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Fertility and polygyny: Experimental evidence from Burkina Faso ☆

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ABSTRACT

Decision-making about fertility differs between monogamous and polygynous households. In an experiment in Burkina Faso that gives women access to free contraceptives, either alone or with their husband, involving the husband decreases contraceptive use among monogamous women, but not among polygynous women. Where there is co-wife rivalry, it increases contraceptive use. This is consistent with a model where monogamous women have a stronger preference for contraceptives than their husband, while this preference difference is smaller or even reversed among polygynous households due to co-wife competition around fertility.

1. Introduction

While in most low- and middle-income countries fertility has decreased substantially in recent decades, it remains high in sub-Saharan Africa, at an average of 4.6 live births per woman (United Nations, 2019).[1] Even though modern contraceptives have been made more available in sub-Saharan Africa, less than 25% of women use them (United Nations, 2017). This points to an important demand constraint (Alkema et al., 2013).[2] Several studies have looked at the demand side by analyzing the decision-making process around fertility, mostly focusing on monogamous households.[3] Fertility decisions in polygynous households – where one man lives with multiple wives – have received little attention in economics. This is surprising given the high prevalence of polygyny in sub-Saharan Africa. 25% of married women in sub-Saharan Africa live in polygynous households (Arthi and Fenske, 2018), and in West-Africa even 40% (Dalton and Leung, 2014).

This evidence gap might constrain the design of effective policies, since what we know works for monogamous households might not work or even be counterproductive for polygynous households. For example, from Ashraf et al. (2014) we know that where men have stronger fertility preferences than their wife, involving the husband in the decision process might reduce the uptake of concealable contraceptives. This finding suggests that if policy aims to increase contraceptive uptake, it would need to reduce men's fertility preferences or bypass men altogether. This might not work for polygynous households if fertility preferences of men and women strongly differ between monogamous and polygynous households.

Sociologists, anthropologists and demographers have long discussed the link between polygyny and fertility, which can be structured along two views. The first view argues that polygyny *lowers* fertility per woman because of a 'substitution effect' (Pebley et al., 1988; Pison, 1986). As men focus on the total number of children and can divide their ideal number of children between co-wives, the number of children per woman would be lower in polygynous households than in monogamous households. The second view argues that polygyny *increases* fertility per woman because of a 'competition effect'. Women in polygynous households compete for social status, the affection and love

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[1] Most countries have gone through a transition from a state of high birth and mortality levels to a state of low birth and mortality levels. As such transition typically starts with declining mortality followed by declining fertility, the slow transition in sub-Saharan Africa leads to rapid population growth and consequent difficulties to raise living standards (Bongaarts and Casterline, 2013).

[2] This is in line with the view among economists that fertility preferences are the main driving factors rather than the supply of contraceptives (Pritchett, 1994).

[3] It has been documented that the low use of contraceptives in sub-Saharan Africa is explained by men's stronger fertility preferences (Mason and Taj, 1987; Westoff, 2010; Doepke and Tertilt, 2018) combined with their larger decision-making power (World Bank, 2012). The gender gap in desired fertility makes that bargaining over fertility (Rasul, 2008; Doepke and Tertilt, 2018) and strategic concealing of contraceptives from the husband (Ashraf et al., 2014) are common.

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by the husband, and future access to the husband's resources through inheritance, which increase with the number of children (Jankowiak et al., 2005; Bove and Valeggia, 2009; Mammen, 2019).

Both effects would decrease or even reverse fertility preference differences between husband and wife. This might change the effect of the husband's involvement on the uptake of contraceptives. Specifically, while the involvement of the husband decreases the uptake of contraceptives among monogamous couples, this effect would be weaker or even reverse sign among polygynous households.

To test this, we use a field experiment with a sample of 1074 couples, stratified between monogamous and polygynous couples, in rural Burkina Faso. In the experiment, we distribute a voucher that gives women access to free family planning services and a modern contraceptive supplied by local health facilities. We experimentally vary the husband's involvement by randomizing whether the woman in private or the husband with the woman being present receives the voucher.

Using these data, we investigate the effect of the husband's involvement on the likelihood that the voucher is used, and we compare this effect between monogamous and polygynous couples. These pre-specified analyses are complemented with more exploratory analyses. Specifically, to explain differences in the effect of the husband's involvement, we investigate the role of co-wife rivalry and rank in polygynous households. Next, we compare voucher use between monogamous and polygynous couples within the separate treatments to identify the role of women's and husbands' preferences. Finally, we look at contraceptive choice in the experiment, and we analyze heterogeneity by whether women had once used contraceptives (but stopped using them) before the experiment.

Our results are summarized as follows. We find that the husband's involvement decreases the use of the voucher among monogamous women by 5 percentage points (with a base of 12.9% in the woman treatment), but not among polygynous women. Where there is co-wife rivalry in polygynous households, as proxied by a lack of co-wife friendship, the husband's involvement increases voucher use by 10.8 percentage points (with a base of 4.5% in the woman treatment). This effect is strongest among wives of rank 2+ (i.e., wives who were married after the first wife) in polygynous households. These results are consistent with a model where monogamous women have a stronger preference for contraceptives than their husband, while co-wife competition reverses this preference difference among polygynous households. Additional analysis suggests that co-wife competition influences the preferences of both the wife and the husband.

We make the following contributions to the literature. First, there is very little empirical evidence in economics on how fertility decisions are made in polygynous households. We know that the involvement of the husband is key in monogamous households (e.g., Ashraf et al., 2014; D'Exelle and Ringdal, 2022), but know little about the husband's role in polygynous households. Rossi (2018) is the only empirical study known to us that investigates fertility decisions in polygynous households. This study exploits the transition between monogamous and polygynous households to analyze fertility decisions, but does not look at the effect of the husband's involvement in the decision. Also, it is unable to separate the competition effect from the substitution effect. Experimentally varying the involvement of the husband not only allows us to analyze how the effect of the husband's involvement varies between monogamous and polygynous households. It also enables us to unpack the different channels, by separately identifying the influence of husbands and wives, and how they interact with each other. Our contribution to the work of Rossi (2018) is therefore twofold. Not only do we separately identify a competition effect and a substitution effect. We also look at how husbands in polygynous union moderate co-wife competition for more children. This is a new mechanism, which has not been documented yet.[4]

Second, mixed evidence exists on women's relation with co-wives in polygynous households. It has been documented that this relation can be collaborative or competitive (Mason, 1988; Hamadeh, 1999).[5] Evidence about the role of co-wife rank in polygynous households is more consistent. Several studies from different disciplines have documented how lower-ranked co-wives (i.e., women who were married after the first wife) have less favorable access to household resources, as measured by children's education (Matz, 2016; Mammen, 2019), children's growth (Gibson and Mace, 2007; Wagner and Rieger, 2015) or income obtained in a public goods game implemented in an experimental lab (Munro et al., 2019; Hidrobo et al., 2020). Our study contributes to this literature by documenting how co-wives compete over fertility, how husbands moderate co-wife competition over fertility, and how both depend on co-wives' relation and rank.

The remainder of the paper is organized as follows. Section 2 presents the context, while Section 3 explains the design and the data collected. Section 4 develops hypotheses and an empirical strategy to test them. Section 5 presents the results, followed by some extensions in Section 6. Section 7 concludes.

2. Context

We conducted our study in rural Burkina Faso. This country has with 5.35 children per woman one of the highest fertility rates in the world. While the use of modern contraceptives has doubled from 15% in 2010 to 31% in 2019, 23% of women of reproductive age still have an unmet need for family planning (PMA2020, 2019). From eight sub-Saharan African countries studied by Field et al. (2016) Burkina Faso has the largest gender gap in desired fertility and completed fertility. Married men desire more children than women, and have more children than women of the same cohort. One potential explanation for the latter finding is the high prevalence of polygyny. In Burkina Faso, more than half (52%) of cohabiting or married women of childbearing age live in polygynous households (Institut National de la Statistique et de la Démographie - INSD/Burkina Faso and ICF International, 2012), which places it as the African country with the highest prevalence of polygyny in Africa and the highest number of co-wives after Guinea.

