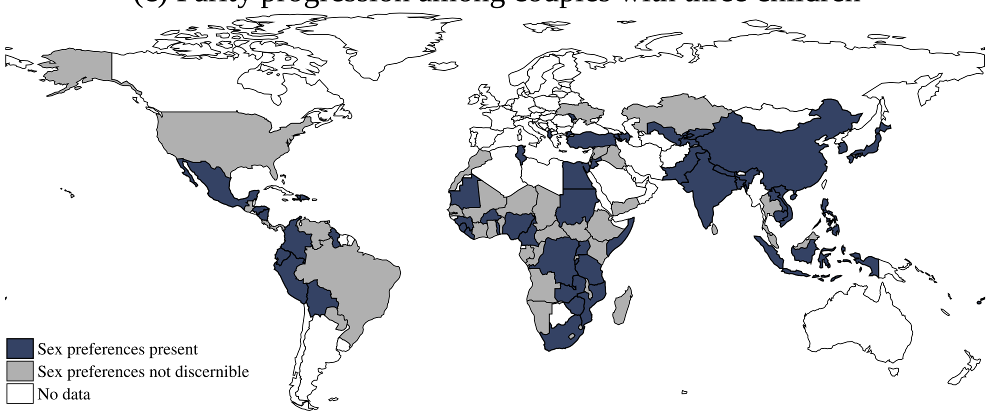
(a) Parity progression among couples with one child



(b) Parity progression among couples with two children

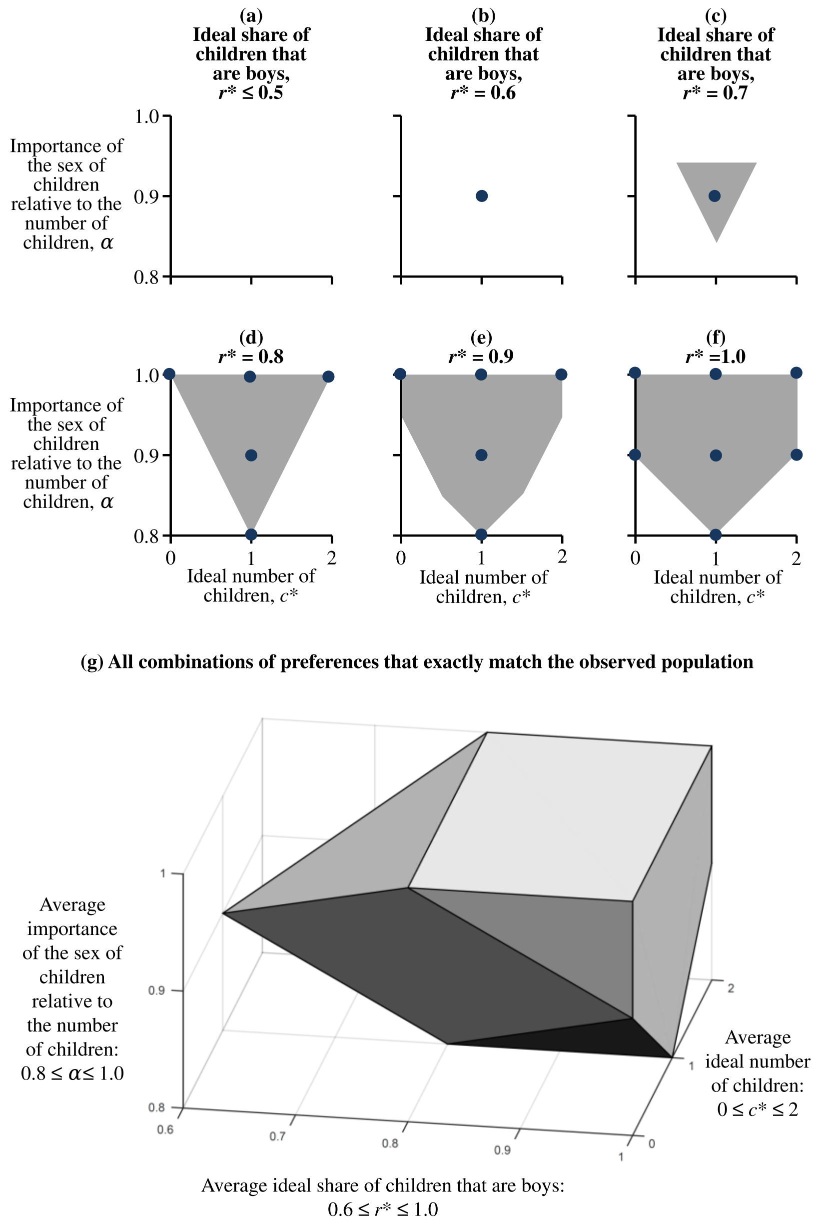


(c) Parity progression among couples with three children



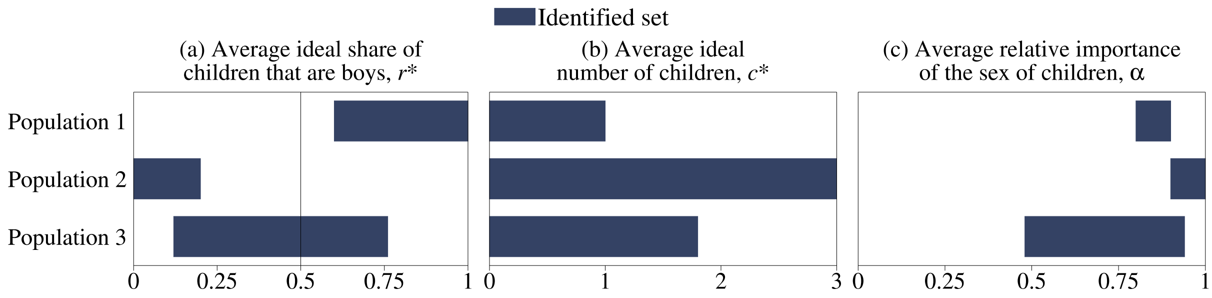
Notes: Using survey data described in Table 1.2, this map indicates countries for which the minimum p-value from the binomial test described in Table 1.2 is less than 0.05. For these countries, highlighted in dark blue, sampling error alone cannot explain observed variation in parity progression ratios, suggesting that the sex of previous children influences whether parents have another child. For countries highlighted in gray, sampling error alone could explain observed variation and sex preferences are not discernible. Panels (a), (b), and (c) perform this test for parity progression ratios among parents that have one child, two children, and three children.

Figure 1.3: Combinations of Preferences that Exactly Match Simulated Population 1



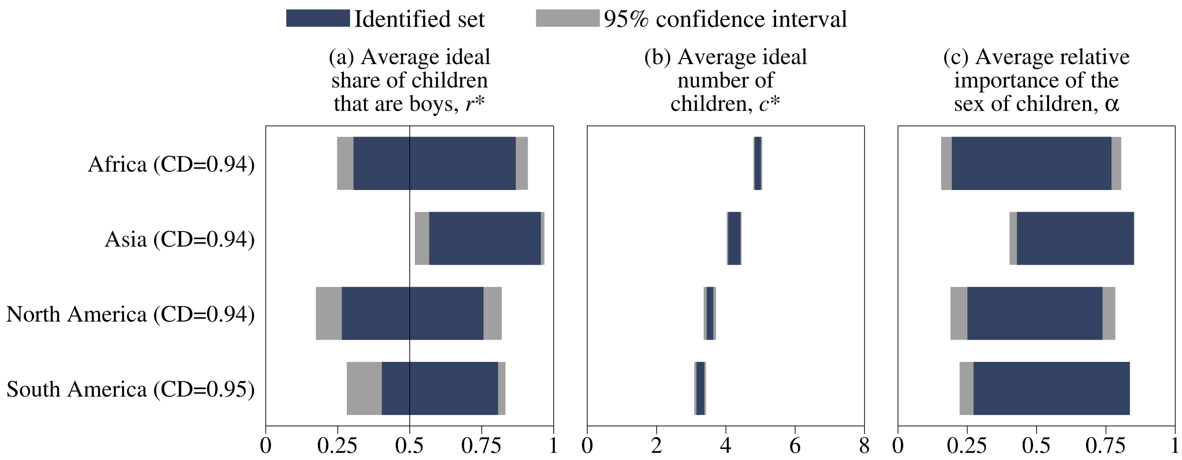
Notes: This figure presents preferences that best explain simulated population 1 in Table 1.1, calculated assuming two childbearing periods, an even chance that each child is a son, and perfect control over conception. The dots in panels (b) through (f) each represent a population in which all parents have the same preferences. In each of these populations, the expected distribution of sequences of children exactly matches the observed population. For example, the final strategy listed in **A** in Table 1.7 (r^*=1, c^*=2, α=1) exactly matches the observed population and is given by the dot in the upper-right corner of panel (f). Each vertex of the three-dimensional object in panel (g) corresponds to a dot in panels (b) through (f) and is a unique combination of preferences that, in expectation, exactly matches the observed population. Because any population that consists of combinations of couples following any of these unique strategies also exactly matches the observed population, the polyhedron in panel (g) is a convex set of all possible combinations of average values of r^*, c^*, and α that exactly match the observed population. Each of the polygons in panels (c) through (f) provide slices of the polyhedron in panel (g), holding average r^* constant.

Figure 1.4: Estimated Bounds on Average Values of Preferences in Simulated Populations



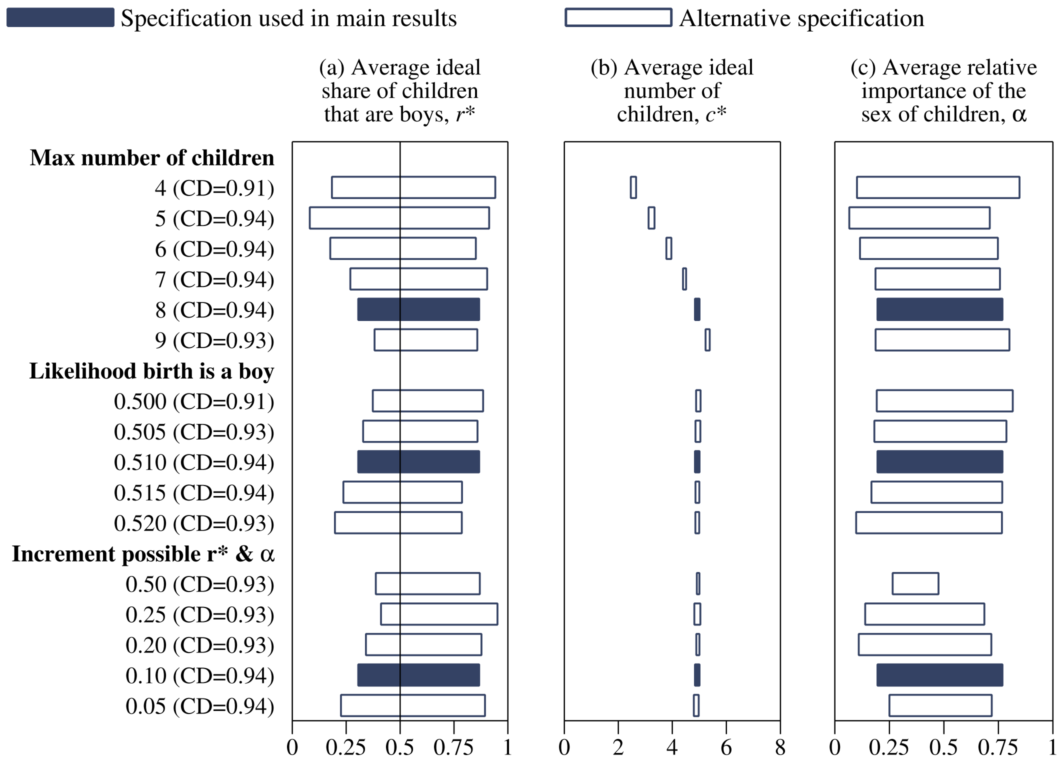
Notes: Populations defined in Table 1.1. The rectangles provide estimated bounds on the average value of preferences that best explain the observed populations, calculated according to the procedure given in Section 1.3, assuming three childbearing periods, a one-half chance that each birth is a boy, and perfect control over conception. For example, in population 1, the average ideal share of children that are boys could be anywhere between 0.6 and 1.

Figure 1.5: Estimated Bounds on Average Values of Preferences, by Continent



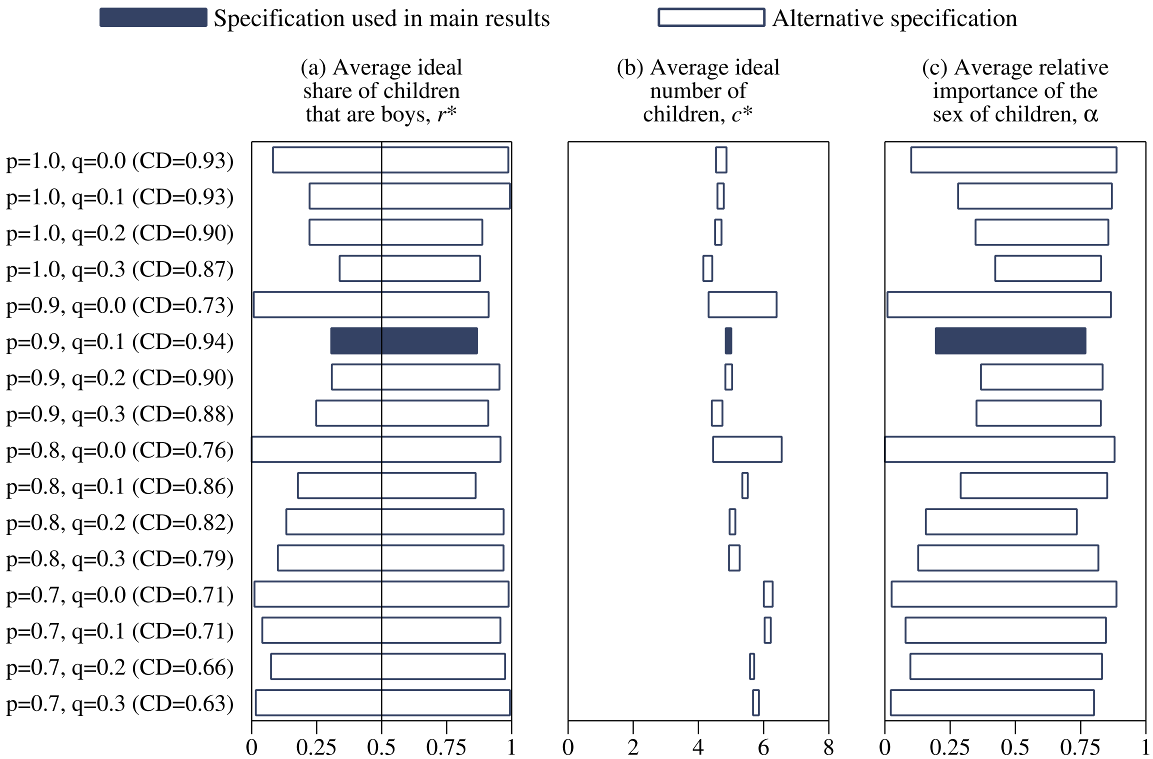
Notes: The dark rectangles provide bounds on average values of preferences, calculated according Section 1.3 with parameter values given in Section 1.4. The light rectangles provide 95-percent confidence intervals around the unknown true value, calculated from 1,000 subsamples drawn according to Romano and Shaikh (2008). Coefficients of determination (CD) calculated according to McKean and Sievers (1987). For example, in Africa the average ideal share of children that are boys is between 0.25 and 0.9. Sample defined in Table 1.2, restricted to women that gave birth eight or fewer times and do not have any twin births.

Figure 1.6: Robustness of Estimates in Africa to Choice of Model Parameters



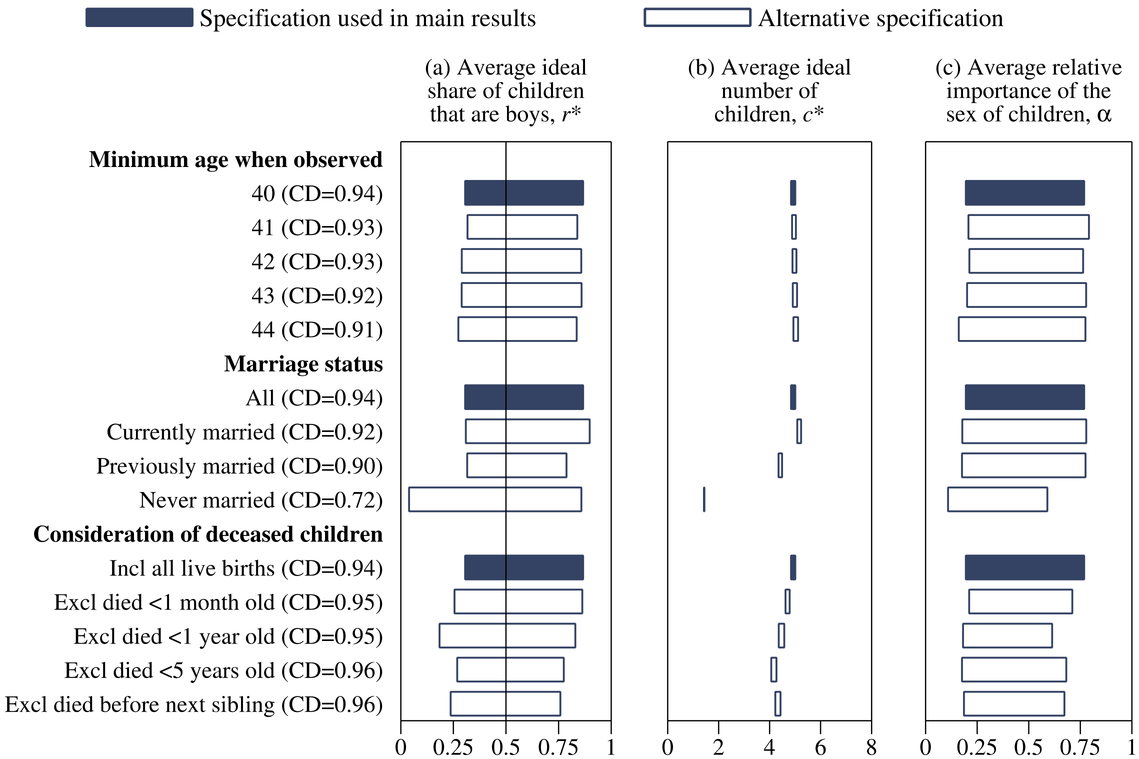
Notes: This figure compares the estimated bounds on average values of preferences in Africa (solid rectangles) with estimated bounds under alternative assumptions (hollow rectangles). Calculations are performed according to Section 1.3, with the main specification given in Section 1.4. Coefficients of determination (CD) calculated according to McKean and Sievers (1987). The first set of comparisons varies the number of childbearing periods, T, which is also the maximum number of children permitted in the sample. The second set of comparisons varies the likelihood that each birth is a boy, l. The final set of comparisons varies the increment between every possible ideal share of children that are sons, r^*, and between every possible relative importance of the sex of children, α. Sample defined as in Figure 1.5.

Figure 1.7: Robustness of Estimates in Africa to Assumed Control over Conception



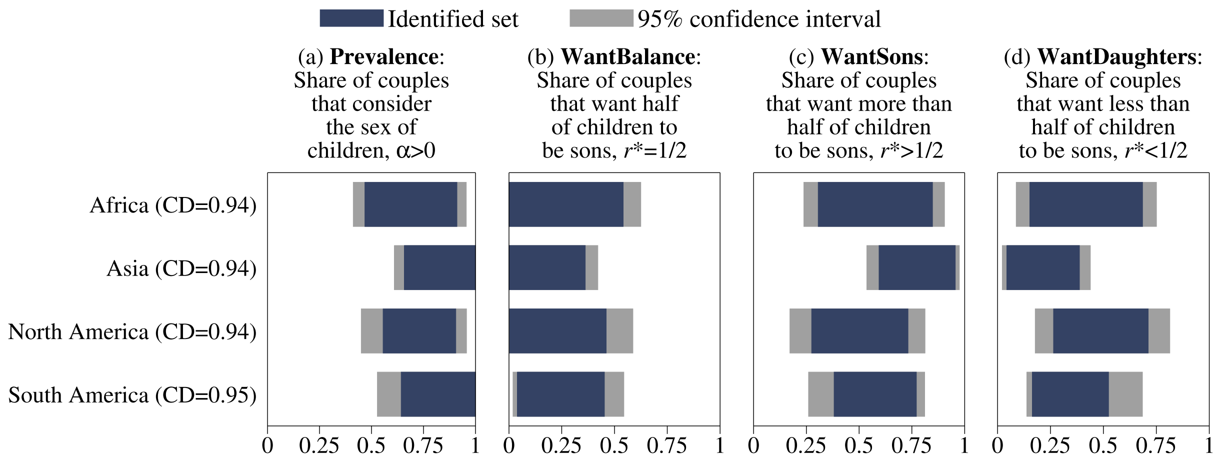
Notes: This figure compares the estimated bounds on average values of preferences in Africa (solid rectangles) with estimated bounds under alternative assumptions (hollow rectangles). Calculations are performed according to Section 1.3, with the main specification given in Section 1.4. Coefficients of determination (CD) calculated according to McKean and Sievers (1987). *p* is the assumed likelihood of conception when trying to get pregnant, and *q* is the assumed likelihood of conception when not trying to get pregnant. Sample defined as in Figure 1.5.

