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ABSTRACT

It takes a woman and a man to make a baby. This fact suggests that for a birth to take place, the parents should first agree on wanting a child. Using newly available data on fertility preferences and outcomes, we show that indeed, babies are likely to arrive only if both parents desire one, and there are many couples who disagree on having babies. We then build a bargaining model of fertility choice and match the model to data from a set of European countries with very low fertility rates. The distribution of the burden of child care between mothers and fathers turns out to be a key determinant of fertility. A policy that lowers the child care burden specifically on mothers can be more than twice as effective at increasing the fertility rate compared to a general child subsidy.

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1 Introduction

A basic fact about babies is that it takes both a woman and a man to make one. Implied in this fact is that some form of agreement between mother and father is required before a birth can take place.[1] In this paper, we introduce this need for agreement into the economic theory of fertility choice. In particular, we provide empirical evidence that agreement (or lack thereof) between potential parents is a crucial determinant of fertility; we develop a bargaining model of fertility that can account for the empirical facts; and we argue that the need for agreement between parents has important consequences for how policy interventions affect childbearing.

Even if one accepts that agreement between the parents is important for fertility in principle, it may still be the case that most couples happen to agree on fertility in practice (i.e., either both want a child, or neither wants one). Hence, the first step in our analysis is to document empirically the extent of disagreement on childbearing within couples. We draw on evidence from the Generations and Gender Programme (GGP), a longitudinal data set covering 19 countries[2] that includes detailed information on fertility preferences and fertility outcomes. For each couple in the data set, there is a separate question on whether each partner would like to have "a/another baby now." Thus, we observe agreement or disagreement on having a first/next child for each couple.[3] The data reveal that there is much disagreement about having babies. Moreover, disagreement increases with the existing number of children. For couples who have at least two children already, in all countries we observe more couples who disagree (i.e., one partner wants to have another baby, and the other does not) than couples who both want another child. Moreover, women are generally more likely to be opposed to having another child than are men, particularly so in countries with a

[1]While exceptions from this rule are possible (such as cases of rape, deception, and accidental pregnancy), these do not account for a major fraction of births in most places and will not be considered here.

[2]The countries covered are Australia, Austria, Belgium, Bulgaria, the Czech Republic, Estonia, France, Georgia, Germany, Hungary, Italy, Japan, Lithuania, Netherlands, Norway, Poland, Romania, the Russian Federation, and Sweden.

[3]Data on fertility intentions have not previously been available at this level of detail; existing data generally have concerned the preferred total number of children, which is less informative for the bargaining process for having another child.

very low fertility rate.

The second step in our analysis is to show that reported preferences for having babies actually matter for fertility outcomes. The GGP survey has a panel structure, so that stated fertility preferences can be linked to subsequent births. The data confirm the intuition that agreement between the potential parents is essential for having children. We compare the fertility of couples where at least one partner desires a child to that of couples who agree not to have a baby, some of whom end up with a baby anyway. Relative to this baseline, the male partner alone wishing to have a child, with the female partner being opposed, has a very low impact on the probability of a baby's arrival (indistinguishable from zero once we condition on the existing number of children). If the female partner wants a child but the male partner does not, subsequent fertility is significantly higher compared to the baseline, but once again the effect on the probability of a birth is quantitatively small. Only couples who agree and both want a baby have a high probability of actually having one. Overall, while women turn out to have some independent control over their fertility, the main finding is that agreement between parents on wanting a baby is essential for babies to be born.

Our ultimate interest is in what this need for agreement between parents implies for the economics of fertility more broadly. Specifically, we would like to know how the possibility of disagreement between mothers and fathers affects the economywide fertility rate, and how it matters for the influence various policy interventions (such as child subsidies or publicly provided child care) can have on fertility. To this end, we develop a bargaining model of fertility decisions. The woman and the man in a given relationship have separate preferences and bargain over household decisions, including fertility and the allocation of consumption. For a birth to take place, agreement is essential: both spouses[4] have to prefer an additional child over the status quo. Disagreement over having babies is possible in equilibrium, because the spouses have a limited ability to compensate each other for having a baby. In particular, our household bargaining model features limited commitment. While bargaining is efficient within the period, the spouses cannot commit to specific transfers or other actions in

[4]We refer to the two partners in a relationship as spouses for simplicity, but the analysis is not restricted to marriage and comprises non-married couples.

the future.[5] Instead, the allocation in each period is determined through cooperative Nash bargaining with period-specific outside options, which are given by a state of non-cooperation in a continuing relationship along the lines of the separate-spheres bargaining model of Lundberg and Pollak (1993b). This matters for fertility because having a child affects future outside options. In particular, if in the non-cooperative allocation one spouse would be stuck with most of the burden of child care, this spouse would lose future bargaining power if a birth were to take place, and thus may be less willing to agree to having a child.

The key novel implication of this setup is that not just the overall costs and benefits of children matter for fertility (which is the focus of models that abstract from bargaining), but also the distribution of costs and benefits within the household. Specifically, in a society where the cost of raising children is borne primarily by mothers, women will be more likely than men to disagree with having another child, and *ceteris paribus* the fertility rate will be lower compared to a society with a more equitable distribution of the costs and benefits of childrearing. This prediction can be verified directly in the GGP data. The data set includes questions on the allocation of childrearing tasks within the household, i.e., whether the mother or father usually puts the children to bed, dresses them, helps them with homework, and so on. Based on the answers we construct an index of fathers' and mothers' shares in raising children. In all countries in our data set women do the majority of the childrearing work, but there is also substantial variation across countries. As predicted by the theory, it is precisely in the countries where men do the least amount of work where the fertility rate is the lowest, and where women are especially likely to be opposed to having another child.

In the final part of our analysis, we examine the efficacy of policies that aim to increase the fertility rate. We focus on such policies because recently many industrialized countries have experienced historically unprecedented low fertility rates. In Japan, Germany, Spain, Austria, and many Eastern European countries, the total fertility rate has remained below 1.5 for more than two decades.[6] Such fertility rates, if sustained, imply rapid population aging and declining popula-

[5]We also consider an extension in which partial commitment is possible.

[6]The replacement level of the total fertility rate (at which the population would remain constant in the long run) is about 2.1.

tion levels in the future, creating big challenges for economic and social policy. The population of Germany, for instance, is projected to decrease by about 13 million from the current level of 80 million by 2060.[7] Hence, even though the optimal level of fertility is not obvious from a theoretical perspective,[8] the current fertility rate in these countries is widely perceived to amount to a demographic crisis, one that has so far proved resistant to many attempted interventions.

With the focus on the European fertility crisis in mind, we parameterize a dynamic, quantitative version of our model to match fertility intentions and outcomes in the GGP data for countries with a total fertility rate of below 1.5. A crucial aspect of the estimation procedure is to match the evolution of couples' fertility intentions over time. Doing so is important to capture whether disagreement within couples is predominantly about the timing of births, or also about the total number of children a couple will have. We use the quantified model to compare the effectiveness of alternative policies aimed at increasing fertility. We show that policies that lower the child care burden specifically for mothers (e.g., by providing public child care that substitutes time costs that were previously borne mostly by mothers) can be more than twice as effective than policies that provide general subsidies for childbearing. This is primarily because mothers are much more likely to be opposed to having another child than are fathers. Notably, the countries in our sample that have relatively high fertility rates close to the replacement level (France, Belgium, and Norway) already have such policies in place. Other countries that highly subsidize childbearing but in a less targeted manner (such as Germany) have much lower fertility rates.

Our work builds on different strands of the literature. Existing empirical evidence on fertility preferences has usually relied on surveys which ask participants about their ideal family size. This evidence shows that disagreement about fertility is commonplace. For example, Westoff (2010) reports that in 17 out of 18 surveyed African countries men desire more children than women do, with an average gap in desired family size of 1.5 and a maximum of 5.6 in Chad. The key

[7] Source: "Bevölkerung Deutschlands bis 2060," German Statistical Office, April 2015. Decline of 13 million is for forecast assuming relatively low net migration; for high net migration the projected population decrease is 7 million.

[8] Decisions on optimal population size involve judgements on the value of children that are never born; see Golosov, Jones, and Tertilt (2007).

advantage of the data used here (other than the focus on industrialized countries) is that we have information on the intention of having a/another baby at the time of the survey, which tells us a lot more about agreement and disagreement over childbearing and which can be matched directly into a bargaining model of fertility.[9]

In terms of the application of our theory to the European fertility crisis, there is existing empirical work that also points to a link between low fertility and a high child care burden on women (e.g. Feyrer, Sacerdote, and Stern 2008). Here the contribution of our paper is to show explicitly how the large child care burden on women is reflected in high rates of women being opposed to having another child, and to develop a bargaining model of fertility that fully accounts for these facts and is useful for policy analysis. Relative to the existing literature on the response of fertility to financial incentives (e.g., Cohen, Dehejia, and Romanov 2013, Laroque and Salanié 2014, and Raute 2015), our contribution is to consider the differential impact of policies targeted at mothers or fathers.

The existing theoretical literature on models of fertility choice has relied mostly on unitary models of household decision making.[10] In a unitary model a common objective function for the entire household is assumed to exist, and hence there is no conflict of interest between spouses and no scope for disagreement. Such models do not speak to the issues discussed in this paper. Within the smaller existing literature that does take bargaining over fertility into account, our paper builds most directly on Rasul (2008). Rasul develops a two-period model in which there is a possibility of limited commitment, and where the threat point is characterized by mothers bearing the entire cost of childrearing.[11] Using house-

[9] Hener (2014) empirically investigates how differences in fertility preferences of partners affect their fertility outcomes using individual child preference data from the German Socio-Economic Panel (GSOEP). However, the GSOEP asks only about how important it is for respondents to have children in general. Therefore it contains information neither about the desired timing of birth, nor about the importance of having an additional child for respondents who already have children.

[10] See, for example, Becker and Barro (1988) and Barro and Becker (1989).

[11] A recent paper along similar lines is Kemnitz and Thum (2014). Dynamic models of fertility choice that also include implications for the marriage market have been developed by Greenwood, Guner, and Knowles (2003), Caucutt, Guner, and Knowles (2002), and Guner and Knowles (2009). Endogenous bargaining power also plays a central role in Basu (2006) and Iyigun and Walsh (2007), although not in the context of fertility. The extent of commitment within house-

hold data from the Malaysian Family Life Survey, he finds evidence in favor of the limited commitment model. In terms of emphasizing the importance of bargaining and limited commitment, our overall approach is similar to Rasul (2008). However, there are also key differences. Most importantly, in Rasul's setting the mother decides unilaterally on fertility (while taking the impact on future bargaining into account), whereas our point of departure is that both parents have to agree for a child to be born. To our knowledge, our paper is the first in the fertility literature to take this perspective.[12] Moreover, we consider a dynamic model with multiple periods of childbearing, which allows us to distinguish disagreement over the timing of fertility from disagreement over the total number of children.

In Section 2, we analyze data from the Generations and Gender Programme and document the prevalence of disagreement over fertility among couples, as well as the importance of agreement for a birth to take place. In Section 3, we introduce our bargaining model of fertility, and in Section 4 the full quantitative model is developed. In Section 5 we match the model to the GGP data. Policy simulations are described in Section 6, and Section 7 concludes.

2 Evidence from the Generations and Gender Programme

We use data from the "Generations and Gender Programme" (GGP) to evaluate the importance of agreement on fertility decisions. The GGP is a longitudinal survey of adults in 19 mostly European countries that focuses on relationships

holds with respect to consumption allocations is analyzed more generally by Mazzocco (2007). Empirical studies of the link between female bargaining power and fertility include Ashraf, Field, and Lee (2014), who suggest that more female bargaining power leads to lower fertility rates in a developing-country context.

[12]Brown and Flinn (2011) develop a non-cooperative model of marriage where both spouses have to contribute for a child to be born, but the analysis is not focused on this aspect (the paper deals with the impact of policies governing parenting after divorce) and the paper does not consider data on fertility intentions. The need for agreement is also a key distinction between our work and bargaining models of fertility where household decisions can be expressed as the maximization of a weighted sum utility of the spouses with fixed bargaining weights. Such models of fertility choice are studied by Blundell, Chiappori, and Meghir (2005) and Fisher (2012). Cherchye, De Rock, and Vermeulen (2012) empirically evaluate a version of the model of Blundell, Chiappori, and Meghir (2005) and find evidence that bargaining power matters for expenditures on children. Eswaran (2002) considers a model where different fertility preferences between mothers and fathers (which in other studies are taken as primitives) arise endogenously.

within households, in particular between partners (spouses) and between parents and children. Topics that are covered include fertility, partnership, labor force participation, and child care duties.

In this section, we use the GGP data to document a set of facts regarding agreement and disagreement over having babies. The GGP provides much more detailed information on fertility intentions than do earlier data sets. The questions we use to determine fertility preferences and agreement or disagreement among spouses are:

> Q1: "Do you yourself want to have a/another baby now?"

for the respondent, and:

> Q2: "Couples do not always have the same feelings about the number or timing of children. Does your partner/spouse want to have a/another baby now?"

for the respondent's partner or spouse.[13] Our sample includes all respondents who answer these two questions in Wave 1 of the survey (at most two waves are available to date). Given that these questions are asked of all respondents who indicate that they are in a relationship, the sample includes married and non-married couples, and both cohabitating couples and those who have separate residences. Data for these questions are available for 11 countries in Wave 1 of the survey (which was carried out between 2003 and 2009), with a total of 35,688 responses. The included countries are Austria, Belgium, Bulgaria, the Czech Republic, France, Germany, Lithuania, Norway, Poland, Romania, and Russia. Table 1 reports summary statistics of the Wave 1 sample. The average age of the respondents is in the mid to late thirties, about 70 percent of couples are married, and close to 90 percent are cohabitating. The table provides a first glimpse of disagreement over having children: In more than 27 percent of couples at least one partner desires a baby, but in less than 17 percent of couples both partners do.

[13] There is only one respondent per couple. This raises the question how reliable the answer regarding the fertility intention of the non-responding partner is. While there may be some misreporting, we find that the patterns of disagreement reported by female and male respondents are essentially identical, which speaks against a substantial bias.

Table 1: Summary statistics of the Wave 1 sample

Variable	Mean
Age of female partner	34.02
Age of male partner	37.03
Respondent Female (in %)	51.66
Married couple (in %)	69.54
Cohabiting (in %)	87.95
Number of existing children	1.46
Women wanting a baby (in %)	21.00
Men wanting a baby (in %)	22.78
Couples where at least one wants a baby (in %)	27.15
Couples who both want a baby (in %)	16.63

Notes: 35,688 observations. Included countries are Austria, Belgium, Bulgaria, Czech Republic, France, Germany, Lithuania, Norway, Poland, Romania, and Russia.