Burkina Faso is currently investing considerable resources in family planning, which it sees as an important priority to reduce maternal and child mortality and promote economic development. In 2012, the government introduced a national family planning week, an event that takes place twice a year and combines awareness campaigns on the benefits of family planning with the provision of free family planning visits and contraceptives. To reach the goal of a prevalence of modern contraceptive use of 60% in 2025 (de la Santé, 2017), in January 2020 the government decided to make family planning services and modern contraceptives free. Despite an increase in knowledge of family planning methods, acceptance of family planning remains low in Burkina Faso. One of the main barriers identified by the government is the low preference of men for family planning combined with their high decision-making power in the couple. To tackle this barrier, they are currently experimenting with 'husbands schools' (de la Santé, 2017).

[4] While some recent experiments studied intra-household decision-making in polygynous households (see e.g., Boltz and Chort, 2016; Barr et al., 2019; Munro et al., 2019; Heath et al., 2020; Hidrobo et al., 2020), its link with fertility remains understudied. Polygyny has also received attention among economists who linked it with agricultural production (Jacoby, 1995; Akresh et al., 2016), women's saving behavior (Boltz and Chort, 2016), child mortality (Arthi and Fenske, 2018), child nutritional (Amare et al., 2021), historical education (Fenske, 2015) and economic development (Tertilt, 2006).

[5] Others argue that this varies across domains, with cooperation needed for economic activities and chores (e.g., child rearing), while competition evolving around the husband's resources (Bove and Valeggia, 2009). Barr et al. (2019) found in a public goods game implemented in a lab-in-the-field experiment in Nigeria that co-wives cooperate less with one another than monogamous husbands and wives.

In polygynous households each husband-wife pair is considered a separate entity. Most co-wives live with their children in separate nuclear units or houses. Like women in monogamous households, they provide for the basic needs of their children. Male heads are expected to provide food and cover expenses (e.g., school fees, medical costs), but in practice, women often cover expenses themselves and supply their own food (Akresh et al., 2016). In polygynous households food preparation is often rotated among the different co-wives. Food is usually provided by the husband, while the cooking wife only provides ingredients for the 'sauce' of the cooked meal. The first wife tends to hold more power than more junior co-wives and co-wife relationships can be conflictual or amicable (Mason, 1988; Jankowiak et al., 2005; Akresh et al., 2016).

3. Experimental design and data

In this section, we present the voucher experiment and the treatments, the sample, and the different data sources.

3.1. Voucher experiment

To study the effect of the husband's involvement on the uptake of contraceptives, we use data from an experiment in which we distributed a voucher that gave access to free family planning services and a modern contraceptive supplied by existing health facilities. The voucher was valid for one month after its delivery. We created experimental variation in the husband's involvement by randomizing whether the voucher was given to the wife without the husband being present ('woman treatment'), or to the husband with the wife being present ('couple treatment'). The experimental protocol was as follows: when the enumerator arrived at the house of the recruited participant, she asked the husband for permission to conduct an interview with the wife in private. All enumerators were female, to avoid potential gender biases in the data collected during the interview. At the end of the interview, the enumerator gave a voucher and explained how to use it.

The treatment assignment was randomized at the enumerator level, so that it was balanced across enumerators. To implement this, we used the last digit of a unique identification number, preprinted on the voucher, and assigned vouchers with even numbers to the same treatment, while odd numbers were assigned to the other treatment. Each enumerator was given a series of vouchers with consecutive voucher numbers and followed the order of the voucher numbers when interviewing the respondents assigned to them. The enumerators were not informed how treatment assignment was determined. Using a tablet to record the respondent's responses, enumerators entered the voucher number at the start of the interview and then followed the instructions shown on the tablet.

In section F of the Appendix, we give an example of a voucher and present the experimental script, which was read verbatim in the local language (Dioula or Moore) by the enumerators. At the end of the interview, enumerators wrote on the voucher the name of the health facility where the voucher could be used, the expiry date of the voucher, and the respondent's name. In this way, the respondent's identity could be checked by a health worker, when she presented the voucher at the health center.

The health workers involved in our study were asked to organize the family planning meetings in exactly the same way as they did outside the experiment. During the visit, health workers provided information on the benefits of modern contraceptives. Next, they offered a prescription for a free modern contraceptive chosen by the participant and provided information on the use of the contraceptive. Participants had the possibility to choose from the following modern contraceptives: pill, injectables, implants, or an intrauterine device (IUD). Prior to the start of the experiment, we checked the stock of pills, IUD, implants and injectables in the participating health facilities and we reimbursed health facilities the required medical consumables needed to deliver the contraceptive methods.[6] Information obtained from interviews with health workers and participants did not identify any issues of concern in terms of the delivery of the health services.

3.2. Sample

Our study took place in the Province of Houet, located in western Burkina Faso. We recruited women of childbearing age (18–40) who met the following criteria at the time of the study: (i) lived with their partner/husband; (ii) were not currently pregnant; (iii) were not menopausal, had neither been sterilized nor had a hysterectomy; (iv) had never been advised by a health worker to avoid the use of modern contraceptives because of a health condition; (v) were not using any modern contraceptives. In other words, our study population are monogamous and polygynous women in a stable relation, whose fertility can be controlled with the use of modern contraceptives. To obtain a representative sample of this population we used the following procedure.

We started by conducting a census in 30 randomly selected villages. A few weeks before the experiment, which took place in June-July 2018, we randomly selected from this census 2997 couples in which the wife was of childbearing age (18–40) and in a stable relation. We visited all women but only selected them in the study if they fulfilled all selection criteria. For polygynous households, the co-wife was randomly selected from all co-wives. If she did not meet the eligibility criteria, another co-wife was randomly selected. If none of the co-wives met these criteria, the household was not included in the study. Of the 2997 women, only 15 (0.5%) of them refused to participate in the study, and 1074 women met the inclusion criteria and were included in the final sample.[7]

In a final step, women were randomly assigned to the experimental treatments.[8] Fig. 1 presents the sample sizes of each treatment arm. Table A.1 in the Appendix shows that treatment assignment in the polygynous and monogamous samples is balanced on a large list of socio-economic characteristics. Using a joint test of orthogonality we find that the null hypothesis of all differences being equal to zero cannot be rejected for monogamous households ($F = 0.96$; two-sided $p = 0.541$) and polygynous households ($F = 0.86$; two-sided $p = 0.700$).

3.3. Baseline

Women were interviewed individually and in private before the voucher was given. In the interview, we checked whether women fulfilled the selection criteria, and we collected information on socio-demographic characteristics, reproductive health, household decision-making, perceived quality of care at local health facilities, etc. We also

[6] The contraceptives were subsidized by the government at the moment of our experiment. We covered the remaining (non-subsidized) costs of the contraceptives. While medical consumables needed for the delivery of the contraceptives (e.g., iodized polyvidone, cotton, syringe, etc.) should be delivered freely, in practice women were expected to buy them. To ensure that participants were not forced to do so, we delivered them to the health facilities.

[7] Monogamous women who fulfilled all criteria except criterion (v) (they were already using a modern contraceptive), were still given a voucher and were told to transfer it to someone else. 645 of the 1922 ineligible women were in this category. As explained in the pre-analysis plan, we thought it could be interesting to test whether the likelihood of such transfers differed between treatments. The number of participants who transferred the voucher, however, was too low to do any meaningful analysis.

[8] Enumerators were instructed to revisit the household if the husband was not around. If the husband was also absent at the second visit, the couple was replaced using a reserve list that we had prepared for this purpose. Based on information we received from the field team, the non-availability of husbands at repeat visits was low.