Figure 1.8: Robustness of Estimates in Africa to Changes in Sample Definition



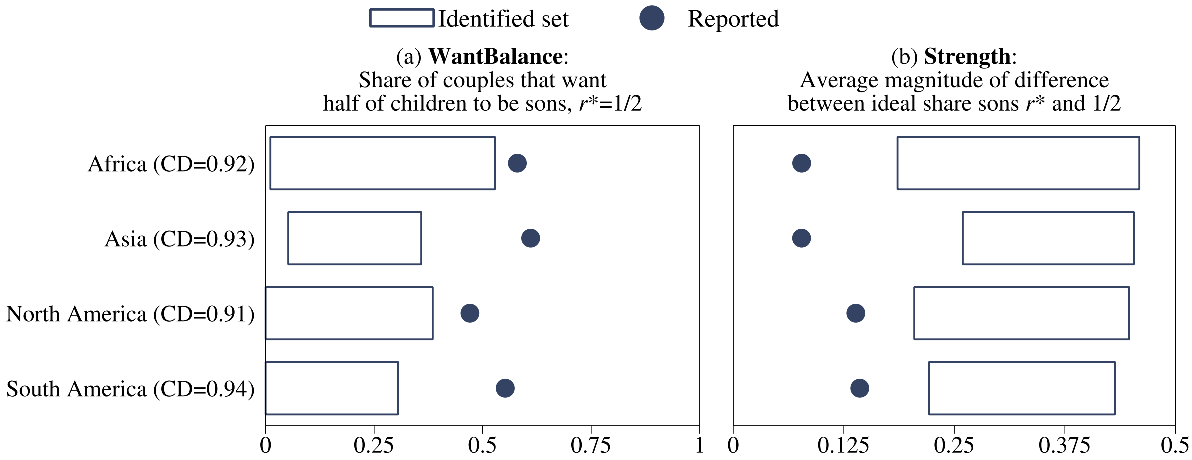
Notes: This figure compares the estimated bounds on average values of preferences in Africa (solid rectangles) with estimated bounds under alternative assumptions (hollow rectangles). Calculations are performed according to Section 1.3, with the main specification given in Section 1.4. Coefficients of determination (CD) calculated according to McKean and Sievers (1987). The first set of comparisons varies the minimum age at observation for which women are included in the sample. The second set varies the marriage status of women whose birth histories are included in the analysis sample. The final set varies how deceased children are included in the analysis sample. Sample defined as in Figure 1.5.

Figure 1.9: Additional Summary Measures of Sex Preferences



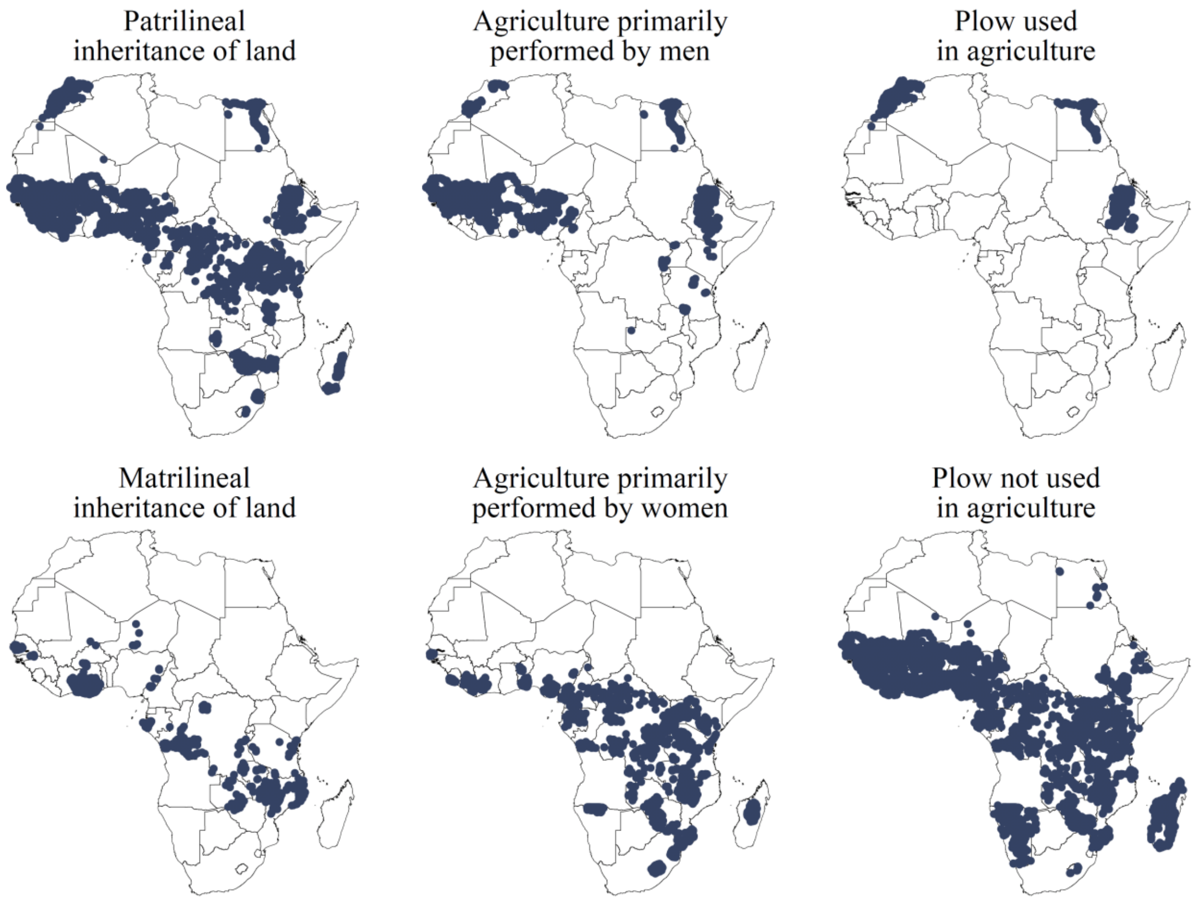
Notes: The dark rectangles provide bounds on summary measures of preferences, defined in Section 1.4.3 and calculated according to Section 1.3. The light rectangles provide 95-percent confidence intervals around the unknown true value, calculated from 1,000 subsamples drawn according to Romano and Shaikh (2008). Coefficients of determination (CD) calculated according to McKean and Sievers (1987). For example, in Africa the share of parents that make childbearing decisions that depend on the sex of previous children is between 0.4 and 0.95. Sample defined as in Figure 1.5.

Figure 1.10: Comparison between Estimated and Reported Preferences



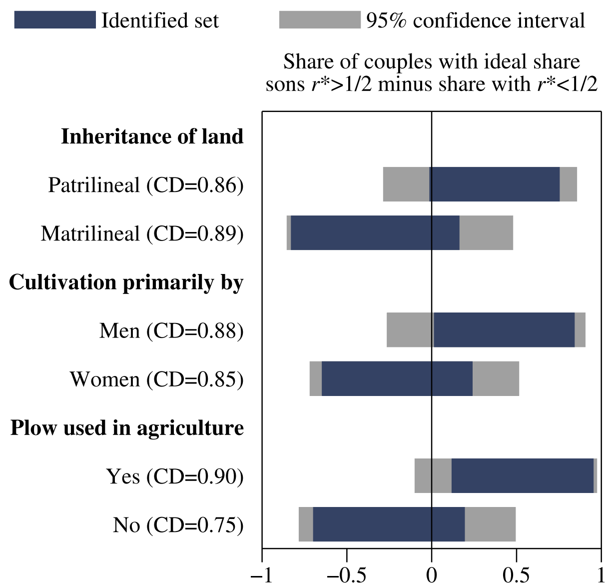
Notes: The hollow rectangles provide bounds on summary measures of preferences, defined in Sections 1.4.3 and 1.4.4 and calculated according to Section 1.3. The solid circles provide average reported values of these summary measures, as recorded in Demographic and Health Surveys. The surveys ask women to report the number of total children, sons, and daughters they wanted at the start of their childbearing career. Coefficients of determination (CD) calculated according to McKean and Sievers (1987). For example, 60 percent of parents in Africa report wanting a balance of sons and daughters, while estimated values of this share are between 2 and 52 percent. Sample defined as in Figure 1.5, restricted to include only women who report wanting eight or fewer children and whose total number of desired children equals the sum of their desired number of sons and desired number of daughters.

Figure 1.11: Respondent Locations by Agricultural Traditions in Africa



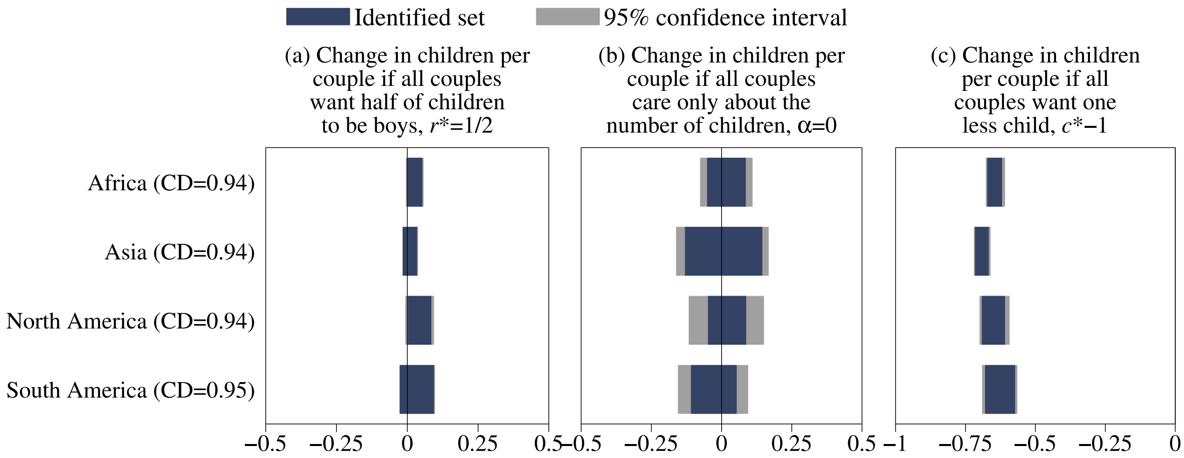
Notes: This figure provides the location of birth history survey respondents in Africa according to traditional agricultural practices. Ethnic group characteristics are taken from George Murdock's Ethnographic Atlas (1967). Not all characteristics are recorded for all ethnic groups. Of the 533 ethnic groups in Africa, inheritance of land traditionally follows the patrilineal line in 307 groups, the matrilineal line in 67 groups, neither in 32 groups, and is not recorded in 127 groups. Agriculture is traditionally primarily performed by men in 76 groups, by women in 146 groups, my men and women equally in 102 groups, and is not recorded in 209 groups. The plow was historically used in agriculture in 32 groups, was not used in 455 groups, and was not recorded in 46 groups. Ethnic group boundaries follow Murdock's Tribal Map of Africa (1959). Nunn and Wantchekon (2011) generously make available an electronic shapefile of the Tribal Map, and Fenske (2009) generously provides a crosswalk between the Tribal Map and Ethnographic Atlas. Birth histories are drawn from all Demographic and Health Surveys that record respondent latitude and longitude. These locations are recorded with up to five kilometers of imprecision, so I exclude respondents that live within five kilometers of an ethnic group boundary.

Figure 1.12: Direction of Sex Preferences by Agricultural Tradition in Africa



Notes: The dark rectangles provide bounds on the direction of sex preferences, defined in Section 1.5 and calculated according to Section 1.3. The light rectangles provide 95-percent confidence intervals around the unknown true value, calculated from 1,000 subsamples drawn according to Romano and Shaikh (2008). Coefficients of determination (CD) calculated according to McKean and Sievers (1987). Estimates are calculated according to traditional agricultural practices as given in Figure 1.11. For example, in areas where the plow was traditionally used in agriculture, the identified set for the direction of preferences is mostly positive, suggesting son preference. Sample defined as in Figure 1.11.

Figure 1.13: Estimated Change in Children per Couple as Preferences Change



Notes: The dark rectangles provide bounds on the estimated change in overall fertility levels as preferences change, defined in Section 1.6 and calculated according to Section 1.3. The light rectangles provide 95-percent confidence intervals around the unknown true value, calculated from 1,000 subsamples drawn according to Romano and Shaikh (2008). Coefficients of determination (CD) calculated according to McKean and Sievers (1987). For example, if all parents in the sample in Africa desired half of their children to be boys, overall fertility would rise by at most 0.05 children per woman. Sample defined as in Figure 1.5.

CHAPTER II

Family Planning and Fertility in South Africa under Apartheid

2.1 Introduction

In 1950, the total fertility rate stood at more than six children per woman in both South Africa and Sub-Saharan Africa as a whole. By 1990, fertility had nearly halved in South Africa but barely changed across Sub-Saharan Africa (United Nations 2014a). During this interval, the national government in South Africa expanded its provision of family planning services by establishing thousands of stationary and mobile clinics, sending family planning advisors door-to-door, and offering free contraception. Government expenditure on family planning rose from a tiny amount in the 1950s to comprise roughly one-quarter of all government spending on health in the late 1980s (Republic of South Africa 1950–1989).

Brown (1987), De Vos (1988), and Kaufman (1996, 2000) argue that the coincidence of rising public provision of family planning services and falling fertility suggests that these services contributed to South Africa's fertility decline. However, as shown in Figure 2.1, the fertility decline was underway by the 1950s, well before government spending on family planning started to surge in the 1970s. The time series of family planning expenditure and fertility rates over the last half of the twentieth century alone are not sufficient to establish whether public provision of family planning contributed to South Africa's fertility decline. In this paper, I develop a new approach that additionally uses spatial variation in the availability of family planning services. This variation directly resulted from the political ideology governing South Africa at the time.

From 1948 until 1994, South Africa was governed by a system of apartheid. Apartheid was political, economic, and residential separation on the basis of race. White South Africans controlled the national government and major economic institutions. All other South Africans – formally, African, coloured, or Asian – could not vote and faced restrictions on their mobility and employment. This separation was particularly acute for Africans, who comprised roughly three-quarters of the population. Every African was officially a citizen of one of ten "homelands." These generally poor, rural homelands covered 13 percent of the land area of South Africa, and by 1960 every African was required to reside in a homeland unless he or she had permission to live and work in the more prosperous "white areas." Roughly half of Africans lived in homelands, the rest in urban townships and white-owned farms in white areas. Apartheid therefore generated separation not just between whites and non-whites but also between Africans living in white areas and Africans living in homelands.

This separation extended to access to family planning services. White South Africans consistently exhibited the lowest birth rates of the four racial groups and, by the early 1960s, national government officials cited a dwindling white minority as cause for alarm (Brown 1987, Chimere-Dan 1993, Kaufman 1996, Mostert et al. 1998). In response, the government encouraged immigration from Europe, urged white families to have additional children, and expanded direct provision of family planning services (Smith 1976, Brown 1987). Because many white residents but few non-white residents already enjoyed access to family planning services through private physicians, this expansion most substantially increased access to family planning services for non-white residents. However, the national government delegated control over homeland health services to homeland governments (Department of Health 1973). These governments largely declined to provide family planning services, in part due to the overtly political motive behind the national government's provision of family planning services (President's Council 1983, de Beer 1984). As a result, African residents of white areas generally enjoyed easier access to family planning services than did African residents of the homelands.

Using a new compilation of demographic surveys conducted since the 1970s, I measure use of family planning services and childbearing patterns over time separately for African women in white areas and African women in homelands. I show that African women living in white areas were consistently more likely to use contraception and be visited by family planning advisors than were African women living in homelands. I also show that fertility rates among African women declined sharply in white areas relative to homelands in the early 1970s as the national government began to directly provide family planning services. Deferral of childbearing contributed to this fertility decline: African women in white areas first gave birth later in life, had longer intervals between births, and stopped giving birth later in life. Among cohorts of African women who entered their main childbearing years after 1970, lifetime fertility fell by one child per woman in white areas relative to homelands.

Imperfect recordkeeping during the apartheid era prevents a complete accounting of the many factors that may have contributed to South Africa's fertility decline. Particularly in the homelands, wage rates and other employment information is largely unknown, and incomplete coverage in many censuses makes even precise population counts difficult to establish. However, the particular timing of the decline in African fertility in white areas in the early 1970s strongly suggests that the corresponding surge in government provision of family planning services in these areas helped women have fewer children. The national government achieved its immediate objective of slowing population growth. But, to the extent that this slowdown in African population growth helped the apartheid government stay in power, the effect did not last long: apartheid ended barely a generation after the government first provided family planning services.

2.2 Government Provision of Family Planning Services in South Africa

Since at least the start of the twentieth century, private physicians in South Africa supplied contraception to white patients. Dedicated family planning clinics first opened in Cape Town in 1932, and local family planning associations founded clinics in other major cities over the subsequent decades. Family planning services during the first half of the twentieth century were generally restricted to white residents (aside from a single clinic in Cape Town) and received little government funding (Caldwell 1992, Caldwell and Caldwell 1993, Klausen 2004).

By the early 1960s, a National Family Planning Association operated several dozen urban clinics that offered family planning services to members of all racial groups. In 1963, the national government first provided a small grant to the National Family Planning Association. These grants rose steadily throughout the rest of the decade and, in 1970, the government fully funded and began to assume control of the Association's clinics (Caldwell 1992, Caldwell and Caldwell 1993). In 1974, having taken control of all of the clinics, the government announced a National Family Planning Program (Bernstein 1985, Brown 1987). Stand-alone clinics, mobile clinics, and door-to-door recruiters offered free contraception and family planning counseling (Department of Health 1976). By the end of the 1980s, there were thousands of stationary clinics and tens of thousands of mobile service delivery points (Department of Health 1987). This increase in the public provision of family planning services came amidst a wave of similar programs in other countries, and the distribution of services was shaped by the political environment in South Africa.

2.2.1 Family Planning in International Context

During a period of particularly rapid population growth during the middle of the twentieth century, Malthusian concerns about famine and large populations outstripping scarce resources motivated publications, such as Paul Ehrlich's *The Population Bomb*, and a series of United Nations conferences on population (Ehrlich 1968, Finkle and Crane 1975, Lam 2011, United Nations 2014b). In response, many countries relaxed restrictions on the distribution of contraception, increased subsidies to encourage their use, or expanded public provision of family planning services (Finlay et al. 2012). South Africa was one of these countries. As early as 1955, a government commission proposed a planned parenthood campaign as a solution to "the population problem in South Africa" (Union of South Africa 1955, page 25). Little more than a decade later, one projection held that, if left unchecked, South Africa's population would rise from 21 million in 1970 to 700 million within a century. In response, Connie Mulder, South Africa's Minister of Information, advocated for family planning as a way to prevent "such an unrealistic growth to eventuate – a growth which must inevitably lead to poverty, under-nourishment, bankruptcy and ruin in South Africa" (Van Rensburg 1972, page viii). Other officials expressed similar concerns, and government expenditure on family planning services climbed steadily throughout the 1970s and 1980s.

Developments in birth control technology facilitated expanded public provision of family planning services. Through the early twentieth century, available forms of artificial birth control (as opposed to withdrawal, rhythm, and other natural methods) largely consisted of barrier methods that often suffered from high failure rates and, in the case of condoms, required that men cooperate with their use (Potts and Tsang 2002). The development of more reliable oral and injectable contraceptives in the 1950s and 1960s allowed women greater control over conception, and these forms of birth control became central to public family planning campaigns aimed at women in many countries. The government of South Africa heavily promoted the injectable contraceptive Depo Provera, oral contraceptives, and intrauterine devices, and these became the most commonly used forms of contraception among African residents (Kaufman 1996). Because Depo Provera was administered on a three-month schedule, mobile family planning vans were able to travel on regular routes through rural areas, increasing the reach of the family planning program beyond residents that lived near stationary clinics in cities. Condoms gained popularity alongside widespread public awareness of HIV in the 1990s, but HIV was not yet a primary focus of public contraception campaigns in South Africa during most of the apartheid era.

There is little evidence that the apartheid government forced residents to involuntarily avert births (Brown 1987). Sterilization and abortion – two forms of birth control that have been used coercively in China, India, Sweden, and elsewhere (Vicziany 1982, Hyatt 1997, Ebenstein 2010, Zampas and Lamačková 2011) – were relatively rare in South Africa. By the late 1980s, less than five percent of African residents had been sterilized, while white residents were more than twice as likely to have been sterilized (Kaufman 1997). Except in strict circumstances, abortion remained illegal in South Africa until 1996 (Klugman 1993, Cooper et al. 2004).

2.2.2 Family Planning in Domestic Political Context

Starting in the mid-nineteenth century, a series of white-controlled governments progressively partitioned South Africa into white areas and African areas (Bundy 1979). In 1913, the government of what was then the Union of South Africa formally set aside nine percent of the land for the country's African residents (Horrell 1969). Over the following five decades, white-controlled governments established pass laws mandating that African men, and later women, demonstrate proof of employment in order to remain in white areas of the country (these pass laws were repealed in 1986; Platsky and Walker 1985, Savage 1986, Phillips 1997, Beinart 2001). During the apartheid era, the government forcibly removed more than 3.5 million African residents from white areas (Platzky and Walker 1985). Starting in the 1960s, the apartheid government consolidated and enlarged the reserves to cover thirteen percent of the country's land area (see Figure 2.2) and began to consider them ethnic "homelands" (or "black states" or "Bantustans") that would eventually become independent countries. In the late 1970s and early 1980s, the government conferred nominal independence, which no other country recognized, on four of the homelands (Transkei, Bophuthatswana, Venda, and Ciskei); the other six (Gazankulu, KaNgwane, KwaNdebele, KwaZulu, Lebowa, Qwaqwa) remained "self-governing" (Posel 1991, Beinart 2001). Upon the end of apartheid, all homelands were reintegrated into a unified South Africa.