The participants in the study are surveyed again in Wave 2, which takes place three years after the initial interview. So far, Wave 2 data on fertility outcomes are available for four countries (Bulgaria, the Czech Republic, France, and Germany), with more to become available in the coming years. The availability of data on fertility outcomes makes it possible to study the link between gender-specific fertility intentions and outcomes in detail. The sample size for each country in each wave is given in Tables 8 and 10 in Appendix A. This appendix also provides a detailed description of the data set.

Here we focus on basic facts regarding fertility intentions, fertility outcomes, and the division of child care tasks between the spouses within the household. These are the key variables with which to evaluate the predictions of our theory. We document three facts that inform our economic model, namely:

1. Many couples disagree on whether to have a (or another) baby.

2. Without agreement, few births take place.

3. In countries where men do little child care work, women are more likely to be opposed to having more children.

The data set contains a great deal of other information. In Appendix A we provide some additional empirical analysis to show how other characteristics of individuals and couples relate to fertility intentions, agreement on fertility, and fertility outcomes.

We now turn to the three main facts to be documented.

2.1 Many Couples Disagree on Whether to Have a Baby

In order to document the extent of disagreement over having babies, we focus on the number of couples who disagree as a fraction of all couples where at least one of the partners wants to have a baby. We condition on at least one spouse wishing a child because in the entire sample, most couples either haven't yet started to have children or have already completed their fertility. Hence, both partners not wanting a/another baby at the present time is the most common state. In contrast, we are interested in disagreement over having babies as an obstacle to fertility among couples where there is at least some desire for having a child.

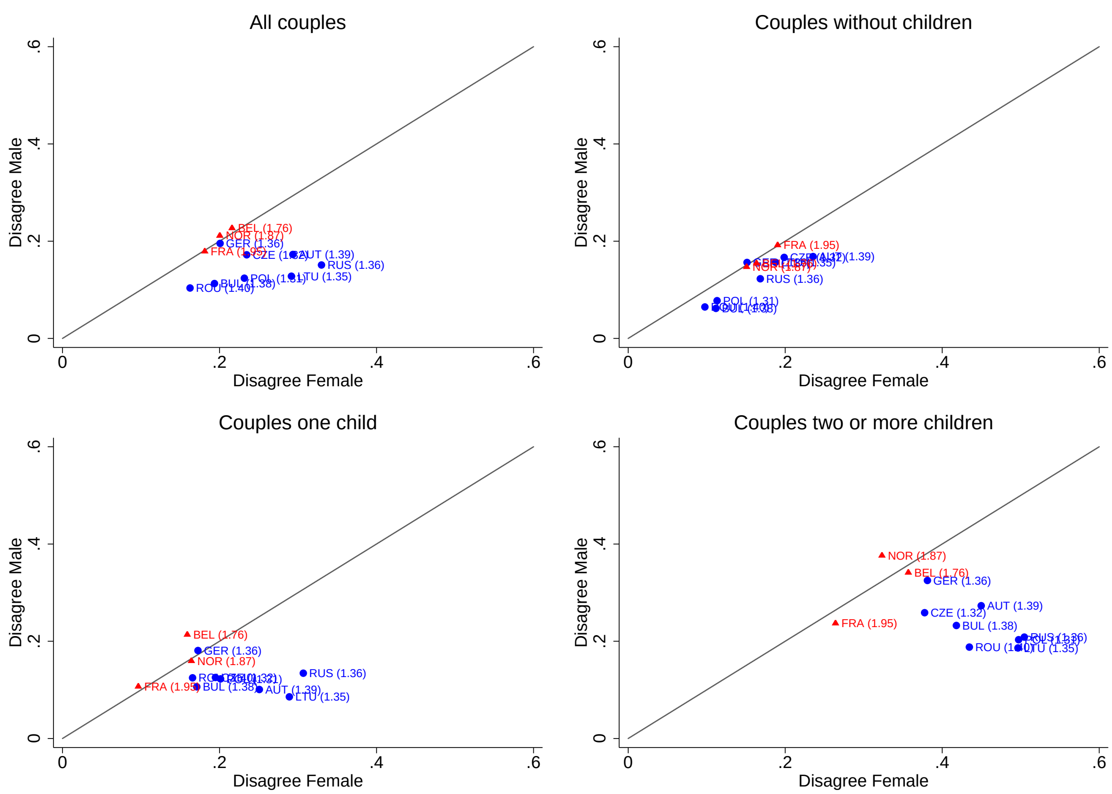
Based on the answers to questions Q1 and Q2, a couple can be in one of four states. Let AGREE denote a couple where both spouses desire a baby; SHE YES/HE NO denotes the case where the wife/female partner desires a baby, but the husband/male partner does not; and SHE NO/HE YES means that he desires a baby, but she does not. The remaining possibility is that neither spouse wants to have a baby. Let $\nu(\cdot)$ denote the fraction of couples in a given country in one of these states. We now compute the following disagreement shares:

$$\text{DISAGREE MALE} = \frac{\nu(\text{SHE YES/HE NO})}{\nu(\text{AGREE}) + \nu(\text{SHE YES/HE NO}) + \nu(\text{SHE NO/HE YES})},$$

$$\text{DISAGREE FEMALE} = \frac{\nu(\text{SHE NO/HE YES})}{\nu(\text{AGREE}) + \nu(\text{SHE NO/HE NO}) + \nu(\text{SHE NO/HE YES})}.$$

Figure 1 displays the extent of disagreement over fertility across countries, where the total fertility rate for each country is shown in parentheses.[14] In this graph, if all couples in a country were in agreement on fertility (either both want one or both do not), we would get a point at the origin. In a country that is on the 45-degree line, women and men are equally likely to be opposed to having a baby.

Figure 1: Disagreement over having a baby across countries



The main facts displayed in the first panel of Figure 1 can be summarized as follows. First, there is a lot of disagreement; in 25 to 50 percent of couples where at least one partner desires a baby, one of the partners does not (the total disagreement is the sum of the values on the x and y axes). Second, women are more often in disagreement with their partner's desire for a baby than the other way around (i.e., most countries lie to the right of the 45 degree line). Third, the tilt towards

[14]We obtained the total fertility rates for each country from the 2014 World Bank Development Indicators and use a simple average between the years 2000 and 2010.

more female disagreement is especially pronounced in countries with very low total fertility rates, whereas disagreement is nearly balanced by gender in the countries with a relatively high fertility rate (France, Norway, and Belgium).

The picture as such does not allow conclusions about whether disagreement affects the total number of children a couple ends up with. It is possible that the disagreement is about the timing of fertility, rather than about how many children to have overall. This issue will be addressed in the quantitative analysis below by exploiting repeated information on child preferences for couples who took part in both waves of the survey. As a first pass, it is indicative to consider disagreement as a function of the existing number of children. The total fertility rate of a country is more likely to be affected by disagreement over higher-order children; e.g., if a couple has at least two children already, it is more likely that the potential baby to be born is the marginal child (so that the total number of children would be affected). The remaining panels of Figure 1 break down the data by the number of children already in the family. The main observations here are that among couples who have at least two children, the extent of disagreement is even larger (50 to 70 percent), and the tilt towards female disagreement in low-fertility countries is even more pronounced.

2.2 Without Agreement, Few Births Take Place

Next, we document that disagreement is an important obstacle to fertility. The basic facts can be established through simple regressions of fertility outcomes on intentions of the following form:

$$\text{BIRTH}_i = \beta_0 + \beta_f \cdot \text{SHE YES/HE NO}_i + \beta_m \cdot \text{SHE NO/HE YES}_i + \beta_a \cdot \text{AGREE}_i + \epsilon_i.$$

Here $\text{BIRTH}_{i,t+1}$ is a binary indicator which is one if couple i has a baby in the three years after stating fertility intentions (as observed in Wave 2 of the survey), and the right-hand side variables denote the fertility intentions of couple i in Wave 1. The constant β_0 captures the baseline fertility rate of couples in which both partners state not to want a baby. The parameters β_f, β_m, and β_a measure the increase in the probability of having a baby compared to the baseline for couples in each of the three other states. In a world where women decide on fertility on their own, we would expect to find $\beta_f = \beta_a > 0$ and $\beta_m = 0$. If each spouse's intention had an independent influence on the probability of having a baby, we would observe $\beta_f > 0$, $\beta_m > 0$, and $\beta_a = \beta_f + \beta_m$. Finally, if a birth can take place only if the spouses agree on having a baby (i.e., each spouse has veto power), we expect to find $\beta_f = \beta_m = 0$ and $\beta_a > 0$. Least squares estimates for this regression, using pooled data as well as samples split by the number of existing children for all available countries, are shown in Table 2.

Table 2: Impact of fertility intentions on probability of birth

	Whole Sample	By Number of Children		
		$n = 0$	$n = 1$	$n \geq 2$
SHE YES/HE NO	0.115***	0.026	0.160***	0.082**
	(0.024)	(0.042)	(0.052)	(0.032)
SHE NO/HE YES	0.061***	0.030	0.020	0.024
	(0.017)	(0.037)	(0.032)	(0.022)
AGREE	**0.350***	**0.266***	**0.325***	**0.340***
	(0.015)	(0.029)	(0.026)	(0.038)
Constant	0.055***	0.124***	0.109***	0.033***
	(0.004)	(0.019)	(0.011)	(0.003)
Observations	6577	1227	1608	3742
R^2	0.167	0.081	0.128	0.115

Notes: Robust standard errors in parentheses. *: $p < 0.10$, **: $p < 0.05$, ***: $p < 0.01$. Each column is a linear regression of a binary variable indicating whether a child was born between Wave 1 and Wave 2 (i.e., within three years after Wave 1) on stated fertility intentions in Wave 1. Countries included (i.e., all countries where data from both waves are available) are Bulgaria, Czech Republic, France, and Germany.

We find that all coefficients are significant for the pooled sample, but the agreement term β_a is the largest in size, and about twice as large as the sum of β_f and

β_m.[15] A couple that agrees has an almost three times higher incremental likelihood of having a baby than does a couple where the man disagrees, and a more than four times higher likelihood than does a couple where the woman disagrees.

Next, we break down the regressions by parity, i.e., the number of children the couple already has. The need for agreement is most pronounced for couples with no children. For these couples, the probability of having a child when one partner desires one is not significantly different from the probability of couples that agree not to have a child. Perhaps not surprisingly, for higher-order children, the woman's intention turns out to be more important than the man's. In fact, if the woman disagrees, the man's desire for a child has no significant impact on the likelihood of a birth. But even for a woman, having her partner agree greatly increases the probability of having a child.

In summary, the data show that agreement between the potential parents is essential for babies to be born. While women have some independent control over their fertility, only couples who agree on the plan to have a baby are likely to end up with one.

2.3 When Men Do Little Child Care Work, Women Are More Likely to Be Opposed to Having More Children

In the theory articulated below, disagreement between spouses regarding fertility can arise because couples cannot commit to a specific allocation of child care duties in advance. To show that the distribution of child care between mothers and fathers matters in the GGP data, here we calculate the average share of men in caring for children at a national level by coding the answers to the following questions:

> "I am going to read out various tasks that have to be done when one lives together with children. Please tell me, who in your household does these tasks?
>
> 1. Dressing the children or seeing that the children are properly dressed;

[15] β_a is statistically different from $\beta_m + \beta_f$ at the 1 percent level in all regressions.

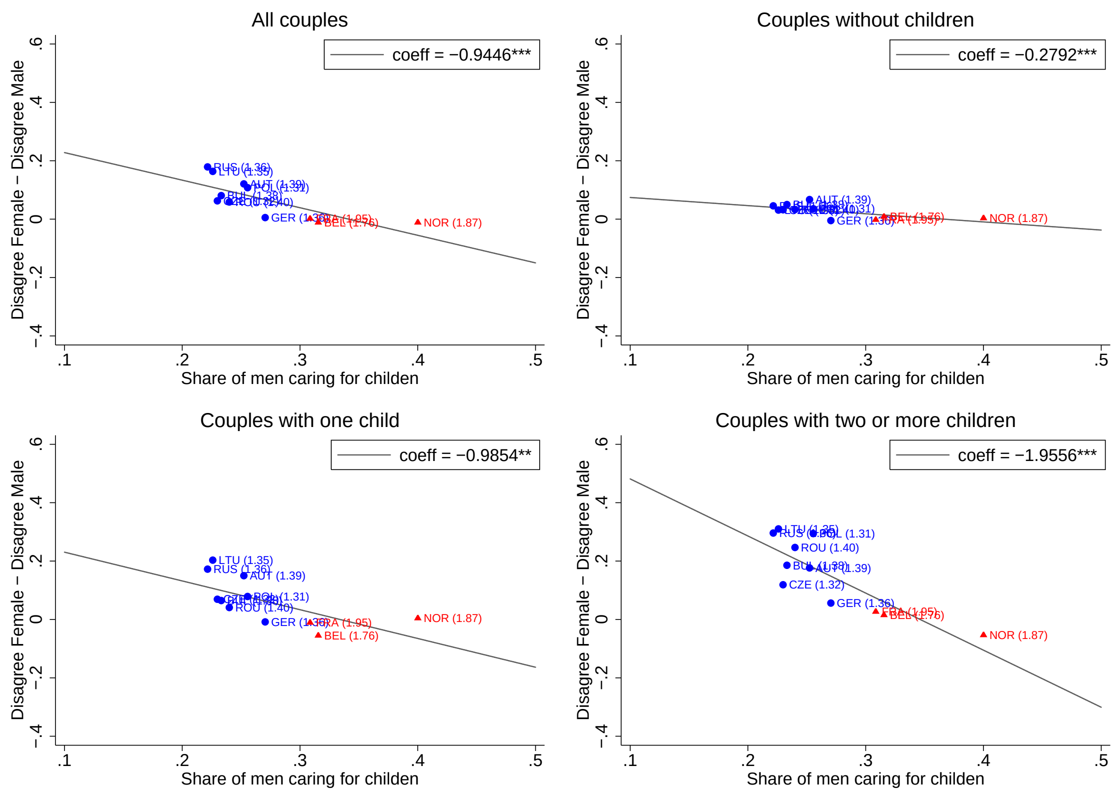
2. Putting the children to bed and/or seeing that they go to bed;
3. Staying at home with the children when they are ill;
4. Playing with the children and/or taking part in leisure activities with them;
5. Helping the children with homework;
6. Taking the children to/from school, day care centre, babysitter or leisure activities."

The possible answers to these questions are "always the respondent," "usually the respondent," "about equal shares," "usually the partner," and "always the partner." We code these answers as 0, 0.1, 0.5, 0.9, and 1 if the respondent is female and 1, 0.9, 0.5, 0.1, and 0 if the respondent is male. We aggregate the answers by forming a simple mean per household and calculating the average for every country. This gives us a proxy for the share of men in child care for every country. In all countries in the data set, women carry out the majority of these tasks, but there is also considerable variation across countries. The countries with the highest fertility (Belgium, France, and Norway) also have the highest participation of men in child care. Men do the most child care work in Norway with a share of about 40 percent, whereas Russian men do the least with a share of less than 25 percent.