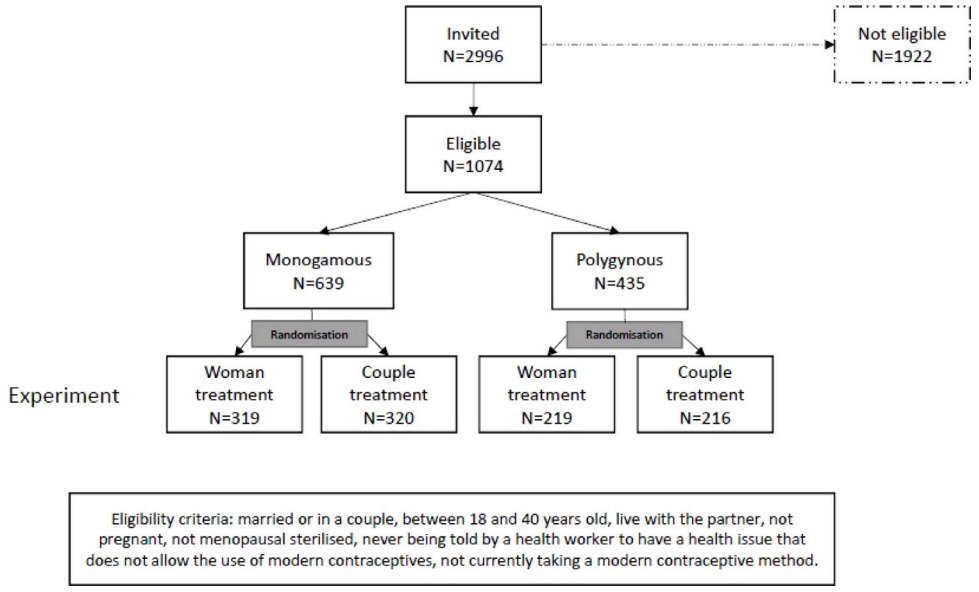

Fig. 1. Sample.

asked some questions about their husband. At the end of the interview, the voucher was given either to the woman in private or to the husband with the woman being present. Detailed instructions were given on how to use the voucher. After distributing the voucher, the enumerator checked the participant's understanding of the procedures to use the voucher by asking several control questions. If some of these questions were answered incorrectly, the enumerator re-explained the procedures that were unclear to the participant.

3.4. Health facility logs

Information on the use of the voucher was collected directly from the health facilities. Health staff in charge of the family planning visits in each health facility kept a list of the visits. Each voucher showed (i) the health facility where the voucher needed to be used, (ii) the ID and full name of the participant, (iii) the date when the voucher was received, (iv) the expiry date, (v) the village where the participant lives, (vi) the unique identification number of the voucher and (vii) the stamp of the research organization in charge of the implementation of the experiment, and the signature of the enumerator. These elements ensured that there was no fake voucher circulating in the villages and that the woman attending the visit was the person who had received the voucher. Health workers would verify that the identity of the ID card of the participant matched with the information provided on the voucher. A voucher was considered used if the health staff had a record of its unique identification number.

3.5. Endline

Six months after the first interview, we interviewed participants again to collect information on contraceptive use, pregnancy, the quality of care received at the health center, and how decisions were made about the use of the voucher. We managed to re-interview 83.9% of the women who participated in the experiment. Attrition was not different between polygynous and monogamous women (16.3% versus 15.9%), and between the woman treatment and the couple treatment (16.9% versus 15.3%). For more details, including other correlates of attrition see Table D.1 in Appendix D.

We found that the average waiting time at the health centers was 23 min and the average length of the visit was 20 min. 82% of the women who attended the visit received information on the benefits of family planning, 92% were offered a prescription for a modern contraceptive. 93% of the participants received the contraceptive method of their choice, and 93% were explained how to use the contraceptive. The contraceptives were made free to 99% of the women who used the voucher. These statistics confirm that participants in our study received good quality of care from the participating health centers.

With the endline survey, we also verified directly with the participants whether they used the voucher. Only 14 participants (1.5%) disagreed with the voucher use as recorded by the health workers. Most disagreements related to the expiry of the voucher. Some women whose voucher was registered as 'non-used' claimed that they made the visit at the health center after the expiry date.

4. Hypotheses and identification strategy

In this section, we develop hypotheses and a strategy to test them. We start by presenting a theoretical model that compares optimal fertility of husbands and wives between monogamous and polygynous households. Thereafter, we use the model to develop hypotheses on the effect of the husband's involvement in the experiment on voucher use. Finally, we explain how we will use the experimental data to test the hypotheses.

4.1. Theoretical model

To model the decision-making process around the use of the voucher, we start by modeling optimal fertility of men and women, and how it compares between monogamous and polygynous households. For the moment, we make abstraction of who is involved in the decision and we also ignore the voucher. We will look at both elements in the next section, where we make a link with the experimental treatments and we develop hypotheses on their effect on voucher use.

Following Rossi (2018), we assume that men and women have defined preferences about the number of children they want to have, and that in a polygynous households women also care about the number of children born to the co-wife, while husbands only care about the total number of children. Specifically, we assume that each spouse i has an individual concave utility function u_i, which differs between husbands and wives, and between monogamous and polygynous households.

For monogamous households, the wife's and husband's utilities $u_w^m = u_i(n)$ and $u_h^m = u_i(n)$ depend on n, being the expected lifetime fertility,

i.e., the expected number of children born during the wife's reproductive period. In polygynous households, u_i^p depends on the number of children of each co-wife. Specifically, for husbands in polygynous union, the utility function u_h^p depends on the total number of children, $n_w + n_{-w}$:

$$u_h^p = u_h(n_w + n_{-w}) \tag{1}$$

As the husband's utility only depends on the total number of children, children of co-wives are perfect substitutes. It can then be shown that in polygynous households the husband's optimal number of children with each of the co-wives n_w or n_{-w} will be equal or smaller than the ideal number of children in monogamous households. We call this a 'substitution' effect.

For women in polygynous union, we add a concave term $s(n_w, n_{-w})$ as follows:

$$u_w^p = u_w(n_w) + s(n_w, n_{-w}) \tag{2}$$

This term captures the wife's access to household resources. We assume that $\frac{\delta s}{\delta n_w} > 0$ and $\frac{\delta s}{\delta n_{-w}} < 0$. This is the case as with more children *relative to the co-wife*, the wife will be able to claim a larger part of the household resources, get more attention, affection and love from the husband, and increase future access to the husband's resources through inheritance (Jankowiak et al., 2005; Bove and Valeggia, 2009; Mammen, 2019). We also assume that the larger the number of children of the co-wife, the more can be gained by increasing n_w, i.e., $\frac{\delta s}{\delta n_w \delta n_{-w}} > 0$.

It can be shown that the optimal n_w^* and n_{-w}^* will be larger than the wife's optimal n^* in monogamous households. This is the direct result of the addition of the term $s(.)$, which increases the marginal utility for each co-wife. Given that co-wives compete for the same household resources, there might also be a positive correlation between n_w^* and n_{-w}^*. This is the result of the positive cross-derivative: each wife would increase n_w if the co-wife increased n_{-w}. Both mechanisms lead to a so-called 'competition' effect, which is responsible for a higher desired fertility among women in polygynous households.

4.2. Hypotheses

Having defined the optimal fertility for husbands and wives, we need to do two things to develop hypotheses on the treatment effects. First, we need to link voucher use with expected fertility. We assume that n is a function of voucher use $x \in \{0, 1\}$, with $n(x = 1) < n(x = 0)$, i.e., the use of contraceptives reduces expected lifetime fertility.[9] Second, we need to model the decision-making of the couple that participates in the experiment. We consider a couple with two decision-makers, $i \in \{w, h\}$, where w represents the wife and h represents the husband involved in the experiment. We assume that the couple chooses x such that it maximizes the weighted sum of the utilities of the husband and wife who participate in the experiment, as captured by the following function:

$$\mu u_w + (1 - \mu)u_h \quad s.t. : x \in \{0, 1\} \tag{3}$$

with $0 \leq \mu \leq 1$ representing the decision power of the wife.[10] We use this model to develop predictions about the effect of the husband's involvement on voucher use. For this, we assume that μ is higher in the woman treatment than in the couple treatment.

We start with monogamous couples. For couples where both spouses have the same fertility preferences, we do not expect any treatment differences. In couples where spouses have different preferences, we assume that the wife has a lower desired number of children than the husbands, as documented by studies referred to in the introduction. This implies that the wife is more likely to prefer to use contraceptives (i.e., $x = 1$) than the husband. As μ is higher in the woman treatment than in the couple treatment, the voucher is more likely used in the woman treatment than in the couple treatment. This leads to our first hypothesis.