Maintenance of white political control motivated both the partitioning of South Africa and the provision of family planning services to non-white residents of white areas. Soon after the formal start of apartheid in 1948, government officials worried that the growing non-white share of the population would imperil the white minority's political power. While speaking before Parliament in 1962, Prime Minister H. F. Verwoerd asserted that, "If the one multiracial state were to become a federally constituted state or a unitary state (on the basis of the Liberal Party's proposition of 'one man, one vote') and at the same time be truly democratic and in harmony with the spirit of the times, it would inexorably lead to Bantu domination" (Chimere-Dan 1993, page 32). Other government officials expressed concern about social instability in the face of rising numbers of underemployed African residents (Brown 1987). In response, the government encouraged immigration from Europe, urged white families to have additional children, and extended access to family planning services to previously underserved non-white residents (Brown 1987, Caldwell and Caldwell 1993). Although particularly overt, the politicization of family planning was not unique to South Africa. Many governments have targeted family planning to particular groups, including rural residents in Mexico, members of lower castes in India, and poor residents in the United States (Vicziany 1982, Browner 1986, Potter 1999, Bailey et al. 2014).

African leaders generally advocated against family planning. Ferreira (1984, page 7) states that, "For a large number of Blacks, family planning and the political apparatus of the White government are still perceived as indivisible with the result that the motives of the [National Family Planning Program] remain suspect." The *African Communist* newspaper summarized the skepticism: "The so-called national family planning program is being used to perpetuate White domination and the oppression and exploitation of the Black majority" (Unsigned 1982, page 87). Concerns about cancer-causing effects of Depo Provera further generated suspicion. Several countries, including the United States and Zimbabwe, restricted the sale of Depo Provera, but the South African government consistently offered it at family planning clinics (Kaler 1998). As nominally independent or self-governing territories, the homelands assumed full financial and administrative responsibilities for their health services and declined to establish extensive family planning programs (Department of Health 1973, Mostert et al. 1988). As depicted in Figure 2.3, per-capita expenditure on family planning in homelands never exceeded 7 percent of that in white areas.

2.3 Empirical Strategy

Through the 1960s, contraception was available to African women in South Africa at only a few clinics in major cities. Given the legal restrictions on African residents' mobility, many African women did not have access to these clinics. Starting in the early 1970s, the national government opened additional clinics in urban areas, sent mobile clinics to rural areas, and offered contraception for free at these clinics. The government therefore increased the number of family planning clinics, reduced the sticker price of contraception by offering it for free, and reduced transportation costs that African women faced in obtaining contraception. Although there are no records of the quantity of contraceptives distributed, the jump in the number of clinics from a few dozen in the 1960s to thousands in the 1980s suggests a substantial increase in the supply of contraception.

Public provision of family planning services may have also changed demand for contraception. By sending family planning advisors door-to-door, the government tried to increase information about and demand for contraception. However, concerns about the program's political objectives could have had the reverse effect and dampened demand among African residents. If demand remained price-inelastic or even declined, it is possible that the large increase in supply translated into little additional use of contraception and had little effect on fertility. In the remainder of this paper, I evaluate whether greater use of family planning services and lower fertility rates accompanied the government's family planning program.

2.3.1 Identification Strategy

Branson and Byker (2015) use the precise location of family planning clinics that targeted youth during the post-apartheid era to show that women who grew up near clinics were less likely to give birth as a teenager. A similar strategy would be ideally suited for evaluating whether proximity to a family planning clinic allowed African women to have fewer children during the apartheid era. Unfortunately, I am unable to find information about the precise location of family planning clinics during this period. Annual government expenditure and health reports offer the most complete surviving documentation. These reports record annual expenditure on family planning services in white areas and most homelands, and in some years record the total number of clinics in white areas. It is these reports that indicate a surge in family planning expenditure in the 1970s in white areas (depicted in Figure 2.1) and a relative lack of funding in the homelands (depicted in Figure 2.3).

The empirical strategy in this paper uses the fact that expansion of family planning services followed the partitioning of South Africa into white areas and homelands. Family planning clinics and advisors served African residents of townships and white-owned farms, while African residents of homelands generally lived further away from these services. This distinction was not absolute – some residents that lived near the edges of homelands could travel to white areas to obtain services (Kaufman 1997) – but the greater concentration of services in white areas suggests that any resulting increase in the use of contraception and decline in fertility should have been greater in white areas. I separately group together all residents of white areas and all residents of homelands, and I compare differences in use of contraception and fertility over time between these two groups. Because only Africans lived in homelands, I similarly consider only African residents of white areas.

I employ a difference-in-differences empirical strategy to compare fertility rates in white areas and homelands before and after the government began directly providing family planning services in 1970. I show that fertility rates were similar in white areas and homelands in the 1960s. After 1970, there was a sharp drop in fertility in white areas, the timing of which coincides with the large surge in government provision of family planning services. However, to causally attribute the decline in fertility to the family planning program, a parallel trends assumption must be satisfied: absent family planning, any difference in fertility rates between African women living in white areas and African women living in homelands before 1970 would have continued after 1970.

There are other factors that may have contributed to a decline in fertility in white areas over time. African residents of white areas were by regulation employed and African women living in white areas, many of whom were employed as domestic workers and could have lost their jobs upon becoming pregnant, had strong incentive to postpone childbearing (Caldwell and Caldwell 1993). In the densely populated homelands, jobs were more scarce, incomes generally lower, and unemployment rates higher (Wilson and Ramphele 1989), suggesting a lower opportunity cost to giving birth. Additionally, due to labor migration of African men from homelands into white areas, there were 55 adult men for every 100 adult women in the homelands at the end of the 1950s. This distorted sex ratio eased over the subsequent decades as the apartheid government forcibly removed millions of African residents from white areas. By the 1980s, there were 69 men for every 100 women in the homelands (Wilson 1972; Simkins 1983; Moultrie 2001). This balancing of sex ratios may have made family formation in the homelands easier over time.

These internal migration restrictions and segmented labor markets generated incentives to have fewer children in white areas. However, there is insufficient annual information on forced removals or labor market conditions to properly control for these factors when tracking birth rates over time. Therefore, although I do not know of evidence that these factors changed sharply in 1970 in a way that could explain suddenly lower relative fertility in white areas, I cannot conclude that public provision of family planning services alone changed relative fertility rates in white areas and homelands after 1970. I will only be able to conclude that the coincident timing of family planning expansion and fertility changes in white areas suggests that, in combination with economic, social, and political factors, rising public provision of family planning services led to changes in fertility.

2.3.2 Data on Use of Contraception and Fertility

South Africa's Human Sciences Research Council (HSRC) conducted several surveys during the apartheid era that recorded use of contraception by married African women. Surveys in 1969 and 1982 were administered only in white areas, but surveys in 1974 and 1987 were administered nationwide and allow a comparison between use of contraception among African women living in white areas and African women living in homelands (Du Plessis and Coetzee 1974, Van Tonder 1985, Caldwell and Caldwell 1993). After a series of reports in the late 1970s and early 1980s, the 1974 Fertility Survey remained unused in the HSRC archives (Lötter and Van Tonder 1976, Lötter 1977). In 2014, with the assistance of several HSRC staff and researchers, I was able to locate the survey records on an IBM datatape and convert the tape into modern computer format. The 1987 Demographic and Health Survey (DHS) is available at the National Research Foundation's South African Data Archive. By using both surveys, this paper for the first time tracks use of contraception by African residents over time in both white areas and homelands.

Demographic measurement of African residents was incomplete during the apartheid era. The national government maintained vital registries of births for White, coloured, and Asian but not African residents, and censuses were often incompletely administered in African communities (Moultrie and Timaeus 2003). In this paper, I use household surveys that record the timing of each of a woman's births and offer the most representative record of African fertility in both white areas and homelands. Birth history surveys suffer from four shortcomings, discussed below. Despite these shortcomings, birth histories have been used in studies of fertility in South Africa and elsewhere (Burger et al. 2012, Bongaarts and Casterline 2013).

First, birth history surveys do not record births to women who have died. Because the apartheid government did not maintain registries of deaths of African residents, it is not possible to adjust later birth histories for mortality in white areas and homelands.

Second, mothers may inaccurately report their children's dates of birth or may not report children who have died (Potter 1977, Beckett et al. 2001). Among all children born between 1953 and 1992 that appear in the main dataset used in this paper, 22.2 percent are recorded as having been born in years ending in 0 or 5, above the expected 20 percent in truly random large sample. This birth-year heaping suggests some misreporting of children's dates of birth, but is of similar magnitude in white areas and homelands (22.4 percent and 21.8 percent), suggesting similar ability to remember and report previous births.

Third, while the retrospective nature of birth histories permits calculation of fertility rates in the years leading up to the survey, these surveys are often collected only from women currently of childbearing age. Although they comprehensively measure fertility at time of survey, births many years earlier are only recorded if the mothers were young at the time. Because all birth history surveys were conducted at and after the end of apartheid, the fertility statistics that I calculate in the early years of apartheid come from women who were young at the time.

Fourth, birth history surveys do not record each child's place of birth. This final shortcoming is particularly relevant for South Africa. More than 3 million African residents were forcibly removed from white areas during apartheid, and there was substantial internal migration after mobility restrictions were lifted in 1985 (Platzky and Walker 1985, Reed 2013). Where a woman currently lives may not be where she gave birth. Because migration itself could be a consequence of family planning if women with access to contraception were able to delay childbearing and migrate in search of work, I use a woman's place of birth to represent where she lived during her childbearing years.

Three surveys conducted during and after the end of apartheid record women's complete birth histories and place of birth: the 1987 DHS, 1994 and 1995 October Household Surveys (OHS), and the National Income Dynamics Study (NIDS) that began in 2008. The DHS records birth histories from women ages 15–49 who are married or have ever given birth, and records whether each woman was born in a white area or homeland. The OHS records birth histories from all women ages 12–54 regardless of marriage status, and records each woman's magisterial district of birth, the land area of all of which lie at least 90% in an apartheid-era white area or apartheid-era homeland. The NIDS records birth histories from all women regardless of age or marriage status, but records place of birth according to post-apartheid district council boundaries, many of which substantially overlap both historical white areas and historical homelands. So that I may measure fertility regardless of marriage status, I use the OHS and NIDS data in this paper. To minimize white area/homeland location measurement error, I use OHS records for the main analyses, and supplement with NIDS records to measure long-term cohort fertility. I mark as white areas all post-apartheid districts in which at least 90 percent of the land area covers historical white areas. I mark all other districts as homelands.

2.4 Results

2.4.1 Increased Use of Contraception

Increased use of contraception accompanied the increase in public provision of family planning services during the 1970s and 1980s. As given in panel (a) of Figure 2.4, 32 percent of African women living in white areas in 1974 had ever used contraception. In the homelands, this figure was lower, at 15 percent. By the late 1980s, the share of women who had ever used contraception rose by nearly 40 percentage points in both white areas and homelands. As given in panel (b), the share of women currently using contraception similarly rose over time countrywide and remained higher in white areas. These statistics indicate that, between the early 1970s and late 1980s, use of contraception among African women rose substantially and African women living in white areas remained consistently more likely to use contraception than African women living in homelands. As given in panel (c), among African women that were using contraception, those living in white areas in 1987 had been doing so for 44 months on average, 3 months longer than women in homelands.

African women living in white areas were also consistently more likely to report having access to family planning services. As given in panel (d), 9 percent of African women living in white areas in 1974 had been visited by a family planning advisor in the past year. In homelands, this figure stood at 2 percent. Similarly, as given in panel (e), 16 percent of African women living in white areas in the late 1980s received contraception from a mobile clinic or family planning advisor, but only 6 percent of African women in homelands did so. However, as given in panel (f), reported intentions to use contraception varied little between white areas and homelands: 49 percent of African women living in white areas in 1987 reported that they intended to use contraception in the future, a figure that was just one percentage point lower in the homelands.

Although there was no measurement of the use of contraception in both white areas and homelands before national government involvement in family planning, the evidence in Figure 2.4 shows that, once the family planning program was underway in the 1970s and 1980s, African women in white areas were consistently more likely to use contraception than were women in homelands. Visits by family planning advisors and mobile clinics were more common in white and may have facilitated greater use of contraception in white areas. Women living in homelands likely had to travel further to obtain contraception. However, reported intentions to use contraception, while only a course measure of demand, suggests that desire to use contraception was roughly the same countrywide. Therefore, widespread provision of family planning services in white areas, rather than stronger demand for contraception in white areas, may have been responsible for greater use of contraception in white areas. In the next section, I show that differences in fertility accompanied these differences in use of contraception.

2.4.2 Fertility Decline in White Areas Relative to Homelands

Fertility rates in white areas and homelands diverged in the early 1970s. As shown in the first panel of Figure 2.5, through the 1960s the annual share of African woman born in white areas that gave birth was the same as the share of African women born in homelands gave birth. As the government first provided family planning services in white areas, African fertility in white areas fell relative to African fertility in homelands. In 1960, about 3 percent of women born in white areas and homelands gave birth; in 1977, 9 percent of women born in white areas gave birth while 13 percent of women born in homelands gave birth. (Again, the share of women giving birth appears to rise in the 1950s and 1960s in both white areas and homelands because of sample censoring: the OHS records only women who were teenagers in the 1950s, but by the 1970s a wider age range of mothers are recorded.)

The relative decline in fertility in white areas was substantial. The following event study difference-in-differences, or interrupted time series, calculates the difference in fertility among African women born in white areas and homelands in each year minus the difference in 1969, the year before the government first directly provided family planning services:

$$b_{it} = \alpha L_i + \sum_{y \neq 1969} \beta_y 1(t = y) + \sum_{y \neq 1969} \delta_y L_i \times 1(t = y) + \varepsilon_{it}. \tag{1}$$

Each woman, i, has a separate observation for each year, t, in which she was between the ages of 12 and 54. b_{it} equals one if woman i gave birth in year t, L_i equals one if woman i was born in a white area, and $1(t = y)$ equals one if $t = y$ for years $y \neq 1969$. The δ_y coefficients presented in the second panel of Figure 2.5 provide the difference-in-differences estimates of the likelihood of giving birth in white areas minus homelands in year y minus the difference in 1969. At its nadir in 1977, the difference in the share of women born in white areas that gave birth minus the share of women born in homelands that gave birth was nearly 4 percentage points lower than in 1969. Given that 13 percent of African women born in homelands gave birth in 1977, this difference stood at nearly one-third of African fertility in the homelands in 1977. Fertility rates in white areas and homelands converged somewhat in the 1980s.

2.4.3 Robustness of Fertility Decline across Subgroups

Among African women observed in the 1994 and 1995 OHS, women born in white areas and women born in homelands are not balanced across demographic characteristics. Women born in white areas are older, have more standards of schooling (roughly equivalent to years of schooling), are more likely to live in an urban area, and are more likely to have ever been married than those born in homelands (Table 2.1). Figure 2.6 repeats the difference-in differences estimates presented in the second panel of Figure 2.5 for subsamples grouped according to women's birth cohort, educational attainment, urban/rural residence, and marriage status. Because of small sample sizes in some years, these estimates of δ_y are calculated as follows for five-year groups (y = 1955–59, 1960–64, …, 1990–94):

$$b_{it} = \alpha L_i + \sum_{y \neq 1965-69} \beta_y 1(t = y) + \sum_{y \neq 1965-69} \delta_y L_i \times 1(t = y) + \varepsilon_{it}. \qquad (2)$$

Panel (a) of Figure 2.6 demonstrates that, among women born in the early 1940s, the likelihood of giving birth fell by four percentage points during the 1970s for women born in white areas relative to women born in homelands. Panels (b) through (d) similarly indicate that relative fertility fell in white areas in the 1970s for women born in the late 1940s, early 1950s, and late 1950s. Panels (e) and (f) demonstrate that the decline in fertility was of similar magnitude among more and less-educated women. Panels (g) and (h) demonstrate that the decline was earliest and most persistent among women living in urban areas, consistent with the rollout of clinics and family planning advisors first in urban areas and then in rural areas (Department of Health 1976). Similarly, panels (i) and (j) demonstrate that the decline was earliest and most persistent among women who had ever been married. Again, though, educational attainment, urban/rural residence, and marriage status were measured only in 1994 and 1995, after women had made childbearing decisions. Available data do not permit measuring changes in fertility by contemporary educational attainment, urban/rural residence, or marriage status.

2.4.4 Deferral of Childbearing and Decline in Lifetime Fertility

Figure 2.5 indicates that, relative to birth rates in homelands, birth rates in white areas declined in the 1970s and then partially rebounded in the 1980s. Figure 2.7 demonstrates that deferral of childbearing in white areas contributed to this pattern. The estimates in Figure 2.7 are calculated using a sample of women age 40 and above when observed in the 2008 NIDS. While some women give birth after turning 40, this age is commonly used as a cutoff to identify women who have plausibly completed childbearing (Modrek and Ghobadi 2011, Beaujouan and Solaz 2013, Cornolli and Bernardi 2015). Panel (a) of Figure 2.7 presents the average age at first birth among African women born in white areas and African women born in homelands. These averages are calculated for five-year birth cohorts of women. For example, women born in white areas in the late 1930s first gave birth on average at age 25, as did women born in homelands. Relative age at first birth declined for cohorts of women born in white areas in the 1940s, but rose starting with cohorts of women born in the early 1950s. Panel (b) demonstrates that average age at last birth remained consistently lower in white areas than in homelands. But, as with age at first birth, relative age at last birth started to rise for cohorts of women born in white areas in the 1950s. Panel (c) demonstrates that average spacing between births also started to lengthen for cohorts of women born in white areas in the 1950s.

Bongaarts (1999) demonstrates how deferral of childbearing can lead to a temporary decline in fertility but may leave lifetime fertility unchanged. Panels (a) through (c) of Figure 2.7 together suggest that deferral of childbearing may explain the drop in relative fertility in white areas in the 1970s followed by a rebound in the 1980s, depicted in Figure 2.5. Starting with cohorts of women born in the early 1950s, who were entering their twenties just as the national government began directly providing family planning services in the early 1970s, women born in white areas began giving birth later in life, had greater spacing between births, and stopped giving birth later in life. These patterns contribute to a deferral of childbearing from the 1970s into the 1980s. Longer spacing between births improves each child's likelihood of survival, and South African women's use of contraception to postpone and spread out births is consistent with use of contraception for similar purposes in other parts of Sub-Saharan Africa (Lesthaeghe et al. 1981, Cohen 1998, Westoff 2006).

However, deferral of childbearing alone does not account for the entire drop in fertility in white areas in the 1970s. As given in panel (d) of Figure 2.7, lifetime fertility was more than five children per woman for cohorts of women born through the late 1940s, regardless of whether the women were born in white areas or homelands. Fertility fell countrywide for women born starting in the 1950s, but this drop was particularly precipitous among women born in white areas. For cohorts of women born in the early 1950s through the early 1960s, women born in white areas had one fewer child on average than did women born in homelands. Given that women born in homelands in the 1960s had four children each on average, this difference in lifetime fertility of one child per woman suggests that government provision of family planning services accounted for up to a 25 percent drop in fertility among African residents of white areas.

A decline in the share of women with large families drove this drop in average number of children born per woman. Figure 2.8 presents the distribution of African women by their number of children. Among African women born in white areas in the late 1930s, few had zero children or one child. The shares of women with two, three, and four children were each roughly 15 percent. The remaining 55 percent of women had five or more children. Among African women born in homelands in the late 1930s, few had zero children, the shares with one, two, three, and four children were each about 10 percent, and the remaining 60 percent of women had five or more children. These family sizes persisted for cohorts of women born in the 1940s: in both white areas and homelands, more than half of women had five or more children. Starting with cohorts of African women born in the early 1950s, lifetime fertility declined countrywide, but this decline was steepest among women born in white areas. Among women born in white areas the early 1960s, a two-child family was most common, and only 20 percent of women had five or more children. Among women born in homelands, the share with two, three, and four children rose slightly over the 1950s, but by the early 1960s a five-child family remained most common.

2.5 Family Planning, Fertility, and a Legacy of Apartheid

Over the last half of the twentieth century, the total fertility rate nearly halved among African residents of South Africa but barely declined in the rest of Sub-Saharan Africa. This remarkable decline in fertility occurred during the formation, entrenchment, decay, and ultimate dissolution of the apartheid state in South Africa. Starting in the early 1970s, the national government provided free family planning services in white areas of the country. Although many African leaders expressed apprehension, over the following two decades rates use of contraception among African women doubled and birth rates fell. Despite a rebound in childbearing in the 1980s, lifetime fertility fell by one child per woman in white areas relative to homelands during the last half of the apartheid era.

Available fertility records do not permit calculation of the number of births that the family planning program may have averted. The apartheid government did not maintain vital records of African residents, censuses did not fully cover all homelands, and most household surveys conducted after the end of apartheid collected birth histories only from women who were young during the early years of the family planning program. However, the total drop in fertility in the country serves as an extreme upper bound on the number of births averted. In 1969, the year before the apartheid government first provided free family planning services, 21.921 million people lived in South Africa and the crude birth rate was 38.047 births per 1,000 residents, indicating that 834,000 children were born in 1969 (21.921 million × 0.038047). The lower line in Figure 2.9 depicts the actual numbers of births calculated similarly for each year from 1970 until apartheid ended in 1994. The slope of this line falls over time because the crude birth rate fell to 26.474 in 1994. Had 1969's crude birth rate of 38.047 persisted through 1994, the population would have grown more quickly and there would have been more births each year. The upper line in Figure 2.9 provides the number of births that would had occurred had 1969's birth rate persisted.

The difference between the two lines in Figure 2.9, 5.13 million, provides a rough approximation of the number of births that were averted during the last half of the apartheid era. Family planning was one of many factors that may have led to this decline in births, so 5.13 million is an extreme upper bound on the number of births that government provision of family planning services averted during the apartheid era. Between 1970 and 1994, the apartheid government spent $779 million (2012 USD) on family planning and population development, yielding an estimated cost per averted birth between 1970 and 1994 of at least $152 ($779 million ÷ 5.13 million).