To examine how the allocation of child care duties is related to fertility intentions, we plot the male share in child care against the difference between female disagreement and male disagreement with having another child (i.e., the difference between the DISAGREE FEMALE and DISAGREE MALE variables displayed in Figure 1). This yields Figure 2 (which also includes regression lines). The figure shows that in countries where women do most of the work in raising children, women are more likely to be opposed to having more children, and fertility is low. This effect is especially pronounced for couples that already do have children.

While these relationships make intuitive sense and confirm some of the conventional wisdom on European fertility, notice that it takes a particular kind of model to capture these facts. First, a bargaining model is required, since a unitary model

Figure 2: Disagreement over fertility and men's share in caring for children



is not designed to account for disagreement. Second, the link from disagreement to total fertility suggests that men are not able to fully compensate their partners for their child care duties in order to implement their own (higher) fertility preference. We take the perspective that this is due to limited commitment within the household. Next, we describe the theoretical framework that spells out this mechanism and that can account for all three facts documented above.

3 A Bargaining Model of Fertility

In this section, we develop our bargaining model of fertility choice. We consider the decision problem of a household composed of a woman and a man. Initially the couple does not have children. To have a child, the partners have to act jointly, and hence a child is created only if both spouses find it in their interest to participate. Without agreement, the status quo prevails. We start our analysis with the case of a one-time choice of a single child. We contrast the cases of commitment and limited commitment, and show that the distribution of the child care burden between the spouses is an important determinant of the total fertility rate. Next, we extend the analysis to a two-period model and show that the evolution of child preferences over time also needs to be taken into account if we want to disentangle the effects of possible policy interventions on period fertility and cohort fertility. These insights lead to the development of a multi-period model with stochastically evolving child preferences in Section 4.

3.1 Commitment versus Limited Commitment in the One-Child Case

Consider an initially childless couple consisting of a woman f and a man m. The couple has to decide on whether to have a child. The market wages for the woman and the man are w_f and w_m. The total cost of a child in terms of consumption[16] is given by ϕ. Utility $u_g(c_g, b)$ of spouse $g \in \{f, m\}$ is given by:

$$u_g(c_g, b) = c_g + bv_g, \tag{1}$$

where $c_g \geq 0$ is consumption, $b \in \{0, 1\}$ indicates whether a child is born, and v_g is the additional utility spouse g receives from having a child compared to the childless status quo.

In addition to the opportunity to have children, an added benefit of being in a relationship is returns to scale in consumption. Specifically, if a couple cooperates, their effective income increases by a factor of $\alpha > 0$ (or, equivalently, the effective cost of consumption decreases by a factor of $1/(1+\alpha)$). For a cooperating couple, the budget constraint is then given by:

$$c_f + c_m = (1 + \alpha)\left(w_f + w_m - \phi b\right). \tag{2}$$

The household reaches decisions through Nash bargaining. Consider first the case of commitment, in which the spouses can commit to a future consumption

[16] We abstract from time costs for simplicity; expressing a part of the cost of a child in terms of time would not substantially alter the analysis.

allocation before having a child. This case amounts to choosing consumption and fertility simultaneously subject to a single outside option. The outside option is not to cooperate, in which case the couple does not have a child and forgoes the returns to scale from joint consumption. Utilities $u_g^d(0)$ in the outside option are therefore given by:

$$u_f^d(0) = w_f \quad \text{and} \quad u_m^d(0) = w_m. \tag{3}$$

We denote the ex-post utility of woman and man (i.e., taking wages, costs of children, and the bargaining outcome into account) as $u_g(0)$ when no child is born and $u_g(1)$ when a child is born, where $g \in \{f, m\}$. We assume equal bargaining weights throughout.[17]

Proposition 1 (Fertility Choice under Commitment)**.** *Under commitment, the couple decides to have a child if the condition:*

$$v_f + v_m \geq \phi(1 + \alpha) \tag{4}$$

is met. Moreover, when (4) *is met, we also have:*

$$u_f(1) \geq u_f(0) \quad \textit{and } u_m(1) \geq u_m(0).$$

That is, each spouse is individually better off when the child is born. Conversely,

$$v_f + v_m < \phi(1 + \alpha)$$

implies

$$u_f(1) < u_f(0) \quad \textit{and } u_m(1) < u_m(0),$$

i.e., if the couple decides not to have a child, each spouse individually is better off without the child. Taking together, the conditions imply that under commitment the couple always agrees about the fertility choice and this choice is efficient.

The implication of perfect agreement on fertility among the spouses conflicts with our empirical observation of many couples who disagree on having a child. To allow for disagreement, we now consider a setup with limited commitment.

[17] All results can be generalized to arbitrary weights.

In this case, bargaining proceeds in two stages. In the first stage, the spouses decide whether to have a child. In the second stage, resources are divided, given the outside option after the fertility decision is sunk. Hence, for each spouse there are two different outside options, for the case where the couple has a child and for the case where it doesn't. This setup captures lack of commitment, in the sense that the spouses are not able to make binding commitments for transfers in the second stage during the first-stage bargaining over fertility (allowing for commitment to such transfers would return us to the full commitment case discussed above).

The outside options conditional on not having children are still given by (3). To formulate the outside options when there is a child, we have to take a stand on who bears the cost of raising children in the non-cooperation state. We assume that the cost shares of woman and man are given by fixed parameters χ_f and χ_m with $\chi_f + \chi_m = 1$. The new outside options therefore are:

$$u_f^d(1) = w_f + v_f - \chi_f \phi, \tag{5}$$

$$u_m^d(1) = w_m + v_m - \chi_m \phi. \tag{6}$$

Notice that in the outside option, the spouses still derive utility from the presence of the child. We interpret the outside option as non-cooperation within a continuing relationship, as in Lundberg and Pollak (1993b). That is, the couple is still together and both partners still derive utility from the child, but bargaining regarding the allocation of consumption breaks down, the division of child care duties reverts to the defaults given by χ_f and χ_m, and the couple no longer benefits from returns to scale in joint consumption. We do not take an explicit stand on how the default child cost shares χ_f and χ_m are determined. We can imagine that traditional gender roles within a country are relevant (as emphasized by Lundberg and Pollak 1993b), but government policies determining the availability of market-based child care should also matter.[18] Another possibility is that the default cost shares are in part controlled by the couple. For example, cost shares

[18]The role of country-specific social norms regarding the division of labor in the household for outcomes such as marriage and fertility have been empirically documented by Fernández and Fogli (2009) and Sevilla-Sanz (2010), among others.

may depend on the couple's decision of where to live (say, close to grandparents who would be willing to help with child care). Endogenous default cost shares result in a model with partial commitment, which we consider as an extension in Appendix B.3 below.

We now characterize the fertility choice under lack of commitment.

Proposition 2 (Fertility Choice under Lack of Commitment)**.** *Under lack of commitment, we have $u_f(1) \geq u_f(0)$ (the woman would like to have a child) if and only if the condition*

$$v_f \geq \left(\chi_f + \frac{\alpha}{2}\right)\phi \tag{7}$$

is satisfied. We have $u_m(1) \geq u_m(0)$ (the man would like to have a child) if and only if the condition

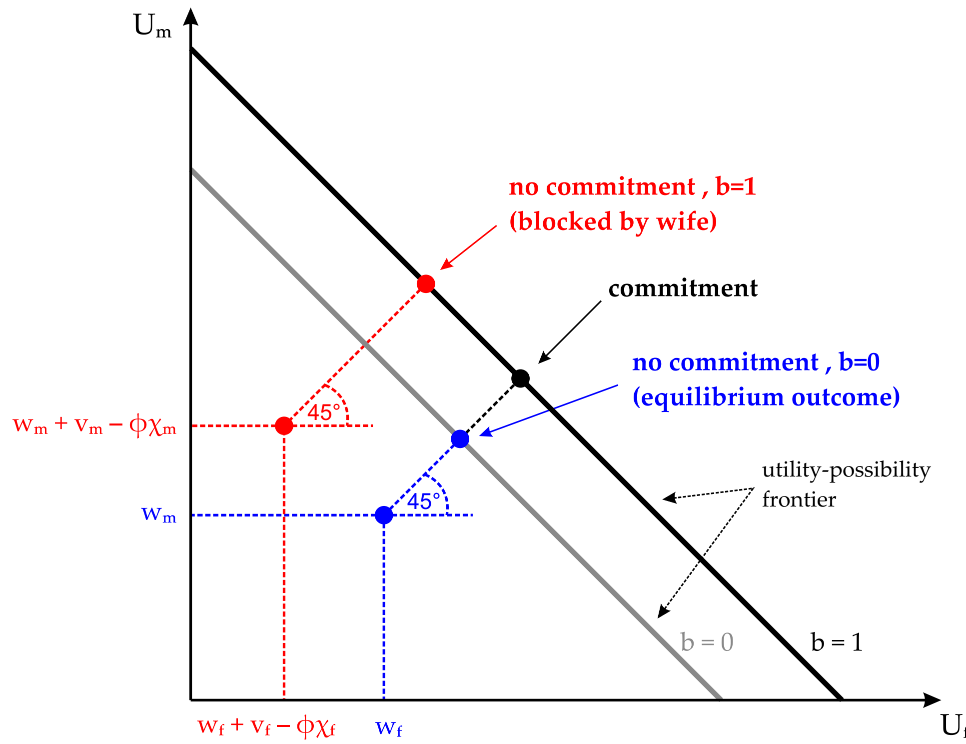
$$v_m \geq \left(\chi_m + \frac{\alpha}{2}\right)\phi \tag{8}$$

is satisfied. The right-hand sides of (7) *and* (8) *are constants. Hence, depending on v_f and v_m, it is possible that neither condition, both conditions, or just one condition is satisfied. Since child birth requires agreement, a child is born only if* (7) *and* (8) *are both met.*

The reason for the possible disagreement is that after the child is born, the outside options of the two partners shift away from the outside options in the full commitment model. Figure 3 illustrates this issue for the case in which the woman bears a larger share of the entire child cost than the man does.

Under full commitment, the outside option is given by (w_f, w_m). The line $b = 0$ shows the utility possibility frontier for the case in which the couple does not have a baby, and the line $b = 1$ shows the frontier for the case of having one. In the depicted situation, having a baby yields a higher utility level. The utility allocation between the woman and the man is given by the intersection between the utility possibility frontier and a 45-degree line starting from the outside option (because of equal bargaining weights). Note that under full commitment, for each partner the utility level of having a child is higher than the utility level of not having a child, so that the partners agree and will act jointly to have a child. More generally, under full commitment the partners will agree to have a child if

Figure 3: Full versus limited commitment bargaining



and only if the utility possibility frontier for $b = 1$ is higher than the frontier for $b = 0$, and they will agree not to have a child if $b = 1$ lowers the utility possibility frontier. Since along the 45-degree line from the outside option (or, more generally, any line with positive slope corresponding to a set of bargaining weights) the woman's and the man's utility move in the same direction, there cannot be disagreement, i.e., a situation where only one of the partners wishes to have a child.

In the case of limited commitment, there are two outside options, the one without children and the one with children. Again, the solution to the bargaining problem is the intersection of the utility possibility frontier and the 45-degree line starting at the relevant outside option. However, because the outside option now depends on the fertility decision, there is a possibility of disagreement over fertility, which is the case drawn here. Because she bears a large share of the child cost and hence loses bargaining power if a child is born, the woman will have a lower utility level in the case with a child compared to the one without. Hence, she will not agree to a birth and the couple will remain childless, even though they could both be better off with a child if they were able to commit.

In Appendix B.3, we also consider a model with partial commitment, where in the first stage the couple can make investments that affect the cost shares χ_f and χ_m that enter the outside option conditional on having a child. Examples of such investments would include a choice of location that affects the availability of child care (i.e., close to grandparents or a daycare facility), and buying durable goods (such as household appliances or minivans) that facilitate taking care of children. We show that as long as the ex-post cost shares can be moved only within a limited range, the partial commitment model has the same qualitative implications as the setup with fixed cost shares considered here.

3.2 The Distribution of the Burden of Child Care and the Fertility Rate

Our results so far suggest that the distribution of the child care burden between spouses matters for fertility; if one spouse bears a disproportionate burden, that person will be unlikely to agree to a birth because of the loss in the outside option implied by having a child. We now make this intuition more precise by examining how, in an economy with many couples who are heterogeneous in child preferences, the average fertility rate depends on the distribution of the child care burden.

Consider an economy with a continuum of couples. The cost shares χ_f and $\chi_m = 1 - \chi_f$ are identical across couples. We interpret the cost parameters as driven partly by government policy, and partly by social norms. For example, there may be a social norm that women do most of the work in raising children, especially in the case of non-cooperation between the couples (which is where the distribution of the burden matters). The extent to which this norm will affect bargaining will depend also on the availability of public child care. If child care can be provided through the market, the man may be more likely to contribute to the cost of raising children compared to the case where children are always raised within the home by their parents, in which case there would be a greater push towards specialization in child care (see also Appendix A.3 and A.4).

Child preferences are heterogeneous in the population, with a joint cumulative distribution function of $F(v_f, v_m)$. For a child to be born, both (7) and (8) have to be satisfied. For ease of notation, we denote the threshold values for the woman's and man's child preference above which they would like to have a child by $\tilde{v}_f$ and $\tilde{v}_m$:

$$\tilde{v}_f = (\chi_f + \alpha/2)\,\phi, \tag{9}$$
$$\tilde{v}_m = (\chi_m + \alpha/2)\,\phi = (1 - \chi_f + \alpha/2)\,\phi. \tag{10}$$

The expected number of children $E(b)$ (i.e., the fraction of couples who decide to have a child) is given by:

$$E(b) = 1 - F(\tilde{v}_f, \infty) - F(\infty, \tilde{v}_m) + F(\tilde{v}_f, \tilde{v}_m). \tag{11}$$

That is, the couples who don't have a child are those where either the woman's or the man's fertility preference is below the threshold; the last term is to prevent double-counting couples where both spouses are opposed to having a child.

To gain intuition for how fertility depends on the distribution of child costs, it is useful to consider the case of independent distributions $F_f(v_f)$ and $F_m(v_m)$ for female and male child preferences, so that $F(v_f, v_m) = F_f(v_f)F_m(v_m)$. Expected fertility can then be written as:

$$E(b) = 1 - F_f(\tilde{v}_f) - F_m(\tilde{v}_m) + F_f(\tilde{v}_f)\,F_m(\tilde{v}_m). \tag{12}$$

If the distribution functions are differentiable at $\tilde{v}_f$ and $\tilde{v}_m$, the marginal effect of a change in the female cost share χ_f on fertility is:

$$\frac{\partial E(b)}{\partial \chi_f} = \phi F_m'(\tilde{v}_m)\left[1 - F_f(\tilde{v}_f)\right] - \phi F_f'(\tilde{v}_f)\left[1 - F_m(\tilde{v}_m)\right]. \tag{13}$$

The first (positive) term represents the increase in the number of men who agree to have a child if the female cost share χ_f increases (and hence the male cost share declines), and the second (negative) term is the decline in agreement on the part of women. The first term has two components: $F_m'(\tilde{v}_m)$ is the density of the distribution of male child preferences at the cutoff, which tells us how many men switch from disagreeing to agreeing with having a child as χ_f rises. The second component $1 - F_f(\tilde{v}_f)$ is the fraction of women who agree to have children. This term appears because the man switching from disagreeing to agreeing only results in a birth if the woman also agrees. If most women are opposed to having a child, an increase in male agreement has only a small effect on fertility. In the same way, the negative impact of a decline in female agreement on fertility, measured by $F_f'(\tilde{v}_f)$, is weighted by the share of men agreeing to have a child $[1 - F_m(\tilde{v}_m)]$.