Hypothesis 1. Among monogamous couples, voucher use is higher in the woman treatment than in the couple treatment

Continuing with polygynous couples, we expect the preferences for the voucher to change in the following way. Given the differences in optimal fertility between men and women and between monogamous and polygynous households as predicted by our model, we expect that the competition effect would weaken women's preference for the voucher, while the substitution effect would strengthen men's preference for the voucher, so that we expect that:

$$u_w^p(x = 1) - u_w^p(x = 0) < u_w^m(x = 1) - u_w^m(x = 0) \tag{4}$$

$$u_h^p(x = 1) - u_h^p(x = 0) > u_h^m(x = 1) - u_h^m(x = 0) \tag{5}$$

Using both equations and the assumption that μ is larger in the couple treatment than in the woman treatment, we expect that the predicted difference in voucher use between both treatments among monogamous couples (Hypothesis 1) is smaller or even changes sign among polygynous couples. This is summarized in the following second hypothesis.

Hypothesis 2. The (negative) difference in voucher use between the couple treatment and the woman treatment among monogamous households will be smaller among polygynous households or even become positive

To disentangle the substitution and competition effects, we can look at the within-treatment differences. We assume for the moment that (1) $\mu = 1$ in the woman treatment and $\mu = 0$ in the couple treatment. The within-treatment comparisons can then provide the following insights. With $\mu = 1$ in the woman treatment, the optimal choice is the one that maximizes $u_w(x)$. Following Eq. (4), we should then observe that in the woman treatment the voucher is less likely chosen among polygynous households than among monogamous households. With $\mu = 0$ in the couple treatment, the optimal choice is the one that maximizes $u_h(x)$. Following Eq. (5), we should then observe that in the couple treatment the voucher is more likely chosen among polygynous households than among monogamous households. We summarize this in a new hypothesis.[11]

[9] Without loss of generalizability, we ignore the specific functional form. We only assume that voucher use reduces lifetime fertility.

[10] Note that for a monogamous household this is the same as the collective household model (Chiappori, 1988, 1992). For polygynous households this only covers the decision made in the experiment by the participating couple, and not the co-wife who is not offered a voucher. The co-wife can obviously still have an influence through her desired fertility n_{-w}^*.

[11] Women might involve their husband in the woman treatment and also have an influence in the couple treatment, even though our setting is characterized by large gender inequality. This implies that $\mu < 1$ in the woman treatment and $\mu > 0$ in the couple treatment. It can be shown that as long as μ is large enough in the woman treatment, and small enough in the couple treatment, substitution and competition effects will still create the hypothesized within-treatment differences. In other words, if we find such differences, we can interpret this as support for both effects. Note that our model also assumes that levels of bargaining power in each treatment are the same in polygynous and monogamous unions, so that the involvement of the husband leads to the same change in μ. If this does not hold, within-treatment differences may not be attributed solely to competition or substitution effects. Section 4.3 will discuss how our estimation strategy will deal with potential confounding effects.

Hypothesis 3. In the woman treatment voucher use will be lower among polygynous households than among monogamous households. In the couple treatment voucher use will be higher among polygynous households than among monogamous households.

The substitution and competition effects can also interact with each other. If the husband anticipates that co-wife competition increases the likelihood that the total number of children exceeds his desired fertility, he may have a stronger preference to use the voucher in an attempt to weaken the competition effect. This would increase the likelihood that polygynous households use the voucher in the couple treatment.[12]

To separate both effects and identify their interaction, we can exploit variation in the quality of the co-wife relation. It is plausible to assume that the competition effect is smaller where the quality of the relation among co-wives is better. Where co-wives 'cooperate', the available resources can be used more efficiently leading to a larger cake, and co-wives may be more inclined to share benefits. This would reduce the $s(.)$ term in Eq. (2), and hence weaken the competition effect. As a result, the hypothesized differences in hypotheses 2 and 3 will be larger (smaller) with lower (higher) quality co-wife relationships. Note that where husbands care about the competition among their co-wives, we would also expect the difference in voucher use to be larger (smaller) in the couple treatment with lower (higher) quality co-wife relations. We summarize this in a new hypothesis.

Hypothesis 4. The difference in treatment effects and the within-treatment differences will be larger when comparing monogamous households with polygynous households with low quality co-wife relations

4.3. Estimation strategy

To identify treatment differences in the use of the voucher, we estimate the following regression:

$$Y_{ij} = \beta_0 + \beta_1 T_{ij} + \epsilon_{ij} \tag{6}$$

where Y_{ij} is equal to one if the voucher is used by woman i in village j, zero otherwise. T_{ij} is a binary variable equal to one for the couple treatment, zero for the woman treatment. ϵ_{ij} is the error term. β_1 estimates the average treatment difference. To investigate whether the treatment difference depends on polygyny status, we add a binary variable P_{ij} equal to one for a polygynous household, zero for a monogamous household, in the following way:

$$Y_{ij} = \beta_0 + \beta_1 T_{ij} + \beta_2 P_{ij} + \beta_3 T_{ij}.P_{ij} + \beta_4 C_{ij} + \beta_5 T_{ij}.C_{ij} + \eta_j + \epsilon_{ij} \tag{7}$$

The regressions are estimated with ordinary least squares (OLS). We use OLS instead of a logit regression, as it can be combined with village fixed effects and it is easier to analyze the heterogeneity of the treatment differences. Specifically, the latter does not depend on the specific values given to the set of covariates used in the regression.[13]

As variable P_{ij} is not randomized, it might be correlated with ϵ_{ij}, which potentially biases the regression estimates. To reduce the risk of omitted variable bias, we include a set of control variables. Specifically, we use socio-demographic characteristics (C_{ij}) that differ between monogamous and polygynous households, and potentially influence the likelihood that the voucher is used. As a robustness test, we will also interact T_{ij} with C_{ij}.[14] Finally, we include village fixed effects (η_j), to control for observable and unobservable village characteristics that might correlate with both voucher use and the presence of polygyny.

To support Hypothesis 1, which predicts that voucher use is lower in the couple treatment than in the woman treatment among monogamous couples, we need that coefficient β_1 is negative. For Hypothesis 2, we need to compare the effect of the couple treatment between monogamous and polygynous couples. The difference between both effects is captured by β_3, which needs to be positive to support the hypothesis. The interaction effect $\beta_3 T_{ij}.P_{ij}$ captures the difference between the treatment effects among monogamous households ($\beta_2 T_{ij}$) and among polygynous households ($\beta_2 T_{ij} + \beta_3 T_{ij}.P_{ij}$). The interaction effect also measures the difference between monogamous and polygynous households in the woman treatment ($\beta_2 P_{ij}$) and the difference between monogamous and polygynous households in the couple treatment ($\beta_2 P_{ij} + \beta_3 T_{ij}.P_{ij}$). Both differences will be used to test Hypothesis 3. To test Hypothesis 4, we will exploit variation in the reported quality of the co-wife relationship.

5. Results

In this section, we first look at the effect of the husband's involvement on voucher use, and how this effect differs between monogamous and polygynous households (Hypotheses 1–2). When doing so, we will also report on the within-treatment differences between monogamous and polygynous households (Hypothesis 3). Next, to provide further evidence for the mechanisms behind the differences between monogamous and polygynous households, we look into the role of co-wife rivalry and rank in polygynous households (Hypothesis 4).

5.1. Voucher use by treatment and polygyny status

Table 1 presents the estimated effect of the husband's involvement on voucher use. The constant term in Column 1 tells us that voucher use is around 13% in the woman treatment. It decreases by 5 percentage points in the couple treatment, which is statistically significant. This supports Hypothesis 1. Among polygynous women (Column 2), in contrast, the treatment difference is not statistically different from zero.

To test whether the treatment differences vary between monogamous and polygynous households, we pool monogamous and polygynous households and interact the treatment dummy with a dummy equal to one for polygynous households, zero otherwise (Column 3). In Column 4, we add controls for differences in relevant exogenous characteristics between monogamous and polygynous households.[15] In Column 5, we also interact these controls with the treatment dummy, using Eq. (7).

