His and Her Fertility Preferences: An Experimental Evaluation of Asymmetric Information in Family Planning

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Abstract

The total fertility rate in rural Tanzania is nearly four times higher than the global rate of 2.3 births per woman. In the northern rural Meatu District, only 12 percent of women are using contraceptives, although 89 percent report wanting to delay or prevent pregnancy. This study evaluates the effect of a family planning program designed to improve information about contraceptives through a randomized control trial. I estimate the effect of asymmetric spousal information, randomizing the inclusion of husbands in household consultations about family planning. I find that the informational treatment had a significant effect on reducing pregnancies. Women who benefited from asymmetric information and consulted with a family planning worker alone (without their husbands) reduced pregnancies by a significantly larger amount (16 percentage point). However, husbands who were involved in family planning consultations with their wives reduced their (relatively large) fertility desires. This research provides support for community-based health services and demonstrates the trade-offs of providing asymmetric information to spouses.

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1 Introduction

When men desire nearly three times as many additional children as their wives and possess most of the decision-making power in the household, the discordance of preferences leads to excess fertility and welfare losses for wives, who bear almost all of the costs of pregnancy and child-rearing. High rates of fertility persist in sub-Saharan Africa, where in 2013, the total fertility rate was 5.1 births per woman relative to the total fertility rate of the 2.3 births per woman in the rest of the world (World Bank, 2014). The rate in rural Tanzania stood even higher, at 8.4 births per woman (DHS, 2010). In fact, if the current natality trends in Tanzania continue, its population will triple by 2050 (United Nations, 2015). The benefits of planned and spaced births include positive outcomes for children, including better nutrition and more years of schooling (Do and Phung, 2010), and better maternal health (Winikoff, 1983; Norton, 2005). While previous economic studies indicate that high fertility is usually a consequence of large desired family sizes (Rosenzweig and Wolpin, 1980a,b; Moffitt, 2005), it is not yet clear how high fertility is affected by heterogeneous spousal fertility desires.

According to the 2010 Tanzania Demographic and Health Survey (DHS), 27 percent of rural Tanzanian women say that they would like to delay a birth by at least two years but are not using contraception. This gap is even larger in the data collected for this study. In the 2012 baseline household data from the Meatu district of northern Tanzania, 76 percent of women report that they want to delay a birth by at least two years but are not using contraception. Knowledge of fertility control is poor in this context. Eighty percent of women believe that folkloric methods of birth control (such as luck charms) are effective in preventing pregnancy. Additionally, husbands generally have more pronatalist fertility preferences than their wives in Sub-Saharan Africa (Ezeh et al., 1996). This preference is also confirmed in the Meatu household survey, where women, on average, report desiring an additional 1.4 children and men report desiring an additional 4.5 children. The lack of knowledge about family planning methods combined with heterogeneous fertility preferences among spouses may prevent women from achieving their desired family sizes.

This study addresses the problem of wives' excess fertility by proposing two main research questions. First, can the number of unwanted pregnancies be reduced through an informational family planning program that reduces the psychosocial cost of contraceptives? And secondly, in the presence of heterogeneous spousal fertility preferences, what is the effect of including husbands in family planning consultations? I measure the impact of family planning worker household consultations through a small field experiment that randomized the inclusion of husbands. The study sample includes approximately 600 randomly-selected households across 12 villages in the district of Meatu. I use a conceptual framework based on non-cooperative game theory to explain fertility decisions and make predictions about the effect of family planning information on fertility behavior under different expectations about husbands' violent behavior.

The main findings provide evidence of a trade-off between welfare gains for women and marital gains from better-aligned preferences. The family planning program reduced psychosocial cost of contraception adoption and thus reduced pregnancies significantly in the treatment group. Women who consulted with the family planning worker individually (without their husbands) had a significantly larger reduction in pregnancies than women who consulted together with their husbands. Yet, the joint conversation about family planning as part of the couples consultation also had an effect, reducing men's (relatively large) fertility desires. And, as predicted by the conceptual framework, when women expect their husbands to be abusive, the asymmetric family planning information (excluding husbands from consultations) has a positive effect (though not statistically significant) on pregnancies.

This study builds on a body of literature on the determinants of fertility choices and intra-household bargaining. Service delivery through the decentralized provision of sexual and reproductive health care using locally-based health workers has proven effective in rural areas of developing countries. The seminal experimental Matlab Project in Bangladesh showed that through a community health worker program, poor populations reduced fertility rates and improved child health (Bhatia et al., 1980). Several studies have documented the sizable impact of this particularly intensive program, and showed that family planning efforts can affect fertility even in the absence of major socioeconomic improvements (Bhatia et al., 1980; Joshi and Schultz, 2007; Sinha, 2005).

However, observational studies of changes in fertility in developing countries lack random assignment of family planning policies or programs. When program placement is not exogenous to the outcome, a number of unobservable factors (e.g. demand for contraceptives, labor market, status of women) may lead to biased estimates of the program impact (Pitt et al., 1993; Molyneaux, 1994). This evaluation challenge is particularly problematic amid economic development and rising levels of income (Pritchett, 1994; Miller, 2009). Pritchett (1994) argued that the supply of family planning services is not a dominant determinant of fertility differences because fertility is largely determined by demand. And rising income and economic development affect the main determinants of couples fertility desires: the relative costs of children versus other goods, the couple's income, and their preferences for children versus competing forms of consumption (Becker, 1960). I overcome the evaluation challenge by implementing a randomized field experiment. Although the region may see rising incomes over the study period, the information provided in household family planning consultations was randomly assigned to villages.

The role of husbands' preferences in intra-couple fertility decisions has been evaluated through experimental designs that exploit random inclusion of men in family planning consultations. Terefe and Larson (1993) first examined the experimental effect of men in family planning decisions in urban Ethiopia and discovered that women who consulted with a family planning nurse while their husbands were present were more likely to adopt contraceptive methods than women who consulted with the nurse alone. Ashraf et al. (2014), however, found contrasting evidence about the role of husbands in Zambia. They administered a one-time voucher for access to discrete contraceptives through household family planning consultations. The authors found that women who received the voucher privately (without their husbands) were more likely to seek family planning services than women who received the voucher with their husbands. The distinction in Ashraf et al. (2014) provides evidence of women taking advantage of asymmetric information to behave strategically and achieve their own desired fertility.

My contribution is three-fold. First, because the psychosocial cost of concealed contraceptive use is borne over time, I expand on Ashraf et al. (2014) by examining intra-household bargaining over fertility for a longer-term (fifteen-month) family planning intervention, allowing more time for spousal discussion, in region where women have limited intra-household bargaining power (as empirically supported by minimal decision-making ability within the household). Second, for the unresolved question on whether husbands should be included in family planning education, my results provide evidence of the positive cooperation effects of inclusion while also supporting private welfare gains for women in individual consultations. And finally, I provide evidence about the significant role of intimate-partner violence in reducing the beneficial effect of family planning information.

This paper is organized as follows. Section 2 outlines the conceptual framework for understanding spousal behavior. Section 3 presents the methods of implementation of the randomized field experiment. Section 4 discusses the empirical strategy for measuring the program impact. Section 5 presents descriptive statistics. Section 4 presents and discusses the empirical results, and Section 7 concludes.

2 Conceptual Framework

In this section, I develop a framework that describes inter-spousal family planning decisions to make predictions about behavior that I test in the empirical analysis. The basic model is similar to the non-cooperative framework used in Ashraf et al. (2014), although I simplify the model payoffs in order to explicitly solve for best response functions and then examine the changing effect of husbands' behavior. This model predicts two key testable hypotheses: (1) a reduction in the psychosocial cost of contraception adoption leads to an increase in the use of contraceptives (with a corresponding reduction in pregnancies); and (2) whether women adopt contraceptives depends on their expectations of their husbands' violent behavior.

2.1 Non-cooperation and Inefficiency

The collective model of the household describes two agents making decisions that affect one another (Manser and Brown, 1980; McElroy and Horney, 1981). The weights on agents' utility functions are thought to be affected by external factors such as income. Through bargaining over household resources, the couple reaches decisions that are Pareto efficient. The consequences of intra-household bargaining have been empirically observed in fertility decisions, household finances and investments in children (Thomas, 1990; Duflo, 2000; Rangel, 2006) However, a key assumption for efficiency in collective bargaining is mutual knowledge of each others' preferences, resources and choices, which includes perfect information and perfect contracts between spouses. According to baseline Meatu data, most couples (65 percent) have never had any conversation about fertility desires or family planning, so it is unlikely that the couples have bargained efficiently to the point of reaching a binding agreement. Further, the assumption of efficiency in collective bargaining has been rejected by empirical evidence, especially in Sub-Saharan Africa (Duflo and Udry, 2004; Udry, 1996).

Rasul (2008) frames a model of collective bargaining over fertility and finds that investments in fertility are efficient only if couples agree to a contract, or binding commitment, on the number of children to have. Despite this, the empirical evidence indicated that all types of couples bargain without commitment. Referencing the hold-up problem, Rasul (2008) concludes that without commitment, the influence of each spouse's fertility preferences depends on the individual's bargaining power within the marriage (Grossman and Hart, 1986; Hart and Moore, 2008).[1] Unequal levels of bargaining power allow for opportunistic behavior when one spouse is exposed to private information. Individuals have been shown to use money and information differently when given the opportunity to hide these resources from their spouse (Castilla and Walker, 2013; Aker et al., 2014). Thus, under the collective model, asymmetric information between spouses is a potential source of inefficient household decisions and inefficient investments in fertility (Ashraf et al., 2014; Kebede et al., 2013).