The terms for the existing fractions of women and men agreeing to have a child in (13) introduce a force that leads to high fertility if agreement on having children is balanced between the genders. In the extreme, if all women were opposed to having a baby but at least some men wanted one, the only way to raise fertility would be to lower the female cost share (and vice versa if all men were opposed). The overall relationships between cost shares, agreement rates, and fertility can be fully characterized when child preferences are uniform, so that the densities $F_f'(\tilde{v}_f)$ and $F_m'(\tilde{v}_m)$ are constant. In particular, if female and male fertility preferences have the same uniform densities (but potentially different means), fertility is maximized when equal fractions of women and men agree to having a child. If one gender has more concentrated fertility preferences (higher density), fertility is maximized at a point where the rate of agreement in this gender is proportionately higher also. The following proposition summarizes the results.

Proposition 3 (Effect of Distribution of Child Cost on Fertility Rate)**.** *Assume that the female and male child preferences follow independent uniform distributions with means μ_g and densities d_g for $g \in \{f, m\}$. Then expected fertility $E(b)$ is a concave function of the female cost share χ_f, and fertility is maximized at:*

$$\hat{\chi}_f = \min\left\{1, \max\left\{0, \frac{1}{2} + \frac{1}{2\phi}\left[\mu_f - \mu_m + \frac{1}{2}\frac{d_m - d_f}{d_f d_m}\right]\right\}\right\}. \tag{14}$$

Hence, if women and men have the same preferences ($\mu_f = \mu_m$, $d_f = d_m$), fertility is maximized when the child care burden is shared equally. Moreover, if the distributions of female and male preferences have the same density ($d_f = d_m$), equal shares of men and women agree to having a child at the maximum fertility rate, even if $\mu_f \neq \mu_m$ (provided *that $\hat{\chi}_f$ is interior). If $d_f \neq d_m$, at $\hat{\chi}_f$ more individuals of the gender with the more concentrated distribution of preferences (higher d_g) agree to having a child than individuals of the gender with more dispersed preferences. Specifically, fertility is maximized when the ratio of agreement shares $(1 - F_f(\tilde{v}_f))/(1 - F_m(\tilde{v}_m))$ is equal to the ratio of densities d_f/d_g.*

The result suggests that if the distribution of the child care burden is not at the fertility-maximizing level, the fertility rate could be raised by policies that shift these responsibilities in a particular direction. Likewise, subsidies for childbearing would be more or less effective depending on whether they specifically target one of the spouses (say, by providing publicly financed alternatives for tasks that previously fell predominantly on one spouse). For a concrete policy analysis, we need to add more structure to the analysis. We do this in Section 4 in a more elaborate quantitative version of our theory. When matched to the GGP data, that model indeed predicts that the effectiveness of policies designed to promote childbearing crucially depends on how the policies are targeted.

For non-uniform distributions of child preferences, the same intuitions regarding the effects of a change in cost shares that arise from Proposition 3 still apply locally. In particular, given (13), the local effect of a change in cost shares is driven by the density of the child preferences of each gender and by the existing shares of agreement and disagreement by gender. Global results can be obtained only by placing at least some restrictions on the overall shape of preferences.[19] Empirically, we do not have information on the global shape of child preferences away from the cutoffs, because we observe only a binary variable on child preferences. We therefore use uniform distributions in the quantitative implementation of the dynamic model described below, while noting that the measured effects should be considered to be locally valid. In the quantitative model, we also allow for correlation in child preferences within households. In the mathematical appendix,

[19] One can even construct cases (albeit unrealistic ones) where fertility is maximized when one gender bears the entire child care burden. For example, consider a preference distribution (identical between men and women) where 50 percent of each gender want to have a child even if they have to bear the entire child cost, whereas the other 50 percent agree to having a child only if they bear none of the cost. In this case, 50 percent of couples have a child if one spouse bears all the cost, whereas only 25 percent of couples have a child if both spouses make a contribution.

we show that results analogous to those in Proposition 3 also go through in the correlated case.

3.3 The Timing of Births

The analysis so far shows that limited commitment potentially can account for our observations on agreement and disagreement on having children, and that a limited commitment model implies that cultural norms or policy measures affecting the distribution of the child care burden within the family can affect fertility outcomes. However, a limitation of the static model is that it does not distinguish between the timing of births and the total number of births. In a dynamic setting, there is an important distinction between spouses' disagreement about the total number of children they want to have, and disagreement about when to have them. In the extreme, one can envision a setting in which all couples agree on how many children they ultimately want to have, and the only source of conflict is whether to have them early or late. In this case, an intervention that reshuffles the child care burden between the spouses may affect when people have children, but it would not affect the ultimate outcome in terms of the total number of children per couple. If the policy aim is to raise fertility rates, understanding whether policy affects total fertility or only the timing of fertility is clearly important.

In this section, we extend our analysis to a two-period setting in order to clarify how this issue relates to the persistence of child preferences between periods. In the quantitative model introduced in Section 4 below, we will then use repeated observations of the child preferences of a given couple from multiple waves of the GGP survey to pin down this critical aspect of the analysis.

As before, there is a continuum of couples, and the wages w_f and w_m, the child cost ϕ, and the cost shares χ_f and $\chi_m = 1 - \chi_f$ are identical across couples and over the two periods $t = 1, 2$. The child cost accrues only in the period when a child is born (to be relaxed in Section 4). Preferences are as in (1), but extending over two periods with discount factor β, where $0 < \beta \leq 1$. Child preferences in the second period may depend on the fertility outcome in the first period. First-period child preferences are denoted as $v_{f,1}$, $v_{m,1}$, and second-period preferences are given by $v_{f,2}$ and $v_{m,2}$. Hence, the expected utility function is:

$$E\left[u_g(c_{g,1}, b_1, c_{g,2}, b_2)\right] = c_{g,1} + b_1 v_{g,1} + \beta E\left[c_{g,2} + b_2 v_{g,2} \mid b_1\right]. \tag{15}$$

The expectations operator appears because we allow for the possibility that child preferences in the second period are realized only after decisions are made in the first period. As before, we focus on the case of limited commitment. In each period, the spouses bargain ex post over consumption after the fertility decision has been made; in addition, the spouses are unable to commit to a specific second-period consumption allocation during the first period. There is no savings technology, so that (in the case of cooperation) the per-period budget constraints are as in (2) above. In addition, the outside option of non-cooperation affects only a single period. That is, a non-cooperating couple in the first period returns to cooperation in the second period.

The second period of the two-period model is formally identical to the static model, and Propositions 2 and 3 apply. For a given couple with a given preference draw, let $EV_{f,2}(0)$ and $EV_{m,2}(0)$ denote equilibrium second-period expected utilities conditional on no child being born in the first period, and $EV_{f,2}(1)$ and $EV_{m,2}(1)$ denote expected utilities if there is a first-period birth. Here the dependence of second-period utility on first-period fertility is solely due to preferences in the second period being allowed to depend on the fertility outcome in the first period. We start by characterizing the conditions for births to take place.

Proposition 4 (Conditions for Child Birth in Two-Period Model)**.** *In the second period, a birth takes place ($b_2 = 1$) if and only if the following conditions are satisfied:*

$$v_{f,2} \geq \left(\chi_f + \frac{\alpha}{2}\right)\phi \equiv \tilde{v}_{f,2}, \tag{16}$$

$$v_{m,2} \geq \left(\chi_m + \frac{\alpha}{2}\right)\phi \equiv \tilde{v}_{m,2}. \tag{17}$$

In the first period, a birth takes place ($b_1 = 1$) if and only if the following conditions are *met:*

$$v_{f,1} \geq \left(\chi_f + \frac{\alpha}{2}\right)\phi + \beta\left(EV_{f,2}(0) - EV_{f,2}(1)\right) \equiv \tilde{v}_{f,1}, \tag{18}$$

$$v_{m,1} \geq \left(\chi_m + \frac{\alpha}{2}\right)\phi + \beta\left(EV_{m,2}(0) - EV_{m,2}(1)\right) \equiv \tilde{v}_{m,1}. \tag{19}$$

Hence, the main change compared to the static case is that when deciding on fertility in the first period, the spouses also take into account how having a child affects their utility in the second period. Depending on how preferences evolve, this effect could go in either direction. If future preferences are uncertain, there can be an option value of waiting, i.e., a couple may delay having a child in the hope of a more favorable future preference realization.

We now illustrate how the evolution of child preferences determines whether shifts in the distribution of the child care burden (say, induced by targeted policies) affect the total number of children (denoted by $n = b_1 + b_2$) or just the timing of fertility. We do so by considering two polar cases. The first one is where first-period fertility does not affect preferences in the second period; instead, fertility preferences are drawn repeatedly from the same distribution. In this scenario, shifts in the cost share affect only total fertility, but not the timing of fertility.

Proposition 5 (Level and Timing of Fertility with Independent Draws)**.** *Assume that in both periods, the female and male child preferences follow independent uniform distributions with identical means μ_g and densities d_g for $g \in \{f, m\}$. Then expected fertility $E(b_1)$ and $E(b_2)$ in the two periods depends on the female cost share χ_f as described in Proposition 3. For any χ_f, we also have $E(b_1) = E(b_2)$, so that total expected lifetime fertility $E(n) = E(b_1) + E(b_2)$ satisfies:*

$$E(n) = 2E(b_1) = 2E(b_2).$$

The timing of fertility, as measured by the ratio $E(b_1)/E(b_2)$, is independent of χ_f.

Next, we consider an opposite polar case where having a child in the first period removes the desire for additional children.

Proposition 6 (Level and Timing of Fertility with Fixed Desire for Children)**.** *Assume that in the first period, the female and male child preferences follow independent* *uniform distributions with means μ_g and densities d_g for $g \in \{f, m\}$. In the second period, preferences depend on first-period fertility: if $b_1 = 1$, we have $v_{f,2} = v_{m,2} = 0$, and if $b_1 = 0$, we have $v_{g,2} = (\chi_g + \alpha)\,\phi$. Then the total fertility rate is constant for all $\chi_f \in [0, 1]$:*

$$E(n) = E(b_1) + E(b_2) = 1. \tag{20}$$

Fertility in the first period depends on χ_f as described in Proposition 3 for the transformed parameter $\tilde{\alpha} = (1 + \beta)\alpha$. Given that $E(n)$ is constant and:

$$\frac{E(b_1)}{E(b_2)} = \frac{E(b_1)}{1 - E(b_1)}, \tag{21}$$

the cost share χ_f affects only the timing, but not the level of fertility.

The proposition captures an extreme case where all individuals eventually want to end up with exactly one child, and the only disagreement is over when that child should be born. But the intuition from this example carries over to the general case where a birth leads to at least some downward shift in future fertility preferences. This is a plausible scenario, because as long as the marginal utility derived from children is diminishing, some such downward shift will be present. If this effect is strong, policies that aim to shift the distribution of the child care burden may have little impact on the overall fertility rate, even when the data in a given cross section suggest a lot of disagreement over fertility.

To deal with this issue and to allow for a meaningful policy analysis, we need to capture how a given couple's child preferences shift over time, and how this depends on child birth. Doing this in a quantitatively plausible manner requires a more elaborate model, which we turn to next.

4 A Dynamic Model with Evolving Child Preferences

As we have shown, in order to understand the ramifications of disagreement over fertility for policy interventions, it is essential to allow for couples' fertility preferences to evolve in a way that is compatible with empirical evidence. Hence, we now extend our model to a dynamic setup with stochastically evolving preferences that can be matched to the GGP data.

We model couples that are fertile from period 1 to period $T = 8$. Each model period lasts three years of actual time. The first period corresponds to ages 20–22, the second to 23–25, and so on up to period 8 (ages 41–43). Parents raise their children for $H = 6$ periods (corresponding to 18 years). Hence, after completing fertility, the couple continues to raise its children until all children have reached adulthood by period $T+H$. Couples start out with zero children and can have up to three children. We denote by b the fertility outcome in a given period, where $b = 1$ in case a child is born in the period and $b = 0$ otherwise. Also, n denotes the total number of children of a couple, where $0 \leq n \leq 3$.

In a given period, a person of gender $g \in \{f, m\}$ derives utility from consumption c_g and fertility $b \in \{0, 1\}$. The utility v_g that a person derives from the arrival of a child is stochastic and evolves over time (to be described below). The individual utility of a household member of gender $g \in \{m, f\}$ at age t is given by the value function:

$$V_g^t(a_1, a_2, a_3, v_f, v_m) = u(c_g, v_g, b) + \beta E\left[V_g^{t+1}(a_1', a_2', a_3', v_f', v_m') \mid b\right]. \tag{22}$$

Here a_1, a_2 and a_3 denote the ages of the children at the beginning of the period, v_f and v_m are the child preferences of the two partners, and β is a discount factor that satisfies $0 < \beta < 1$. In writing the value function this way, it is understood that c_g and b are functions of the state variables that are determined through bargaining between the spouses. We have $a_i = 0$ for a potential child that has not yet been born. Since in the model no interesting decisions are made after all children are grown, we assume that parents die at that point and hence $V_g^{T+H+1} = 0$.

As in Section 3 above, utility is linear in consumption and additively separable in felicity derived from the presence of children. Instantaneous utility is given by:

$$u(c_g, v_g, b) = c_g + v_g \cdot b.$$

Notice that the couple derives utility from a child only in the period when the child is born. However, this is without loss of generality, since only the present value of the added utility of a child matters for the fertility decision.

Children are costly as long as they live with their parents. Given the age distribution of children a_i, we can calculate the total number of children living in the household as:

$$n_h = \sum_i \mathbb{1}(0 < a_i < H) + b,$$

where H is the duration of childhood. The cost of raising n_h children is

$$k(n_h) = \phi \cdot (n_h)^{\psi},$$

with $\phi, \psi > 0$. Depending on the value for ψ, we allow for the possibility of economies or diseconomies of scale. Couples split the cost of children according to the cost shares χ_f and χ_m with $\chi_f + \chi_m = 1$. For now, these cost shares are taken as exogenous.