The coefficient of the interaction term 'Couple treatment x Polygynous' is positive and statistically significant in Column 3, and is robust to the use of controls in Columns 4 and 5. This provides support for Hypothesis 2. The results reported in Columns 3–5 also allow us to compare voucher use within treatments. The negative and significant effect of 'Polygynous' indicates that in the woman treatment voucher use is lower among polygynous couples than among monogamous couples. To compare voucher use in the couple treatment, we look at the combined effect of 'Polygynous' and 'Couple treatment x Polygynous', which is not

[12] The competition effect might also be stronger where the substitution effect lowers the ideal number of desired children of the husband below the total number of children the co-wives desire to have. This might speed up the race among co-wives to reach their desired number of children.

[13] As we will show, the results obtained with OLS regressions are qualitatively similar to the results of logit regressions (see Tables C.1 and C.2 in Appendix C).

[14] We expect the results to be fairly robust as the use of C_{ij} should to a large extent also deal with potential endogeneity of $T_{ij}.P_{ij}$, given that T_{ij} is random. Put differently, the use of C_{ij} would remove that part of the error term that might correlate with both P_{ij} and $T_{ij}.P_{ij}$.

[15] From Table A.2 in the Appendix, we see that monogamous and polygynous households differ on woman's age, whether the woman was born in the village, whether she wants another child, the woman's beliefs about the husband's fertility preferences, number of children, spousal communication about family planning, woman's education, household wealth, and woman's religion and ethnicity.

Table 1
Treatment effect on voucher use.

	(1) Monogamous	(2) Polygynous	(3) All	(4) All	(5) All
Couple treatment	−0.050**	0.019	−0.050**	−0.054**	0.119
	(0.024)	(0.026)	(0.024)	(0.024)	(0.115)
Polygynous			−0.060**	−0.048*	−0.057*
			(0.025)	(0.028)	(0.030)
Couple treatment × Polygynous			0.070**	0.079**	0.103**
			(0.035)	(0.036)	(0.041)
Constant	0.129***	0.068***	0.129***	0.171***	0.080
	(0.019)	(0.017)	(0.019)	(0.060)	(0.083)
Observations	639	435	1074	1073	1073
Controls	No	No	No	Yes	Yes[a]

Notes: OLS regressions with dependent variable equal to 1 if voucher is used, zero otherwise. Robust standard errors between parentheses. Controls: village fixed effects, woman's age, woman born in the village, woman's number of children, woman did not talk about FP with husband in last 6 months, woman went to school, household wealth, household size, woman's religion (Catholic, Muslim) and ethnicity (Mossi). For the coefficients of the controls in Column 4, see Table B.1.

*Indicate two-sided significance levels at 10%.

**Indicate two-sided significance levels at 5%.

***Indicate two-sided significance levels at 1%.

[a]Controls are interacted with the treatment dummy.

statistically different from zero (Column 3: chi2 = 0.16, two-sided p = 0.688; Column 4: chi2 = 1.35, two-sided p = 0.246; Column 5: chi2 = 2.67, two-side $p = 0.102$). In sum, these within-treatment comparisons provide only partial support for Hypothesis 3.

5.2. Co-wife relations

To test Hypothesis 4, we exploit variation in the quality of the co-wife relationship, by focusing on (1) friendship among co-wives, and (2) co-wife rank.[16] As documented in the literature, co-wives of lower rank (i.e., women who were married later than the first wife) face less favorable access to household resources (Gibson and Mace, 2007; Wagner and Rieger, 2015; Matz, 2016; Mammen, 2019; Munro et al., 2019; Hidrobo et al., 2020) and might therefore face more competition (Gerdemann, 2019).

5.2.1. Co-wife friendship

29% of the polygynous women in our sample are not friends with their co-wife/wives, as measured by the baseline survey. Table 2 disaggregates the treatment difference by whether women are friends with co-wives. The constant term in Column 1 tells us that among polygynous women who are friends with co-wives, the uptake of the voucher in the woman treatment is around 8%, and is not significantly different in the couple treatment. We do find a significant treatment difference among polygynous women who are not friends with co-wives (Column 2). Interestingly, among this group of women the use of the voucher is 10.8 percentage points *higher* in the couple treatment than in the woman treatment.

To compare the treatment difference between both types of polygynous households, we pool all polygynous households, and use an interaction term between the treatment dummy and a dummy 'Not friends' equal to one if the respondent reports that she is not friends with her co-wife/wives. We estimate regressions with and without controls, as a comparison between polygynous households with and without co-wife friendship can be confounded by socio-economic differences between both types of households.[17] We find that the treatment difference depends on whether the respondent has a friendship relation with other co-wives, as confirmed by the coefficient of 'Couple treatment x Not friends' which is significant in Column 3 and marginally significant in Column 4.

This brings us to the question of whether the previously observed differences in treatment effects between monogamous and polygynous women (see Table 1) are driven by polygynous households without co-wife friendship. To test this, we use the full sample of monogamous and polygynous households and divide polygynous women by their relation with co-wives. To do so, we interact the couple treatment dummy with two binary variables: 'Not friends' equal to one if the respondent is in a polygynous household and is not friends with her co-wives, zero otherwise; and 'Friends' equal to one if the respondent is in a polygynous household and is friends with her co-wives, zero otherwise. As we only have two categories among polygynous women ('Friends' and 'Not friends'), monogamous women are used as reference category. To test the robustness of the results, we estimate this model without controls (Column 5), with controls (Column 6), and with interactions between the treatment and the controls (Column 7).

Looking at the results of Columns 5–7, we observe that the coefficient of the interaction term 'Couple treatment x Not friends' is positive and statistically significant while the coefficient of 'Couple treatment x Friends' is not. Both coefficients are also statistically different from each other (Column 5: chi2 = 4.08, two-sided p = 0.043; Column 6: chi2 = 3.92, two-sided p = 0.048; Column 7: chi2 = 4.80, two-sided $p = 0.029$). This confirms that the previously observed difference in treatment effects between polygynous and monogamous women is driven by polygynous women without co-wife friendship.

To compare voucher use within the woman treatment, we look at the coefficients of 'Not friends' and 'Friends'. The coefficient of 'Not friends' is statistically significant in Columns 5–7, while the coefficient of 'Friends' is not. However, both coefficients are not statistically different from each other (two-sided p-value of a chi-square test > 0.12). To compare voucher use within the couple treatment, we look at the combined effect of 'Not friends' and 'Couple treatment x Not friends', as reported in panel b. It is not statistically different from zero in Column 3, is marginally significant in Column 4, and statistically significant in Column 5. The combined effect of 'Friends' and 'Couple treatment x friends' is not statistically significant in any of the models.

[16] While the analysis of co-wife rank was specified in our pre-analysis plan, we did not specify the comparison along co-wife friendship.

[17] Table A.3 in the Appendix shows the main differences. We observe that co-wife friendship is correlated with whether one is born in the village, household size, the number of co-wives and household wealth. In the last four rows we also see that co-wife friendship correlates with the frequency of help with children's education, financial help, communication, including communication about contraceptives.

Table 2
Treatment effect on voucher use, by co-wife friendship.

	(1) Friends	(2) Not friends	(3) Polyg.	(4) Polyg.	(5) All	(6) All	(7) All
Couple treatment	−0.015	0.108**	−0.015	−0.011	−0.050**	−0.054**	0.108
	(0.029)	(0.054)	(0.029)	(0.030)	(0.024)	(0.024)	(0.115)
Not friends			−0.034	−0.030	−0.084***	−0.081**	−0.092**
			(0.034)	(0.033)	(0.032)	(0.034)	(0.036)
Couple treatment × Not friends			0.123**	0.118*	0.158***	0.167***	0.195***
			(0.061)	(0.062)	(0.059)	(0.060)	(0.061)
Friends					−0.050*	−0.035	−0.040
					(0.029)	(0.031)	(0.033)
Couple treatment × Friends					0.035	0.044	0.061
					(0.038)	(0.039)	(0.044)
Constant	0.079***	0.045*	0.079***	0.185**	0.129***	0.171***	0.085
	(0.022)	(0.025)	(0.022)	(0.082)	(0.019)	(0.060)	(0.083)
Observations	309	126	435	434	1074	1073	1073
Controls	No	No	No	Yes[a]	No	Yes[b]	Yes[c]
b. Comparison by polygyny status in couple treatment							
Not friends (Couple treatment = 1)					0.074	0.086*	0.103**
					(0.049)	(0.051)	(0.050)
Friends (Couple treatment = 1)					−0.014	0.009	0.022
					(0.025)	(0.026)	(0.028)

Notes: OLS regressions with dependent variable equal to 1 if voucher is used, zero otherwise. Robust standard errors between parentheses.
*Indicate two-sided significance levels at 10%.
**Indicate two-sided significance levels at 5%.
***Indicate two-sided significance levels at 1%.
[a]Controls: village fixed effects, woman born in the village, household size, household wealth, number of co-wives, help among co-wives with children's education, financial help among co-wives, and communication with co-wives.
[b]Controls: village fixed effects, woman's age, woman born in the village, woman's number of children, woman did not talk about FP with husband in last 6 months, woman went to school, household wealth, household size, woman's religion (Catholic, Muslim) and ethnicity (Mossi). For the coefficients of the controls see Table B.2.
[c]Controls are interacted with the treatment dummy.