Table 2.3 compares the effects of family planning programs in several countries. Although the drop in fertility was of similar magnitude in South Africa as in other countries, the cost per averted birth in South Africa may have matched or exceeded that in the Matlab region of Bangladesh. As in Bangladesh, South Africa's family planning program involved intense outreach over many years and was effective but expensive (Joshi and Schultz 2007). Given that the largest relative decline in lifetime fertility in white areas occurred for African women born in the early 1950s, who were just entering their main childbearing ages as the national government first provided family planning services in the early 1970s, the marginal effectiveness of additional increases in government expenditure on family planning appears to have been quite low. This conclusion confirms Caldwell and Caldwell's (1993) assertion that South Africa's fertility decline was not as large as might have been expected given the national government's substantial attention to family planning.

The full consequences of family planning in South Africa extend beyond a tally of averted births. Family planning was central to the apartheid state's population control objectives: slower population growth among African residents in white areas would permit the government to maintain power. Family planning effectively lowered fertility but did not achieve its political objective, at least not for long: apartheid formally ended in 1994, barely twenty years after the government first provided family planning services. By expanding access to family planning services to members of all racial groups, government provision of family planning narrowed the racial gap in access to health care. However, these services were available mostly in white areas. The homelands remained poorer than the rest of the country during the apartheid era and after reunification, and family planning was one of many apartheid policies that entrenched differences between African residents of white areas and African residents of the homelands.

2.6 Works Cited

Angeles, Gustavo, David K. Guilkey, and Thomas A. Mroz. 1998. "Purposive Program Placement and the Estimation of Family Planning Program Effects in Tanzania." Journal of the American Statistical Association, 93(443): 884–899.

Angeles, Gustavo, David K. Guilkey, and Thomas A. Mroz. 2005. "The Determinants of Fertility in Rural Peru: Program Effects in the Early Years of the National Family Planning Program." Journal of Population Economics, 18(2): 367–389.

Bailey, Martha, Olga Malkova, and Johannes Norling. 2014. "Do Family Planning Programs Decrease Poverty? Evidence from Public Census Data." *CESifo Economic Studies*, 60(2): 312–337.

Beaujouan, Eva, and Anne Solaz. 2013. "Racing Against the Clock? Childbearing and Sterility among Men and Women in Second Unions in France." *European Journal of Population*, 29(1): 39–67.

Beckett, Megan, Julie Da Vanzo, Narayan Sastry, Constantijn Panis, and Christine Peterson. 2001. "The Quality of Retrospective Data: An Examination of Long-Term Recall in a Developing Country." *Journal of Human Resources*, 36(3): 593–625.

Beinart, William. 2001. *Twentieth-Century South Africa*. Second edition. Oxford: Oxford University Press.

Bongaarts, John, and John Casterline. 2013. "Fertility Transition: Is Sub-Saharan Africa Different?" *Population and Development Review*, 38(1): 153–168.

Bongaarts, John. 1999. "The Fertility Impact of Changes in the Timing of Childbearing in the Developing World." *Population Studies*, 53(3): 277–289.

Branson, Nicola, and Tanya Byker. 2015. "Impact of a Youth-Targeted Reproductive Health Initiative on Teen Childbearing in South Africa." Working paper.

Brown, Barbara B. 1987. "Facing the 'Black Peril': The Politics of Population Control in South Africa." *Journal of Southern African Studies*, 13(2): 256–273.

Browner, C. H. 1986. "The Politics of Reproduction in a Mexican Village." *Signs*, 11(4): 710–724.

Bundy, Colin. 1979. *The Rise and Fall of the South African Peasantry*. London: James Currey Ltd.

Burger, Rulof, Ronelle Burger, and Laura Rossouw. 2012. "The Fertility Transition in South Africa: A Retrospective Panel Data Analysis." *Development Southern Africa*, 29(5): 738–755.

Caldwell, John C. 1992. "Family Planning Programs and Official Policy Decisions in Southern Africa." Health Transition Working Paper, no. 15. Canberra: Australian National University.

Caldwell, John C., and Pat Caldwell. 1993. "The South African Fertility Decline." *Population and Development Review*, 19(2): 225–262.

Chimere-Dan, Oreieji. 1993. "Population Policy in South Africa." *Studies in Family Planning*, 24(1): 31–39.

Cohen, Barney. 1998. "The Emerging Fertility Transition in Sub-Saharan Africa." *World Development*, 26(8): 1431–1461.

Cooper, Diane, Chelsea Morroni, Phyllis Orner, Jennifer Moodley, Jane Harries, Lee Cullingworth, and Margaret Hoffman. 2004. "Ten Years of Democracy in South Africa: Documenting Transformation in Reproductive Health Policy and Status." *Reproductive Health Matters*, 12(24): 70–85.

Cornolli, Chiara Ludovica, and Fabrizio Bernardi. 2015. "The Causal Effect of the Great Recession on Childlessness of White American Women." *IZA Journal of Labor Economics*, 4(1): 1–24.

De Vos, Susan. 1988. "Population and Development among Blacks in South Africa." University of Wisconsin-Madison, Center for Demography and Ecology, Working Paper 88–25.

Department of Health. 1973, 1976, 1987. *Annual Report*. Pretoria, South Africa: Republic of South Africa.

Du Plessis, J.L., and J.K. Coetzee. 1974. *Fertility and Family Planning among Bantu in Metropolitan Areas of the Republic of South Africa: A Review*. Pretoria: Human Sciences Research Council.

Ebenstein, Avraham. 2010. "The 'Missing Girls' of China and the Unintended Consequences of the One Child Policy." *Journal of Human Resources*, 45(1): 87–115.

Ehrlich, Paul. 1968. *The Population Bomb*. New York: Ballantine.

Ferreira, Monica. 1984. *Some Attitudes of Black Opinion Leaders Towards Family Planning and the National Family Planning Programme*. Pretoria, South Africa: Human Sciences Research Council.

Finkle, Jason L., and Barbara B. Crane. 1975. "The Politics of Bucharest: Population, Development, and the New International Economic Order." *Population and Development Review*, 1(1): 87–114.

Finlay, Jocelyn E., David Canning, and June Y. T. Po. 2012. "Reproductive Health Laws Around the World." Harvard University Program on the Global Demography of Aging, Working Paper no. 96.

Gertler, Paul J., and John Molyneaux. 1994. "How Economic Development and Family Planning Programs Combined to Reduce Indonesian Fertility." Demography, 31(1): 33–63.

Horrell, Muriel. 1969. *The African Reserves of South Africa*. Johannesburg, South Africa: South Africa Institute of Race Relations.

Hyatt, Stephanie. 1997. "A Shared History of Shame: Sweden's Four-Decade Policy of Forced Sterilization and the Eugenics Movement in the United States." *Indiana International and Comparative Law Review*, 8: 475–503.

Joshi, Shareen, and T. Paul Schultz. 2007. "Family Planning as an Investment in Development: Evaluation of a Program's Consequences in Matlab, Bangladesh." Yale University Economic Growth Center Discussion Paper No. 951.

Kaler, Amy. 1998. "A Threat to the Nation and a Threat to the Men: The Banning of Depo-Provera in Zimbabwe, 1981." *Journal of Southern African Studies*, 24(2): 347–376.

Kaufman, Carol. 1996. *The Politics and Practice of Reproductive Control in South Africa: A Multilevel Analysis of Fertility and Contraceptive Use*. University of Michigan Ph.D. thesis.

Kaufman, Carol. 1997. "Reproductive Control in South Africa." Population Council, Policy Research Division, working paper no. 97.

Kaufman, Carol. 2000. "Reproductive Control in Apartheid South Africa." *Population Studies*, 54(1): 105–114.

Kearney, Melissa S., and Phillip B. Levine. 2009. "Subsidized Contraception, Fertility, and Sexual Behavior." Review of Economics and Statistics, 91(1): 137–151.

Klausen, Susanne M. 2004. *Race, Maternity, and the Politics of Birth Control in South Africa, 1910–39*. New York: Palgrave MacMillan.

Klugman, Barbara. 1993. "Balancing Means and Ends; Population Policy in South Africa." *Health Matters*, 1(1): 44–57.

Lam, David. 2011. "How the World Survived the Population Bomb: Lessons from 50 Years of Extraordinary Demographic History." *Demography*, 48(4): 1231–1262.

Lesthaeghe, Ron, P. Ohadike, J. Kocher, and Hilary Page. 1981. "Child-spacing and Fertility in Sub-Saharan Africa: An Overview of Issues." Chapter 1 of *Child Spacing in Tropical Africa: Traditions and Change*, edited by Hilary Page and Ron Lesthaeghe. New York: Academic Press.

Lötter, J.M. 1977. "The Effect of Urbanization and Education on the Fertility of Blacks in South Africa." *Humanitas*, 4(1): 21–28.

Lötter, J.M., and J.L. van Tonder. 1976. *Fertility and Family Planning among Blacks in South Africa: 1974*. Pretoria: Human Sciences Research Council.

Miller, Grant. 2009. "Contraception as Development? New Evidence from Family Planning in Colombia." Economic Journal, 120(545): 709–736.

Modrek, Sepideh, and Negar Ghobadi. 2011. "The Expansion of Health Houses and Fertility Outcomes in Rural Iran." Studies in Family Planning, 42(3): 137–146.

Mostert, W.P., B.E. Hofmeyr, J.S. Oosthuizen, and J.A. van Zyl. 1998. *Demography: Textbook for the South African Student*. Pretoria: Human Sciences Research Council.

Mostert, W.P., J.L. van Tonder, and B.E. Hofmeyr. 1988. "Demographic Trends in South Africa." In H. C. Marais, editor, *South Africa: Perspectives on the Future*. Pinetown, South Africa: Owen Burgess.

Moultrie, Tom A. 2001. "Racism and Reproduction: The Institutional Effects of Apartheid on the South African Fertility Decline." Paper presented at the XXIV IUSSP General Population Conference, Salvador, Brazil.

Moultrie, Tom A., and Ian Timaeus. 2003. "The South African Fertility Decline: Evidence from Two Censuses and a Demographic and Health Survey." *Population Studies*, 57(3): 265–283.

Phillips, Heston. 1997. *Utilization of Maternal Health Care Services among African Women in South Africa*. University of Michigan Ph.D. thesis.

Phillips, James F., Ayaga A. Bawah, and Fred N. Binka. 2006. "Accelerating Reproductive and Child Health Programme Impact with Community-based Services: The Navrongo Experiment in Ghana." Bulletin of the World Health Organization, 84(12): 949–955.

Platzky, Laurine, and Cherryl Walker. 1985. *The Surplus People: Forced Removals in South Africa*. Johannesburg: Raven Press.

Portner, Claus, Kathleen Beegle, and Luc Christiaensen. 2011. "Family Planning and Fertility: Estimating Program Effects Using Cross-Sectional Data." World Bank, Policy Research Working Paper No. 5812.

Posel, Deborah. 1991. *The Making of Apartheid 1948–1961*. Oxford: Clarendon Press.

Potter, Joseph. 1977. "Problems in Using Birth-History Analysis to Estimate Trends in Fertility." *Population Studies,* 31(2): 335–364.

Potter, Joseph. 1999. "The Persistence of Outmoded Contraceptive Regimes: The Cases of Mexico and Brazil." *Population and Development Review,* 25(4): 703–739.

Potts, Malcolm, and Thomas Tsang. 2002. "History of Contraception." *Gynecology and Obstetrics*, 6(8): 1–23.

Reed, Holly. 2013. "Moving Across Boundaries: Migration in South Africa, 1950–2000." *Demography,* 50(1): 71–95.

Republic of South Africa. 1950–1989. *Estimate of the Expenditure to be Defrayed from State Revenue Account*. Pretoria: Government Printer.

Savage, Michael. 1986. "The Imposition of Pass Laws on the African Population in South Africa 1916–1984." *African Affairs*, 85(339): 181–205.

Simkins, Charles. 1983. *Four Essays on the Past, Present, and Possible Future of the Distribution of the Black Population in South Africa*. Cape Town: University of Cape Town.

Simmons, George B, Deborah Balk, and Khodezatul K. Faiz. 1991. "Cost-Effectiveness Analysis of Family Planning Programs in Rural Bangladesh: Evidence from Matlab." Studies in Family Planning, 22(2): 83–101.

Smith, David M. (editor). 1976. *Separation in South Africa: People and Policies*. London: University College London.

Union of South Africa. 1955. *Summary of the Report of the Commission for the Socio-Economic Development of the Bantu Areas within the Union of South Africa*. Pretoria: Government Printer.

United Nations. 2014a. "UNdata." Available at <http://data.un.org/Data.aspx?d=PopDiv&f=variableID:54>, accessed February 14, 2014.

United Nations. 2014b. "United Nations Conferences on Population." Available at <http://www.un.org/en/development/desa/population/events/conference/index.shtml>, accessed September 4, 2014.

Unsigned. 1982. "Family Planning in South Africa – A Kind of Genocide?" *African Communist*, 3: 73–88.

Van Rensburg, Nic J. 1972. *Population Explosion in Southern Africa*. Pretoria: Aurora Printers.

Van Tonder, J.L. 1985. *Fertility Survey 1982: Data Concerning the Black Population of South Africa*. Pretoria: Human Sciences Research Council.

Vicziany, Marika. 1982. "Coercion in a Soft State: The Family-Planning Program of India: Part I: The Myth of Voluntarism." *Pacific Affairs*, 55(3): 373–402.

Westoff, Charles. 2006. "New Estimates of Unmet Need and the Demand for Family Planning." DHS Comparative Reports No. 14. Calverton, Maryland: ICF Macro.

Wilson, Francis, and Mamphela Ramphele. 1989. *Uprooting Poverty: The South African Challenge*. New York: Norton.

Wilson, Francis. 1972. *Labour in the South African Gold Mines 1911–1969*. London: Cambridge University Press.

Zampas, Christina, and Adriana Lamačková. 2011. "Forced and Coerced Sterilization of Women in Europe." *International Journal of Gynecology and Obstetrics*, 114(2): 163–166.

2.7 Data Sources

Household surveys

Human Sciences Research Council. 1974. *Fertility Survey*.

Human Sciences Research Council. 1999. *Demographic and Health Survey, 1987*. Available at <http://sada.nrf.ac.za/ahdetails.asp?catalognumber=0115>, accessed June 10, 2013.

Central Statistical Service. 1994 and 1995. "October Household Survey." Available at <http://www.datafirst.uct.ac.za/>, accessed August 6, 2013.

Southern Africa Labour and Development Research Unit. 2008. "National Income Dynamics Study." Available at <http://www.datafirst.uct.ac.za/>, accessed January 14, 2013

Expenditure on family planning services

***Estimates of Expenditure*, published by national and homeland governments as follows**

Republic of South Africa: 1950–1994

Bophuthatswana: 1978–1994

Ciskei, 1981–1994

Gazankulu, 1980–1993

Kangwane, 1990

KwaNdebele, 1982–1988 and 1991–1994

Kwazulu, 1979–1994

Lebowa, 1977–1981

Qwaqwa, 1978–1994

Transkei, 1975–1989

Venda, 1978–1985 and 1990

Political demarcations

Homelands

Municipal Demarcation Board. 2014. "Districts." Available at <http://www.demarcation.org.za>, accessed August 18, 2014.

Magisterial districts in 1991

Giraut, Frédéric, and Céline Vacchiani-Marcuzzo. 2009. *Territories and Urbanisation in South Africa: Atlas and Geo-Historical Information System (DYSTURB)*. Marseille: IRD.

District councils in 2001

Statistics South Africa. 2014. "District Councils."

Population

South Africa, 1950–1989

Organization for Economic Co-operation and Development. 2014. "Stat Extracts." Available at <http://www.stats.oecd.org>, accessed August 25, 2014.

All homelands in 1970 except KwaNdebele and Lebowa

Bureau for Economic Research re Bantu Development (BENBO). 1976. *Economic Revue*. Pretoria: BENBO. [Individual publications for each homeland]

Lebowa in 1970

Bureau for Economic Research re Bantu Development (BENBO). 1976. *Black Development in South Africa*. Pretoria: BENBO. [Table 2.B.15.1]

All homelands in 1985

Mostert, W.P., J.L. van Tonder, and B.E. Hofmeyr. 1988. "Demographic Trends in South Africa." Chapter 4 in *South Africa: Perspectives on the Future*, ed. H.C. Marais. Pinetown, South Africa: Owen Burgess. [Table 2.2]

Birth and death rates

Total fertility rate in South Africa and in Sub-Saharan Africa as a whole

United Nations. 2014. "UNdata." Available at <http://data.un.org/Data.aspx?d=PopDiv&f=variableID:54>, accessed February 14, 2014.

Crude birth rate and crude death rate in South Africa

World Bank. 2016. "World Data Bank." Available at <http://data.worldbank.org/>, accessed March 18, 2016.

Prices

Price index for all retail items in South Africa, 1950–1957

South African Reserve Bank. 1960. Quarterly Bulletin of Statistics, No. 58, December 1960. Pretoria, South Africa: Republic of South Africa.

Consumer price index in South Africa, 1957–2012

Organization for Economic Co-operation and Development. 2014. “Stat Extracts.” Available at <http://www.stats.oecd.org>, accessed August 25, 2014.

Exchange rates

Currency conversion from Pound to South African Rand at rate of 2 Rand per Pound

Reserve Bank. 2001. “The Reserve Bank and the Rand: Some Historic Reflections.” Available at <https://www.resbank.co.za/Publications/Speeches/Detail-Item-View/Pages/default.aspx?sarbweb=3b6aa07d-92ab-441f-b7bf-bb7dfb1bedb4&sarblist=a01d874c-c3f6-4b93-a9dc-c984cf8652cf&sarbitem=200>, accessed August 25, 2014.

Exchange rate of 8.0396 Rand per US Dollar on January 1, 2012

OANDA. 2014. “Historical Exchange Rates.” Available at <http://www.oanda.com/currency/historical-rates/>, accessed September 8, 2014.

Table 2.1: Sample Characteristics

	Born in white areas	Born in homelands	Difference
Number of women	41,521	28,161	
Average age at survey	31.648	30.699	0.949
	(0.088)	(0.116)	(0.146)
Average number of standards of schooling	5.200	4.841	0.359
	(0.018)	(0.021)	(0.028)
Share that live in an urban area	0.541	0.147	0.394
	(0.003)	(0.002)	(0.003)
Share that have ever been married	0.431	0.400	0.031
	(0.003)	(0.003)	(0.004)

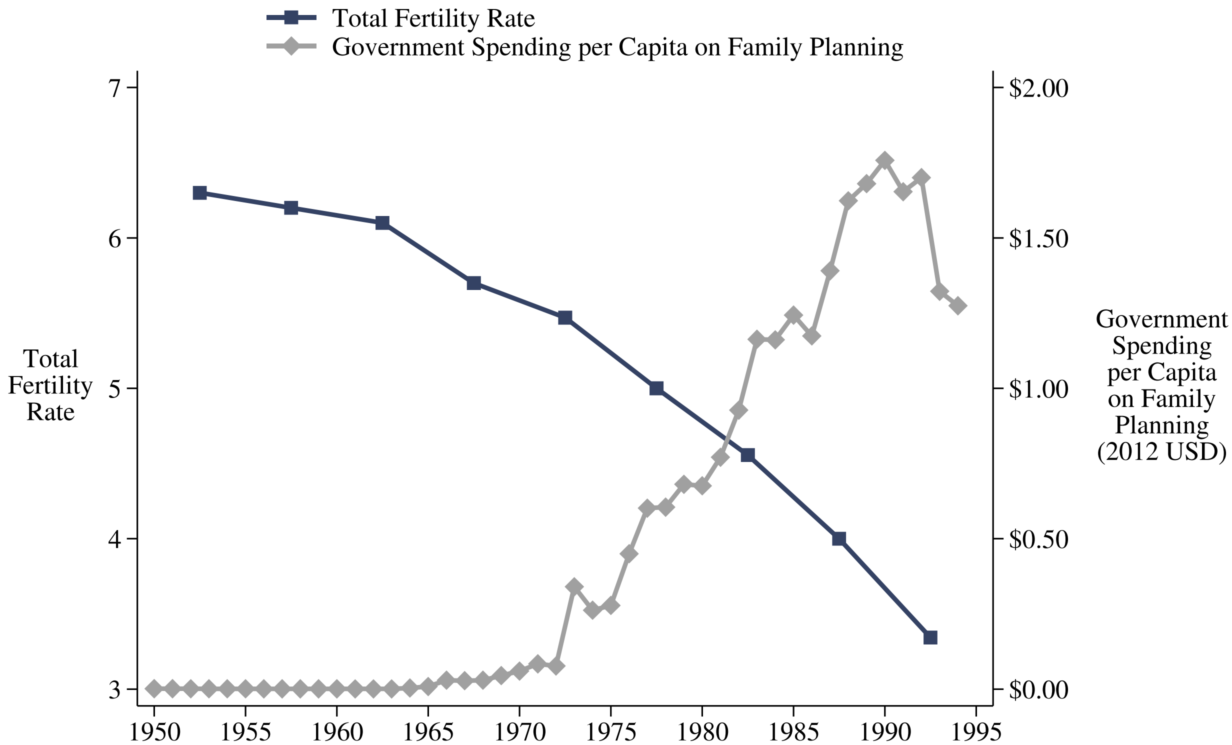
Notes: Sample consists of all African women ages 12–54 observed in 1994 and 1995 October Household Surveys who were born in a white area or born in a homeland. Standard errors given in parentheses. *Source*: See Data Sources.