Couples engage in a cooperative Nash-bargaining game without commitment. Specifically, the spouses cannot commit to future transfers. Bargaining takes place regarding the distribution of consumption within a given period, taking the current number of children and also future utility as given. Both spouses participate in the labor market, with gender-specific wages w_g. Hence, analogous to (5) and (6) in the static model, utility in the outside option is:

$$u(c_g, v_g, b) = w_g - \chi_g k(n_h) + v_g \cdot b,$$

that is, each spouse consumes his or her own labor income net of the cost of taking care of the children. The outside option captures non-cooperation for a single period, with an expectation that cooperation will resume in the future. Hence, future utility is identical in the outside option and on the equilibrium path, and does not enter the bargaining problem of allocating consumption in a given period.

The couple's budget constraint in the case of cooperation reads:

$$c_f + c_m = (1 + \alpha) \left[w_f + w_m - k\left(n_h\right) \right].$$

Here $\alpha > 0$ parameterizes increasing returns to joint consumption that the couple can enjoy if there is cooperation. Assuming equal bargaining weights (which can easily be generalized), the solution to the cooperative bargaining game is the solution to the maximization problem:

$$\max_{c_f, c_m} \Big[c_f - (w_f - \chi_f k(n_h)) \Big]^{0.5} \Big[c_m - (w_m - \chi_m k(n_h)) \Big]^{0.5}$$

subject to the above budget constraint. Future utility does not enter here because the evolution of the state variables is unaffected by the current consumption allocation; hence, the bargaining problem regarding consumption is static. Analogous to (25) and (26) in the proof of Proposition 2, the solution to the maximization problem is:

$$\begin{aligned} c_f(n_h) &= w_f - \chi_f k(n_h) + \frac{\alpha}{2}\left[w_f + w_m - k(n_h)\right], \\ c_m(n_h) &= w_m - \chi_m k(n_h) + \frac{\alpha}{2}\left[w_f + w_m - k(n_h)\right]. \end{aligned}$$

That is, each spouse receives its outside option plus a fixed share of the surplus generated by cooperation.

Up to this point, this setup differs from the one considered in Section 3 in that we allow for more periods, and for a richer structure of the costs of children. These changes lead to a more complicated tradeoff involved in the fertility decisions, because having a child changes the outside option for as long as the child remains in the household. A spouse with a high cost share will realize that her future bargaining power will decrease if a baby is born, giving her pause to agree. Conversely, a spouse with a low cost share will realize that the other spouse's loss of bargaining power improves her own future bargaining position, which makes having children attractive over and above the direct utility benefit.

We now introduce two additional modifications that are important for matching the model to the GGP data, namely a more general mapping from fertility intentions into outcomes, and a flexible model for how child preferences evolve over time.

Regarding fertility, both spouses still form their intentions at the beginning of each period, before the bargaining over the consumption allocation takes place. Let $i_g \in \{0, 1\}$ denote the intention of spouse g, where $i_g = 1$ denotes that the spouse would like to have a baby. Formally, i_g is determined as follows:

$$i_g = I\Big\{u(c_g, v_g, 1) + \beta E\left[V_g^{t+1}(a_1', a_2', a_3', v_f', v_m')|b=1\right] \\ \geq u(c_g, v_g, 0) + \beta E\left[V_g^{t+1}(a_1', a_2', a_3', v_f', v_m')|b=0\right]\Big\}, \quad (23)$$

where $I(\cdot)$ is the indicator function. (23) expresses that a spouse intends to have a child if having a child increases expected utility. In Section 3, we assumed that having a baby requires agreement, i.e., a child was born ($b = 1$) if and only if $i_f = 1$ and $i_m = 1$. In the GGP data explored in Section 2, we found that although agreement between the spouses greatly increases the likelihood of having a baby, some births occur nevertheless without perfect agreement. We therefore allow for a general mapping of fertility intentions to outcomes that also depend on the existing number of children. Given fertility intentions and the existing number of children n, the probability of having a baby in a given period is given by a function $\gamma(i_f, i_m, n)$. Later on, we will choose this function to match the observed birth probability for each combination of intention and existing number of children in the GGP data. We take this function as exogenous and without regard to how it is generated; some factors that are likely to play a role are natural fecundity (births are not guaranteed even if the spouses agree), imperfect birth control, measurement error, and change over time in fertility intentions.

Regarding child preferences, we saw in Section 3.3 that the persistence of child preferences over time determines the extent to which disagreement over having babies matters for the timing of fertility versus total lifetime fertility. To allow for persistence, we model child preferences as follows. The couple starts out with an initial preference draw v_f, v_m from a joint uniform distribution with gender-specific means and correlation ρ between the spouses. If no child is born ($b = 0$), with probability π the couple's fertility preferences are unchanged in the next period. With probability $1 - \pi$, the couple draws new fertility preferences from the same distribution. When a birth takes place ($b = 1$), the couple draws new fertility preferences, where the mean of the distribution depends on the existing number of children. The dependence of fertility preferences on the number of existing children captures the possibility of declining marginal utility from additional children. This process is formalized as follows. In every period, a couple draws potential fertility preferences $\tilde{v}_f$, $\tilde{v}_m$ from a joint uniform distribution that depends on the existing number of children n:

$$\begin{bmatrix} \tilde{v}_f \\ \tilde{v}_m \end{bmatrix} \sim U \left(\begin{bmatrix} \mu_{f,n} \\ \mu_{m,n} \end{bmatrix}, \begin{bmatrix} \sigma_f^2 & \rho\sigma_f\sigma_m \\ \rho\sigma_f\sigma_m & \sigma_m^2 \end{bmatrix}, \right).$$

In the first period, actual preferences v_f, v_m are equal to potential preferences, $v_g = \tilde{v}_g$ for $g \in \{f, m\}$. In subsequent periods, a couple with current preferences v_f, v_m retains the existing preference draw with probability $\pi(1-b)$, and adopts the potential preference draw $\tilde{v}_f$, $\tilde{v}_m$ with probability $1 - \pi(1-b)$:

$$\begin{bmatrix} v'_f \\ v'_m \end{bmatrix} = \begin{cases} \begin{bmatrix} v_f \\ v_m \end{bmatrix} & \text{with probability } \pi(1-b) \\ \begin{bmatrix} \tilde{v}_f \\ \tilde{v}_m \end{bmatrix} & \text{with probability } 1 - \pi(1-b). \end{cases}$$

Here v'_g denotes fertility preferences in the following period. By matching the evolution of fertility preferences to the GGP data (where fertility preferences for the same couple are observed in repeated waves), we can ensure that the model reproduces the proper mapping from current fertility preferences to long-run fertility outcomes.

5 Matching the Model to Data from the Generations and Gender Programme

We now want to quantify our theory of fertility choice by matching the dynamic model to the GGP data. We interpret the data from the various countries as driven by the same structural model, but with potential differences across countries in fertility preferences and in the distribution of the child care burden. One might argue that inherent fertility preferences should be comparable across countries. However, measured differences in child preferences may reflect differences in child support policies, work environments, and other country-specific factors affecting fertility that we do not model explicitly. With this possibility in mind, we use all available data to estimate model parameters that are assumed identical across countries (such as the mapping of fertility intentions into outcomes). In contrast, the child care burden and fertility preferences are matched to the low-fertility countries in our sample (Austria, Bulgaria, Germany, Lithuania, Poland, Romania, and Russia), which display distinct patterns in fertility intentions and fertility rates. Our policy experiments in the following section therefore should be interpreted as being valid for the initial conditions of a low fertility country.

We choose the model parameters in two steps. First, we pin down a number of parameters individually, either by setting them to standard values or by estimating them directly from the data. Second, we jointly estimate the remaining parameters, concerning the distribution of child preferences and the evolution of preferences over time, to match data from the low fertility countries.

5.1 Preset and Individually Estimated Parameters

Some parameters that are less central to our analysis are set to values that are standard in the literature. First we set the discount factor to $\beta = 0.95$, which corresponds to an interest rate of about five percent. Next, we set the economies of scale in the family to $\alpha = 0.4$, as in Greenwood, Guner, and Knowles (2003). We abstract from economies of scale in childbearing and set $\psi = 1$, that is, all children are equally costly.[20] We do not need to set the level of wages, because utility is linear in consumption and hence wages do not matter for fertility decisions.[21] The final preset parameter is the level of the child cost ϕ. Given that utility is linear in consumption, ϕ is a scale parameter that does not matter directly for any of our results regarding fertility.[22] However, for interpreting policy experiments such as child subsidies it is still useful to attach a specific value to ϕ. The aim is

[20]This assumption is less restrictive than it seems, because the means of the child preferences for second and the third child would adjust in our estimation according to the assumed economies of scale.

[21]Of course, wages do matter for the consumption allocation. Also, wages enter into the cost of children if part of the costs of children is in terms of time. However, in the calibration procedure we set the cost of children directly to match available empirical estimates.

[22]Specifically, if ϕ is increased by a given amount, the estimated distribution of child preferences in the final step would shift up by a corresponding amount to give identical results for fertility intentions and outcomes.

to have a realistic measure of the (annual) cost a couple incurs for raising a child.

In reality, child costs are a combination of direct expenses, payments for child care, forgone earnings, and opportunity costs of reduced leisure. While accounting for all of these makes it challenging to arrive at a precise number, the literature suggests a plausible range for theses costs. Guner, Kaygusuz, and Ventura (2014) estimate the average annual expenditure on child care for U.S. parents to range between $4,851 and $6,414 per year, depending on the age of a child. Adda, Dustmann, and Stevens (2016) quantify the cost of having a child and working for German women to range between €12.6 and €31.1 per day. With about 250 working days per year this leads to a cost of between €3,150 and €7,775. Baudin, de la Croix, and Gobbi (2015) estimate the time cost of having a child at 20 to 30 percent of the time endowment of a woman. With an average salary of around €36,000 for full-time working women in Germany, this would imply a cost of €7,200 to €10,800. In addition, the OECD consumption equivalence scale quantifies the consumption cost of a child to be around 0.3 times the consumption of an adult. Adda, Dustmann, and Stevens (2016) estimate this equivalence scale to be 0.4. The statistical office of Germany estimates the consumption expenditure of couples with children to average at €38,000 in 2011. Using the OECD equivalence scale for a couple with two children, this would lead to an annual expenditure of around €5,000 per year. To reflect all these cost components in our model—direct expenses, time cost in forgone earnings, and consumption spending—we assume that the annual cost of one child amounts to €10,000.

The first parameters that we estimate directly from the data are the probabilities of having a child within three years conditional on the intentions of the male and the female spouse $\gamma(i_f, i_m, n)$. We assume that these parameters do not vary across countries, and hence we construct them from the whole sample of countries for which we have two waves of data (Bulgaria, Czech Republic, France, and Germany), allowing us to link intentions and outcomes.[23] We choose $\gamma(i_f, i_m, n)$ to match the regression results reported in Table 2. From these regression results, we derive the numbers shown in Table 3. We use a value of zero where the coefficients are not significantly different from zero. Using the point estimates instead

[23] We use all available data because the number of data in each cell would become too small if we estimated the regressions separately by country.

does not substantially alter our findings.

Table 3: Fertility rates in GGP data by fertility intention (percent of couples with each combination of female intent, male intent, and existing number of children that will have a baby within three years)

Existing children	$n = 0$		$n = 1$		$n = 2$	
	He no	He yes	He no	He yes	He no	He yes
She no	12.43	12.43	10.87	10.87	3.34	3.34
She yes	12.43	39.01	26.89	43.39	11.53	37.31

Next, we pin down the child care burden χ_g. As already shown in Section 2, the Generations and Gender Programme asks individuals which parent carries out specific child care tasks. From these questions, we construct the share of men in total child care (see Figure 2). We set the male cost share χ_m to the mean of the share of men in child care for the low fertility countries, which is 0.24. Below, we will also use information on the variation in male cost shares across low fertility countries (which vary between 0.22 and 0.27 in our sample) as target moments to specify additional parameters.

5.2 Jointly Estimated Parameters

The remaining parameters to be determined concern the distribution of female and male child preferences and the persistence of child preferences over time. These parameters are summarized in the following vector:

$$\theta = \begin{bmatrix} \mu_{f,1} & \mu_{f,2} & \mu_{f,3} & \sigma_f & \mu_{m,1} & \mu_{m,2} & \mu_{m,3} & \sigma_m & \rho & \pi \end{bmatrix}'.$$

They include the means of preferences for the first, second, and third child for women and men as well as their standard deviations and within-couple correlation. In addition, we have to determine the persistence of child preferences over time π. To specify all these parameters we use the following identification strategy.

To pin down the means and the correlation of the distribution of child preferences, we use the reported data on fertility intentions by the two spouses conditional on the number of existing children. Given that fertility can be at most three in the model, for fertility intentions given $n = 2$ we group all couples with two or more children. We generate this data from a pooled sample of the low fertility countries in the Generations and Gender Programme, which are Austria, Bulgaria, the Czech Republic, Germany, Lithuania, Poland, Romania, and Russia. We have a total of 25,612 observations with 5,084, 7,664, and 12,864 observations in the $n = 0$, $n = 1$, and $n = 2$ groups, respectively. To pool the sample, we calculate the country-specific cross tables of fertility intentions of men and women, using the sample weights. We then take the non-weighted average across countries to derive the pooled intention tables. The results are shown in the first part of Table 4. These 12 data moments determine seven model parameters, namely six mean parameters for child preferences and one correlation parameter.

Table 4: Distribution of fertility intentions in GGP data and model

		$n = 0$		$n = 1$		$n = 2$	
		He no	He yes	He no	He yes	He no	He yes
Data	She no	50.74	7.40	63.10	8.19	89.27	4.81
	She yes	5.64	36.22	4.55	24.16	2.57	3.35
Model	She no	49.11	5.18	65.61	7.89	84.96	7.00
	She yes	5.87	39.83	3.19	23.31	3.52	4.51

In order to calibrate the preference persistence parameter π, we use data from all low fertility countries for which we have two waves, namely Bulgaria, the Czech Republic, and Germany. In these countries we select couples that didn't have a baby in between Waves 1 and 2. We drop couples in which the female spouse is beyond the age of 35 in the first wave and couples who report that it is physically impossible for them to have a baby. This leaves us with 1,291 couples. We look at these couples' combinations of fertility preferences in Wave 1 and calculate the share that reports to have the same preferences in Wave 2. These statistics should tell us how persistent certain combinations of child preferences are over time. The result is shown in Table 5. We use this table to identify our persistence

Table 5: Share of couples with same fertility intentions in both waves in GGP data (population 35 and under)

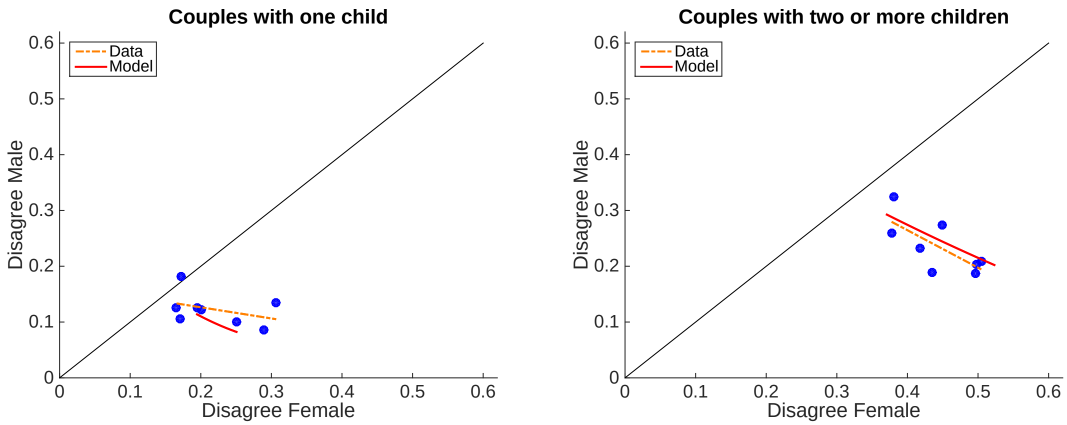
	Data		*Model*	
	He no	He yes	He no	He yes
She no	85.20	22.56	62.63	26.47
She yes	24.30	59.08	25.15	52.41

parameter π by calculating the corresponding statistics in our model.