5.2.2. Co-wife rank

A second proxy of co-wife competition is co-wife rank. To test whether differences in treatment effects are driven by co-wife competition, we can exploit the variation in rank in our sample.[18] To do so, we run the regressions reported in Table 1 with a sample that combines the monogamous households with either polygynous households with wives of rank 1 or polygynous households with wives of rank 2+ (i.e., women who were married after the first wife). Table 3 presents the results. Comparing the coefficient of the interaction 'Couple treatment x Polygynous' across Columns 3–6, it is clear that the difference in treatment effects is driven by wives of rank 2+. The same conclusion is reached when looking at the within-treatment comparisons, for which we look at the coefficients of 'Polygynous' and 'Polygynous + Couple treatment x Polygynous' (reported in panel c). Here again, we observe that the differences are largest when comparing monogamous households with wives of rank 2+.

5.2.3. Co-wife friendship and rank

In a next step, we separate the effects of rank and friendship. We also look at how both effects interact with one another. For example, the effect of a lack of co-wife friendship might be stronger among wives of rank 2+. To conduct this analysis, we disaggregate Columns 6 and 7 of Table 2 by rank. Table 4 presents the results. Looking at the size of the treatments effects in panel b, we observe that among wives of rank 2+ who are not friends with co-wives the likelihood that the voucher is used is 20 percentage points higher in the couple treatment than in the woman treatment, while no treatment effects are observed among wives of rank 1, or wives of rank 2+ who are friends with co-wives. Also the previously identified interactions between co-wife friendship and the treatment effects are driven by wives of rank 2+. Comparing the coefficients of 'Couple treatment x Not friends' and 'Couple treatment x Friends', we find that they are statistically different in Columns 5 and 6 (Column 5: chi2 = 6.05, two-sided p = 0.014; Column 6: chi2 = 7.05, two-sided $p = 0.008$), but not in Columns 3 and 4 (two-sided p-value of a chi2 test > 0.450).

To look at the within-treatment comparisons between polygynous and monogamous households, we use the coefficients of 'Friends' and 'Not friends'. The coefficient of 'Not friends' is negative and statistically significant in Columns 5–6, but not in Columns 3–4. The coefficient of 'Friends' is not statistically significant in any of the columns, and is statistically different from the coefficient of 'Not friends' in Columns 5–6 (Column 5: chi2 = 6.21, two-sided p = 0.013; Column 6: chi2 = 7.56, two-sided $p = 0.006$), but not in the other columns.

Looking at the difference in voucher use between polygynous and monogamous households in the couple treatment, as reported by panel c, we observe that in Columns 5 and 6 voucher use is 10–11 percentage points higher among polygynous women who are not friends with co-wives compared to women in monogamous households. No such effect is observed with wives of rank 2+ who are friends with co-wives, or with wives of rank 1.

Putting all results together, we find strong support for Hypothesis 4. The difference in treatment effects and the within-treatment differences are stronger when comparing monogamous households with polygynous households with low quality co-wife relations, as measured by co-wife friendship, co-wife rank or a combination of both. These findings are in line with our model, which predicts that co-wife competition leads to important differences in fertility preferences of men and women, between monogamous and polygynous couples.

6. Extensions

When linking the predictions made by our theoretical model with our empirical findings, we make two important assumptions. First, we attribute differences in treatment effects between monogamous and polygynous households to differences in lifetime fertility preferences. Second, we assume that the experimental treatments create variation in the weight assigned to the husband's and wife's preferences. In this section, we present additional evidence in support of both assumptions.

[18] Table A.4 presents important correlates of co-wife rank in polygynous households.

Table 3
Treatment effect on voucher use, by co-wife rank.

	All		Monog. and Wife 1		Monog. and Wife 2+	
	(1)	(2)	(3)	(4)	(5)	(6)
Couple treatment	−0.054**	0.119	−0.056**	0.035	−0.057**	0.097
	(0.024)	(0.115)	(0.024)	(0.145)	(0.024)	(0.127)
Polygynous	−0.048*	−0.057*	−0.038	−0.047	−0.063**	−0.069**
	(0.028)	(0.030)	(0.038)	(0.040)	(0.030)	(0.034)
Couple treatment × Polygynous	0.079**	0.103**	0.022	0.055	0.111***	0.123***
	(0.036)	(0.041)	(0.049)	(0.056)	(0.041)	(0.047)
Constant	0.171***	0.080	0.147*	0.096	0.161**	0.082
	(0.060)	(0.083)	(0.077)	(0.111)	(0.068)	(0.093)
Observations	1073	1073	798	798	914	914
Controls interacted	No	Yes	No	Yes	No	Yes
b. Treatment effect among polygynous women						
Couple treatment	0.025	0.039	−0.034	−0.008	0.054*	0.063*
	(0.026)	(0.029)	(0.042)	(0.047)	(0.033)	(0.037)
c. Comparison by polygyny status in couple treatment						
Polygynous	0.031	0.046	−0.016	0.007	0.048	0.055*
	(0.027)	(0.028)	(0.035)	(0.038)	(0.031)	(0.032)

Notes: OLS regressions with dependent variable equal to 1 if voucher is used, zero otherwise. Robust standard errors between parentheses. Controls: village fixed effects, woman's age, woman born in the village, woman's number of children, woman did not talk about FP with husband in last 6 months, woman went to school, household wealth, household size, woman's religion (Catholic, Muslim) and ethnicity (Mossi). For the coefficients of the controls see Table B.3.
*Indicate two-sided significance levels at 10%.
**Indicate two-sided significance levels at 5%.
***Indicate two-sided significance levels at 1%.

Table 4
Treatment effect on voucher use, by co-wife friendship and rank.

	All		Monog. and Wife 1		Monog. and Wife 2+	
	(1)	(2)	(3)	(4)	(5)	(6)
Couple treatment	−0.054**	0.108	−0.056**	0.035	−0.057**	0.078
	(0.024)	(0.115)	(0.024)	(0.145)	(0.024)	(0.128)
Not friends	−0.081**	−0.092**	−0.035	−0.050	−0.134***	−0.142***
	(0.034)	(0.036)	(0.059)	(0.061)	(0.027)	(0.032)
Couple treatment × Not friends	0.167***	0.195***	0.074	0.110	0.237***	0.257***
	(0.060)	(0.061)	(0.097)	(0.099)	(0.065)	(0.067)
Friends	−0.035	−0.040	−0.040	−0.046	−0.037	−0.040
	(0.031)	(0.033)	(0.042)	(0.044)	(0.036)	(0.039)
Couple treatment × Friends	0.044	0.061	0.005	0.035	0.061	0.067
	(0.039)	(0.044)	(0.052)	(0.058)	(0.045)	(0.052)
Constant	0.171***	0.085	0.149*	0.098	0.163**	0.094
	(0.060)	(0.083)	(0.078)	(0.112)	(0.068)	(0.094)
Observations	1073	1073	798	798	914	914
Controls interacted	No	Yes	No	Yes	No	Yes
b. Treatment effect among polygynous women						
Couple treatment (Not friends = 1)	0.125**	0.150***	0.019	0.053	0.193***	0.211***
	(0.056)	(0.057)	(0.094)	(0.095)	(0.061)	(0.062)
Couple treatment (Friends = 1)	0.010	0.022	−0.046	−0.021	0.025	0.029
	(0.031)	(0.035)	(0.046)	(0.052)	(0.038)	(0.044)
c. Comparison by polygyny status in couple treatment						
Not friends (Couple treatment = 1)	0.086*	0.103**	0.039	0.060	0.103*	0.115**
	(0.051)	(0.050)	(0.079)	(0.078)	(0.060)	(0.058)
Friends (Couple treatment = 1)	0.009	0.022	−0.035	−0.011	0.025	0.028
	(0.026)	(0.028)	(0.035)	(0.037)	(0.031)	(0.032)

Notes: OLS regressions with dependent variable equal to 1 if voucher is used, zero otherwise. Robust standard errors between parentheses. Controls: village fixed effects, woman's age, woman born in the village, woman's number of children, woman did not talk about FP with husband in last 6 months, woman went to school, household wealth, household size, woman's religion (Catholic, Muslim) and ethnicity (Mossi). For the coefficients of the controls see Table B.4.
*Indicate two-sided significance levels at 10%.
**Indicate two-sided significance levels at 5%.
***Indicate two-sided significance levels at 1%.