The evidence of unsuccessful fertility contracting between couples (Rasul, 2008), the potential advantage of private information about contraceptives, and evidence from the Meatu context suggest a non-cooperative fertility bargaining framework with incomplete information. The non-cooperative framework does not assume efficiency at the outset and allows for limited commitment and asymmetric information about resources, choices and preferences. Lundberg and Pollak (1993) provide the original framework for a non-cooperative household model with limited commitment

[1]The hold-up problem results when agents refrain from cooperation and do not reach efficient contracts due to unequal levels of bargaining power.

and Chen (2013) expands the model in the case of imperfect information.

In the non-cooperative model without commitment, each person's action is a best response to his or her spouse's actions. I characterize an extensive form game of incomplete information. The husband (H) and wife (W) cannot reach a contract on fertility behavior, so they choose actions that maximize their own payoffs. The players in the game include Nature, Wife, and Husband. Nature moves first and makes contraception available ($A = 1$) with probability α, or unavailable ($A = 0$).[2] The availability of contraceptives is only observed by the wife. She observes Nature's action and, if contraceptives are available, makes the second decision, choosing to adopt contraception ($C = 1$) with probability κ, or not ($C = 0$). The husband also does not observe this action.[3] If contraceptives are not available, she does not take contraceptives ($A = 0$ implies $C = 0$). If contraceptives are not adopted, Nature moves again in deciding if a birth will take place ($B = 1$) with probability β, or no birth ($B = 0$). If contraceptives are adopted, no birth takes place ($C = 1$ implies $B = 0$). The husband observes this final action of Nature and is allowed the possibility to feel aggrieved in response to a no birth outcome (husbands are assumed to be pronatalist) and thus choose to punish ($P = 1$) with probability π, or not to punish ($P = 0$).[4] In this context, punishments can be understood as intimate partner violence, which is prevalent in this district. In the model, the husband uses the threat of violence in attempt to convince her not to take contraceptives.[5] If a birth occurs, the husband does not punish ($B = 1$ implies $P = 0$).

The players, actions (in capital letters), probabilities (under each node) and payoffs (on the far right) can be viewed in Figure 1. Because this is an extensive form game of incomplete information, it is useful to outline what each player knows and does not know. The wife knows the availability of contraceptives (A), whether she has adopted them (C), whether a birth has occurred (B). She does not know whether the husband will punish (P), knows the probability that he will punish (π).

[2] Nature is a game theoretical representation of luck. While in reality, availability of contraceptives is determined by health provisions and societal acceptance, these outside factors are simplified and represented by Nature in this framework.

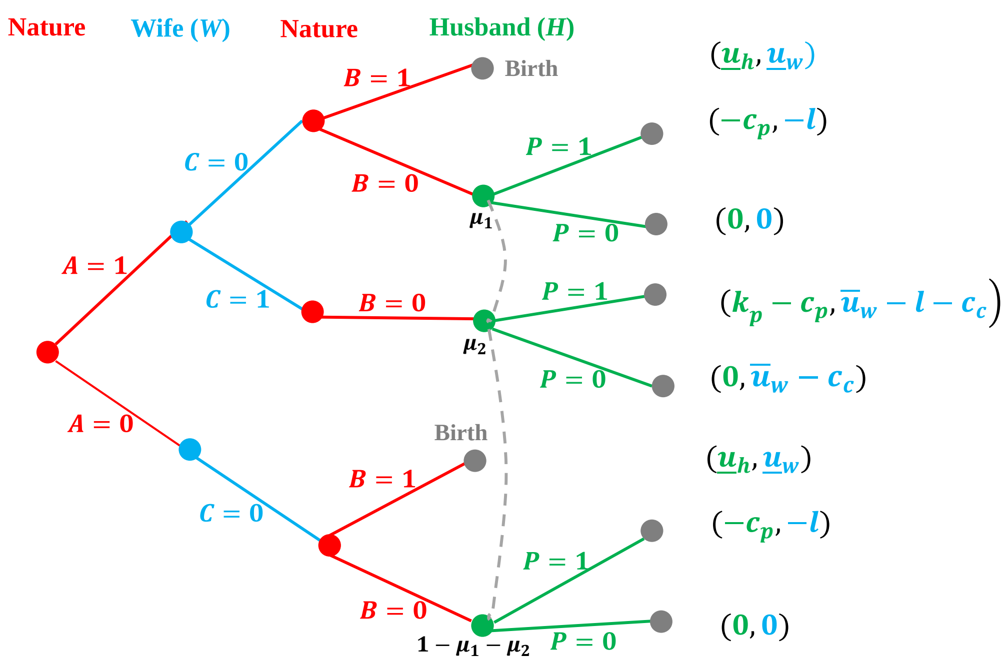
[3] The most popular contraceptive methods in Tanzania are quarterly injections (e.g. Depo Provera), the pill or female sterilization. Because condoms are not popular in this region, the model assumes that women chose to adopt female-centered contraception.

[4] He punishes through a process that Hart (2008) refers to as "shading", in which the husband inflicts negative behavior on his wife as a result of feeling short-changed by the outcomes.

[5] In fact, 35 percent of women in the baseline survey had experienced intimate partner violence and a few women in focus group discussions recalled threats of violence related to contraceptive use.

The husband knows whether or not a birth has occurred. He does not know whether contraceptives are available (A) or whether his wife has taken them (C), but he forms beliefs about the availability (α) and the likelihood that she will take them (κ). He also knows the range of these probabilities ($0 \leq \alpha \leq 1$; $0 \leq \kappa \leq 1$). The wife's choice variable is C and the husband's choice variable is P, which they both determine by maximizing their own expected utilities. The final outcomes are represented by the nodes on the right side of the figure with corresponding payoffs displayed as (H,W).

Figure 1: Conceptual Framework Game



The payoffs to W depend on her utility of a giving birth to a child now ($\underline{u}_w$), her utility of delaying the birth of a child ($\overline{u}_w$),[6] the (psycho-social) cost of adopting contraception (c_c), and the utility loss imposed by a punishing husband (l). Because W is assumed to prefer a delayed birth, $\overline{u}_w > \underline{u}_w$. The highest payoff for W is in the case of taking contraception, delaying a birth and not experiencing punishment. Her lowest payoff is in the case of not taking contraceptives yet

[6]This term captures the utility of a delayed birth for women, but it also represents the confidence that a woman has knowing that she will not get pregnant at this time. Although she may not have a birth when she does not take contraception, she does not gain the utility of $\overline{u}_w$ in those cases because she knows the likelihood of a birth is high and that this is determined by nature (luck).

also not giving birth. The payoffs to taking contraceptives, however, depend on the probability of punishment, π.

The payoffs to H depend on the utility of a birth ($\underline{u}_h$), the gain he receives from punishing when she is using contraception (k_p)[7] minus the additional cost he bears of being a punishing husband (c_p). The cost of being a punishing husband is not large enough to lower his utility because the gain from punishing is at least as large as this cost ($k_p \geq c_p$). The highest payoff for H is in the case of a birth, while his lowest payoff is in the case of no birth and imposing punishment.

The payoffs to each player depend on the framework's parameters, but can be ranked from highest to lowest utility.

$$-l < \underline{u}_w < 0 < \overline{u}_w - \pi l - c_c < \overline{u}_w - c_c \text{ for } \pi < X \tag{2.1}$$

$$\text{For some value of } X, \text{ such that } 0 \leq X \leq 1 \tag{2.2}$$

$$-c_p < 0 < k_p - c_p < \underline{u}_h \tag{2.3}$$

2.2 Best Response Functions

The husband's expected utility can be defined in terms of parameters and probabilities. For simplicity sake, I use μ_1, μ_2 and $(1 - \mu_1 - \mu_2)$ to represent H's beliefs that he is at each subgame choice set (decision node). The top, middle and bottom decision nodes are informationally equivalent, although his beliefs may vary. In this case, $\mu_1 = \alpha(1-\kappa)(1-\beta)$ ($H's$ top decision node), $\mu_2 = \alpha\kappa(1-\beta)$ ($H's$ middle decision node) and $1 - \mu_1 - \mu_2 = (1-\alpha)(1-\beta)$ ($H's$ bottom decision node). The husband does not observe A or C; he only observes B, whether a birth has occurred. He has beliefs, though, about the probability of available contraceptives and the probability of his wife taking contraceptives. Because the husband does not punish if a child is born, his decision of whether to punish depends only on his expected utility function for the payoffs and probabilities that involve no birth. The game results in the following expected utilities for the husband to

[7] Although the husband does not directly observe A, and thus cannot know that he is punishing while she is using contraceptives, he can gain utility from k_p based on his own belief that he is correct (which is a function of α and κ).

punishing, $P = 1$, and not punishing, $P = 0$:

$$E[U_h^{P=1}] = \mu_1 * (-c_p) + \mu_2 * (k_p - c_p) + (1 - \mu_1 - \mu_2) * (-c_p) \tag{2.4}$$

$$E[U_h^{P=0}] = \mu_1 * (0) + \mu_2 * 0 + (1 - \mu_1 - \mu_2) * 0 \tag{2.5}$$

To solve for $H's$ best response function and determine the conditions under which he will punish, I first define the indifference surface. Based on μ_1 and μ_2, this surface expresses $H's$ indifference between choosing $P = 1$ or $P = 0$.