The last two parameters to set are the standard deviations of child preferences σ_f and σ_m. These standard deviations determine how strongly men and women react to changes in the cost of children. Intuitively, if the standard deviation is small, the density of preferences around the cutoff between wanting and not wanting a child is high. A small change in child costs will then change the fertility intentions of many individuals, leading to a large change in the fertility rate. The standard deviations therefore are important determinants of the effectiveness of policies aimed at raising fertility. We cannot identify the standard deviations from the distribution of child preferences in Table 4 alone (for the same reason that standard deviations are fixed in a probit model). Instead, we make use of the cross country variation in disagreement shares in our sample of low-fertility countries. We interpret this variation as driven by variation of the share of men in caring for children, as captured by Figure 2. Intuitively speaking, if across countries the female disagreement share varies a lot but the male disagreement share varies little, this indicates that women's preferences react more strongly to changes in the relative child care burden, and hence suggests that women's fertility preferences are more concentrated than men's ($\sigma_f < \sigma_m$).

Formally, we measure the relative variation of female and male disagreement by

Figure 4: Fertility intentions across countries, GGP data and model



running cross-country regressions of the form:

$$\text{Disagree male}_i = \beta_0 + \beta_1 \cdot \text{Disagree Female}_i + \epsilon_i,$$

with i denoting the country index, separately for couples with one child and couples with two or more children.[24] Figure 4 displays the data and the resulting regression lines. The target moments used to pin down the standard deviations σ_f and σ_m are the left and right endpoints of the regression lines (i.e., evaluated at the lowest and highest value for the "Disagree Female" variable in the sample). The corresponding statistics computed from the model are female and male disagreement shares for the lowest and highest value of the male cost share χ_m observed across the low-fertility countries, i.e., 0.22 and 0.27. The relationships generated by the estimated model are displayed in Figure 4 as solid lines. By matching the target moments, we ensure that the estimated model generates an empirically plausible response in male and female fertility intentions to variations in cost shares.

[24]We focus on couples who already have children because preferences for the marginal (last) child are what matters for predictions for overall fertility rates.

5.3 Parameter Choices and Model Fit

Let Y denote the 20 target moments we describe above, i.e. the 12 values for the distribution of fertility intentions, the four values for the persistence of child preferences, and the four end points of the regression lines in Figure 4. In addition, let $\hat{Y}(\theta)$ denote the model simulated counterparts for a set of parameters θ. To pin down the parameters, we numerically solve the problem

$$\min_{\theta} \quad \left[\hat{Y}(\theta) - Y\right]' \cdot \left[\hat{Y}(\theta) - Y\right],$$

i.e., we minimize a simple residual sum of squares. The resulting set of parameters is shown in Table 6. The model-predicted distributions of fertility intentions and the predictions about the persistence of child preferences are shown in Tables 4 and 5. The cross-country predictions of fertility intentions are shown as solid lines in Figure 4.

Table 6: Calibrated child preference parameters

Description	*Parameter*	*Value*
Mean women first child	$\mu_{f,1}$	200,387
Mean women second child	$\mu_{f,2}$	97,436
Mean women third child	$\mu_{f,3}$	42,069
Std. dev. women	σ_f	73,705
Mean men first child	$\mu_{m,1}$	224,732
Mean men second child	$\mu_{m,2}$	-117,530
Mean men third child	$\mu_{m,3}$	-410,880
Std. dev. men	σ_m	347,746
Correlation	ρ	0.7890
Persistence	π	0.2299

The calibrated model provides a good fit for the data on fertility intentions and the persistence of child preferences over time, especially for couples in which at least one of the partners wants to have a baby. For us these couples are the most important ones, since they will be most prone to changing their fertility intentions in reaction to policy. The model also does well at fitting the slope of the relationship between male and female disagreement across countries in Figure 4, and particularly so for couples that have two or more children.

The estimated parameters suggest steeply declining marginal utility from having children, especially for men. From the second child onwards, women are estimated to have stronger child preferences than men. Intuitively, this arises because the estimated cost share implies that women carry most of the child care burden, yet there are still at least some women who desire a second or third child. The estimation rationalizes this pattern by assigning a stronger child preference to women. In fact, from the second child onwards, mean child preferences for men are estimated to be negative. This occurs because most couples agree on not currently wanting a child, so that the couples desiring one are in the upper tail of the distribution of child preferences. Moreover, men benefit from having children not just in terms of direct utility, but also through an improved bargaining position.

Child preferences turn out not to be highly persistent but strongly correlated within couples. As argued above, the persistence of preferences is important for shaping how disagreement versus agreement on children translates into lifetime fertility rates. The high correlation may appear surprising, given that we document substantial disagreement among couples about having children. However, at all parities the majority of couples agree that they don't want to have a child, which the model accounts for with highly correlated preferences. The less-than-perfect correlation leaves enough room for disagreement to arise for a substantial portion of couples.

Table 7 reports some demographic statistics for the model. The model predicts a total fertility rate of the low fertility countries of 1.47, which is a little higher than the average in these countries of 1.36. Some of the gap is due to the fact that our calibration is to a data set consisting of couples, whereas the actual fertility rate is pulled down to some extent by women who are not in a relationship and do not have children. Given that the fertility rate was not targeted, the close fit suggests that the measured fertility intentions translate into overall outcomes in

Table 7: Demographic statistics generated by estimated model

Total fertility rate	1.4726
Fraction of couples without children	0.1546
Fraction of couples with one child	0.4059
Fraction of couples with two children	0.3905
Fraction of couples with more than two children	0.0490

an accurate manner. The model also predicts that after having completed the fertile period, i.e. at the age of 45, most couples have one or two children, which is also true in the data. Only a small fraction has three children, and about 15 percent of couples are childless. For comparison, the German Statistical Office reports that in 2008, about 19 percent of women between the ages 40 and 49 had no children (some of whom presumably will go on to have children in their 40s).

6 Policy Experiments: The Effectiveness of Targeted Child Subsidies

We now turn to the policy implications of our analysis. In many countries, historically low fertility rates are considered a major challenge for future economic prospects, because it is difficult to sustain economic growth with a shrinking population and to maintain social insurance systems with an aging population. Already, child bearing is subsidized and publicly supported in various ways in many countries, but there are doubts about how effective such policies are. Here, we study the effect of targeted subsidies in the context of our calibrated model. We assume, in line with Lundberg and Pollak (1993a) and Lundberg, Pollak, and Wales (1997), that subsidies for children can be targeted towards a specific spouse. Intuitively, consider a country where, for mothers, the main component of the child care burden is forgone earnings, because of an absence of market-based child care and hence the necessity to stay home with young children. In such a setting, public provision of child care centers that allow mothers to go back to work could be considered a policy that is targeted at mothers, whereas a monetary transfer sent to the man would be a policy that is targeted at fathers.[25] Hence, while in the context of the model we speak of monetary transfers, these policies can be interpreted more generally as interventions that specifically relieve the child care burden of one of the spouses.

Formally, let $s_g(n_h)$ denote the total amount of subsidy paid to the partner g for the n_h children currently living in the household. Then the distribution of consumption taking subsidies into account reads

$$c_f(n_h) = w_f - \chi_f k(n_h) + s_f(n_h) + \frac{\alpha}{2}\left[w_f + w_m - k(n_h) + s_f(n_h) + s_m(n_h)\right],$$
$$c_m(n_h) = w_m - \chi_m k(n_h) + s_m(n_h) + \frac{\alpha}{2}\left[w_f + w_m - k(n_h) + s_f(n_h) + s_m(n_h)\right].$$

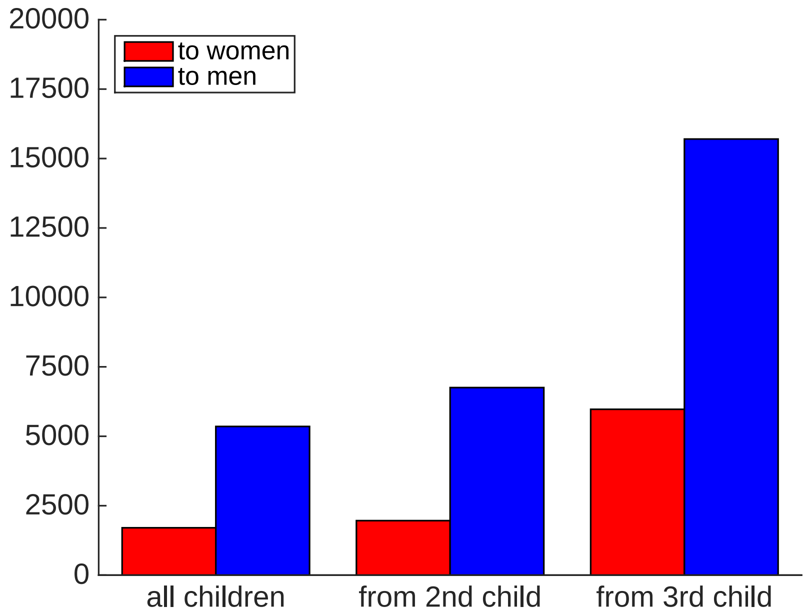
We now carry out the following experiment. We assume that the government wants to increase the total fertility rate by 0.1 (i.e., one in ten women should have an additional child, increasing the fertility rate from 1.47 to 1.57). It can use subsidies to either women or men to do so. In addition, it can choose to pay subsidies only for higher-order children, i.e., from the second or the third child onwards.

Figure 5 shows the subsidy amounts that would be needed to increase the total fertility rate by 0.1. There are two things to note here. First, whether subsidies are paid for all children or from the second child onwards does not change the amount very much. However, when given for the third child only, the government needs to pay substantially more per child. While for women the annual subsidy needed to increase the total fertility rate by 0.1 is around €2,000 in the former case, it amounts to €6,000 in the latter.

The second and most important feature is that it is much more effective to target subsidies towards women than towards men. Specifically, the subsidy needs to be about 2.6 to 3.4 times larger when targeted towards men than towards women.

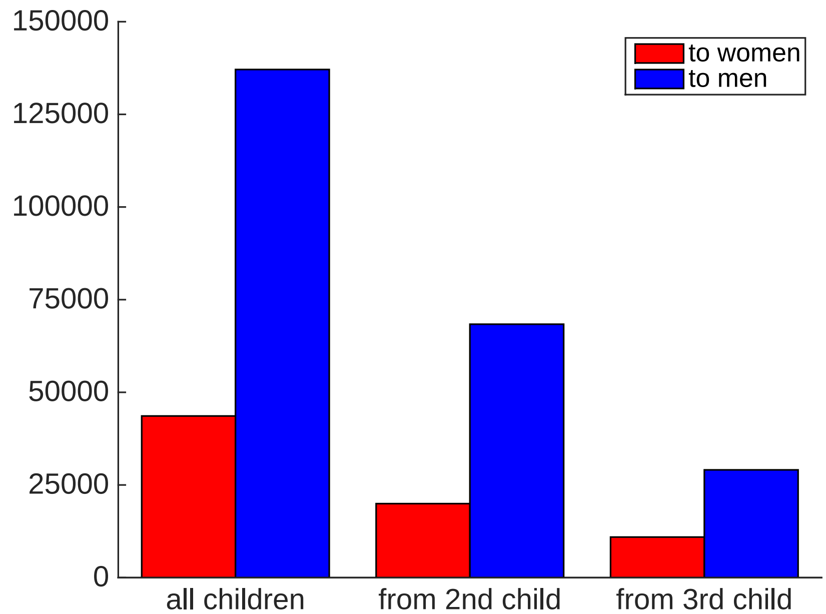
[25] See Bick (2015) for a quantitative study of the effects of child care policies on female labor supply and fertility in Germany, albeit in a setting that abstracts from bargaining. Another example of a change that specifically benefited one spouse was the introduction of infant formula, which reduced mother's need to breastfeed and hence greatly enhanced their flexibility in dealing with the needs of young children. Albanesi and Olivetti (2016) argue that the introduction of infant formula contributed to the simultaneous rise in female employment and fertility observed in the United States between the 1930s and 1960s.

Figure 5: Annual subsidy amounts to men and women required to raise total fertility rate by 0.1



This finding is novel to our analysis and would not arise in a model that abstracts from bargaining. The reason for the finding is threefold. First, as displayed in Figure 1, in the low fertility countries that we calibrate to, many more women are opposed to having another child than are men. Thus, women are more likely to be pivotal in the household decision (see Proposition 3), which means that subsidies directed to women are more effective. There are additional forces that amplify this effect. The second reason for our finding is related to the distribution of fertility preferences. Looking at the estimation results in Table 6, we can see that the variance of child preferences for women is lower than for men, indicating that there are more women close to the threshold at which they switch to wanting a baby. Consequently, with a given subsidy the government can incentivize more women than men to switch their opinion towards having another baby. The third reason can be gleaned from the fertility rate regressions in Table 2, where we can see that women have a larger impact on the fertility decision in the household. In fact, the coefficient for couples in which the woman doesn't want to have a baby but the man does (SHE NO/HE YES) on the fertility outcome of the family is never significantly different from zero. These three reasons combined imply that subsidies that are targeted towards women are much more likely to succeed in raising the total fertility rate.

Figure 6: Average total cost per couple required to raise total fertility rate by 0.1



The data shown in Figure 5 do not allow us to compare the desirability of subsidies that target all children versus, say, only third children and onwards. While the per-child subsidy needs to be higher when only higher-order births are subsidized, there are also fewer of those children. The total cost of each version of the subsidy is summarized in Figure 6, which displays the average cost per couple, over their whole life course, that needs to be paid by the government to raise fertility a given amount. The figure reveals that while the required per-child subsidy is the smallest if given for all children, the total cost of this policy is in fact the largest. Increasing the total fertility rate by 0.1 is about twice as expensive if all children are subsidized compared to only subsidizing higher-order children. This finding can be explained by the distribution of completed fertility in Table 7. The table shows that there are many couples who would have at least one child even without the subsidy. All subsidies given to these couples for the first child do not affect the total fertility rate. These sunk costs make the policy costly in the aggregate. Targeting subsidies to higher-order children is more cost effective, since the program is better targeted towards marginal children.