Table 2.2: Reductions in Fertility Attributable to Family Planning Programs

	Dates	Absolute reduction in children born per woman	Percent reduction in children born per woman	Cost per birth averted (2012 USD)
South Africa	1970 – 1989	≤1	≤25	≥$152
Bangladesh (Matlab)[A]	1978 – 1985		21	$384
Colombia[B]	1964 – 1993	0.25 – 0.33	5	$124 – $167
Ethiopia[C]	1990 – 2004	1	20	
Ghana (Navrongo)[D]	1993 – 1999	1	15	
Indonesia[E]	1982 – 1987	0.04 – 0.08	1 – 2	
Iran[F]	1967 – 2006		18 – 28	
Peru[G]	1985 – 1991	0.93 – 1.30	25 – 35	
Tanzania[H]	1970 – 1991		10.9 – 21.0	
United States[I]	1988 – 2003		1.7 – 8.9	$6,800

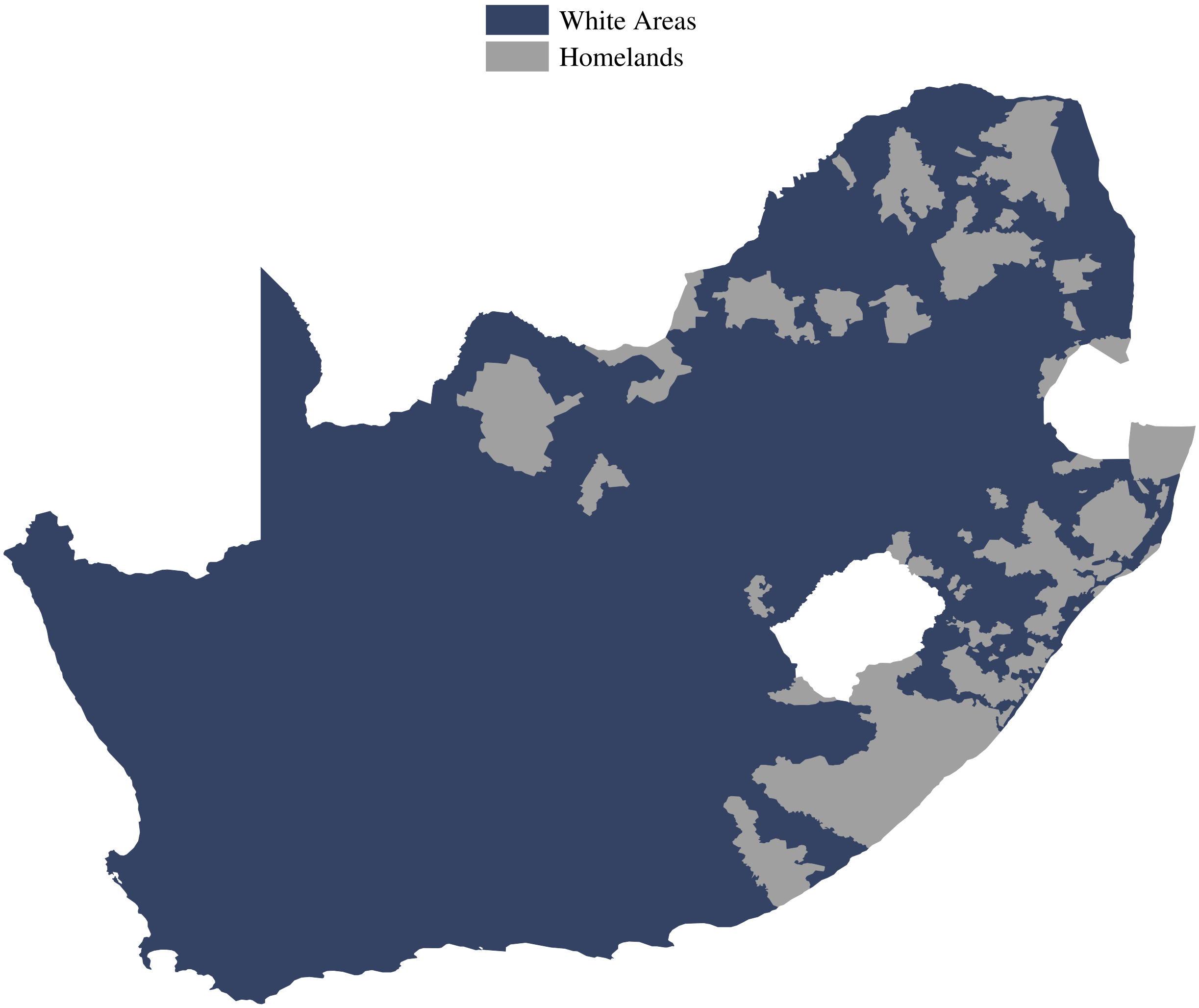
Notes: Values for South Africa described in Sections 2.4 and 2.5. *Sources*: [A] Simmons et al. 1991, [B] Miller 2009, [C] Portner et al. 2011, [D] Phillips et al. 2006, [E] Gertler and Molyneaux 1994, [F] Modrek and Ghobadi 2011, [G] Angeles et al. 2005, [H] Angeles et al. 1998, [I] Kearney and Levine 2009.

Figure 2.1: Total Fertility Rate and Government Spending Per Capita on Family Planning



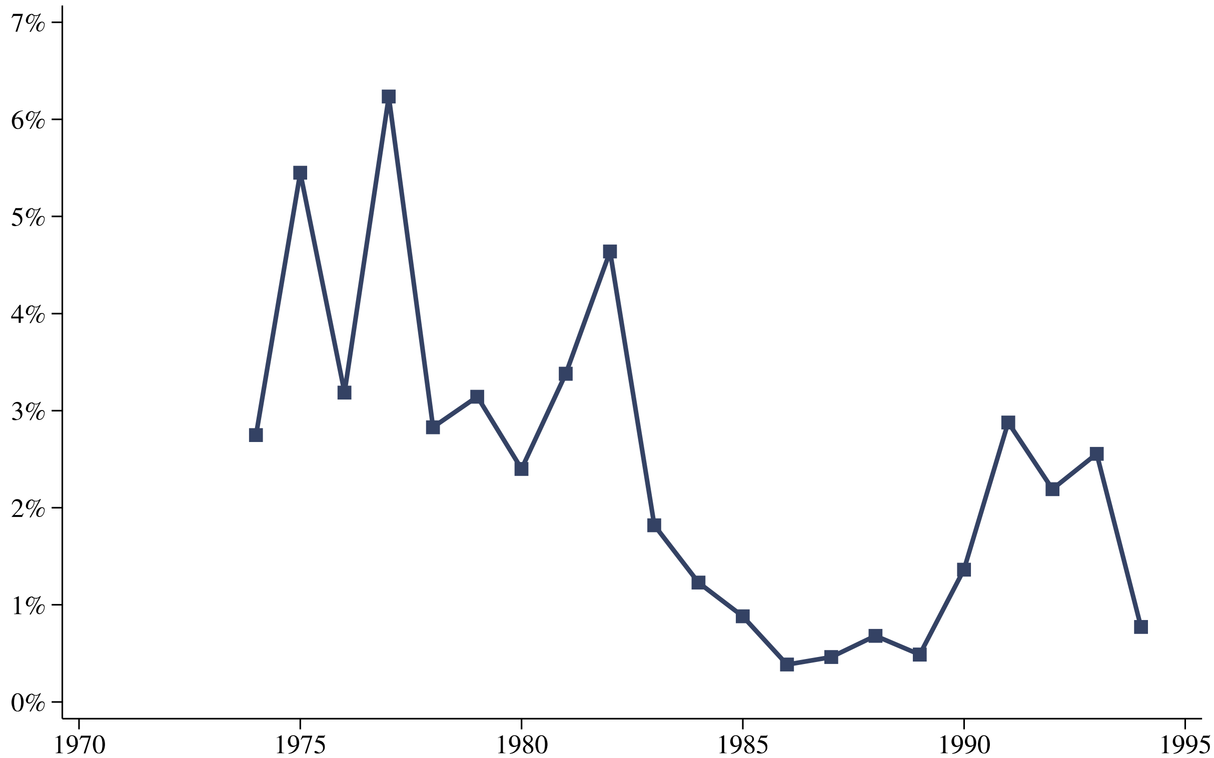
Notes: The total fertility rate is for all residents of South Africa. Spending per capita calculated to equal national government spending divided by the total population of South Africa. Nominal spending on family planning (not per capita) remained steady or rose in every year between 1950 and 1994 except for declines in 1974 and 1993. *Sources*: See Data Sources.

Figure 2.2: Partitioning of South Africa during Apartheid



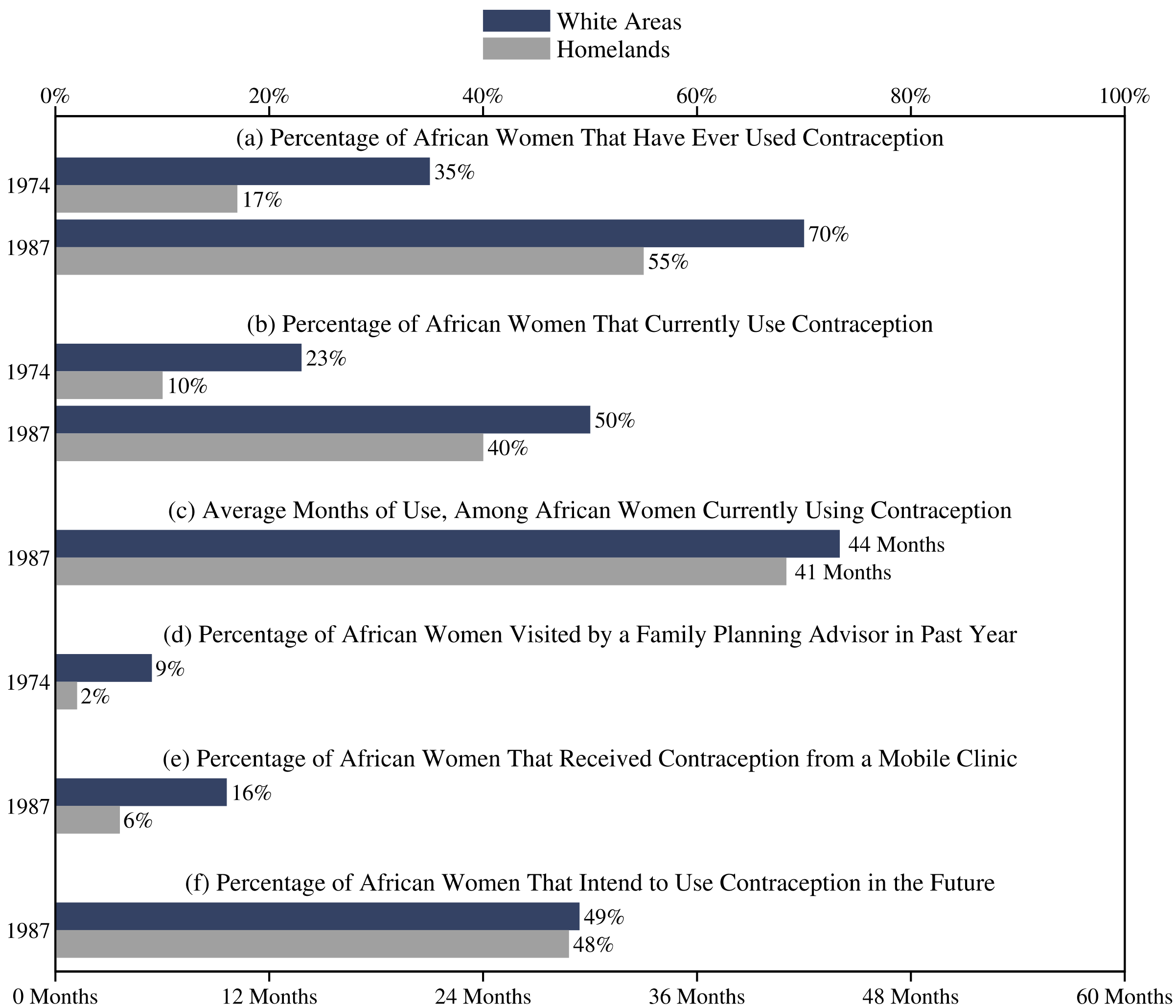
Source: See Data Sources.

Figure 2.3: Homeland Government Spending per Capita on Family Planning as a Percentage of National Government Spending per Capita on Family Planning



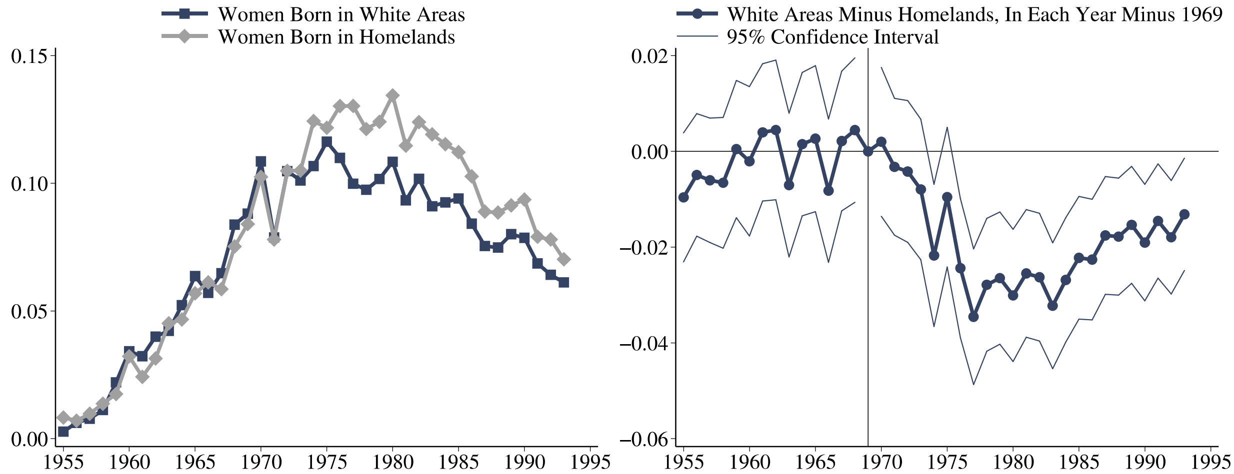
Notes: For each year, this plot includes only those homelands for which I have been able to locate expenditure reports that itemize health department spending. For many homelands, family planning spending is sometimes not provided. Most years' reports provide detail on dozens or hundreds of categories of health spending and rarely list expenditure of zero for any category. Omission of family planning from a report in which other categories of health spending are listed likely suggests that the homeland government did not fund family planning, not that family planning spending is lumped in with another category of spending. I therefore treat missing family planning spending as zero. Excluding these missing values shifts the plot up by roughly two percentage points and does not substantially change the conclusion that the national government provided much greater funding for family planning than did homeland governments. Only in Venda in 1979 and 1982 did a single homeland's per-capita expenditure on family planning approach half that of the national government. Population counts are available every year for the country as a whole, in 1970 for all homelands except KwaNdebele, and in 1985 for all homelands. For all homelands except KwaNdebele, I impute missing annual population counts assuming constant growth between 1970 and 1985, and assuming that the homeland grew at the same rate as the country as a whole after 1985. I impute missing annual KwaNdebele population counts by assuming it grew at the same rate as the country as a whole. National government spending is divided by the population of white areas, which is calculated as the population of the country as a whole minus the population of all homelands. *Sources*: See Data Sources.

Figure 2.4: Use of and Access to Contraception among African Women



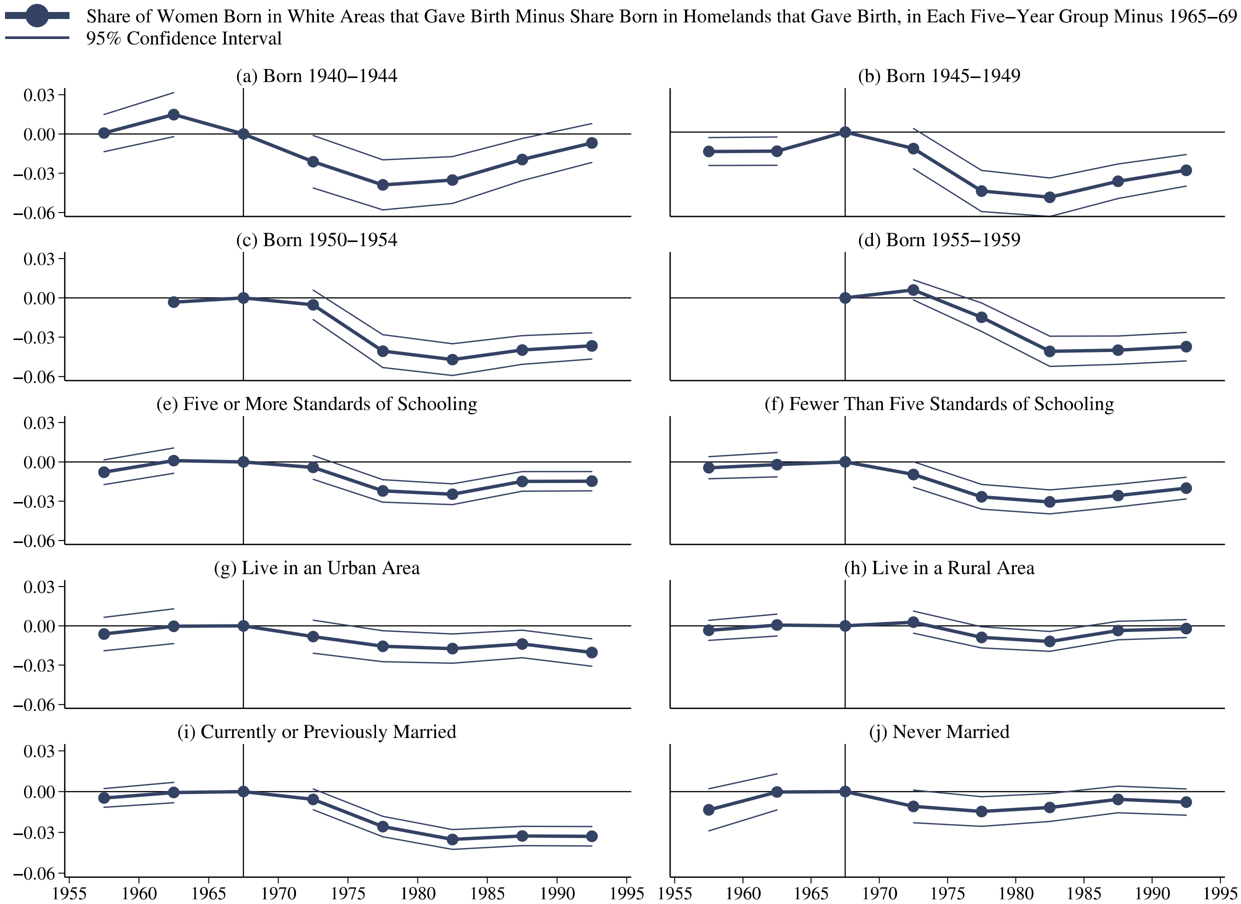
Notes on 1974: Sample consists of African women ages 15–44 who have had at least one child and are married or living with a man. Of the 6,000 cases originally collected, 5,792 remain. *Notes on 1987–89*: Sample consists of African women ages 12–49 who have given birth, have ever been in a union, or are pregnant. Calculations performed using weights that accompany the survey. *Sources*: See Data Sources.

Figure 2.5: Share of African Women that Gave Birth, by Year



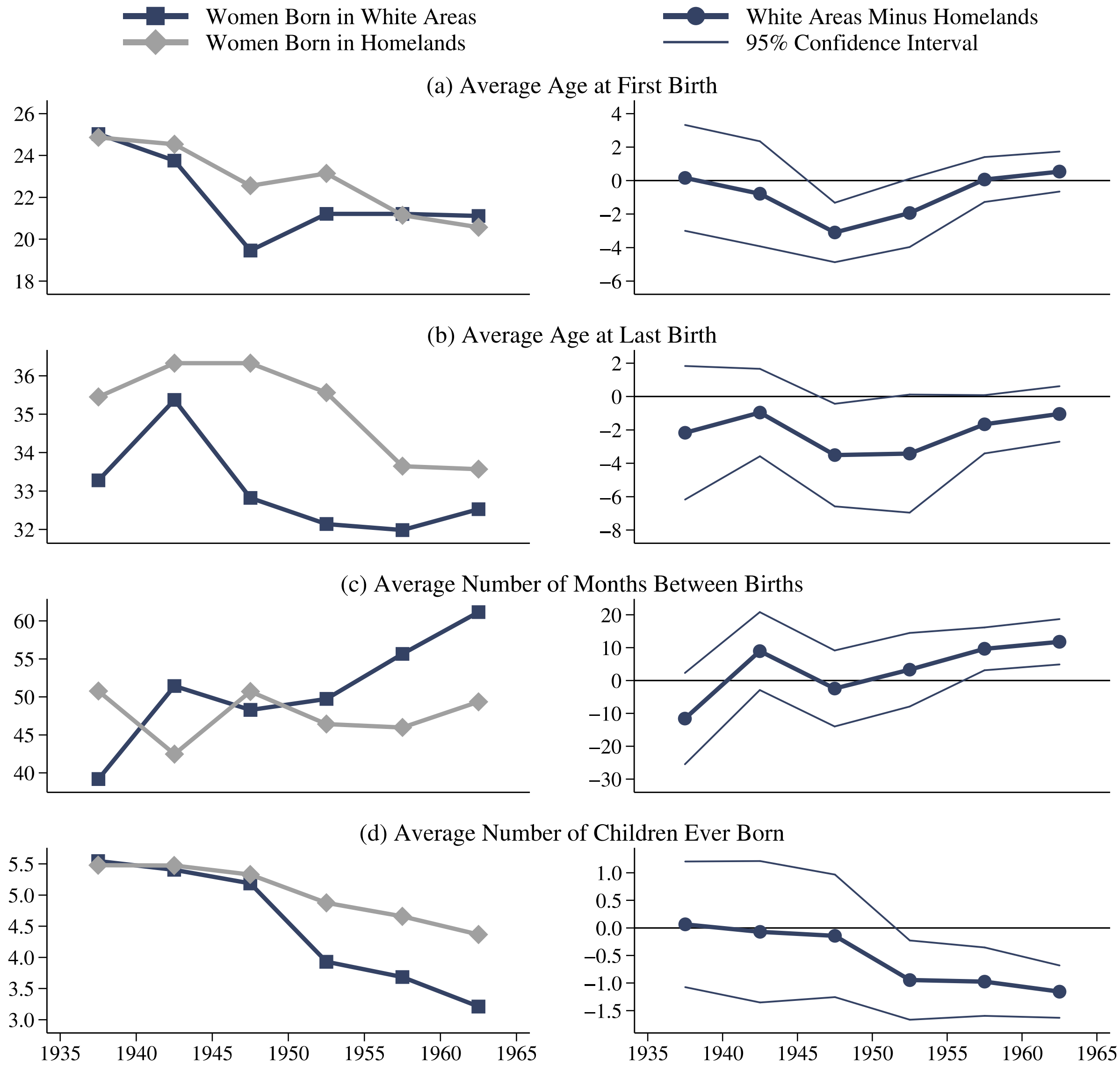
Notes: Sample consists of all African women ages 12–54 observed in 1994 and 1995 October Household Surveys who were born in a white area or born in a homeland. Data reshaped to consist of one observation per woman per year for each year the woman was age 12–54. Calculations performed using weights that accompany each survey. The second graph plots δ_y from specification 1 in Section 2.4.2, where the omitted year is 1969 (the year before the national government fully funded all family planning clinics and began to directly provide family planning services).
Source: See Data Sources.