$$E[U_h^{P=1}] = E[U_h^{P=0}] \tag{2.6}$$

$$\mu_1 * (-c_p) + \mu_2 * (k_p - c_p) + (1 - \mu_1 - \mu_2) * (-c_p) = 0 \tag{2.7}$$

$$\mu_2 = \frac{c_p}{k_p} \tag{2.8}$$

$$\alpha\kappa(1 - \beta) = \frac{c_p}{k_p} \tag{2.9}$$

The husband is indifferent between choosing $P = 1$ or $P = 0$ when the above condition on is true. The husband prefers to punish when: $\alpha\kappa(1 - \beta) > \frac{c_p}{k_p}$. Intuitively, this indicates that if the probability of W taking contraceptives when they are available and not having a birth are larger than the cost-benefit ratio of being a difficult husband, then he will punish. The husband is more likely to punish when he believes it is highly likely that his wife will have access to, and desire for, contraception. His best response function σ_h follows.

$$\sigma_h = \begin{cases} \pi = 1, & \mu_2 > \frac{c_p}{k_p} \\ \pi \in [0, 1], & \mu_2 = \frac{c_p}{k_p} \\ \pi = 0, & \mu_2 < \frac{c_p}{k_p} \end{cases}$$

Next, I solve for the wife's best response function to determine the conditions under which she will choose to take contraceptives. I define her indifference surface through expected utility of her actions. The wife's choice between taking contraceptives, $C = 1$, or not, $C = 0$, results in the following expected utilities:

$$E[U_w^{C=1}] = \pi * (\overline{u}_w - l - c_c) + (1 - \pi) * (\overline{u}_w - c_c) \tag{2.10}$$

$$E[U_w^{C=0}] = (1 - \beta) * \pi * (-l) + (1 - \beta) * (1 - \pi) * 0 + \beta \underline{u}_w \tag{2.11}$$

Based on the probabilities and payoffs of each choice, her indifference surface can be defined by solving for the conditions that equate the expected utilities:

$$E[U_w^{C=1}] = E[U_w^{C=0}]$$

$$\overline{u}_w - \pi l - c_c = \beta \underline{u}_w - (1 - \beta)\pi l$$

$$c_c = \overline{u}_w - \beta(\underline{u}_w + \pi l) \tag{2.12}$$

The wife is indifferent between choosing $C = 1$ or $C = 0$ when the above condition is true. She will choose contraceptives when $c_c < \overline{u}_w - \beta(\underline{u}_w + \pi l)$. In other words, she will take contraception when the cost of adopting is not too high. Her best response function, $\sigma(w)$, is written more formally as:

$$\sigma_w = \begin{cases} \kappa = 1, & c_c < \overline{u}_w - \beta(\underline{u}_w + \pi l) \\ \kappa \in [0, 1], & c_c = \overline{u}_w - \beta(\underline{u}_w + \pi l) \\ \kappa = 0, & c_c > \overline{u}_w - \beta(\underline{u}_w + \pi l) \end{cases}$$

Testable Hypothesis 1

An important observation here is that as the pyschosocial cost of contraception (c_c) decreases, the woman is more likely to adopt contraception. This testable hypothesis predicts how the first research question will be answered. In the experimental context, although contraceptives are free, the psychosocial cost of adopting contraceptives (e.g. acquiring health information and defying social stigma) may be preventing women from acheiving desired fertility. This psychosocial cost is lowered through the family planning intervention, as health information is brought to individuals in their home and conversations with a trusted community member reduce the social stigma of contraceptives. I test whether women in the treatment groups are more likely to adopt contraceptives and reduce pregnancies than women in the control group.

2.3 Characterization of Equilibria

Here I will characterize the Bayesian perfect equilibria of this game (three pure strategy and a mixing strategy). I define each equilibrium as a pair of the players actions, $[H, W]$ and discuss each possible solution. I begin by conditions for the husband to be indifferent between punishing, $P = 1$, and not punishing, $P = 0$. The husband's indifference surface can be reduced to:

$$\mu_2 = \frac{c_p}{k_p}$$

I first discern the equilibria solutions when the husband is violent. Based on conditions derived in the wife's best response functions, I determine if the equilibrium strategy $[P = 1, C = 1]$ is subgame perfect equilibria if:

$$c_c < \overline{u}_w - \beta(\underline{u}_w + l) \tag{2.13}$$

In order for the equilibrium strategy $[P = 1, C = 1]$ to be a Bayesian perfect equilibrum, the conditions of their actions must be supported by beliefs. Since this strategy implies he will punish and she will use contraceptives, I apply his belief about μ_2 and infer that:

$$\alpha \geq \frac{c_p}{k_p} \tag{2.14}$$

If both 2.13 and 2.14 hold, then the solution $[P = 1, C = 1]$ is a Bayesian perfect equilibrium. Next, I determine if $[P = 1, C = 0]$ can be a subgame perfect equilibrium. If the husband knew that the wife was playing $C = 0$, based on his best response function, he would never choose the lower payoffs associated with $P = 1$. Therefore, sequential rationality implies the solution $[P = 1, C = 0]$ cannot be subgame perfect. Within the second research question on whether or not husbands should be included in family planning consultations, I explore two testable hypothesis related to expectations on the husbands behavior. When the husband is likely to punish, how will the loss he imposes have an effect on contraceptive use? I explore how her best response may change in the case where he is likely to be a punishing husband by varying π. She has beliefs about the value of π based on prior experiences. I compare $U_w^{C=1}(\pi = 1)$ to $U_w^{C=0}(\pi = 1)$, using equation 2.10 and 2.11.

$$E[U_w^{C=0}(\pi = 1)] = \overline{u}_w - l - c_c <> \beta \underline{u}_w - (1 - \beta)l = E[U_w^{C=0}(\pi = 1)] \tag{2.15}$$

$$l > \underline{u}_w + \frac{\overline{u}_w + c_c}{\beta} \tag{2.16}$$

Testable Hypothesis 2a

When the husband is likely to punish ($\pi = 1$), the threat of imposing l is effective in inducing the wife to not take contraception. In 2.15, we can see that l has a larger negative effect on the left hand side (when taking contraceptives). For any values of c_c and β, a one unit increase in l will reduce W's expected utility by one. On the right hand side, l reduces her utility by $(1 - \beta)$, having a relatively less negative effect. So, she would choose $C = 0$. In this case, his threat of abuse is effective in affecting her behavior: l will make the wife choose not to adopt contraception. This is the last testable hypothesis. When women expect husbands to be abusive, they would be less likely to adopt contraceptives and reduce pregnancies.

Next, I give the conditions for equilibria solution when the husband is not violent. Applying sequential rationality to the wife's best response function, the equilibrium strategy $[P = 0, C = 0]$ can be subgame perfect equilibria if:

$$c_c \geq \overline{u}_w - \beta(\underline{u}_w) \tag{2.17}$$

This strategy implies that she will not use contraceptives, thus applying Bayes rule of supporting beliefs implies that $\mu_2 = 0$. The players actions remain best responses given the updated beliefs, so $[P = 0, C = 0]$ is a Bayesian perfect equilibrium. Likewise, applying sequential rationality to the wife's best response function, I determine the conditions for $[P = 0, C = 1]$ to be subgame perfect:

$$c_c \geq \overline{u}_w - \beta(\underline{u}_w) \tag{2.18}$$

Adding to this condition, this solution will be a Bayesian perfect equilibrium if the players' actions are supported by their beliefs. In this case, knowing that she is using contraceptives and applying the husband's belief about μ_2 implies that:

$$\alpha \leq \frac{c_p}{k_p} \tag{2.19}$$

If 2.19 holds, then [P=0, C=1] is a Bayesian perfect equilibrium.

Expanding on the second research question, I explore the conditions necessary for the wife to choose contraceptives given that the husband is expected to never punish. I compare her payoffs to each choice under the H chooses $P = 0$. This is the comparison of $EU_w^{C=1}(\pi = 0)$ to $EU_w^{C=0}(\pi = 0)$, applying $\pi = 0$ to equation 2.10 and 2.11. Taking contraception will be optimal when:

$$E[U_w^{C=1}(\pi = 0)] = \overline{u}_w - c_c > \beta\underline{u}_w = U_w^{C=0}(\pi = 0) \tag{2.20}$$

$$c_c < \overline{u}_w - \beta\underline{u}_w \tag{2.21}$$

Testable Hypothesis 2b

Equation 2.21 indicates that if the husband is not going to punish his wife, the wife will take contraceptives when the cost of doing so is small relative to a function of her utility of delayed birth less the expected utility of an early birth. Note that this definition of the conditions for a $[P = 0, C = 1]$ equilibrium depend only on her own utility functions and the probability of a birth, not on the loss of punishment. The husband's threats to induce her to avoid contraception will not be effective (will not change her behavior) if she believes the probability of him being a punishing husband is 0. Testing the effect of the treatment under different expectations of his behavior provides insight into whether husbands should be included in family planning consultations. When women do not expect husbands to be abusive, they would be more likely to adopt contraceptives and reduce pregnancies.