To reiterate our conclusions here: subsidies are most effective when targeted towards higher-order children and towards women. Raising fertility by subsidizing men is 2.6 to 3.4 times more costly compared to subsidizing women. Hence, in the low fertility environment that our model is calibrated to, accounting for the patterns of agreement and disagreement on having babies makes a big difference for policy effectiveness.

7 Conclusions

In this paper, we have examined the demographic and economic implications of the simple fact that it takes agreement between a woman and man to make a baby. Using newly available data from the Generations and Gender Programme, we have shown that disagreement between spouses about having babies is not just a theoretical possibility, but a commonplace occurrence: for higher-parity births, there are more couples who disagree about having a baby than couples who agree on wanting one. We have also shown that disagreement matters for outcomes, in the sense that a baby is unlikely to be born unless both parents desire one. We interpret the data using a model of marital bargaining under limited commitment, and show that our calibrated model provides a close match for the data on fertility intentions and outcomes.

Our findings have both positive and normative implications for the economics of fertility choice. On the positive side, our theory suggests a novel determinant of a country's average fertility rate, namely the distribution of the child care burden between mothers and fathers. If one gender carries most of the burden, we would expect to observe a lopsided distribution of fertility intentions, and the fertility rate can be low even if childbearing is highly subsidized overall. Indeed, in the sample of European countries in the GGP data, we find that all low fertility countries are characterized by many more women than men being opposed to having another child.

In terms of normative implications, the analysis suggests that policies that aim at raising the fertility rate will be more effective if they specifically target the gender more likely to disagree with having another child. In our quantitative model calibrated to the European low fertility countries, we find that a child subsidy that specifically lowers women's child care burden (i.e., by publicly funding child care that allows a mother to return to work earlier) is, dollar for dollar, up to three times as effective at raising fertility than is a subsidy targeted at fathers. In many industrialized countries, today's extremely low fertility rates are projected to cause major problems for the sustainability of social insurance systems in the future, which makes raising fertility a key policy challenge.

We believe that examining policies from the perspective of their effect on agreement and disagreement within couples on fertility is an important direction for future theoretical and applied research. One immediate implication is that optimal policy will be country specific, because patterns of disagreement over fertility vary widely across countries. In the GGP sample, it is notable that the high fertility countries (Belgium, France, and Norway) already have broadly balanced fertility intentions between women and men, so that there is less need for targeted policies.

We have kept some aspects of our analysis simplified in order to focus on the core issue of fertility intentions and outcomes in a setting with bargaining under limited commitment. To further refine the policy implications, the next step of this research program will need to add detail to other aspects of the theory. In particular, here we do not address the exact composition of the child care burden. For policy implications, it is important to know whether, say, a parent's ability to return to work, monetary expenses, or the division of general household chores is the main issue leading to disagreement.[26] We plan to examine such dimensions both empirically and theoretically in future research.

[26] In addition, if child care time is what matters, it is also important whether disagreement is over child care time that competes with work (i.e., during usual working hours) or with leisure; see Schoonbroodt (2016).

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A Data Description and Further Analysis

The "Generations and Gender Programme" is a panel survey conducted in 18 countries, namely Australia, Austria, Belgium, Bulgaria, Czech Republic, Estonia, France, Georgia, Germany, Hungary, Italy, Lithuania, Netherlands, Norway, Poland, Romania, Russian Federation, and Sweden. The survey can be connected to an associated survey conducted in Japan. As already mentioned above, we are interested in the answers to question *a611* that asks

> "Do you yourself want to have a/another baby now?"

and question *a615* that asks

> "Couples do not always have the same feelings about the number or timing of children. Does your partner/spouse want to have a/another baby now?"

For those respondents who didn't give an answer to question *a611*, we recover their intention towards having a baby from question *a622*, which asks the respondents about their plans to have a child within the next three years.[27] We only use the answer to this question if the female household member is not currently pregnant.

A.1 Sample Selection for Intention Data

We select Wave 1 of our sample as follows. We use only those respondents who gave a clear answer to both questions *a611*[28] and *a615*, meaning that they responded either yes or no. In addition, we select couples in which the female partner is between the ages of 20 and 45. These selection criteria naturally rule out single households. However, we do not restrict the sample to married couples, i.e. we include couples that are in any form of relationship.[29] We also do not require partners to live in the same household. As we will see below, being married and living in the same household can impact our variables of interest. These selection criteria give us the sample sizes reported in Table 8.

Table 9 reports additional descriptive statistics for the Wave 1 sample (see also Table 1). We define individual skill levels using the ISCED classification standard and assume that

[27] This time span corresponds to the interval between two waves of the survey.
[28] Including those with recovered answers.
[29] There are no same sex couples in our sample.

Table 8: Wave 1 sample with questions about fertility preferences

Country	No. of Respondents		
	female	male	Total
Austria	2,149	1,219	3,368
Belgium	1,159	1,058	2,217
Bulgaria	2,691	1,708	4,399
Czech Republic	1,120	1,276	2,396
France	1,640	1,285	2,925
Germany	1,644	1,281	2,925
Lithuania	1,024	1,175	2,199
Norway	2,488	2,446	4,934
Poland	2,211	1,638	3,849
Romania	1,587	1,835	3,422
Russia	1,640	1,414	3,054
Total	19,509	16,179	35,688

a person is high-skilled if her highest education level is of type 5 or 6, meaning that she has completed some tertiary education. According to this definition, almost 30 percent of the female partners in the sample are high skilled, whereas for men it is only 25 percent. 66 percent of the female partners are working, where working is defined as either being officially employed, self-employed, or helping a family member in a family business or a farm. On the other hand, 86 percent of the male partners are working. 38 percent of couples in which the respondent has at least one biological child report to regularly use some institutional or paid child care arrangement. 42 percent regularly get help with child care from someone for whom caring for children is not a job. We interpret this as family based child care arrangements.

A.2 Sample Selection for Birth Data

When combining the first wave with data from Wave 2, we apply one additional selection criterion, namely that respondents are present in both waves. This selection gives us the sample size reported in Table 10. Note that the second wave is only available for a smaller number of countries. However, we find that the composition of the sample with respect

Table 9: Additional descriptive statistics of the sample (Wave 1)

	Mean
Female partner high skilled (in %)	29.66
Male partner high skilled (in %)	25.21
Female partner working (in %)	66.41
Male partner working (in %)	86.49
Use institutional child care (in %)	37.71
Use family child care (in %)	41.88

Notes: 35,688 observations. Included countries are Austria, Belgium, Bulgaria, Czech Republic, France, Germany, Lithuania, Norway, Poland, Romania, and Russia. Child care questions only asked of couples with at least one child.

to the variables reported in Table 9 is remarkably similar.

Table 10: Wave 2 sample with questions about fertility preferences and observed fertility

Country	No. of Respondents		
	female	male	Total
Bulgaria	1,898	1,190	3,088
Czech Republic	392	254	646
Germany	576	354	930
France	1,099	816	1,915
Total	3,965	2,614	6,579

When a couple is present in both waves, we can compute whether they had (at least one) child in the time span between Waves 1 and 2.[30] We do this using the difference in the number of biological children of the respondent, where biological children can be either with the current or a former partner. We therefore abstract from both adoption and fostering. We find that in roughly 15 percent of couples in our sample at least one child

[30]For 98.63 percent of our sample this time span was 3 years, whereas for only 1.37 percent the time span amounted to 4 years.

is born between Waves 1 and 2. We can also check how stable partnerships are in our sample. In fact, 93 percent of couples are still in a relationship in Wave 2. Only 1 percent of respondents have changed the partner and about 6 percent have split up and live on their own.

To check how important child birth to single women is in the data, we construct a comparison group of female respondents who in Wave 1 report not to have a partner. For this group, we find that around 7 percent of respondents are having a child in between the two waves. This number may suggest that being in a partnership is not a prerequisite for having a baby. However, a further investigation of the partnership status of the respondents in Wave 2 reveals that the vast majority of children in this sample is born to women who have found a partner in the three years between the two waves. The number of children born to women who are single in both waves is very small.

A.3 Determinants of Fertility Intentions

In the following we provide some further investigation of the variables we are using to pin down essential parameters of our model. Specifically, we want to study what are covariates of fertility intentions, the degree of agreement, as well as the male share in child care activities in the sample. We therefore use our fertility intention data from Wave 1 and run a OLS regressions of intentions on regressors that may be related or our variables of interest. For all the regressions we use country fixed effects to account for different social and institutional environments. In Tables 11 and 12, we regress the female and the male fertility intention on all the variables reported in the descriptive statistics Tables 1 and 9, including a squared term for the age of the female partner and a variable for the age difference between the man and the woman. We use dummy variables for marriage, cohabitation, high skills (education), and so on. We run these regressions separately for couples with no children, one child, and two or more children. Note that we can only include dummies for the use of child care for couples that already have at least one child. In addition, we include a dummy variable for the gender of the first child. We also run two separate regressions with either marriage or cohabitation as a regressor, since the two tend to be highly collinear.

We find that the coefficients for both female and male fertility intentions are very similar in terms of signs, magnitude and significance. The results show a clear hump-shaped pattern of fertility intentions by age for both men and women. Figure 7 visualizes this pattern for couples without children and those with one child, where we evaluate all

Table 11: What covaries with women's intention to have a baby?

	without children		with 1 child		with 2+ children	
	(1)	(2)	(1)	(2)	(1)	(2)
Age woman	0.1519***	0.1494***	0.0696***	0.0719***	−0.0199***	−0.0219***
	(0.0086)	(0.0086)	(0.0103)	(0.0102)	(0.0064)	(0.0064)
Age squared/100	−0.2499***	−0.2414***	−0.1390***	−0.1419***	0.0156*	0.0182**
	(0.0133)	(0.0134)	(0.0153)	(0.0152)	(0.0088)	(0.0088)
Age difference	0.0015	0.0022	−0.0050***	−0.0049***	−0.0001	−0.0003
	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0007)	(0.0007)
Married	0.2316***		0.0623***		−0.0343***	
	(0.0147)		(0.0155)		(0.0090)	
Cohabiting		0.1575***		0.1029**		−0.0595**
		(0.0144)		(0.0416)		(0.0294)
Educ. woman	−0.0171	−0.0156	0.0507***	0.0533***	0.0169**	0.0162**
	(0.0152)	(0.0154)	(0.0148)	(0.0148)	(0.0071)	(0.0071)
Educ. man	−0.0442***	−0.0436***	0.0613***	0.0644***	0.0201***	0.0187***
	(0.0142)	(0.0145)	(0.0152)	(0.0152)	(0.0072)	(0.0072)
Working woman	0.0636***	0.0578***	0.0148	0.0167	0.0061	0.0052
	(0.0140)	(0.0142)	(0.0140)	(0.0140)	(0.0056)	(0.0056)
Working man	0.0538***	0.0525***	0.0015	0.0033	−0.0115	−0.0149*
	(0.0158)	(0.0160)	(0.0215)	(0.0215)	(0.0085)	(0.0085)
Inst. child care			0.0610***	0.0607***	0.0146**	0.0149**
			(0.0141)	(0.0141)	(0.0059)	(0.0059)
Family child care			−0.0057	−0.0061	−0.0074	−0.0069
			(0.0130)	(0.0129)	(0.0058)	(0.0058)
First child male			0.0209*	0.0214*	0.0055	0.0057
			(0.0120)	(0.0120)	(0.0048)	(0.0048)
Respondent female	−0.0226*	−0.0267**	0.0180	0.0182	−0.0265***	−0.0269***
	(0.0119)	(0.0120)	(0.0122)	(0.0122)	(0.0049)	(0.0049)
Observations	6259	6280	6431	6438	13081	13103
R^2	0.569	0.559	0.451	0.451	0.130	0.128

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

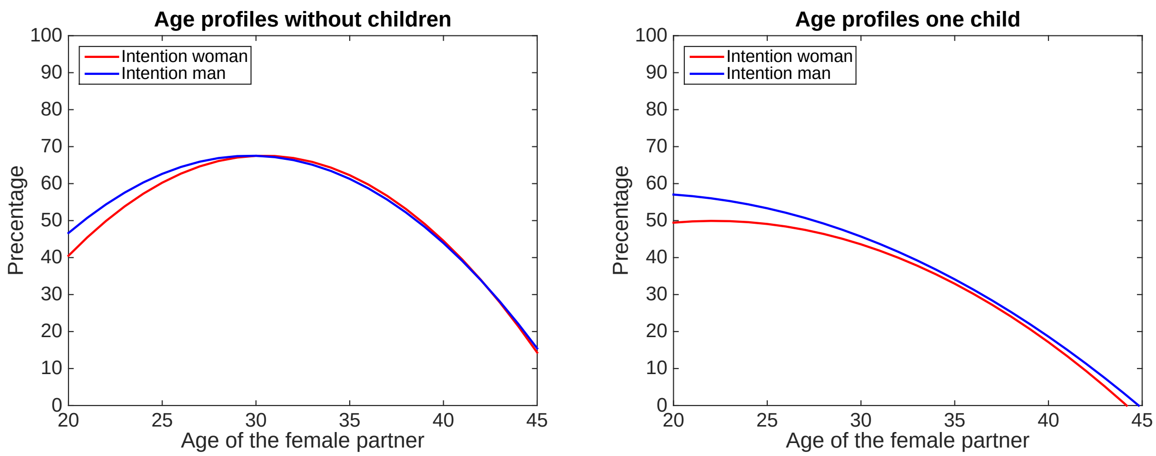
Table 12: What covaries with men's intention to have a baby?

	without children		with 1 child		with 2+ children	
	(1)	(2)	(1)	(2)	(1)	(2)
Age woman	0.1321***	0.1298***	0.0436***	0.0467***	−0.0156**	−0.0175**
	(0.0087)	(0.0088)	(0.0106)	(0.0106)	(0.0068)	(0.0068)
Age squared/100	−0.2224***	−0.2143***	−0.1004***	−0.1044***	0.0085	0.0110
	(0.0135)	(0.0137)	(0.0159)	(0.0158)	(0.0095)	(0.0095)
Age difference	−0.0011	−0.0003	−0.0059***	−0.0058***	−0.0024***	−0.0026***
	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0007)	(0.0007)
Married	0.2309***		0.0835***		−0.0314***	
	(0.0149)		(0.0156)		(0.0094)	
Cohabiting		0.1569***		0.1158***		−0.0908**
		(0.0148)		(0.0402)		(0.0355)
Educ. woman	−0.0174	−0.0159	0.0416***	0.0450***	0.0091	0.0081
	(0.0154)	(0.0156)	(0.0153)	(0.0153)	(0.0075)	(0.0075)
Educ. man	−0.0261*	−0.0256*	0.0638***	0.0676***	0.0238***	0.0227***
	(0.0145)	(0.0147)	(0.0155)	(0.0155)	(0.0077)	(0.0077)
Working woman	0.0463***	0.0420***	0.0287**	0.0311**	0.0019	0.0009
	(0.0143)	(0.0145)	(0.0142)	(0.0143)	(0.0061)	(0.0061)
Working man	0.0848***	0.0831***	0.0129	0.0157	−0.0208**	−0.0239**
	(0.0160)	(0.0161)	(0.0218)	(0.0218)	(0.0096)	(0.0096)
Inst. child care			0.0680***	0.0670***	0.0009	0.0014
			(0.0143)	(0.0143)	(0.0063)	(0.0063)
Family child care			0.0078	0.0066	−0.0008	−0.0007
			(0.0132)	(0.0132)	(0.0063)	(0.0063)
First child male			0.0062	0.0063	−0.0082	−0.0080
			(0.0122)	(0.0122)	(0.0053)	(0.0053)
Respondent female	0.0629***	0.0598***	0.0424***	0.0418***	0.0289***	0.0283***
	(0.0122)	(0.0123)	(0.0124)	(0.0124)	(0.0053)	(0.0053)
Observations	6259	6280	6431	6438	13081	13103
R^2	0.569	0.560	0.475	0.474	0.143	0.142

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

other variables at their sample means. We find that men would agree on having a child a little earlier than women. The age difference between partners, although statistically significant, plays a quantitatively small role.