6.1. Fertility preferences

In our theoretical model, we assumed that the differential effect of the husband's involvement is due to differences between polygynous and monogamous couples in lifetime fertility preferences. In this section, we look for additional evidence that supports this assumption.

6.1.1. Stated preferences on lifetime fertility

To check whether differences in fertility preferences within couples and between monogamous and polygynous households are in line with our theoretical model, we can use stated preferences on lifetime fertility, as elicited by surveys. As we did not interview the husband, we do not have data on within-couple preference differences. The most

Table 5
Treatment effect on contraceptive use, monogamous vs. polygynous.

	(1) Monog.		(2) Polyg.		(3) All		(4) All	
	Inject	Impl	Inject	Impl	Inject	Impl	Inject	Impl
Couple treatment	−0.431	−0.813*	−0.543	1.431**	−0.431	−0.813*	−0.539	−1.049**
	(0.369)	(0.465)	(0.567)	(0.653)	(0.369)	(0.465)	(0.393)	(0.505)
Polygynous					−0.427	−1.290**	−0.429	−1.286*
					(0.415)	(0.639)	(0.466)	(0.710)
Couple treatment × Polygynous					−0.113	2.244***	0.034	2.651***
					(0.676)	(0.802)	(0.708)	(0.881)
Constant	−2.708***	−2.944***	−3.135***	−4.234***	−2.708***	−2.944***	−2.262	−15.276
	(0.237)	(0.265)	(0.341)	(0.582)	(0.237)	(0.265)	(1.428)	(1957.698)
Observations	639		434		1073		1072	
Controls	No		No		No		Yes	

Notes: Multinomial logit regressions. Each panel presents one equation of a set of three equations estimated simultaneously, with 'no voucher used' as omitted category. Controls: woman's age, woman born in the village, woman's number of children, woman did not talk about family planning with husband in last 6 months, woman went to school, household wealth, household size, woman's religion (Catholic, Muslim) and ethnicity (Mossi).

*Indicate two-sided significance levels at 10%.

**Indicate two-sided significance levels at 5%.

***Indicate two-sided significance levels at 1%.

recent round of the Demographic Health Survey (DHS) that is available, however, does have information from both husbands and wives on lifetime fertility preferences, as measured by the *ideal number of children* they would like to have. Table E.1 in Appendix E compares fertility preferences within couples, between monogamous and polygynous households. These results are in line with the lifetime fertility preference differences, as predicted by our theoretical model. We observe that women in monogamous union have weaker fertility preferences compared to their husband, and compared to women in polygynous union. The intra-couple preference difference in polygynous households is also as expected, and most likely underestimated, as the husband's ideal number of children is not divided by the number of co-wives.

6.1.2. Selection effects

To be able to conclude that differences in treatment effects between monogamous and polygynous households are due to preference differences caused by co-wife competition, we should be able to rule out potential selection effects. Polygynous and monogamous households differ on many more dimensions than fertility preferences, and it is possible that the observed differences in treatment effects are partly driven by some of them. This is a challenge as family structure cannot be randomized. The same limitation applies to differences between polygynous women that vary in co-wife friendship or rank. So far, we have controlled for observed differences between polygynous and monogamous households, differences between polygynous households with and without co-wife rivalry, differences between polygynous women of different rank. We included the ones that we deemed important, i.e., the ones we expected to correlate with fertility preferences. For example, it might be that women in monogamous union might be more emancipated and therefore prefer to have fewer children. Education might be a good proxy for emancipation, and in Table A.2 in Appendix A we indeed find that the proportion of women who went to school is significantly higher among monogamous women than among women in polygynous union. A control for education in the regressions would deal with such a potential selection effect. For differences between co-wives that vary in co-wife friendship and rank, see Tables A.3 and A.4, respectively.

To make the selection of controls less arbitrary and the estimates more efficient, we combine regressions with a lasso approach. The results are robust when we use this approach, as reported by Tables C.3, C.4 and C.5 in Appendix C.[19] While we cannot rule out the possibility of some remaining selection effects on unobservables, the fact that we included a very large list of observable characteristics in the lasso regressions, reduces the risk of any remaining selection issues.

6.1.3. Choice of contraceptives

The choice of contraceptives at the health centres could provide further evidence in support of fertility preferences. Women could freely choose from all contraceptives available at the health centers (injectables, implants, pill or IUD). As these methods vary in their duration of protection, it is informative to investigate what contraceptives were chosen, and whether this varies by treatment and polygyny status. Injectables and implants were by far the most common contraceptive methods, chosen respectively by 46% and 37% of respondents who used the voucher. Implants provide long-term protection (usually three years), while most injectables only provide protection for up to three months.

We disaggregate the previous analyses by the type of contraceptive chosen, using a multinomial logit regression with four categories, using 'no voucher used' as base category. The results are presented in Table 5. The coefficient of 'Couple treatment x Polygynous' in Columns 3 and 4 is statistically significant for the use of implants. No such effect is identified for the use of injectables or other contraceptives. This suggests that the previously identified difference in treatment effects on voucher use between monogamous and polygynous households, mainly translates in the use of implants rather than the use of injectables or other contraceptives. This finding suggests it is lifetime fertility preferences that matter rather than shorter term considerations, such as the timing of the next child. This supports the assumption made in our theoretical model that utility and choices are driven by expected lifetime fertility.

6.1.4. Fertility at endline

Using the endline data, we investigate treatment effects on fertility in monogamous and polygynous households, in the following two ways.[20] First, Table D.2 estimates treatment effects on contraceptive

[19] One might also wonder whether the presence of the husband (needed to conduct the couple treatment) was different between monogamous and polygynous households. We do not think it has influenced the observed differences between monogamous and polygynous households in our sample because (1) enumerators visited the household again if the husband was not present, and based on reports from the field team the non-availability of husbands after repeat visits was low.

[20] Effects on contraceptive use of the participating wife were pre-specified, while effects on fertility were not. Effects on contraceptive use and fertility of the co-wife were not prespecified.

use and pregnancy of the participating wife. None of the coefficients are statistically significant. This suggests that differences in contraceptive take-up are often not sustainable and do not necessarily translate into differences in realized fertility. It is also interesting to look at correlations with voucher use, as in our theoretical model we assumed that the use of the voucher reduced expected lifetime fertility among both monogamous and polygynous households. We find that contraceptive use and pregnancy at endline are strongly correlated with voucher use (see Table D.3). The likelihood of contraceptive use is 50 percentage points higher when the voucher is used, among both monogamous and polygynous women. The probability of pregnancy is 14 percentage points lower among monogamous women who used the voucher. This difference is smaller among polygynous women, which is mainly due to the lower likelihood of pregnancy among women who do not use the voucher — probably caused by the lower frequency of sexual intercourse. The latter might actually support the competition effect, as there are fewer opportunities to become pregnant and obtain the desired number of children.