3 Methods and Procedures

The data for this study come from a household survey of 660 households across 12 villages in Meatu District of northern Tanzania. The sample was drawn in the following manner. Of the 19 wards in Meatu district, 9 were randomly selected to be included in the study. Those 9 wards contain 48 villages, of which 12 were randomly selected to participate in the study. Tanzanian law requires researchers to gain permission from village leaders to conduct research in each village. The village leaders in all the original 12 villages agreed to participate. At the village level, each village officer provided a list of every household residing in the village. These household lists were divided by sub-village (2-8 sub-villages per village); 2 to 5 sub-villages were randomly selected from each village for the study. Within each of the 2-5 selected sub-villages, an equal number of households were from each sub-village were randomly selected from the prepared household rosters to be included in the sample. Approximately 5 percent of the households originally selected refused to participate (and they were replaced). Households were considered eligible for participation in the study if they contained a married woman age 13 to 40 and the woman's husband also was living in the household.[8]

The Meatu household survey was implemented in August-November 2012, before the family planning program began, and again starting in July 2014, after the program ended. Due to attrition and migration, the second round of the household survey was not completed until February 2015. This household survey includes separate questionnaires for men and women, both of which include modules on socioeconomic status, health and family planning, spousal relations and agriculture. An average of 55 households were interviewed in each of the 12 study villages (60 households from ten of the villages; 30 households from two villages).

The family planning education program was cluster-randomized at the village level and treatment assignment was stratified along village-level baseline contraceptive use. The family planning program began with a reproductive health training for the community based distributors, provided

[8]If more than one wife was living in the household, the field staff interviewed the oldest wife who was still under 40 years old. This occurred in approximately 10 percent of households. If multiple pairs of spouses were living in the household and eligible, the couple which included the head of household was interviewed. This occurred in approximately 5 percent of households

by the Ministry of Health.[9] Three literate women from each of the eight treatment villages were selected to participate in the training at the district capital, Mwanhuzi, in February 2013. These 24 women then returned to their own villages, where they began work as "community-based distributors" (CBDs), consulting with households about family planning and working with the local dispensary.

Each CBD was paid monthly for visiting households in her village to share the information from the training and to discuss family planning options. During household visits, CBDs were trained to greet all family members first, and then to ensure a private discussion (either for wives or for husbands and wives together). The consultations included a discussion of the benefits of birth spacing, questions to gage interest in family planning, review of the long-term and short-term methods available and the fact that they are available free of charge, and information about the process of acquiring contraceptives. Because exactly three CBDs were selected for the work and paid to visit at least forty households per month, the number of CBD visits per household varies with village size. In general, smaller villages were treated more intensively, with a larger number of household visits, over the fourteen-month intervention. In most cases, the entire village was treated with the CBD visits. But in three of the larger villages (Villages 3, 10 and 11), one to two sub-villages were dropped from the treatment to reduce the amount of work required by the CBDs.[10] The treatment intensity varies from a household visit once every two weeks (mostly in the smaller villages) to a few visits per year. Seventy-three percent of households who were visited by a CBD had at least four visits per year (which could mean up to six visits over the course of the intervention given the timing of the follow-up household survey).[11]

To explore asymmetric information in fertility decisions over the course of the fifteen-month intervention, the treatment villages were split from the outset into two arms. In one treatment

[9]The training curriculum originated from a UNICEF handbook on family planning and child health. The teachers at the training were employed by the district hospital as public health educators, specializing in sexual and reproductive health.

[10]The dropped sub-villages were chosen based on two criteria: 1) They were not part of the random sample of sub-villages during the baseline and 2) They were not where the CBD lived. The CBDs were slightly more likely to live in sub-villages close to the village center. The sub-villages close to village center have more off-farm work opportunities, thus some bias in the sample selection may have been induced.

[11]The household survey data do not include information on which CBDs visited each home. And due to the decentralized implementation, it is also possible that any woman or couple was visited by multiple CBDs. For these reasons, in the analysis, it is not possible to control for *which* CBD visited each woman.

group (four villages), the CBDs consulted with the woman alone (individual treatment group), and in the other four villages, the distributors consulted with the couple together (couples treatment group). This split treatment approach allows one to measure the effect of asymmetric information in household decision-making; husbands in the first treatment group did not receive the information about methods and availability of family planning. Households in the four control villages received no consultations. The second research question, about whether to include husbands, will be tested by comparing the two treatment arms. The individual treatment group meets the criteria for the non-cooperative game defined above because the treatment design excludes husbands from information about the availability of contraceptives. The exclusion of the husband reduces his ability to explicitly prohibit contraceptive use, thus allowing her to choose between $C = 1$ and $C = 0$. The two testable hypotheses under this question (if the husband is expected [not] to be abusive, is she less [more] likely to take contraceptives?) will be explored in measuring the effect of the individual treatment. The geographical dispersion of households in the individual treatment, couples treatment and control group can be viewed in Figure 2. Each blue dot represents a household in the individual treatment, each black dot represents a household in the couples treatment and each red dot represents a control household.

In many cases, opposition from husbands, parents-in-law or from the women themselves prevented the intervention from being fully implemented. Although CBDs were encouraged to visit every household within their assigned sub-villages or village, if there was a conflict or opposition to their visit to a given household, they would not continue to pursue consultations with that household. The CBDs in each village estimated the approximate percentage of households who turned away the visits, and this estimate ranged from one in four households (Villages 3, 4 and 10) to one in twenty households (Village 2). Despite the fact that the CBDs reported that they visited almost all households, 36 percent of households assigned to the treatment group reported that they did not have any CBD visits. This effect is not substantially different across treatment arms: 32 percent of couples treatment households did not report visits, and 40 percent of individual treatment households did not have visits. The households who turn away the CBD visits can be classified as non-compliers (did not take up the treatment, despite assignment). Compliance varies starkly across villages. In Village 2, 94 percent of households were visited by a CBD. However, in

Village 10, where the CBDs were unable to complete assigned work, only 23 percent of households were visited by a CBD.[12]

The map also displays the distribution of village health dispensaries (similar to small clinics with pharmacies). Most women (75 percent) who use contraceptives report that they heard about their current method at the dispensary. As can be seen in Figure 2, many villages have their own dispensary, although in some cases, several villages share a dispensary or clinic (with dispensary). In Figure 2, I have distinguished between control dispensaries and treatment dispensaries. Each village reported the dispensary that villagers would attend for contraception. If that dispensary was also frequented by women who were assigned to the treatment (receiving CBD visits), that dispensary is characterized as a "treatment dispensary." (8 of the total 10 dispensaries).

It is important to note that all forms of contraception in Tanzanian public dispensaries are offered to women free of charge. In the baseline focus group discussions, most women reported that they did not know that contraceptives were free.

The empirical analysis in the study exploits the random assignment of individuals to the two treatment groups or to the control group to directly measure the treatment effect. Selection bias of the estimate of the impact of the program is reduced by the fact that individuals did not self-select into village treatment assignment.

4 Empirical Strategy

I first estimate the effect of the offer of the program on the study population. This estimation, known as the intent-to-treat (ITT) effect measures the effect of being in a treatment village on contraceptive use and pregnancy. It does not distinguish between those who complied with the treatment assignment (living in a treatment village and participating in CBD consultations) and

[12] In Village 10, all three CBDs gave birth during the course of the intervention. One CBD gave birth to triplets and was not able to perform most of her work duties to visit households in her village. Another CBD was married to the Village Executive Officer, who was accused of corruption during the intervention. She was reluctant to visit households in her village during the public accusation. Village 10 is also the largest and most populated village in the study sample (400 households across five sub-villages).

those who did not comply (living in a treatment village but not participating in consultations).

The ITT estimation uses dichotomous outcome variables, so I use a linear probability model (LPM), to estimate the following multivariate regression: [13]

$$y_i = \beta_0 + \beta_T T_i + X_i' \beta + \epsilon_i$$

where y_i represents usage of contraceptives or pregnancy for individual i, T_i is an indicator variable for whether a household was offered the treatment, X_i is a vector of household and individual control variables,[14] and ϵ_i captures all other individual or household unobservable factors that may influence the outcome variable, y_i. If no individuals in the control group participated in the treatment then the estimate of β from this regression is a consistent and unbiased estimate of ITT (impact of offering the treatment). This estimation method assumes that in order for the impact of T_i to be causal on y_i, all (unobservable) factors that are not in X (and thus are in the error term ϵ), are not correlated with treatment, T_i. In other words, $E[T\epsilon] = 0$. Because the assignment to treatment in this study was done through a random number generator that is not based on village or household characteristics, the estimate of β_T is an unbiased estimate of the impact of T_i.

Although villages were randomly assigned to treatment, it is possible that women who complied with participating in the treatment (consulted with the CBD) were different in some unobservable way from those assigned to treatment who did not comply.[15] The varying levels of treatment compliance across villages (from 23 percent in Village 10 to 94 percent in Village 2) require measuring the local average treatment effect (LATE).[16] This estimation strategy measures the treatment effect specifically for those who chose to comply with the treatment, that is, those for whom the offer of

[13] Although LPM does not exclude predicted values outside of [0,1], I use this estimation strategy because it does not impose a functional form on the error term. I also do not make forecasts on the outcome variables.

[14] The control variables include: wife's age, wife's age squared, female off-farm labor, male off-farm labor, wife is over the age of 40, contraceptive use in 2012, husband has been abusive, number of children born, number of children born squared, wife has completed primary school, standardized agricultural income, village population size, husband's desired fertility, wife dislikes family planning, husband wants at least 2 more children than wife, village-level stratification, distance to dispensary, wife wants no more children.

[15] For example, these could may contain husbands who are more willing to let a visitor speak privately to his wife about women's health.

[16] In essence, average treatment effect on the treated (ATT) and LATE require the same regressions. ATT includes a stronger set of assumptions and requires that the control group was not treated. In this case, 4.5 percent of the control group was treated, so the measurement is LATE.

the treatment persuaded them to obtain the treatment. In this case, this means that the estimated treatment effect pertains to a sample of couples that are more likely to invite the CBD into their home.