Figure 2.6: Robustness of Difference-in-Differences Estimates



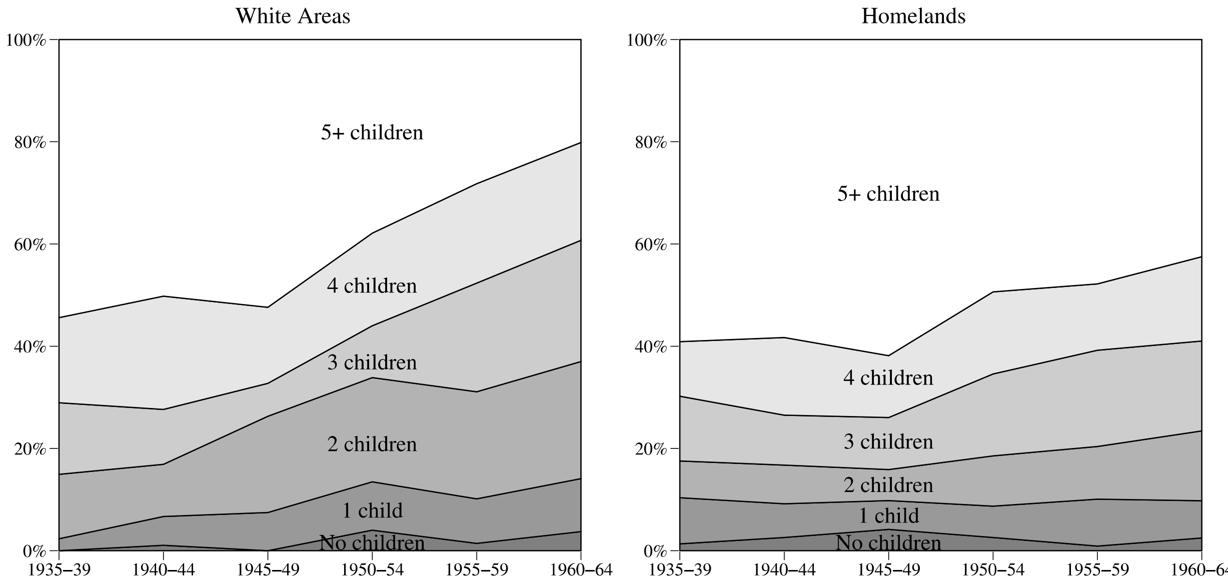
Notes: Sample as given in Figure 2.5. Calculations performed according to specification 2 in Section 2.4.3 for various subgroups of women. For example, the sample in panel (a) is restricted to women born between 1940 and 1944. Educational attainment, urban/rural location, and marriage status are observed in 1994 and 1995.

Figure 2.7: Characteristics of Childbearing, by Women's Year of Birth



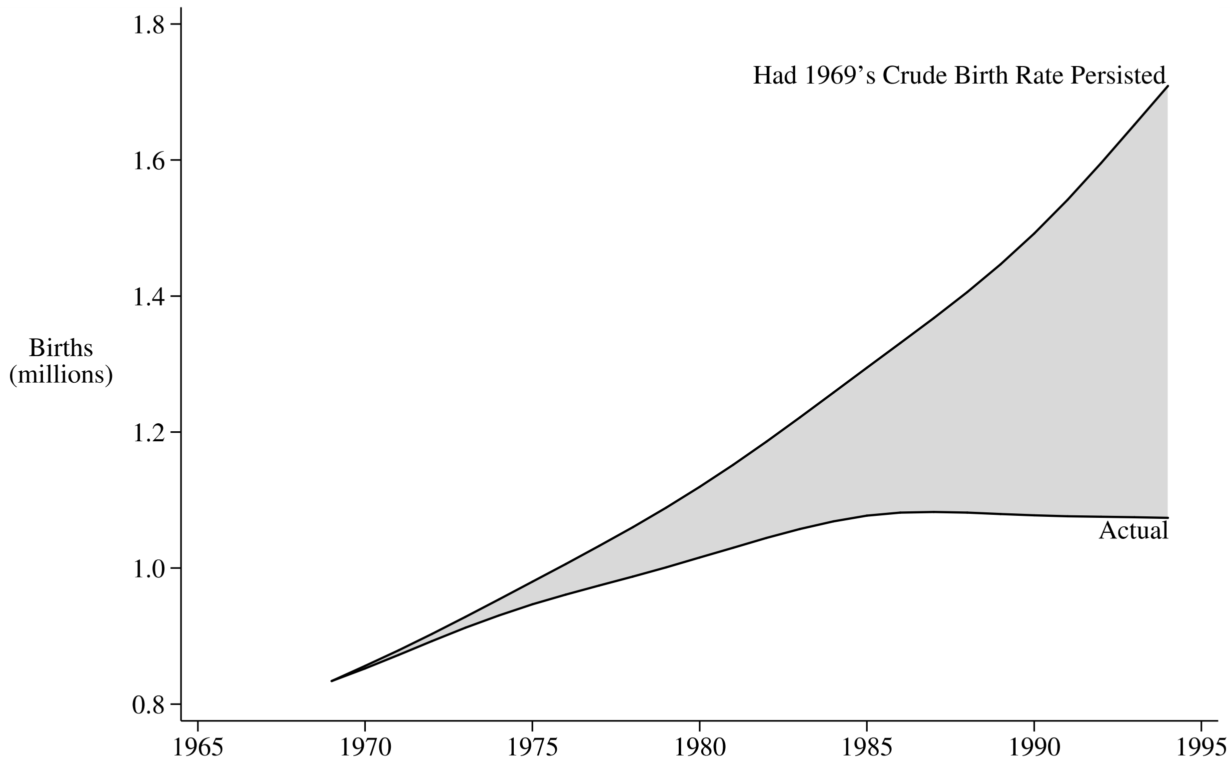
Notes: X-axis in each figure tracks women's year of birth. Sample consists of all African women age 40 or above when observed in 2008 National Income Dynamics Study who were born in a white area or born in a homeland. Calculations performed using weights that accompany the survey. *Source*: See Data Sources.

Figure 2.8: Distribution of Total Number of Children, by Women's Year of Birth



Notes: Sample as given in Figure 2.7.

Figure 2.9: Births in South Africa, 1969–1994



Notes: The lower line plots the actual of births in each year, which equal the total population multiplied by the crude birth rate. For example, in 1969 there were 21,920,560 people in South Africa, the crude birth rate was 38.047 per thousand people, and there were 834,012 births (21,920,560 × 0.038047). Between 1969 and 1994, the crude birth rate fell from 38.047 births per thousand people to 26.474. The upper line plots the number of births there would have been had 1969's crude birth rate persisted unchanged through 1994. For example, in 1970 there were 22,502,430 residents of South Africa, the crude birth rate was 37.883 per thousand people, the crude death rate was 13.879 per thousand people, and the net migration rate was 2.6371 per thousand people. (Sources for the population, crude birth rate, and crude death rate are given in the Data Sources. Net migration is calculated to equal the change in population minus births plus deaths.) There were therefore 852,460 births, 312,311 deaths, and 59,342 net migrants (immigrants minus emigrants) in 1970. At 1969's higher crude birth rate, there would have been 856,150 births in 1970, a rise of 3,690 over the actual number. This rise in births would have in turn raised population in 1971 from 23,101,920 to 23,105,610. In 1971, the crude birth rate was 37.775, the crude death rate was 13.569, and the net migration rate was 29.507. There were therefore 872,213 births in 1971 (23,101,920 × 0.037755). Had 1969's birth rate persisted, there would have been 879,099 births in 1970 (23,105,610 × 0.038047), an increase of 6,886 births. There would also have been more deaths and net migrants, and the population in 1972 would have been 23,739,366 instead of its actual value of 23,728,830. The number of births in each following year are calculated similarly. In total, the decline in the crude birth rate averted 5.13 million births between 1970 and 1994 (this is the area of the gray region on the graph). Family planning was one of many factors that may have led to this decline in births, so 5.13 million is an extreme upper bound on the number of births that government provision of family planning services averted during the last half of the apartheid era.

CHAPTER III

Do Family Planning Programs Decrease Poverty? Evidence from Public Census Data

(with Martha J. Bailey and Olga Malkova)

3.1 Introduction

With U.S. income inequality soaring to its highest level in almost a century (Saez 2013), increasing the economic opportunities of poor children is a growing policy concern. Poor children are significantly more likely to experience delayed academic development, have health problems, live in more dangerous neighborhoods, and attend underperforming schools (Levine and Zimmerman 2010). In the longer-term, children from poorer households have lower test scores (Reardon 2011) are less likely to complete high school, enroll in college, and, conditional upon enrolling, complete college (Bailey and Dynarski 2011), which limits their earnings potential as adults. Ultimately, over 40 percent of children born to parents in the lowest quintile of family income remain in that income quintile as adults (Pew Charitable Trusts 2012).

This paper explores the role of family planning programs as a public policy strategy to improve children's economic resources in childhood. The rationale that family planning programs would increase children's resources and opportunities was integral to their inclusion in U.S. President Lyndon B. Johnson's War on Poverty, which began in 1964. Five years later, when campaigning for a national family planning program, President Richard Nixon asserted their more direct connection to children's economic disadvantage: "Unwanted or untimely childbearing is one of several forces which are driving many families into poverty or keeping them in that condition" (July 18, 1969).

A long theoretical tradition in economics also rationalizes a causal link running from children's economic resources, to their lifetime opportunities, and ultimately to their adult outcomes.[1] This link occurs both through income and price channels. More affluent parents not only have more economic resources, but they may invest more in each child and have fewer children if the income elasticity of parental investments in children ("child quality") exceeds the income elasticity of child quantity (Becker and Lewis 1973, Willis 1973). Having fewer children, in turn, reduces the shadow price of child quality and further encourages investment in children. In addition, credit constraints may lead poorer families to underinvest in their children's formal human capital (Becker and Tomes 1979, 1986).

Family planning programs could increase investments in children through both income and price channels. First, they may induce greater parental investments in their children by reducing the relative price of child quality. Second, they may raise the incomes of the average parent, for instance by reducing the cost of delaying childbearing so that parents can themselves increase their human capital investments, find better partners, and, ultimately, earn higher wages (Christenson 2011, Rotz 2011, Bailey et al. 2012). Family planning programs could also raise the family income of the average child as they disproportionately allow poorer households to delay or avoid additional childbearing.

This paper provides new empirical evidence on the relationship of family planning programs to child poverty rates, both in the short and long-run. Building on Bailey's (2012) research design, we exploit the roll-out of U.S. federally funded family planning grants from 1964 to 1973. The first U.S. family planning programs were quietly funded under the 1964 Economic Opportunity Act and the program expanded under the Family Planning Services and Population Research Act (P.L. 91-572).[2] This legislation supported the opening of new clinics in

[1] Thomas Malthus popularized the link between childbearing and poverty in his *Essay on the Principle of Population* (1798). Malthus argued that this link was rooted in the arithmetic growth of agricultural yields being outstripped by the exponential growth of population. Left unchecked, population growth would outstrip the growth in agricultural production and result in a subsistence economy.

[2] Before 1965, U.S. federal involvement and investments in family planning had been modest. This reflected the view expressed by President Dwight Eisenhower in 1959, who said that he could not "imagine anything more emphatically a subject that is not a proper political or government activity or function or responsibility… The government will not, so long as I am here, have a positive political doctrine in its program that has to do with the problem of birth control. That's not our business" (Tone 2001, p. 214). According to 1967 estimates, expenditure for family planning through the Maternal and Child Health programs (started in 1942; U.S. Department of Health, Education and Welfare [DHEW] 1974, p. 3, citing a 1942 memorandum from Surgeon General Thomas Parran to state health departments) and the Maternal and Infant Care programs under the 1963 Social Security Amendments were small (U.S. DHEW 1974, p. 3, citing House Appropriations Committee hearings; U.S. DHEW 1967, p. 988).

disadvantaged areas and, to a lesser extent, the expansion of existing family planning programs. Federal family planning dollars funded education, counseling, and the provision of low-cost contraceptives and related medical services; they did not fund abortion, which remained illegal in most states until 1973. Use of these programs was not explicitly means tested, but programs tended to benefit lower income women.

Our research design compares the poverty rates of individuals born in the years leading up to and just after federally funded family planning programs began. We draw upon several public-use datasets that measure individuals' ages and place of residence: the 1980 US decennial census observes the potentially affected cohorts as children and the 2000 census and 2005–2011 American Community Survey (ACS) observes the same cohorts as adults.

Our results show that federally funded family planning programs are associated with significant reductions in child poverty rates and, later, poverty rates in adulthood.[3] Individuals born one to six years after program funding were 4.2 percent less likely to live in poverty in childhood and 2.4 percent less likely to live in poverty in adulthood. Although both white and nonwhite children born after family planning programs began experienced large reductions in childhood poverty, white children experienced greater relative reductions in poverty rates in adulthood. Whites born after family planning programs began were 4.1 percent less likely to live in poverty in childhood and 6.1 percent less likely to live in poverty in adulthood. Nonwhites born after family planning programs began were 8.2 percent less likely to live in poverty in childhood, but 2 percent less likely to live in poverty in adulthood.

In short, family planning programs may help break the cycle of poverty. Our results suggest that family planning programs reduce poverty among children and, ultimately, in adulthood. These findings complement a growing body of research that suggests that investments in children can have sizable effects on children's longer-term educational attainment, health, and labor market productivity (Cunha and Heckman 2007, Almond and Currie 2011).

[3] Poverty rates in this paper are defined using the official U.S. measure.

3.2 The Initiation and Potential Impact of U.S. Family Planning Programs

Margaret Sanger's zealous advocacy of what became known as "birth control" is often credited to her encounters with child poverty. Her work as a maternity nurse on the Lower East Side of New York City took her to the residences of poor families with many children living in squalor. She also encountered women who died (or nearly died) from attempted abortions or debilitating contraceptive techniques.[4] The best medical recommendation of the day to prevent unwanted childbearing (as related in a letter to Sanger) was often to tell one's husband to "sleep on the roof."

3.2.1 The Initiation of U.S. Family Planning Programs, 1964 to 1973

The introduction of the first oral contraceptive gave women and physicians much more reliable, safer, and enjoyable options. Its expense, however, prohibited many women from using it. Differences in access to "the Pill" led many to advocate for federal subsidies. Largely due to these efforts, federal grants for family planning began under the Economic Opportunity Act (EOA 1964, Public Law 88-452), a key piece of President Johnson's War on Poverty.[5] Between 1965 and 1970, federal outlays for family planning through the OEO rose more than twenty-fold, from 1.6 to 41 million (2008 dollars). This increase reflects two important sets of policy changes. The first was the 1967 Amendments to the EOA (Public Law 90-222, Title II, Section 222a), which designated family planning as a "national emphasis" program. The second was the increase in outlays under President Nixon, who became president in 1969. The November 1970 enactment of Title X of the Public Health Services Act allowed the Department of Health Education and Welfare (DHEW) to make grants to local organizations directly and prohibited the use of federal funds "in programs where abortion is a method of family planning" (DHEW

---

[4] One letter to Margaret Sanger read, "I am the mother of two lovely little girls. I have been married fifteen years. I married at the age of fifteen to escape a home that was overcrowded with unloved and unwanted children, where there was never clothing or food enough to divide among the eight of us…I have been pregnant 15 times, most of the time doing things myself to get out of it and no one knows how I have suffered from the effect of it, but I would rather die than bring as many children into the world as my mother did and have nothing to offer them" (Sanger 1923).

[5] According to 1967 estimates, expenditures for family planning through the Maternal and Child Health programs (started in 1942) and the Maternal and Infant Care programs under the 1963 Social Security Amendment were small (DHEW 1974, p. 3).

1008). After the enactment of Title X, federal outlays for family planning increased by another 50 percent by 1973.

Federally funded family planning programs provided access to birth control as well as related education and counseling services. These programs tended to open in locations whose residents had limited access to family planning services. In many locations, no program existed prior to the federal grant. In others, programs had existed but were much smaller in scale. Consequently, the federal grants significantly increased availability, reduced wait times, and increased the supply of free or low-cost contraceptives in affected communities. Because federally funded programs did not require an explicit means test, they may have also reduced the costs of visits and supplies at private providers in the area.

Less is known, however, about these programs' day-to-day operations. In the 1960s, programs were subjected to little oversight from the federal government. Not only is information on all federal programs sparse in this period, but officials rarely spoke about this largely taboo topic. In an evaluation of the War on Poverty, Sar Levitan (1969, p. 209) wrote that, "Contrary to the usual OEO tactic of trying to secure the maximum feasible visibility for all its activities, OEO prohibited [family planning] grantees from using program funds to 'announce or promote through mass media the availability of the family planning program funded by this grant.'"[6] The implication is that the treatment effect of these grants can be understood as one of increasing federal funding for "family planning," rather than the effect of a particular, homogeneous intervention.

Figure 3.1 presents the rollout of the first federal family planning grants from 1965 to 1973. Counties that received federal grants in this period (shaded on map; we call these counties "funded") were more likely to be in cities and, consequently, differed in a number of their observable dimensions (Bailey 2012, Table 1). Data from the 1960 census indicates that roughly 60 percent of the U.S. population of women ages 15 to 44 lived in funded counties. Funded counties were more urban, had more elderly residents, and were more educated and affluent than were unfunded counties. Interestingly, funded and unfunded counties had a similar share of residents under age 5 in 1960, suggesting little difference in fertility rates in these areas before

[6] The fact that the OEO might fund birth control was contentious before the EOA passed. For instance, on April 18, 1964, Eve Edstrom in the *Washington Post* (p. A4) reported the controversy on this topic between Representative Phil M. Landrum (D-Ga.), the House sponsor of the EOA, and Republican members of the special House Education and Labor subcommittee.

the passage of the EOA. To account for time-invariant, area-level differences, our analysis includes area fixed effects.

The different shades of gray in Figure 3.1 represent variation in the timing of each county's first federal family planning grant. Counties in the lightest shade of gray first received grants between 1965 and 1967; counties in the next darkest shade of gray first received grants between 1968 and 1969; counties shaded in black first received grants from 1970 to 1973. Although counties in each of the lower 48 states (i.e., excluding Alaska and Hawaii) received grants, the timing of program start dates varied considerably within states: in 43 states, programs were first funded in at least two different years; counties in 41 states first received funding in at least four different years; and, in more than half of all states, counties were first funded in at least five different years of the period considered.

3.2.2 The Expected Effects of Family Planning Programs on Outcomes

The potential effects of these family planning grants on children operate through several channels, each relating to their effects on fertility rates. By providing cheaper, more reliable contraception and more convenient services, family planning should reduce ill-timed and unwanted childbearing. Additionally, reductions in the price of averting births should increase the number of births that parents *choose* to avert or delay.[7] Standard economic models and related empirical work motivate the following expected relationships between family planning policies and poverty rates.

First, holding constant other uses of parents' time, fewer children in a household at a given point in time implies an increase in the availability of parental time and economic resources per child. Fewer children in a household should mechanically reduce poverty rates as a family with a given income is less likely to fall below the poverty threshold.

Second, family planning programs may directly increase household income, thus reducing poverty rates. Cheaper and more reliable contraception reduces the immediate and expected costs of delaying childbearing, freeing up resources for investment in the parents'

[7] Potentially offsetting this effect is the fact that cheaper and more reliable contraception should reduce precautionary undershooting as well (Michael and Willis 1976). Estimates presented later suggest that reductions in childbearing have dominated empirically, so that greater access to cheaper and more reliable contraceptives tends to reduce family size.

human capital. Delaying parenthood, even for just a year or two, could allow soon-to-be parents to get more education, work experience, and job training, and thus increase their lifetime earnings. The results of empirical studies of teen access to the birth control pill are consistent with the claim that delaying childbearing has value. Bailey et al. (2012) show that earlier access to the Pill increased women's investment in their careers and, ultimately, their wages. Hock (2008) shows that early access to the Pill increased men's educational attainment as well. Family planning also reduces the price of delaying marriage (Goldin and Katz 2002) and can improve spousal matching, thereby reducing subsequent divorce rates (Christensen 2011, Rotz 2011). However, delaying childbearing does not necessarily yield economic benefits for mothers. Hotz et al. (2005) show that women who became mothers as teenagers have slightly *higher* subsequent levels of employment and earnings than women of the same age who miscarried as teenagers.