Second, we can look at the effect on the fertility of the co-wife in polygynous households. In our theoretical model, we demonstrated how the fertility of co-wives might be correlated as the result of co-wife competition. It might therefore be possible that the co-wife responds to the decision taken by the husband-wife pair who participates in the experiment. Using endline data, we can test whether this is the case. Table D.5 compares co-wife's contraceptive use and pregnancy at endline by treatment. There is hardly any difference between treatments. This could be due to co-wives not having complete information about each others' contraceptive use. As reported by Table A.3, only a small proportion of women discuss contraception with co-wives, and most women do not know whether their co-wife uses contraceptives. Interestingly, as reported in the last two rows, where there is co-wife rivalry (as measured by a lack of co-wife friendship), communication is even less common.

6.2. What drives the treatment effects?

To attribute variation in voucher use to differences in fertility preferences, we assume that the treatments successfully vary the weight given to the husbands' and wives' preferences, and that spouses have complete information. In this section, we will present additional analyses that provide insights into these assumptions.

6.2.1. Hiding

One way in which the woman treatment gives women more decision-making autonomy is by giving them the option to hide the voucher and its use from their husband. Further analysis, however, shows that this is not common. As reported in Table A.2, only 4% of the women report that they can go out without the husband's permission. While there is not a strong belief that the husband would find out if they visited a health center without telling him, only 14%–16% feel capable to use contraceptives without informing the husband.[21] No differences are detected on these statistics between monogamous and polygynous households. In the endline survey, we asked women about the husband's involvement in the decision to use the voucher. Of the women who used the voucher in the woman treatment 80.85% asked their husband for approval to use the voucher.

[21] Cross-tabulating this percentage by whether they used the voucher, we find that it does not differ much by voucher use in the woman treatment (13.62% among women who did not use the voucher; 16.07% among women who used the voucher; chi2 = 0.2522; p-value = 0.616).

6.2.2. Incomplete information

So far, we have assumed that spouses have complete information. However, there are two domains where this may not hold, and which could explain the treatment effects. First, many couples do not know their spouse's fertility preferences. As reported in Table A.2 more than 80% of the women do not know how many children their husband wants to have.[22] To the extent that women are influenced by their beliefs about their husband's preferences, belief updating might be responsible for the treatment effects. Specifically, in the couple treatment, spouses discuss whether to use the voucher, and might therefore talk about their fertility preferences. As a result, rather than influencing the weight of the husband's preferences, involving the husband might correct women's beliefs about the husband's preferences.

Combining baseline and endline data allows us to analyze whether spousal communication about family planning changed and whether any change varies by treatment. We find that 21.71% of the women had talked about family planning with their husband in the six months before the baseline. At endline, this percentage increased to 50.11%. Looking at the within-change, we observe no difference between treatments (see Table D.4). In other words, while our experiment increased communication about family planning, it does not depend on the treatment used. This finding suggests that treatment effects are unlikely to be driven by the reduction of incomplete information about spousal preferences.

Second, husbands might not have complete information about the voucher in the woman treatment. Whereas in the couple treatment, husbands will get complete information about the voucher, in the woman treatment, it is through communication with their wife that husbands will receive information about the voucher. As a result, in the woman treatment women have some leeway to adjust the presentation of the voucher in line with their preferences. For example, if women have a strong preference to use the voucher but expect some resistance from their husband, they can make it look more acceptable to their husband by presenting it as an opportunity that should not be left unused (e.g., by emphasizing it offers free health services). Similarly, if they do not want to use the voucher, they can present it as an uninteresting offer.

6.2.3. Past contraceptive use

While women in the sample did not use contraceptives at the moment of the experiment, around 40% of them had used modern contraceptives in the past.[23] A comparison between women who stopped using contraceptives and women who had never used contraceptives could provide further insights in what drives the treatment effects. Women who stopped using contraceptives might have more complete information about what to expect from contraceptives, how the health system works, and how other household members would respond if they started using contraceptives (again). They might also have more decision-making autonomy about contraceptives (as they used them in the past).

While we cannot separate these potential drivers, a comparison of treatment effects by past use of contraceptives allows us to investigate its net effect. To do so, we dis-aggregate the analyses by past contraceptive use. Tables C.6 and C.7 in the Appendix present the results. They confirm that the treatment differences are driven by women who used contraceptives in the past.

Putting all results together we conclude that hiding or incomplete information about spousal preferences are probably not major factors

[22] We also observe that while most women believe their husband wants to have another child with them, most of them do not know how long he wants to wait to have the next child.

[23] Most women stopped using contraceptives as they wanted to have another child (55.81%), or because of side-effects of contraceptives (18.68%). Only 3.87% did so because of the husband's refusal of contraceptives.

that drive the treatment effects. This suggests that something else drives the treatment differences. We see two possible explanations. First, it might be the result of differences in entitlement, which depends on who receives the voucher (in the woman treatment we give the voucher to the woman, while in the couple treatment we give it to the husband, with the wife being present). Second, in the woman treatment women have some leeway to change the presentation of the voucher to their husband, such that its perceived attractiveness is in line with women's preferences.

7. Conclusion

This paper reports the results of an experiment in which women received a voucher that gave them access to free contraceptives at local health centers in rural Burkina Faso. We randomized whether the voucher was given to the woman in private or the husband in the presence of his wife. A comparison between both treatments allows us to identify the effect of the husband's involvement on the use of the voucher. Monogamous and polygynous households responded very differently to the husband's involvement. Specifically, involving the husband *decreased* voucher use among women in monogamous households, but *increased* its use among polygynous women with low-quality co-wife relations, as measured by co-wife friendship, co-wife rank or a combination of both. These results are in line with our theoretical model that predicts differences in spousal preference heterogeneity between monogamous and polygynous households due to co-wife competition.

The observation that in the woman treatment voucher use is lower among polygynous women where there is co-wife rivalry – as proxied by a lack of co-wife friendship or co-wife rank – than among monogamous couples, provides support for a competition effect. The finding that in the couple treatment voucher use is higher among polygynous households with co-wife rivalry than among monogamous households suggests that also husbands are influenced by co-wife competition. If the difference in voucher use was the result of a substitution effect, it should not depend on co-wife friendship or rank. Husbands may control their wife's fertility in an attempt to weaken the competition effect, as competition increases the likelihood that the total number of children exceeds their desired fertility.

In our model, competition around fertility can influence preferences in two ways. First, in polygynous households fertility influences access to household resources, such that the marginal utility of lifetime fertility (hence the optimal fertility) is higher in polygynous households than in monogamous households. Second, given that co-wives compete for the same household resources, this access reduces with the fertility of the co-wife. This might increase optimal fertility even further. However, we found no effect of voucher use on co-wife fertility at endline. This could be due to the fact that communication among co-wives about contraceptive use is not very common.

Policymakers in many African countries aim to increase contraceptive use to minimize the negative impacts of the currently slow fertility transition. Our findings provide the following insights that could help design more effective policies. First, the involvement of the husband matters for the uptake of modern contraceptives, and could be exploited by policymakers to increase contraceptive use. Specifically, the uptake of contraceptives in monogamous households could be increased if policymakers find acceptable ways to bypass husbands. This could be achieved with the help of concealable injectables, which have become more available. This is not without limitations, though, as it risks reducing women's well-being by undermining the quality of the marriage, as documented by Ashraf et al. (2014). In polygynous households with co-wife rivalry, this approach might be counterproductive, as the involvement of husbands might actually increase the use of contraceptives. Second, the involvement of the husband matters most for the use of long-term contraception, and among couples who used contraceptives in the past, hence have already some familiarity with contraceptives. Third, rather than focusing on the involvement of the husband, one could try to change spousal preferences about fertility and family planning. Husband schools, which the government in Burkina Faso is experimenting with, might help create a more positive view about family planning and reduce fertility preferences among husbands. Among polygynous households, contraceptive use could increase if co-wife competition around fertility is weakened. To achieve this, however, we might need deeper cultural change that reduces women's dependence on children to achieve social status and access to household resources.

CRediT authorship contribution statement

Ben D'Exelle: Project administration, Funding acquisition, Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Aurélia Lépine:** Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing – original draft. **Richard Bakyono:** Project administration, Supervision, Investigation, Data curation. **Ludovic D.G. Tapsoba:** Supervision, Investigation, Data curation.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

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