For the LATE, I measure the effect of P (actual participation in the treatment), instrumented with assignment to treatment (T), using the following first stage equation:

$$P_i = \beta_0 + \beta_T T_i + X_i'\beta + u_i$$

The instruments include village treatment assignment and village level dosage of CBD treatment (3 CBDs/village population) to represent the varying level of household visits as a function of village population. I then use the predicted values of the treatment, P_i, to estimate the effect on contraceptive use in the following second stage equation:

$$y_i = \beta_0 + \beta_P \hat{P}_i + X_i'\beta + \epsilon_i$$

Again, for this analysis to provide a causal and unbiased estimate of the effect of the treatment on the compliers (i.e. LATE), several assumptions must hold. First, the instruments, T_i must have relevant explanatory power for P_i. In other words, $Cov[T_i, P_i] \neq 0$. This can be tested by examining the combined significance of the instruments in the first stage equation. Second, the instrument must be exogenous to the second stage equation. In other words, $E[T_i'u_i] = 0$. Using the randomly implemented treatment variable (village treatment assignment) as an instrument for having actually been visited by a CBD is the key to the LATE estimation strategy. Treatment dosage (3 CBDs/ village population) is exogenous variables to the key intervention outcome, y_i, contraceptives use, as village population size was set prior to the intervention and is not related to village-level random assignment.

Next, I attempt to obtain a precise estimate of the treatment effect by using Difference-in-Differences (DID) estimation. This econometric method accounts for any time-invariant unobservable baseline differences. I measure the DID treatment effect by estimating the following regression:

$$y_{it} = \beta_0 + \beta_1 T_i t + \beta_2 T_i + \beta_3 t + X_{it}^{'}\beta + \epsilon_i$$

where i represents individuals, T_i is an indicator variable for the treatment group, t is an indicator variable for the follow-up time period (2014) and ϵ represents any other time-variant unobservable characteristics that may affect the outcome y_{it} (currently using any type of contraceptives). In this case, β_1 captures the treatment effect because it is the coefficient of the interaction of both time and treatment. I also combine the DID method with LATE, instrumenting the interaction variable with treatment assignment, dosage and time. This gives an estimate that accounts for time trends, uses both baseline and endline data and measures the effect of the treatment for those who were induced to participate in the consultations by treatment assignment.

The standard error estimates in this analysis are clustered at the village level and due to a small amount of clusters (12 villages), I employ the wild cluster bootstrap technique to adjust for potential over-rejection (Cameron and Miller, 2015).

5 Descriptive Statistics

The Meatu District, in rural Shinyanga region, is poor even by Tanzanian standards. Almost every home has dirt floors (98 percent) and only 1 percent have public electricity in the dwelling. Descriptive socioeconomic statistics across the control group, individual treatment group and couples treatment group are shown in Table 1. It is rare for women to work for pay outside of the family farm. In this analysis, I define "off-farm work" for both men and women as having employment or income outside of working within the family home or farm. Selling goods at a market or in the village, working as hired labor and teaching primary school are all examples of off-farm work in Meatu villages. Perhaps surprisingly, most households do not identify as religious, although they may still maintain traditional animist beliefs. As another sign of poverty, the majority of households in the study (77 percent) use unprotected improvised wells as a source of drinking water.

This is the least sanitary option in this region because livestock and wild animals can drink from and defecate in these water sources.

T-tests were performed across the three groups to measure statistical difference across the three groups. For most variables, the difference in means is not significant; however, the difference for husbands' desired number of additional children is significant. The average number of children born per woman across all groups (around 5) is high and the local rate of child mortality (around 14 percent of average children born) is also very high. A high infant mortality rate is evidence that parents may view child rearing as a risky investment and want greater numbers of children to compensate for the high risk of child death. This table also shows the difference between women's desired number of additional children, her perception of her husband's desire for additional children, and his actual desired number of children. The average difference between the number of additional children desired by a wife and her husband is 2.5 children. The wife's perception of her husband's desired number of additional children is, on average, larger than her desired number of additional children and much smaller than his desired number of additional children. While it is clear that women want fewer children than their husbands, and that they are not able to estimate their partners desires, they appear to know to some degree that their husbands prefer larger families.

Intimate partner violence is unfortunately common among this population (36 percent on average) and is likely underreported. Women's off-farm employment and husbands' alcohol consumption are both positively correlated with physical abuse. The 2012 levels of violence indicate her expectations on the probability that he will inflict violence in attempt to induce her to not take contraceptives. This is represented by the probability of punishment, π in the model; I will measure how the effect of the family planning program changes based on previous level of violence.

6 Results and Discussion

6.1 Attrition

A number of households could not be traced for the follow-up household interview, either because they refused to participate or due to migration. The rate of attrition in this experiment is 16 percent in the women's survey and 21 percent in the men's survey. In cases of spousal separation, interviewing the woman was prioritized for the second round of the household survey. The rate of attrition varies across villages. Villages 11, 5 and 6 had the highest men's attrition rates at 23 percent. Village 1 and 8 had the lowest attrition men's rates at 8 percent. The final sample size is 559 households.

Attrition did not occur randomly on observable characteristics. The 2012 rate of contraceptive use among those who did not attrit is 13 percent, while the rate of contraceptive use for the attritted households is 9 percent, although this difference is not statistically significant. Attrition levels vary slightly by treatment status: 16 percent attrition in the control group, 16 percent in the individual treatment group and 13 percent in the couples treatment group (differences not statistically significant). However, the attritted households were on average further from dispensaries (by 0.06 km, $t = 1.58$), contained women who were less educated (7.4 percent less primary completion, $t = 2.01$) and were slightly less likely to have women working off the farm (by 6.6 percent, $t = 0.26$). This slightly different attrition patterns by treatment groups make it impossible to completely rule out observable and unobservable differences between treatment and control households; yet, the estimate of the impact of the treatment on fertility behavior is unlikely to suffer from substantial bias due to differential attrition.

6.2 Longitudinal Changes in Family Planning

Changes in contraceptive use pre- and post-intervention can be seen in Table 2. Across all groups, I show the levels of contraceptive use in 2012, the change in current use of contraceptives, changes in pregnancy rates and changes in men's fertility preferences.

The percent of woman who are pregnant dropped over the course of the treatment and this drop is larger in the treatment groups. However the increase in the use of contraception is spread across all groups. The percent of women who were using contraception in 2012, before the intervention in the control, individual and couples treatment groups were 14 percent, 15 percent and 10 percent, respectively. This percentage increased in 2014 to 29 percent, 19 percent and 22 percent, respectively. While this shows a clear increase in the usage of contraceptives, this increase is surprisingly present in the control group as well as in the treatment groups. I discuss possible explanations for this increase in reported contraceptive use in the next section. The household survey data from 2012 provide insights into the main drivers of contraceptive use. Formal education, work status (having an off-farm income) and a larger number of living children increase the likelihood that a woman had ever used contraceptives in 2012.

A second type of data was collected over the course of the intervention to gain insight into the fluctuations in village-level contraceptive use during process of bargaining over fertility (Figure 3). The community-based distributors (CBDs) collected monthly data as they visited each household, thus the observations include only the two treatment groups. The intervention data were recorded for 40 of the households that the CBD visited each month. In many cases, the data were from a different set of 40 households each month (e.g., January was sub-village 1, February was sub-village 2). As a result, the fluctuations observed in Figure 1 are mostly a result of the heterogeneous sampling of observations each month. However, contraception adoption and subsequent abandonment are also common over the course of women's fertility life course. Both the couples and individual treatment groups appear to be increasing their use of contraceptives, although at differing rates.

6.3 Estimation of Treatment Impact

In this section, I first explore the effect of the program's possible reduction in the psychosocial cost of contraceptives and the impact it has on fertility behavior. This exploration involves measuring the *combined* effect of both treatment groups. I then measure the effect of the individual and couples treatment groups separately, to better understand the effect of the inclusion of husbands in consultations about family planning. And finally, I measure heterogeneity of the treatment effects by differences in expectations about the husband's behavior change the treatment effects.

6.3.1 Psychosocial Cost of Contraceptives

I begin by exploring the treatment effect on fertility behavior, which would suggest a reduction in the psycho-social cost of contraceptives through the family planning program. Table 3 shows the negative effects of any treatment (including both couples and individual treatments) on pregnancies. For the entire study population, Column (1) shows that pregnancies decreased by an average of 6.4 percentage points, and this effect is statistically significant at the 1 percent level. In column (2) of Table 3, I measure the intent to treat effect by estimating the effect of an individual being assigned to the individual or couples treatment group on contraceptive use. The ITT is negative but not statistically significant. Columns (3) and (4) of Table 4 show the estimation results for the sub-population of individuals that chose to comply with treatment assignment, or the LATE. Column (3) shows that the instruments (village treatment assignment and dosage (a function of village size)) are significant predictors of whether a household was treated (any type of treatment) (F-stat.=14.5). In column (4), the predicted values of the treatment, $\hat{P}_i$ are used to estimate the local average treatment effect on pregnancies. However, despite the more precise measurement of the effect of the treatment on the subpopulation of compliers, the coefficient in column (4) of Table 3 is still negative and not statistically significant. Finally, under the difference-in-difference estimation strategy, which is a more precise measure of ITT using OLS, the effect of the combined treatment (as an interaction between treatment village and time) is also negative and not statistically significant. Finally, the local average treatment effect, using difference-in-differences estimation, is negative and statistically significant at a 10 percent level. Using the LATE instruments and the interaction of time and treatment, women in the treatment group are 15.4 percentage points less likely to be pregnant in 2014. This table provides support for the programs impact on the reduction of excess pregnancies

Table 4 gives results confirm that much of the descriptive observations in Table 2, there has been a population-wide increase in reported contraceptive use. In Column (1), the effect of time on uptake of contraception is large and significant. Because the control group increased their use of reported contraceptive use more than the treatment groups, the intent-to-treat effect in column (2) is negative (although not statistically significant). Column (4) and (5) demonstrates the negative (though not statistically significant) effects using LATE and DID. This table demonstrates the lack of statistically significant effect of any treatment (couples and individual treatment) on contraceptive use.