Third, family planning programs may affect the composition of parents by benefitting the lower income population. Because higher income households could afford services at private medical providers, federally subsidized services may have disproportionately benefitted poorer families. Consistent with this claim, Torres and Forrest (1985) document that, in 1983, family planning programs served almost 5 million Americans. In the same year, roughly 83 percent of family planning patients had incomes below 150 percent of the poverty line, and 13 percent were recipients of Aid to Families with Dependent Children (AFDC, the principal cash welfare program at the time). Jaffe et al. (1973) report that 90 percent of all patients in organized family planning programs had household incomes of no more than 200 percent of the federal poverty line. If poorer families elected to postpone childbearing or have fewer children, children born following the introduction of the programs would enjoy, on average, greater economic resources.

Finally, parents' investments in children may also be complemented by decreases in children's cohort size. Smaller cohorts could increase the public resources available per child and decrease competition for these limited resources (Easterlin 1978). In schools, for instance, a decrease in cohort size might decrease class sizes, increase the likelihood of getting attention from teachers, and reduce classroom disruptions. Changes in cohort size are unlikely to be accommodated fully by universities, a larger share of these smaller cohorts may be admitted to and complete college (Bound and Turner 2007). Smaller cohort sizes may also affect the scale of markets for illicit drugs and other social "bads" and thereby reduce the incidence of related crimes (Jacobson 2004). Finally, smaller cohorts may reduce aggregate labor supply, decrease workers' competition for firms' resources, increase capital-labor ratios, and tend to raise wages.

In summary, by increasing adults' pre-childbearing human capital and by benefitting lower income families, family planning programs may increase children's economic resources and decrease child poverty rates. Under standard quality-quantity formulations, these changes would tend to increase parental investment in their children (Becker and Lewis 1973). To the extent that family planning increases parental investment in children, it may improve their lifetime opportunities and labor market outcomes as adults. Cohort-size effects tend to reinforce the positive effects of family planning.

Note that these labor market channels—in addition to the within-household spillovers in family income and reductions in the price of child quality—suggest that the consequences of family planning may extend *beyond* the children immediately affected. Access to family planning may benefit slightly older or younger children in the affected households, children in unaffected households in the same cohort, and children in slightly older or younger cohorts in the same labor market. Because our research design compares the outcomes of children who were born in the years leading up to and just after the first funding for federal family planning programs began, this framework implicitly treats the older siblings of children born just before the family planning program as part of the comparison group. We expect, therefore, that our results understate the effects of family planning programs.

3.3 Data and Research Design

Our analysis integrates the approach of Gruber et al. (1999), who study the impact of legalizing abortion on children's economic resources, and Bailey (2012), who studies the impact of funding family planning programs on fertility rates. We use three separate datasets to document effects at different stages by race: Vital Statistics data on fertility rates by race; the 1980 decennial census which contains information on poverty rates among the affected cohorts in childhood; and a pooled sample of the 2000 decennial census and 2005–2011 American Community Surveys (ACS) which contains information on poverty rates among the affected cohorts in adulthood. Our data have been collapsed to birth year × area × year of observation cells, indexed as t, j, and c, respectively. Geographic area is defined either as a county (in the

Vital Statistics data), county group of residence (in the 1980 decennial census), or a public use microdata area of residence (PUMA, in the 2000 census and 2005–2011 ACS).

Our research design compares poverty outcomes in childhood and adulthood between cohorts born before and after their area of birth/residence was first funded within the following linear difference-in-differences specification,

$$Y_{j,t,c} = \tau PostFP_{j,t} + \boldsymbol{X}'_{j,t,c}\boldsymbol{\beta} + \theta_{j,c} + \gamma_{s(j),t} + \varepsilon_{j,t,c}\ , \tag{1}$$

where Y is a poverty rate and $PostFP_{j,t} = 1(t > T_j^*)$ is equal to 1 for areas observed after the first fiscal year family planning programs were funded (T_j^*).[8] Other covariates include either area × year fixed effects (in the 2000 census and 2005–2011 ACS) or area fixed effects (Vital Statistics and 1980 decennial census), θ, to account for within year, area-level differences; a set of year fixed effects or state-by-birth-cohort fixed effects that capture changes in state policies such as the staggered legalization of abortion and the state-level roll-out of Medicaid, γ. $\boldsymbol{X}$ is a set of covariates which are discussed in later sections.

The estimates of interest, τ, capture the average change in outcomes between individuals whose mothers would have had access to a family planning program before childbirth and individuals in the same area whose mothers would have conceived them before federal family planning grants began. In all specifications, estimates are unweighted to minimize the importance of measurement error due to mobility (migration in and out of cities is much higher than in smaller areas). (See also Solon et al. 2013.) Additionally, we present cluster-robust standard errors, which account for an arbitrary covariance structure within each area across birth years (Arellano 1987, Bertrand et al. 2004).

[8] For simplicity in our later exposition, we refer to the year family planning programs were funded as the date they began. The date of the first grant is not technically the date these clinics began operating, but the date of the first grant serves as a close proxy.

3.3.1 Support for Key Identifying Assumptions

A central assumption of this paper's research design is that the roll-out of family planning programs is unrelated to other determinants of childbearing or child outcomes. Evidence for this assumption comes from both historical accounts and quantitative evidence. According to oral histories, the "wild sort of grant-making operation" during the period provides a plausibly exogenous shock to the availability of local family planning services (Gillette 1996, p. 193). Bailey (2012) also provides quantitative support for this assumption. She shows that, although family planning programs were funded earlier in areas with greater urban populations, neither 1960 census characteristics, 1964 fertility levels, 1960 to 1964 fertility changes, nor a rich set of 1965 measures of sexual behavior, birth control use, and childbearing predict *when* federal family planning programs began. She also shows that the timing of the first family planning grant appears unrelated to changes in the funding for other War on Poverty programs.

Another key assumption underlying this paper's empirical strategy is that federal funding of family planning meaningfully increased the *use* of family planning services in the affected areas. This assumption is difficult to test explicitly, but administrative reports suggest that the number of users of federally funded family planning services increased from zero in 1965 to around 1.2 million in 1969 and nearly 5 million in 1983.

Further evidence of these programs' relevance comes from their relationship to reductions in local fertility rates. Bailey's main findings also support this claim. Before federal funding of family planning programs, the trend in the general fertility rate was similar in counties that would eventually receive funding and in those that would not (the pretreatment differences are close to zero and individually and jointly statistically insignificant). However, fertility rates fell sharply in the funded counties after the family planning grants began. Within 3 years of the grant, the general fertility rate had fallen by roughly 1 birth per 1,000 women of childbearing age in these counties on average. By years 6 to 10, it had fallen by an average of 1.5 births per 1,000 women. Fifteen years after an organization received its first federal family planning grant, the fertility rate in funded counties remained 1.4 to 2 percent lower than in the year of first grant receipt, net of declines in fertility in other counties in the same state and after adjusting for observable county-level characteristics. These findings are robust to variations in the specification: omitting unfunded counties, not weighting the regressions, and including county-level linear time trends. In addition, the effects are similar for programs funded before and after Title X began in 1970.

Using Vital Statistics birth certificate records that report mother's county of residence, we provide further evidence on the fertility effects of family planning grants by crude race categories consistently available in this period: white and nonwhite. Due to incomplete reporting of fertility rates by race in the early 1960s, our sample begins in 1968 with the natality microdata files (NCHS 2003). For our fertility analyses, we drop counties that received their first family planning grant before 1968, so our post-grant estimates capture changes in fertility rates for a consistent group of counties. Our overall sample, which aggregates across racial groups, includes 2,633 counties, 514 of which received a federal family planning grant (we call these "funded counties"). The subsample of these counties that allows disaggregation by race (white and nonwhite in this period) consists of 1,481 counties, 197 of which were funded. The Vital Statistics contain information on county of mother's residence for each birth, which makes it possible to compare the results for different estimators and samples.

In practice, θ_j in equation 1 consists of a set of county fixed effects, and $\boldsymbol{X}$ includes county covariates for the number of abortion providers, which account for within-state changes in the provision of abortion from 1970 to 1979 and annual information on per capita measures of government transfers from the Bureau of Economic Analysis Regional Information System (REIS) (cash public assistance benefits such as Aid to Families with Dependent Children, Supplemental Security Income, and General Assistance; medical spending such as Medicare and military health care; and cash retirement and disability payments). In addition, $\boldsymbol{X}$ includes 1960 county covariates interacted with a linear trend.[9] Finally, $PostFP_{j,t}$ is replaced with dummy variables for three birth cohort categories: cohorts born 5 to 1 years before the family planning program began; cohorts born 1 to 15 years after funding began, and cohorts born 16 to 20 years after funding began. The sample consists of a balanced set of counties, while the control group consists of the cohort born at the time of first grant in funded counties and all cohorts in

[9] The interactions of county covariates are identical to those in Almond et al. (2011) and include share of population in urban area, nonwhite, under age five, over age 64; share of households with income under $3000; and the share of the county's land that is rural or a farm. We are grateful to Doug Almond, Hilary Hoynes, and Diane Schanzenbach for providing the REIS data and to the Guttmacher Institute and Ted Joyce for providing the data on abortion providers. Because information on abortion providers is not available at the county level before 1973, we follow Joyce et al. (2013) in assuming the number of providers in 1970 to 1972 in states that legalized before Roe v. Wade are identical to the number observed in 1973. Note that changes in the distance to states providing legal abortion before 1970 are accounted for in the state-by-birth-year fixed effects.

unfunded counties. We report estimates of the effect of federally funded family planning on cohorts born 1 to 15 years after the family planning program was first funded.

Table 3.1 shows the relationship between family planning grants and fertility rates (τ) for all individuals (panel A), whites (panel B) and nonwhites (panel C). Columns labeled (1) use a sample of all counties and include county, year, and state-by-year fixed effects; columns labeled (2) add county-level covariates to the samples in columns labeled (1). The results for all individuals suggest a relationship between family planning programs and fertility rates similar to those reported in Bailey (2012), even though programs funded before 1968 are dropped and the sample only covers years 1968 to 1988 (not 1959 to 1988). One to 15 years after counties first received federal family planning funding, fertility rates remained 2.3 births lower per 1,000 women of childbearing age—a reduction of 2.5 percent over the pre-program mean in funded counties and the overall mean for unfunded counties.[10]

Panels B and C of Table 3.1 present the relationship between family planning programs and fertility rates by race. For both whites and nonwhites, the introduction of family planning is associated with declines in fertility rates. Using the column 2 specification, the white fertility rate was about 2.1 percent lower in the 15 years after first federal funding of family planning programs, and the nonwhite fertility rate was about 1.4 percent lower. For nonwhites, however, these estimates are imprecise and not statistically different from zero.

In summary, these results support previous findings that the introduction of federally funded family planning programs—and the increase in the availability of family planning services they engendered—is associated with reduced fertility rates. Next, our analysis examines the relationship between family planning programs and child poverty.

3.4 Poverty Rates among Affected Cohorts in Childhood

We use measures of child poverty from the 5-percent 1980 Integrated Public Use Microdata Series (IPUMS, Ruggles et al. 2010) sample of the U.S. decennial census. These data have several advantages for the purposes of our analysis. First, they provide large sample sizes

[10] Restricting the sample to funded counties only, however, reduces the magnitudes of these estimates and they become statistically insignificant. Although the estimates remain negative, they are a fraction of the size in Table 1A, which suggests that using funded only counties (as we do in subsequent analyses) may understate the overall impact of the program.

and allow us to compute for each area and birth cohort and race the share of children in families below 100 percent and 200 percent of the poverty line. A second advantage is that information on county group in the 1980 census (the lowest level of geographic identification in the IPUMS files) allows us to link the location of family planning programs to individuals in areas smaller than states.[11]

These data, however, also have limitations for the purposes of this analysis, because they only provide geographic information at the county group level. County groups in the continental U.S. are typically contiguous agglomerations of counties, but some counties are split between different county groups or are noncontiguous. This limits our ability to link covariates to county groups and match them to family planning grant information. For this reason, we restrict our sample to county groups that consist only of contiguous counties and that do not contain split counties. Ongoing work by Bailey et al. (2013) uses the 1970 and 1980 restricted census samples that consist of 16 and 20 percent samples of the population and include the county of residence information. This allows them to provide more precise estimates of the effect of first family planning program grants and to link all households to family planning grants based on their county of residence.

A further limitation of the geographic information in the public files is that county group at the time of the census may not accurately measure mothers' county group around the time of conception. This source of measurement error is empirically important: Bailey et al. (2013) find that migration-induced measurement error in access to family planning is greater in cities and increases in funded areas (relative to unfunded areas) after the first federal family planning grant. They demonstrate that using unweighted regressions and limiting the sample to funded areas generates similar implied reductions in fertility rates in the census as in the Vital Statistics data (compare to this paper's Table 3.1) as a result of family planning program funding. To reduce measurement error in access to family planning in our analysis, we also use unweighted regressions and limit the sample to funded county groups. Out of 1,154 overall county groups, our final sample consists of 251 county groups that do not contain split or non-coterminous

[11] We link *county-level* introduction of family planning to census *county groups* using a cross-walk generously provided by Elizabeth Cascio.

counties and that receive their first federal family planning funding at some point before 1974. Of these county groups, only 154 have sufficient observations on nonwhites for inclusion.[12]

The final limitation of the 1980 IPUMS census derives from the fact that the unit of observation is a household. The census does not measure outcomes of children not *residing* with their parents. Because children often leave home around age 18, we limit our analysis to individuals under age 18, or birth cohorts born from 1963 to 1979. The practical implication of this limitation is that our pre-trend in the 1980 census is very short and begins only two years before the first family planning grant.

The data available in the 1980 public census files necessitate that we estimate a restricted version of equation 1. Only one census year is used, so *c* is 1980 for all individuals, and θ_j is a set of county-group fixed effects. $\boldsymbol{X}$ includes county group covariates for the number of abortion providers and annual information on per capita measures of government transfers from REIS (cash public assistance benefits such as Aid to Families with Dependent Children, Supplemental Security Income, and General Assistance; medical spending such as Medicare and military health care; and cash retirement and disability payments). Finally, $PostFP_{j,t}$ is replaced with dummy variables for three birth cohort categories: cohorts born 10 to 3 years before the family planning program began and cohorts born 1 to 6 years and 7 to 14 years after the family planning program began. The comparison group in this analysis is the cohort born in event years –2 to 0, which is observed for all county groups in the analysis. We report coefficients for the 1 to 6 years post funding category, because they are based on a balanced set of county groups.

Access to affordable family planning may lead to lower poverty rates by permitting families to adjust their childbearing decisions in a way that raises their family income. Table 3.1 shows that family planning grants allowed women to defer childbearing. As we discussed previously, the share of children in poverty may decrease following the introduction of a family planning program due to smaller family sizes, parents' accumulation of more human capital, work experience, higher earning mates, or a change in the income composition of parents.

Table 3.2 presents the estimated relationship between funding for family planning and child poverty rates. Panel A shows the share of children living in families below the poverty line and panel B shows the share of children living in families below twice the poverty line. The

[12] We also exclude Virginia from the analysis, because so many of its counties changed boundaries over the 1970s making it difficult to merge county groups with appropriate covariates.

results suggest that children born after family planning programs were funded were less likely to live in poverty. Children born 1 to 6 years after funding were 0.76 percentage points less likely to live in poverty than the children born before the federal funding began—a reduction of 4.2 percent (from a mean poverty rate of 18.2 percent for children born 0 to 2 years before funding began). These results are robust across specifications that include county group, year and state-by-year fixed effects (column 1) and the addition of county group level controls (column 2).

Federal family planning programs expanded access to and affordability of family planning particularly to disadvantaged individuals. Whether white or nonwhite children experienced greater reductions in poverty depends on how family planning influenced parents' use of their services and also how parents using these services changed their economic circumstances. Different relationships between family planning and poverty rates by race may also result from differences in access to education, job training, or spousal matching for mothers, for instance. To examine these differences, we perform our analysis by crude categories for race to correspond to those categories available in the Vital Statistics data on births. Although both white and nonwhite children were significantly less likely to live in poverty, the reduction was largest among nonwhite children. Column 3 shows that white children are 0.56 percentage points less likely to live in poverty, a reduction of 4.1 percent from a mean of 13.7 percent. Column 4 shows that nonwhite children are 3.2 percentage points less likely to live in poverty, a reduction of 8.3 percent from a mean of 38.7 percent.

A second (and related) hypothesis is that family planning programs would affect more disadvantaged families more, because they are substantially more likely to gain from access to affordable contraception. Consistent with this hypothesis, the relative reductions in the share of children below two times the poverty line are generally smaller than the reductions in the share of children living below the poverty line. Family planning programs are associated with a reduction in the share of children living near poverty, particularly among nonwhite children. Panel B shows that the share of children below two times the poverty line also fell. The relative reductions for all, white and nonwhite children are smaller than the reductions in the share of children living in poverty and the estimates are no longer statistically significant. Compared to white children, the reduction in the share of nonwhite children living near poverty is both absolutely and relatively larger. Nonwhite children born after family planning programs began were 3.0 percent less likely to live below two times the poverty line while white children were 1.1 percent less likely to live below two times the poverty line.

3.5 Poverty Rates among Affected Cohorts in Adulthood

A final analysis investigates the long-run relationship between a mother's access to family planning services and the adult outcomes of the affected children. Children born after the funding of family planning programs may have been part of smaller families and cohorts, were less likely to grow up in poverty, and, consequently, may have benefitted from greater parental and societal investments. The accumulation of these changes in childhood circumstances suggests these cohorts may have been less likely to live in poverty as adults.

We use the 5-percent, public use sample of the 2000 decennial census and the 2005–2011 ACS (Ruggles et al. 2010) to investigate this hypothesis. An advantage of these data for the purposes of our analysis is that they allow the inclusion of a long pre-trend of cohorts, as information on poverty status exists even if individuals do not live with their parents. Our sample, therefore, includes individuals born from 1946 to 1980 who were ages 20 to 59 when observed. We choose these age limits to capture the labor market outcomes of workers after they have left home and before they have retired.

A disadvantage of these data is that they do not contain information on the county in which individuals were born. As in the analysis of the 1980 IPUMS data, we proxy for county of birth using the Public Use Microdata Area (PUMA) of residence at the time of observation.[13] The role of misclassification error induced by this data limitation is difficult to assess without national data on lifetime migration. In the absence of systematic changes in migration, we expect that misclassification error introduced by using PUMA of residence should tend to work against finding results. On the other hand, using PUMAs rather than counties for longer-term outcomes may reduce misclassification error if, for instance, using a slightly larger area improves the assignment of mothers' access to family planning (that is, more of the individuals remain in the PUMA of birth than lived in their county of birth). As in the analysis of the 1980

[13] PUMAS are the finest consistent geographic detail available for all individuals in the publicly-available versions of these data. There are 2,069 distinct PUMAs, each with a population of 100,000 or more, and, unlike county groups, PUMAs do not cross state borders.

census, we estimate unweighted regressions and include only the 1,269 PUMAs that received a family planning grant before 1974 to limit the role of misclassification error.[14]

Our specification of equation 1 is similar to the analysis using 1980 IPUMS data with several exceptions. First, we use multiple survey years, so *c* equals 2000, 2005, 2006, …, 2011. Pooling multiple years yields observations on the same cohorts at different ages, so we include age and age squared as covariates in $\boldsymbol{X}$. Second, due to the difficulty of mapping county characteristics onto PUMAs, we cannot include other covariates in the analysis. Third, $PostFP_{j,t}$ is replaced with dummy variables for three birth cohort categories: cohorts born 27 to 14 years before family planning programs began; cohorts born 1 to 7 years and cohorts born 8 to 15 years after family planning programs began. We omit cohorts born 13 to zero years before family planning programs began, so this category becomes our comparison group. Estimates for the first and last categories are suppressed in the presentation in Table 3.3, because they are estimated using only a subset of cohorts.

Table 3.3 shows that within cohort changes in funding of federal family planning programs are associated with significant reductions in adult poverty rates among cohorts born after the programs began.[15] Many individuals in cohorts born before first funding of family planning programs transitioned out of poverty between childhood and adulthood: 18 percent of these cohorts lived in poverty in childhood, while 12 percent lived in poverty in adulthood. We provide evidence that this transition was significantly greater among cohorts born after family planning programs began. Table 3.3 shows that the share of adults in poverty (panel A) and the share of adults with family income below two times the poverty line (panel B) fell significantly for the affected cohorts. Relative to individuals born in the years prior to when family planning programs began, individuals born in the seven subsequent years were 0.28 percentage points less likely to live in poverty as adults, a reduction of 2.4 percent over the pre-program mean of 11.5 percent. This result is unaltered with the inclusion of age and age-squared controls in column 2.

Following our analysis of child poverty, we also examine reductions in near poverty. The effect of funding family planning programs on the share of adults living near poverty is similar to

---

[14] Some PUMAs overlap multiple counties. The count of PUMAs that contain funded programs exceeds that of counties because we treat each PUMA that overlaps with a funded county as having received a family planning grant in the same year as the county.