How is it possible that reported contraceptive use increased in all groups yet pregnancies dropped only in the treatment group? One possible explanation is a bias in self-reported contraceptive use. The process of enumeration about family planning and the larger focus on improving maternal health in the district could influence respondents' reported answers about contraceptive use and pressure respondents to indicate that they are using contraceptives when they are not. In other words, responses may be subject to desirability bias. Pregnancy, on the other hand, is less likely to be biased and is more easily observed.[17] A second explanation is that the substantial reduction in pregnancies in the treatment groups, amid reported increases in contraceptive use in the entire study sample, provides evidence of a possible lagged dispersion of contraceptive behavior from the treatment group to the control group. It is possible that the women in the control group have just began use of contraceptives, are not using the contraceptive methods properly, or are using them inconsistently. If this theory were true, we would expect to see a reduction in pregnancies in the control group in a later time period. The reduction in pregnancies as a result of treatment is in line with the predictions of the conceptual framework. A decrease in the psychosocial cost of adopting contraceptives (c_c) was predicted to increase use of contraceptives and reduce pregnancies. Improvements in knowledge, reduction in social stigma, and an increased public dialogue around family planning all decreased the psychosocial cost of family planning.

6.3.2 Effect of Including Husbands on Fertility Decisions

The second research question relates to the effectiveness of including husbands in family planning consultations. Table 5 shows the results of separated individual and couples treatment effects on pregnancies and demonstrates that across all specifications, the individual treatment effect is

[17] If anything, it is likely under-reported as many women are not confident of pregnancies in the first trimester

negative. In the LATE+DID specification, women decreased their pregnancies by 15.8 percentage points; this effect is statistically significant at the 10 percent level. Although the couples treatment appears to have a negative effect, it is never statistically significant. Table 6 shows the results of separated individual and couples treatment effects on contraceptive use. The effect of the couples treatment on reported use is mixed. Under ITT, the effect of the couples treatment on contraceptive use is negative. However, the effect is positive under LATE using OLS, DID and LATE using DID. It is not statistically significant under any of these specifications. The effect of the individual treatment on reported contraceptive use is consistently negative across specifications. Under the local average treatment effect, women in the individual treatment are 18.1 percentage points less likely to report contraceptive use than women in the control group (statistically significant at the 5 percent level).

The validity of reported contraceptive use is again called into question given the negative effect of the individual treatment on pregnancies. Pregnancies are likely less subject to reporting bias than contraceptive use. The individual group also received consultations about family planning without their husbands' involvement and potentially without their husbands' approval, so in the case of covert use of contraceptives, these women may be less willing to report contraceptive use to strangers, including enumerators.[18] The statistically significant negative effect of the individual treatment on pregnancies seems to imply that family planning consultations are more effective without husbands' involvement. However, if we examine the effect of the couples treatment on husbands' fertility desires, relative to the individual group and the control group,Table 8 demonstrates that the involvement of husbands had a negative but insignificant effect. It is possible that while excluding husbands may lead to fewer births, including husbands may reduce their highly influential fertility desires.

In addition to the quantitative household and intervention data, I also collected qualitative data through focus group discussions in both 2012 and 2014. The most intriguing of these discussions was with the family planning community-based distributors (CBDs) after the intervention was complete. These women had essentially facilitated family planning learning and experienced bargaining over fertility within their own villages. Both CBDs who implemented the individual treatment and those

[18]The enumerator interviews for the household survey take place in private.

that implemented the couples treatment insisted that including husbands in the consultations is much more effective for education. According to one distributor: "If both husband and wife are involved in the CBD meeting, then the start of the conversation is even and men don't have all the power. They will continue to discuss family planning together and it is easy for them to reference what they learned from the CBD." This observation supports reproductive health policies that build on the couples intervention and intentionally include husbands in conversations about family planning.

The second research question also brings up two testable hypotheses. Whether to include husbands in family planning conversations depends on expectations of violence in the household. The individual treatment allows women covert information about contraceptives. While they appear to reduce births as a result of the treatment, how does this effect change as a result of husbands abusive behavior? These testable hypotheses are: ($2a$) When women do not expect husbands to be abusive ($\pi = 0$), they would be more likely to adopt contraceptives and reduce pregnancies and ($2b$) when women do expect abusive husbands ($\pi = 1$), women would be less likely to adopt contraceptives and reduce pregnancies.

This test involves estimating the effect of the individual treatment group on key outcomes. When husbands are not involved in family planning consultations, his ability to explicitly prohibit contraceptive use is limited. Here, I create a variable to represent the conditions of the model: husbands desire more children than wives, husbands were (or were not) abusive at baseline. I interact this variable with treatment to observe how violence expectations change the effect of the treatment. The results can be seen in Table 7. When women do not expect their husbands to be abusive, they are likely to take contraceptives, as observed in column (1), the coefficient on the interaction between non-violent husband and individual treatment. These women are 7.7 percentage points less likely to be pregnant and endline (statistically significant at 10 percent level). However, while the individual treatment had a consistent negative effect on pregnancy, this effect is reversed to a positive effect in cases of abusive husbands. When women expect husbands to be violent, ($\pi = 1$), they are less likely to privately adopt contraceptives and reduce births. This positive effect is statistically significant at the 5 percent level. The fact that the sign switches from negative to positive under the expectation of a violent husbands supports the framework predictions.

Table 8 shows the effect of the individual and couples treatments on husbands' fertility desires. In column (2), the couples treatment reduces husbands' fertility preferences, though not in a statistically significant way. In column (1), I measure the effect of the couples treatment on hubands' fertility desires for the subsample of violent husbands. The effect is not statistically significant, but shows that the couples treatment again had an effect of reducing husbands' large fertility desires. This indicates that the joint educational conversations with the CBD changed the husbands demand for children. The individual treatment may reduce unwanted pregnancies significantly and this is likely to improve private welfare for the wives (who have smaller fertility desires). This strategic behavior is consistent with the non-cooperative model. Yet, the reduction in the husbands' fertility preferences may change the household model away from strategic behavior and individual best responses towards one of cooperation. This is evidence of an ongoing trade-off between individual welfare gains and cooperative value in marriage.

There are clear policy implications of the above dual treatment effects. The two ways of providing family planning information need not be exclusive. In cases of starkly heterogeneous fertility preferences and low intra-couple bargaining power for women, educational consultations should be joint and provided at the household level. However, a simultaneous informational distribution program about cost and access held privately for women would meet their immediate demand for contraceptives. A dual program, providing both joint education and individual information, would potentially both align preferences for cooperation in the long run and reduce excess fertility in the short run.

7 Conclusion

The experiment described in this paper provides evidence of the positive effect of a community education program in reducing unwanted births in an area of high fertility. The process of training community-based distributors (CBDs) and employing them to visit households and discuss contraceptive options, reduced the psycho-social cost of fertility control and resulted in fewer pregnancies.

The effect of the program is nuanced, though, in the relationship between reported contraceptive use and reduced pregnancies. Over the two-year study time period, reported contraceptive use increased substantially across both treatment groups and the control group. However, the family planning program reduced pregnancies in the treatment group by 15.8 percent, a decrease that is statistically different from the control group.

The decrease in treatment group pregnancies combined with a study-wide reported increase in contraceptive use allows for two potential explanations. First, it is possible that during the process of survey interviews at baseline and endline, respondents felt pressure to report using of contraceptives, even when they were not. Enumeration does not exist within a vacuum and it is entirely possible that the presence of a research project may influence survey responses in a way entirely distinct from the intervention. This sort of desirability bias may have resulted in a larger measurement of contraceptive use in the control group. A second potential explanation is a lagged dispersion of contraceptive behavior from the treatment group to the control group. Households who were visited by a CBD over the course of the treatment may have been able to share this information with neighboring villages, and the effect of the treatment spilled over to non-treated households. At the time of endline enumeration, women in the control group may have just begun using contraceptives, or may not yet be using the properly or consistently.

The answer to the question of how outcomes change when husbands are involved in educational conversations about family planning depends on policy objectives and preferences. Women who consulted with the family planning workers individually (without their husbands) had a larger reduction in pregnancies than those who consulted together with their husbands. However, the involvement of husbands in these discussions had the effect of reducing husbands' fertility preferences. These fertility desires are very influential on high fertility rates. The reduction in fertility desires was small and not significant for the entire population, but much larger and significant for the sub-sample of abusive husbands. In a region of the world where women have limited bargaining power within the household, private information about contraceptives can afford women fertility control and improved welfare. Meanwhile, joint consultations with an informed family planning worker could improve cooperation through aligning preferences for children. The non-cooperative model predicts that, given the opportunity, women will take advantage of private information and delay births. This proposition is confirmed by the empirical evidence of the study population and by the sub-population of abusive households. The model prediction that, when women expect abusive husbands, they will be less likely to adopt contraception is also confirmed the the empirical evidence (though through a small effect).

This randomized field experiment is small in scale: the intervention included 24 family planning workers who had a two-week training in reproductive health and this program affected eight villages across one district in Tanzania. Yet, the study provides substantial support for the effectiveness of community-based distribution of family planning services in reducing excess fertility. The trade-off between improved fertility control for women on one hand, and improved communication and aligned preferences on the other supports policy interventions with both joint and individual informational sessions. Inclusion of husbands in education consultations may reduce large and unequal fertility desires and the exclusion of husbands in informational consultations may allow women to meet immediate demand for fertility control. Further research on the effect of husbands' reduced fertility desires on the fertility bargaining process would lead to a better comparison of these trade-offs. In areas of the developing world with high fertility rates and starkly different spousal fertility preferences, community-based distribution of family planning information plays an important role in reducing unwanted pregnancies.

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8 Figures

Figure 2: Treatment and Control Households in Meatu District

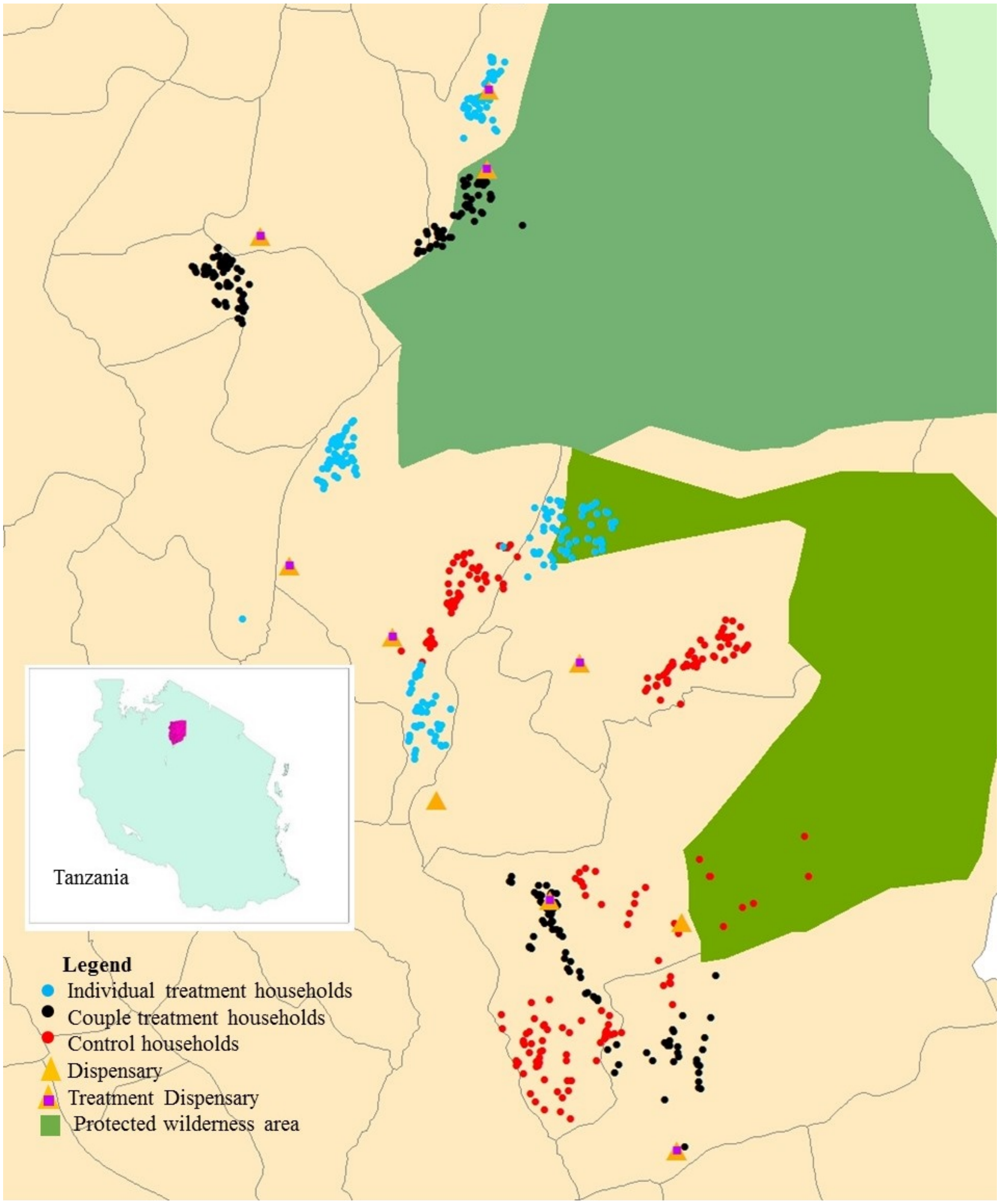
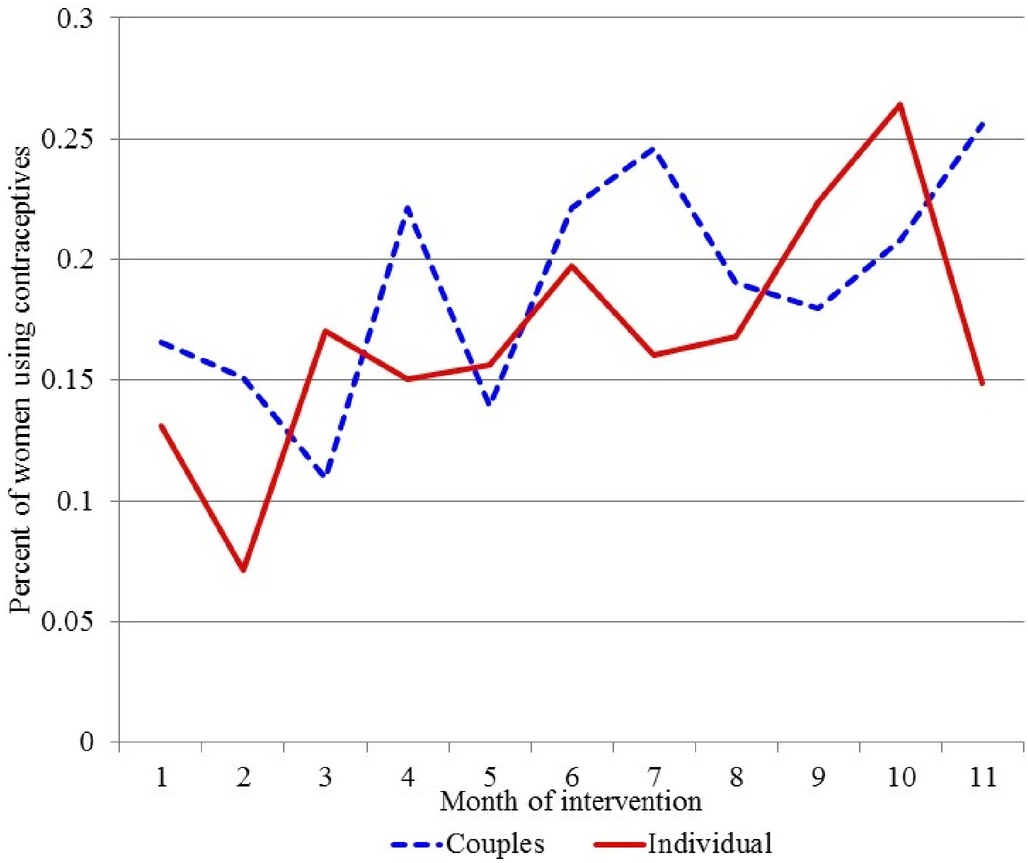


Figure 3: Dynamic Contraceptive Use by Treatment Type



9 Tables

Table 1: Sample Characteristics and Balance

VARIABLES	(1) Control	(2) Indiv. Treat.	(3) Couples Treat.	(4) P-value
Wife has off-farm income	0.08	0.04	0.08	0.78
	(0.02)	(0.02)	(0.02)	
Not religious	0.70	0.60	0.72	0.79
	(0.04)	(0.04)	(0.04)	
Distance to dispensary (km)	0.77	0.66	0.37	0.08*
	(0.02)	(0.03)	(0.02)	
Unprotected well for water	0.96	0.73	0.63	0.14
	(0.02)	(0.04)	(0.04)	
Number of bikes in hh	1.30	1.28	1.27	0.54
	(0.06)	(0.06)	(0.07)	
Rainy season ag income (USD)	833.85	549.39	857.91	0.91
	(74.53)	(38.99)	(55.07)	
Num. cattle owned	18.49	9.18	24.78	0.98
	(2.37)	(0.99)	(7.60)	
Num. children born per woman	5.18	5.46	5.13	0.22
	(0.24)	(0.23)	(0.27)	
Num. children died per woman	0.74	0.77	0.65	0.56
	(0.12)	(0.08)	(0.09)	
Wife desired num. add'l children	1.68	1.43	1.30	0.16
	(0.20)	(0.16)	(0.15)	
Wife's view of husb. desired num add'l chrn	2.38	1.72	1.17	0.08*
	(0.25)	(0.18)	(0.15)	
Husb desired add'l children	4.42	3.27	3.59	0.42
	(0.41)	(0.29)	(0.29)	
Husband has ever been abusive towards wife	0.39	0.39	0.32	0.12
	(0.04)	(0.04)	(0.04)	
Wife has hidden contraception from husb.	0.07	0.03	0.04	0.32
	(0.02)	(0.01)	(0.02)	
Wife has completed primary school	0.90	0.83	0.92	0.44
	(0.02)	(0.03)	(0.02)	
Observations	146	157	144	

Cluster robust standard errors in parentheses using Cameron and Miller (2015) bootstrapping for a small number of clusters.