[15] We borrow from the US census the definition of poverty that uses a family income threshold that depends on the number of overall family members and the number of children (Dalaker and Proctor 2000). For instance, the poverty threshold for the annual income of a household of four is $23,550 in 2013 dollars.

the effect on the share of adults living in poverty. Panel B of Table 3.3 shows that cohorts born after family planning programs were funded were 2.4 percent less likely to live below two times the poverty line as adults, relative to cohorts born before funding began but residing in the same PUMA. In addition, we find that the mean long-run effects are slightly stronger (though not statistically so) among whites. White cohorts born after the introduction of family planning were 4.8 percent (0.97 percentage points) less likely to live below two times the poverty line. The same statistic was 2 percent among nonwhite cohorts. This striking relationship between family planning programs and poverty rates decades later suggests that family planning programs may reduce poverty rates, both in the short and longer term.

3.6 Conclusions

In 2012, approximately one in five U.S. children lived below the official poverty line, only slightly lower than in 1965. The persistence of child poverty and its potentially negative consequences for children's opportunities has made reducing child poverty a public policy concern. While the majority of Americans have higher incomes than their parents, children with parents in the lowest income quintile experience the lowest absolute increase in income through adulthood (Pew Charitable Trusts 2012). In fact, 43 percent of all children and 50 percent of black children with parents in the bottom income quintile remain in the bottom income quintile as adults.

Our findings suggest the potential of family planning programs to disrupt this cycle of disadvantage. Individuals born after family planning programs began were 4.2 percent less likely to live in poverty in childhood and were 2.4 percent less likely to live in poverty as adults, than individuals born just before family planning programs began and residing in the same location.

A simple calculation relies on our estimates to approximate some of the costs and benefits of spending on family planning programs. On the benefit side, we multiply the number of children in funded county groups in 1980 who were born after family planning programs were funded by our estimate in Table 3.2 in panel A of column 2. This calculation implies that 79,800 fewer children (0.0076×10.5 million) lived below the poverty line in 1980 than would have in the absence of the program. To approximate the number of adults who escaped poverty as a result of these programs, we multiply the number of adults ages 20 to 59 living in funded PUMAs in 2000 who were born after program funding by the coefficient in Table 3.3 in panel A of column 2 which yields 46,760 adults (0.0028×16.7 million). Between 1964 and 1973, the federal government spent approximately $2.6 billion (in 2010 dollars) on family planning grants. This implies that each child lifted out of poverty cost approximately $32,581, while the long-run cost of each adult lifted out of poverty was $55,603.

Of course, these calculations likely misstate the effects of family planning for several reasons. First, siblings and slightly older and younger cohorts may also benefit from the programs and they contaminate the comparison group. Second, the mismeasurement of family planning status of parents (due to migration) should lead us to misstate the relationship of interest, and understate it if measurement error is unrelated to access to family planning. Finally, using only changes in poverty rates ignores many of the other consequences of family planning programs, which extend to population growth and labor supply, higher education, labor force participation, and wages (Bailey 2013). Nevertheless, even these conservative estimates of the cost per child or adult exiting poverty suggest that family planning programs could improve economic outcomes over the longer term.

3.7 Works Cited

Almond, Douglas, and Janet Currie. 2011. "Human Capital Development before Age Five." In O. Ashenfelter and D. Card, eds., *Handbook of Labor Economics,* Volume 4B. Maryland Heights, Missouri: Elsevier.

Arellano, Manuel. 1987. "Computing Robust Standard Errors for Within-Group Estimators." *Oxford Bulletin of Economics and Statistics*, 49(4): 431–434.

Bailey, Martha J. 2012. "Reevaluating the Impact of U.S. Family Planning Programs on Fertility: Evidence from the War on Poverty and the Early Years of Title X." *American Economic Journal: Applied Economics* 4(2): 62–97.

Bailey, Martha J. 2013. "Fifty Years of Family Planning: New Evidence on the Long-Run Effects of Increasing Access to Contraception." *Brookings Papers on Economic Activity*, Spring.

Bailey, Martha J., and Susan Dynarski. 2011. "Inequality in College Entry and Completion." In G. J. Duncan and R. J. Murnane, eds., *Whither Opportunity? Rising Inequality and the Uncertain Life Chances of Low-Income Children,* Russell Sage: New York, New York.

Bailey, Martha J., Brad J. Hershbein, and Amalia Miller. 2012. "The Opt-In Revolution? Contraception, Fertility Timing and the Gender Gap in Wages." *American Economic Journal: Applied Economics*, 4(3): 225–254.

Bailey, Martha J., Olga Malkova, and Zoe McLaren. 2013. "Does Family Planning Increase Children's Opportunities?" Working paper.

Becker, Gary S. 1981. *A Treatise on the Family*. Cambridge, Massachusetts: Harvard University Press.

Becker, Gary S., and H. Gregg Lewis. 1973. "On the Interaction between the Quantity and Quality of Children." *Journal of Political Economy*, 81(2): S279–S288.

Becker, Gary S., and Nigel Tomes. 1979. "An Equilibrium Theory of the Distribution of Income and Intergenerational Mobility." *Journal of Political Economy*, 87(6): 1153–1189.

Becker, Gary S., and Nigel Tomes. 1986. "Human Capital and the Rise and Fall of Families." *Journal of Labor Economics*, 4(3): S1–S39.

Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan. 2004. "How Much Should We Trust Differences-in-Differences Estimates?" *Quarterly Journal of Economics*, 119(1): 249–275.

Bound, John, and Sarah E. Turner. 2007. "Cohort Crowding: How Resources Affect Collegiate Attainment." *Journal of Public Economics*, 91(5–6): 877–899.

Christensen, Finn. 2011. "The Pill and Partnerships: The Impact of the Birth Control Pill on Cohabitation." *Journal of Populations Economics*, 25(1): 29–52.

Cunha, Flavio and James Heckman. 2007. "The Technology of Skill Formation." *American Economic Review*, 97(2): 31–47.

Dalaker, Joseph, and Bernadette D. Proctor. 2000. *Poverty in the United States: 1999*. U.S. Census Bureau, Current Population Reports, Series P-60, No. 210.

Department of Health and Economic Welfare (DHEW), Center for Family Planning Program Development (Planned Parenthood-World Population). 1974. *Family Planning, Contraception, and Voluntary Sterilization: An Analysis of Laws and Policies in the United States, each State and Jurisdiction (as of September 1971): A Report of the National Center for Family Planning Services, Health Services and Mental Health Administration*. Rockville, Maryland: U.S. DHEW, Publication No. 74–16001.

Easterlin, Richard. 1978. "What Will 1984 Be Like? Socioeconomic Implications of Recent Twists in Age Structure." *Demography*, 15(4): 397–421.

Edstrom, Eve. 1964. "Anti-Poverty Bill Doesn't Extend to Birth Control, Landrum Says: Monsignor Testified." *Washington Post*, April 18, pp. A4.

Gillette, Michael L. 1996. *Launching the War on Poverty: An Oral History*. New York: Twayne Publishers.

Goldin, Claudia, and Lawrence Katz. 2002. "The Power of the Pill: Oral Contraceptives and Women's Career and Marriage Decisions." *Journal of Political Economy,* 110(4): 730–770.

Gruber, Jonathan, Phillip Levine, and Douglas Staiger. 1999. "Abortion Legalization and Child Living Circumstances: Who is the "Marginal Child?" *Quarterly Journal of Economics*, 114(1): 263–291.

Hock, Heinrich. 2008. "The Pill and the Educational Attainment of American Women and Men." Florida State University Working Paper.

Hock, Heinrich, Susan Williams McElroy, and Seth G. Sanders. 2005. "Teenage Childbearing and Its Life Cycle Consequences: Exploiting a Natural Experiment." *Journal of Human Resources*, 40(3): 683–715.

Jacobson, Mireille. 2004. "Baby Booms and Drug Busts: Trends in Youth Drug Use in the United States." *Quarterly Journal of Economics*, 119(4): 1481–1512.

Jaffe, Frederick S., Joy G. Dryfoos, and Marsha Corey. 1973. "Organized Family Planning Programs in the United States: 1968–1972." *Family Planning Perspectives*, 5(2): 73–79.

Joyce, Ted, Ruoding Tan, and Yuxiu Zhang. 2013. "Abortion Before and After *Roe*." *Journal of Health Economics*, 32(5): 804–815.

Levine, Phillip B., and David J. Zimmerman, eds. 2010. *Targeting Investments in Children*: *Fighting Poverty When Resources are Limited*. Chicago: University of Chicago Press.

Levitan, Sar A. 1969. *The Great Society's Poor Law; A New Approach to Poverty.* Baltimore: Johns Hopkins Press.

Malthus, Thomas R. 1798. *An Essay on the Principle of Population*. London: John Murray.

Michael, Robert T., and Robert J. Willis. 1976. "Contraception and Fertility: Household Production under Uncertainty." *NBER Chapters*, in: Household Production and Consumption, pages 25–98, National Bureau of Economic Research, Inc.

National Archives Records about Community Action Program Grants and Grantees (NACAP). [Electronic Records]; Grantee Organization Masterfile, 7/1/1964–6/30/1971; Grantee Organization Master File, 7/1/1971–9/30/1981; Funded Program Account Master File, 7/1/1964–6/30/1971; Funded Program Account Master File, 7/1/1971–9/30/1977; Funded Program Account Master File, 10/1/1977–9/30/1981; Record Group 381 (National Archives at College Park, College Park, Maryland).

National Archives Records, Federal Outlays System Files, FY1968–FY1980 (599052). (NAFO). [Electronic Record]; Records of the Community Services Administration, Record Group 381 (National Archives at College Park, College Park, Maryland).

National Center for Health Statistics (NCHS). 2003. Natality Detail File, 1968–1988: [UNITED STATES] [Computer file]. Hyattsville, Maryland: U.S. Department of Health and Human Services, National Center for Health Statistics [producer], 1981. Ann Arbor, Michigan: Inter-university Consortium for Political and Social Research [distributor].

Nixon, Richard. 1969. "Special Message to the Congress on Problems of Population Growth." July 18. Available at *The American Presidency Project*, <www.presidency.ucsb.edu/ws/?pid=2132>, accessed September 13, 2013.

Office of Economic Opportunity. 1969. *The Need for Subsidized Family Planning Services: United States, Each State and County, 1968.* Washington, DC: Government Printing Office.

Office of Economic Opportunity. 1971. *The Need for Subsidized Family Planning Services: United States, Each State and County, 1969.* Washington, DC: Government Printing Office.

Office of Economic Opportunity. 1974. *The Need for Subsidized Family Planning Services: United States, Each State and County, 1971*. Washington, DC: Government Printing Office.

Pew Charitable Trusts. 2012. "Pursuing the American Dream: Economic Mobility across Generations." Washington and Philadelphia. Available at <www.pewstates.org/uploadedFiles/PCS_Assets/2012/Pursuing_American_Dream.pdf>, accessed September 13, 2013.

Reardon, Sean. 2011. "The Widening Academic Achievement Gap between the Rich and the Poor: New Evidence and Possible Explanations," In G. J. Duncan and R. J. Murnane, eds., *Whither Opportunity? Rising Inequality and the Uncertain Life Chances of Low-Income Children*. Russell Sage: New York, New York.

Regional Economic Information System (REIS), 1969–1989. 2009. Bureau of Economic Analysis, U.S. Department of Commerce, CIESIN. Available at <http://www.ciesin.org/datasets/reis/reis-home.html>, accessed February 1, 2009.

Rotz, Dana. 2011, "Why Have Divorce Rates Fallen? The Role of Women's Age at Marriage." Social Science Research Network Working Paper.

Ruggles, Steven, J. Trent Alexander, Katie Genadek, Ronald Goeken, Matthew B. Schroeder, and Matthew Sobek. 2010. Integrated Public Use Microdata Series: Version 5.0 [Machine-readable database]. Minneapolis: University of Minnesota.

Saez, Emmanuel. 2013. “Striking it Richer: The Evolution of Top Incomes in the United States (Updated with 2012 Preliminary Estimates).” University of California-Berkeley working paper. Available at <http://elsa.berkeley.edu/~saez/saez-UStopincomes-2012.pdf>, accessed January 19, 2014.

Sanger, Margaret. 1923. “Prevention or Abortion—Which? Letters Showing the Dilemma Faced by Many Mothers.” *Birth Control Review*, 7(7): 181–182.

Solon, Gary, Steven J. Haider, and Jeffrey M. Wooldridge. 2013. “What Are We Weighting For?” Mimeo Michigan State University. Available at <https://www.msu.edu/~solon/WAWWFfeb2013.pdf>, accessed January 19, 2013.

Tone, Andrea. 2001. *Devices and Desires: A History of Contraceptives in America*. New York: Hill and Wang.

Torres, Aida, and Jaqueline Darroch Forrest. 1985. “Family Planning Clinic Services in the United States, 1983.” *Family Planning Perspectives*, 17(1): 30–35.

Willis, Robert J. 1973. “A New Approach to the Economic Theory of Fertility Behavior.” *Journal of Political Economy*, 81(2): S14–S64.

Table 3.1: The Effect of Family Planning on Fertility Rates, by Race

	Dependent Variable: Fertility Rates (Births per 1,000 Women Ages 15–44)					
	A. All Individuals		B. White		C. Nonwhite	
	(1)	(2)	(1)	(2)	(1)	(2)
Mean in Funded Counties Before Funding Began	*90*	*90*	*83*	*83*	*122*	*122*
After Family Planning Program Funding Began	-2.75 [0.43]	-2.26 [0.40]	-1.96 [0.47]	-1.73 [0.45]	-1.28 [1.63]	-1.72 [1.63]
R^2	0.56	0.57	0.52	0.53	0.30	0.31
Counties	2,633	2,633	1,481	1,481	1,481	1,481
Observations	55,293	55,293	31,101	31,101	31,101	31,101
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Birth year FE	Yes	Yes	Yes	Yes	Yes	Yes
State × birth year FE	Yes	Yes	Yes	Yes	Yes	Yes
County characteristics		Yes		Yes		Yes

Notes: The unit of observation is county by year, and estimates of τ are presented using equation 1. The results use the funded and unfunded sample of counties. Estimates are not weighted. Columns labeled (1) include county, year, and state by year fixed effects, while columns labeled (2) add county covariates (1960 county covariates interacted with a linear trend, number of abortion providers, and REIS controls). Panel A presents results for both races, panel B presents results for whites only, and panel C presents results for nonwhites only. Heteroskedasticity-robust standard errors clustered by county are presented beneath each estimate in brackets. *Source*: Vital Statistics.

Table 3.2: The Effect of Family Planning on Next Generation Childhood Poverty, by Race

	All Individuals		White	Nonwhite
	(1)	(2)	(3)	(4)
A. Dependent Variable: Percent with Family Income < Poverty Line				
Mean in Funded Counties Before Funding Began	*18.2*	*18.2*	*13.7*	*38.7*
After Family Planning Program Funding Began	-0.81 [0.31]	-0.76 [0.32]	-0.56 [0.30]	-3.16 [1.22]
R^2	0.27	0.28	0.26	0.30
B. Dependent Variable: Percent with Family income < Two Times the Poverty Line				
Mean in Funded Counties Before Funding Began	*42.9*	*42.9*	*37.0*	*69.7*
After Family Planning Program Funding Began	-0.45 [0.41]	-0.50 [0.42]	-0.40 [0.44]	-2.09 [1.16]
R^2	0.47	0.47	0.47	0.31
County Group FE	Yes	Yes	Yes	Yes
Birth year FE	Yes	Yes	Yes	Yes
State × birth year FE	Yes	Yes	Yes	Yes
County Characteristics		Yes	Yes	Yes
County Groups	251	251	251	154
Observations	4,267	4,267	4,267	2,618

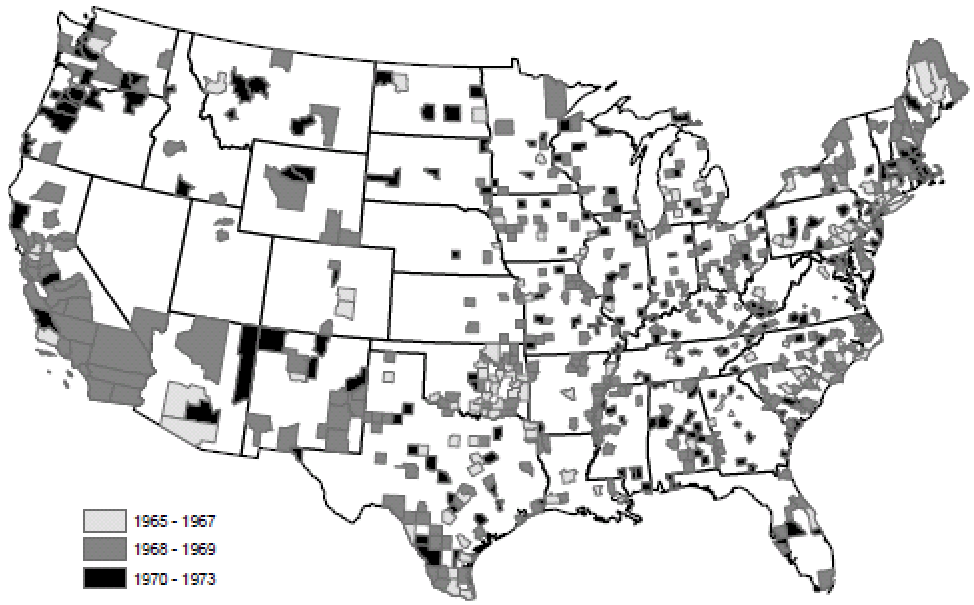
Notes: The unit of observation is county group by year, and estimates of τ are presented using equation 1. The results use the funded only sample. We classify as "white" all individuals in the census who list their race as "white", while "nonwhite" comprises all other individuals. We drop county groups where fewer than 50 nonwhite children were born in any year in the analysis. We drop non-coterminous county groups and county groups that contain split counties. We define the share in poverty as the share of children who live in families whose income is below the poverty threshold, we also compute the share of children who live in families whose income is below 200 percent of the poverty threshold. Column 1 presents results for both races and includes county group, birth year, and state by birth year fixed effects; column 2 adds county characteristics (number of abortion providers and REIS controls) to column 1; column 3 presents results for whites only and includes county group, birth year, state by birth year fixed effects, and county characteristics; column 4 presents results for nonwhites only and adds the same controls as column 3. Panel A presents results when using the share of children living in families whose income is below 100 percent of the poverty line as a dependent variable. Panel B presents results when using the share of children living in families whose income is below twice the poverty line as a dependent variable. Estimates are not weighted. Heteroskedasticity-robust standard errors clustered by county are presented beneath each estimate in brackets. *Source*: 1980 Integrated Public Use Microdata Series.

Table 3.3: The Effect of Family Planning on Next Generation Adult Poverty, by Race

	All Individuals		White	Nonwhite
	(1)	(2)	(3)	(4)
A. Dependent Variable: Percent with Family Income < Poverty Line				
Mean in Funded Counties Before Funding Began	*11.5*	*11.5*	*8.18*	*16.4*
After Family Planning Program Funding Began	-0.28 [0.12]	-0.28 [0.18]	-0.50 [0.14]	-0.32 [0.28]
R^2	0.05	0.06	0.02	0.03
B. Dependent Variable: Percent with Family income < Two Times the Poverty Line				
Mean in Funded Counties Before Funding Began	*27.9*	*27.9*	*20.4*	*38.1*
After Family Planning Program Funding Began	-0.68 [0.18]	-0.68 [0.18]	-0.97 [0.21]	-0.76 [0.34]
R^2	0.13	0.13	0.06	0.05
PUMA × observation year FE	Yes	Yes	Yes	Yes
Birth year FE	Yes	Yes	Yes	Yes
State × birth year FE	Yes	Yes	Yes	Yes
Age and age^2		Yes	Yes	Yes
PUMAs	1,268	1,268	1,268	1,268
Observations	328,403	328,403	320,634	298,216

Notes: We classify as "white" all individuals recorded in the census as belonging to no other racial group and not being Hispanic, while "nonwhite" comprises all other individuals. There were 2,072 PUMAs in the fifty US states in 2000. Following population displacement in Louisiana due to Hurricane Katrina, three PUMAs (1801, 1802, and 1905) were combined, and we merge these PUMAs together throughout the entire 2000–2011 sample period. Additionally, we drop PUMA 5423 in Los Angeles because it has few white residents, for none of whom poverty status is recorded. Our final sample consists of 1,268 PUMAs whose boundaries include all or part of county in which an family planning grant began between 1965 and 1973 and in which poverty status was measured for at least one white and at least one nonwhite resident age 20–59 and born 1946–1980 in each of the eight years of observation (yielding 10,144 unique combinations of PUMA × year of observation). This figure of 1,268 PUMAs exceeds the tally of 654 counties with a grant because, while a single PUMA may span several counties, so too may a single county span several PUMAs. Finally, we average poverty status across all individuals, and separately by race for those who reside in the same PUMA, share the same year of birth, and are observed in the same year. The units of analysis are 328,403 PUMA × year of birth × year of observation cells. Not every cell contains both white and nonwhite individuals for whom poverty status is recorded, so the actual number of units is slightly smaller for the race-specific specifications (3) and (4). Heteroskedasticity-robust standard errors clustered by PUMA and observation year are presented beneath each estimate in brackets. The mean in funded counties before funding began is the average across individuals born two years prior to funding to those born in the year of funding. Estimates are not weighted. *Source*: 2000 US Decennial Census and 2005–2011 American Community Surveys.

Figure 3.1: The Date of the First Federal Family Planning Grant, 1965–1973



Notes: Dates are the year that the county first received a federal grant. Counties not receiving a family planning grant between 1965 and 1973, including communities that received funding but with an unknown starting date, are not shaded. Source: NACAP, NAFO and OEO (1969, 1971 and 1974).