Table 2: Longitudinal Changes in Family Planning

	2012			2014		
VARIABLES	Ctrl.	Indiv. Treat.	Coup. Treat.	Ctrl.	Indiv. Treat.	Coup. Treat.
Woman is using any type contraception	0.14	0.15	0.10	0.29	0.19	0.22
	(0.03)	(0.03)	(0.02)	(0.04)	(0.03)	(0.03)
Wife currently is pregnant	0.19	0.21	0.26	0.18	0.13	0.16
	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)
Wife ever used family planning in 2012	0.19	0.18	0.15			
	(0.03)	(0.03)	(0.03)			
Husb desired add'l children, 2012	4.99	3.73	3.80	3.08	2.71	2.76
	(0.40)	(0.28)	(0.27)	(0.30)	(0.22)	(0.26)
Observations	177	195	183	163	186	165

Standard errors in parentheses

Table 3: Any Treatments: Effect on Pregnancies

VARIABLES	(1) Single difference Time Effect	(2) Single diff. ITT	(3) Single diff. 1st stage	(4) Double diff. LATE	(5) Double diff. ITT	(6) Double diff. LATE
Post	-0.064***				-0.019	-0.006
	(0.023)				(0.292)	(0.046)
Assigned to treatment		-0.025	0.439**		0.046	
		(0.035)	(0.189)		(0.041)	
Dosage of CBDs in vill.			13.724**			
			(5.892)			
Participated in treatment				-0.023		0.119**
				(0.046)		(0.055)
Treatment village*Post					-0.075	
					(0.058)	
Participated * Post						-0.142*
						(0.075)
Controls?	No	Yes	Yes	Yes	Yes	Yes
Observations	1,109	512	560	512	1,066	1,066
R-squared	0.007	0.062	0.332	0.052	0.068	0.065

Control variables include: wife's age, wife's age squared, female off-farm labor, male off-farm labor, wife is over the age of 40, contraceptive use in 2012, husband has been abusive, number of children born, number of children born squared, wife has completed primary school, standardized agricultural income, village population size, husband's desired fertility, wife dislikes family planning, husband wants at least 2 more, children than wife, number of wives, village-level stratification, distance to dispensary, wife wants no more children.

Cluster-robust standard errors in parentheses using Cameron and Miller (2015) bootstrapping for small number of clusters.
*** p<0.01 ** p<0.05 *p<0.1

Table 4: Any Treatments: Effect on Contraceptive Use

VARIABLES	(1) Single difference Time Effect	(2) Single diff. ITT	(3) Single diff. 1st stage	(4) Single diff. LATE	(5) Double diff. ITT
Post	0.095***				0.153***
	(0.023)				(0.000)
Assigned to treatment		-0.087	0.439**		0.006
		(0.078)	(0.189)		(0.011)
Dosage of CBDs in vill.			13.724**		
			(5.892)		
Participated in treatment				-0.130	
				(0.084)	
Treatment village*Post					-0.085
					(0.052)
Controls?	No	Yes	Yes	Yes	Yes
Observations	1,120	519	560	519	1,077
R-squared	0.015	0.180	0.332	0.160	0.362

Control variables include: wife's age, wife's age squared, female off-farm labor male off-farm labor, wife is over the age of 40, contraceptive use in 2012, husband has been abusive, number of children born, number of children born squared, wife has completed primary school, standardized agricultural income, village population size, husband's desired fertility, wife dislikes family planning, husband wants at least 2 more, children than wife, number of wives, village-level stratification, distance to dispensary, wife wants no more children.

Cluster-robust standard errors in parentheses using Cameron and Miller (2015) bootstrapping for small number of clusters.
*** p<0.01 ** p<0.05 *p<0.1

Table 5: Separate Treatments: Effects on Pregnancies

VARIABLES	(1) Single difference ITT	(2) Single diff. LATE	(3) Double diff. ITT	(4) Double diff. LATE
Post				-0.008
				(0.048)
Couples treatment		-0.031		0.050
		(0.046)		(0.040)
Indiv. treatment		-0.007		
		(0.059)		
Assigned to indiv. treat	-0.027		0.002	
	(0.042)		(0.048)	
Assigned to couples treat	-0.022		0.029	
	(0.030)		(0.033)	
Participated in couples * Post			-0.034	-0.079
			(0.054)	(0.063)
Participated in indiv. * Post			-0.016	-0.157**
			(0.179)	(0.073)
Controls?	Yes	Yes	Yes	Yes
Observations	512	512	1,068	1,066
R-squared	0.062	0.054	0.064	0.064

Control variables include: wife's age, wife's age squared, female off-farm labor, male off-farm labor, wife is over the age of 40, contraceptive use in 2012, husband has been abusive, number of children born, number of children born squared, wife has completed primary school, standardized agricultural income, village population size, husband's desired fertility, wife dislikes family planning, husband wants at least 2 more, children than wife, number of wives, village-level stratification, distance to dispensary, wife wants no more children.

Cluster-robust standard errors in parentheses using Cameron and Miller (2015) bootstrapping for small number of clusters.
*** p<0.01 ** p<0.05 *p<0.1

Table 6: Separate Treatments: Effects on Contraceptive Use

VARIABLES	(1) Single diff ITT	(2) Single diff LATE	(3) Double diff ITT	(4) Double diff LATE
Post				0.146***
				(0.033)
Couples treatment		-0.048		0.034
		(0.069)		(0.026)
Indiv. treatment		-0.193**		
		(0.097)		
Assigned to indiv. treat	-0.116		-0.035*	
	(0.075)		(0.020)	
Assigned to couples treat	-0.044		-0.014	
	(0.060)		(0.028)	
Participated in couples * Post			0.002	-0.058
			(0.013)	(0.046)
Participated in indiv. * Post			-0.040	-0.146
			(0.057)	(0.128)
Controls?	Yes	Yes	Yes	Yes
Observations	519	519	1,079	1,077
R-squared	0.184	0.165	0.360	0.358

Control variables include: wife's age, wife's age squared, female off-farm labor, male off-farm labor, wife is over the age of 40, contraceptive use in 2012, husband has been abusive, number of children born, number of children born squared, wife has completed primary school, standardized agricultural income, village population size, husband's desired fertility, wife dislikes family planning, husband wants at least 2 more, children than wife, number of wives, village-level stratification, distance to dispensary, wife wants no more children.

Cluster-robust standard errors in parentheses using Cameron and Miller (2015) bootstrapping for small number of clusters.
*** $p<0.01$ ** $p<0.05$ *$p<0.1$

Table 7: **Changing Treatment Effects Under Violent Behavior Expectations**

VARIABLES	(1) Non-violent husbands Double diff	(2) Violent husbands Double diff
Post	-0.007	-0.007
	(0.048)	(0.048)
Couples treatment	0.038	0.024
	(0.046)	(0.041)
Indiv. treatment		0.070
		(0.055)
Participated in indiv. * Post	-0.161**	-0.161**
	(0.074)	(0.074)
Participated in couples * Post	-0.080	-0.079
	(0.063)	(0.063)
Viol husb desires more chrn than wife * Coup treat		0.085**
		(0.038)
Viol husb desires more chrn than wife * Indiv treat		0.138**
		(0.061)
Non-viol husb desires more chrn than wife * Coup treat	0.028	
	(0.057)	
Non-viol husb desires more chrn than wife * Indiv treat	-0.066	
	(0.053)	
Controls?	Yes	Yes
Observations	1,068	1,068
R-squared	0.059	0.060

Control variables include: wife's age, wife's age squared, female off-farm labor, male off-farm labor, wife is over the age of 40, contraceptive use in 2012, husband has been abusive, number of children born, number of children born squared, wife has completed primary school, standardized agricultural income, village population size, husband's desired fertility, wife dislikes family planning, husband wants at least 2 more, children than wife, number of wives, village-level stratification, distance to dispensary, wife wants no more children.

Cluster-robust standard errors in parentheses using Cameron and Miller (2015) bootstrapping for small number of clusters.
*** p<0.01 ** p<0.05 *p<0.1

Table 8: Effect on Husbands' Fertility Preferences

VARIABLES	(1) Violent husbands Double diff	(2) All husbands Double diff
Post	0.155	0.148
	(0.164)	(0.344)
Couples treatment	-0.233	-0.212
	(0.366)	(0.243)
Indiv. treatment	-0.022	-0.220
	(0.245)	(0.288)
Viol husb desires more chrn than wife * Coup treat	-0.532**	
	(0.229)	
Viol husb desires more chrn than wife * Indiv treat	-0.115	
	(0.329)	
Participated in couples * Post		-0.336
		(0.459)
Participated in indiv. * Post		0.230
		(0.472)
Controls?	Yes	Yes
Observations	986	986
R-squared	0.747	0.744

Control variables include: wife's age, wife's age squared, female off-farm labor, male off-farm labor, wife is over the age of 40, contraceptive use in 2012, husband has been abusive, number of children born, number of children born squared, wife has completed primary school, standardized agricultural income, village population size, husband's desired fertility, wife dislikes family planning, husband wants at least 2 more, children than wife, number of wives, village-level stratification, distance to dispensary, wife wants no more children.

Cluster-robust standard errors in parentheses using Cameron and Miller (2015) bootstrapping for small number of clusters.
*** p<0.01 ** p<0.05 *p<0.1