Figure 7: Life cycle profiles of fertility intentions and agreement



The security of living in a marriage or cohabitation with a partner are major determinants for wanting children at all. For couples without children, the coefficients of the respective dummies are positive, large, and highly significant. For second or higher-order children the effects are much less pronounced, and even turn negative for couples with two or more children. Tertiary education (especially that of men) seems to have adverse effects fertility intentions. This suggests that there is a lot of dispersion in the desire for children of the highly educated workforce. While there are more couples with high skills who want no children at all, those who do get children want more of them than their less educated counterparts. Finally, having a job and therefore a secured source of income is an important covariate for the decision whether to have children at all. The coefficients are positive and significant for employment of both partners on fertility intentions of both men and women. For couples that already have one child, the use (and therefore the availability) of institutional or paid child care comes with a larger intention to have another child. The use of family child care arrangements, on the other hand, hardly covaries with fertility intentions. A reason for this may be that institutional child care usually takes care of children throughout the day so that parents can go to work. Help with child care from the family can also include bringing the children to the grandparents one day on the weekend. The gender of the first child has hardly any impact on fertility intentions. If anything, women's intention to have a second child are slightly larger when the first child is a boy. Finally, the gender of the respondent plays almost no role in the reported fertility intention of women. In contrast, women tend to slightly overestimate the desire for fertility of their male partners.

A.4 Determinants of Agreement

In Table 13 we regress our dummy for agreement of the partners (AGREE) on the same covariates as in the previous tables. We find a hump shaped pattern of agreement with regards to the age of the woman. This suggests that at least part of the conflict between men and women on whether to have a baby is due to differences in desired timing. Marriage and cohabitation come along with a significantly higher level of agreement, where cohabitation tends to play a larger role at least for the second child. This observation suggests, as emphasized by our theoretical analysis, that the ability to commit is a major determinant of agreement and disagreement. With respect to education and having a job, we find similar patterns as in the previous two regressions. Again, for both men and women having a job comes along with a significantly higher degree of agreement on having children at all. Interestingly, the use or availability of institutional child care doesn't impact agreement much, while the use of family child care comes along with a significantly lower level of agreement. Finally, there is a discrepancy between reported agreement between men and women who already have two or more children.

A.5 Determinants of Men's Participation in Child Care

In Table 14 we study covariates of the man's share in caring for the child/children. We exclude age variables from this table, as none of our age covariates turned out significant. Being married is not a strong predictor of men's share in child care, but cohabitation is. When partners have a child and live in one household, not surprisingly, the male partner will take a larger share in childrearing. Men who are educated or whose partners are educated tend to spend more time with the children. Regarding employment, we find that when the mother works, the father has to take a larger share in caring for the children, and vice versa. The use of institutional child care also leads the father to look after the children more. This is consistent with the interpretation underlying our policy analysis, namely that institutional child care tends to substitute child care that is (usually) provided by the mother. Last but not least, men tend to overestimate (or women underestimate) how much time they spend on childrearing.

Table 13: What covaries with agreement on wanting a baby?

	without children		with 1 child		with 2+ children	
	(1)	(2)	(1)	(2)	(1)	(2)
Age woman	0.0876***	0.0765***	0.0534***	0.0604***	0.0308	0.0311
	(0.0143)	(0.0145)	(0.0194)	(0.0190)	(0.0258)	(0.0255)
Age squared/100	−0.1330***	−0.1132***	−0.1095***	−0.1197***	−0.0714*	−0.0720*
	(0.0230)	(0.0233)	(0.0309)	(0.0303)	(0.0378)	(0.0374)
Age difference	0.0010	0.0013	−0.0049**	−0.0047**	0.0044	0.0042
	(0.0019)	(0.0019)	(0.0023)	(0.0022)	(0.0031)	(0.0031)
Married	0.2009***		0.1112***		−0.0192	
	(0.0184)		(0.0232)		(0.0326)	
Cohabiting		0.2193***		0.3509***		−0.1521*
		(0.0234)		(0.0612)		(0.0840)
Educ. woman	−0.0274	−0.0220	0.0287	0.0302	0.0321	0.0290
	(0.0201)	(0.0200)	(0.0215)	(0.0213)	(0.0317)	(0.0316)
Educ. man	−0.0242	−0.0183	0.0477**	0.0522**	0.0638**	0.0634**
	(0.0197)	(0.0197)	(0.0211)	(0.0209)	(0.0307)	(0.0307)
Working woman	0.0918***	0.0795***	0.0178	0.0220	0.0093	0.0052
	(0.0209)	(0.0210)	(0.0207)	(0.0206)	(0.0272)	(0.0272)
Working man	0.0920***	0.0779***	−0.0062	−0.0039	0.0250	0.0208
	(0.0263)	(0.0262)	(0.0304)	(0.0305)	(0.0388)	(0.0386)
Inst. child care			0.0106	0.0134	0.0100	0.0106
			(0.0195)	(0.0194)	(0.0268)	(0.0267)
Family child care			−0.0401**	−0.0438**	−0.0717***	−0.0715***
			(0.0182)	(0.0180)	(0.0267)	(0.0266)
First child male			−0.0125	−0.0134	−0.0124	−0.0101
			(0.0173)	(0.0172)	(0.0244)	(0.0244)
Respondent female	0.0103	0.0076	0.0059	0.0086	−0.0505**	−0.0552**
	(0.0168)	(0.0167)	(0.0176)	(0.0175)	(0.0249)	(0.0249)
Observations	3199	3217	2953	2958	1626	1630
R^2	0.750	0.750	0.719	0.720	0.396	0.397

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 14: What covaries with male participation in child care?

	with 1 child		with 2+ children	
	(1)	(2)	(1)	(2)
Married	0.0142**		0.0041	
	(0.0060)		(0.0046)	
Cohabiting		0.1673***		0.1672***
		(0.0162)		(0.0176)
Educ. woman	0.0161***	0.0157***	0.0213***	0.0210***
	(0.0055)	(0.0054)	(0.0040)	(0.0039)
Educ. man	0.0179***	0.0192***	0.0202***	0.0203***
	(0.0054)	(0.0053)	(0.0039)	(0.0039)
Working woman	0.0930***	0.0946***	0.0826***	0.0834***
	(0.0051)	(0.0051)	(0.0034)	(0.0034)
Working man	−0.0731***	−0.0733***	−0.0653***	−0.0651***
	(0.0090)	(0.0090)	(0.0060)	(0.0060)
Inst. child care	0.0185***	0.0193***	0.0118***	0.0116***
	(0.0051)	(0.0050)	(0.0033)	(0.0033)
Family child care	0.0055	0.0063	0.0030	0.0037
	(0.0047)	(0.0047)	(0.0033)	(0.0033)
First child male	0.0030	0.0036	0.0022	0.0024
	(0.0043)	(0.0043)	(0.0030)	(0.0030)
Respondent female	−0.0712***	−0.0672***	−0.0646***	−0.0630***
	(0.0044)	(0.0045)	(0.0030)	(0.0030)
Observations	6361	6368	12924	12946
R^2	0.754	0.757	0.775	0.776

Robust standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

B Mathematical Appendix

B.1 Proofs for Propositions

Proof of Proposition 1: The bargaining problem can be solved via backward induction, i.e., we first solve for the ex-post allocation for a given fertility choice, and then consider the optimal fertility choice in the first stage.

If the couple decides not to have a child ($b = 0$), then resource allocation is determined by the maximization problem:

$$\max_{c_f, c_m} \quad [c_f - w_f]^{0.5} [c_m - w_m]^{0.5} \quad \text{s.t.} \quad c_f + c_m = (1 + \alpha) [w_f + w_m] .$$

Here α is an efficiency scale factor that defines the surplus of a joint household. Individual consumption in this case is given by:

$$c_f(0) = w_f + \frac{\alpha}{2} [w_f + w_m] \quad \text{and} \quad c_m(0) = w_m + \frac{\alpha}{2} [w_f + w_m] ,$$

and utilities are:

$$u_f(0) = w_f + \frac{\alpha}{2} [w_f + w_m] \quad \text{and} \quad u_m(0) = w_m + \frac{\alpha}{2} [w_f + w_m] .$$

If the partners do decide to have a child ($b = 1$), the resource allocation solves the maximization problem:

$$\max_{c_f, c_m} \quad [c_f + v_f - w_f]^{0.5} [c_m + v_m - w_m]^{0.5} \quad \text{s.t.} \quad c_f + c_m = (1 + \alpha) [w_f + w_m - \phi]$$

The first-order conditions give:

$$c_f + v_f - w_f = c_m + v_m - w_m,$$

and plugging this into the budget constraint yields:

$$c_f(1) = w_f - v_f + \frac{\alpha}{2} [w_f + w_m - \phi] + \frac{1}{2} [v_m + v_f - \phi]$$
$$c_m(1) = w_m - v_m + \frac{\alpha}{2} [w_f + w_m - \phi] + \frac{1}{2} [v_m + v_f - \phi] .$$

Utilities are then:

$$u_f(1) = w_f + \frac{\alpha}{2}\left[w_f + w_m - \phi\right] + \frac{1}{2}\left[v_m + v_f - \phi\right],$$
$$u_m(1) = w_m + \frac{\alpha}{2}\left[w_f + w_m - \phi\right] + \frac{1}{2}\left[v_m + v_f - \phi\right].$$

Consequently, the partners equally share the monetary surplus from cooperation as well as the surplus from having children. Given the utilities for a given fertility choice, we can now consider whether the couple will choose to have a child. The female partner prefers to have a child if:

$$u_f(1) \geq u_f(0) \quad \Leftrightarrow \quad v_f + v_m \geq \phi(1+\alpha)$$

The same condition applies to the male partner. Consequently, there is no disagreement, i.e. either both partners want to have a child, or both prefer to remain childless. □

Proof of Proposition 2: We once again characterize the outcome by backward induction. In the case without children, the resource allocation of the couple solves the maximization problem:

$$\max_{c_f, c_m} \quad \left[c_f - w_f\right]^{0.5}\left[c_m - w_m\right]^{0.5} \quad \text{s.t.} \quad c_f + c_m = (1+\alpha)\left[w_f + w_m\right],$$

which is the same as under the full commitment case. Consequently,

$$c_f(0) = w_f + \frac{\alpha}{2}\left[w_f + w_m\right] \quad \text{and} \quad c_m(0) = w_m + \frac{\alpha}{2}\left[w_f + w_m\right],$$

and utilities are:

$$u_f(0) = w_f + \frac{\alpha}{2}\left[w_f + w_m\right] \quad \text{and} \quad u_m(0) = w_m + \frac{\alpha}{2}\left[w_f + w_m\right]. \tag{24}$$

In the case with children, the maximization problem to determine the resource allocation is now different, because bargaining takes place ex post, with the new outside options given the presence of a child:

$$\max_{c_f, c_m} \quad \left[c_f - (w_f - \chi_f\phi)\right]^{0.5}\left[c_m - (w_m - \chi_m\phi)\right]^{0.5} \quad \text{s.t.} \quad c_f + c_m = (1+\alpha)\left[w_f + w_m - \phi\right].$$

First-order conditions now give us:

$$c_f - (w_f - \chi_f \phi) = c_m - (w_m - \chi_m \phi),$$

and plugging this into the budget constraint yields:

$$c_f(1) = w_f - v_f + \frac{\alpha}{2}\left[w_f + w_m - \phi\right] + \left[v_f - \chi_f \phi\right], \tag{25}$$

$$c_m(1) = w_m - v_m + \frac{\alpha}{2}\left[w_f + w_m - \phi\right] + \left[v_m - \chi_m \phi\right]. \tag{26}$$

Utilities then are:

$$u_f(1) = w_f + \frac{\alpha}{2}\left[w_f + w_m - \phi\right] + \left[v_f - \chi_f \phi\right] \quad \text{and} \tag{27}$$

$$u_m(1) = w_m + \frac{\alpha}{2}\left[w_f + w_m - \phi\right] + \left[v_m - \chi_m \phi\right]. \tag{28}$$

Couples again share the monetary surplus from cooperation, but now the utility surplus from fertility is purely private. We can now move to the first stage and characterize the fertility preferences of the two spouses. The woman wants to have a child if:

$$u_f(1) \geq u_f(0) \quad \Leftrightarrow \quad v_f \geq \left(\chi_f + \frac{\alpha}{2}\right)\phi,$$

and the male partner would like to have a child if:

$$u_m(1) \geq u_m(0) \quad \Leftrightarrow \quad v_m \geq \left(\chi_m + \frac{\alpha}{2}\right)\phi.$$

In these inequalities, the term $\chi_g \phi$ represents the direct cost of having the child to spouse g. Since bargaining is ex post, having a child lowers the outside option, so that (unlike in the commitment solution) the spouse bearing the greater child care burden is not compensated. The second term $(\alpha/2)\phi$ represents the loss in marital surplus due to the cost of a child. This part of the cost of childbearing is shared equally between the spouses.

Depending on v_f and v_m, it is possible that neither, both, or just one of the spouses would like to have a child. Hence, in the case of limited commitment disagreement between the two partners about fertility is possible. $\square$

Proof of Proposition 3: Fertility preferences for gender $g \in \{f, m\}$ have independent uniform density on $\mu_g - (d_g)^{-1}/2, \mu_g + (d_g)^{-1}/2$. The distribution function is given by (in the relevant range):

$$F(v_f, v_m) = \left(v_f - \left(\mu_f - \frac{1}{2d_f}\right)\right) d_f \left(v_m - \left(\mu_m - \frac{1}{2d_m}\right)\right) d_m,$$

and the fraction of couples who have a child is given by:

$$\begin{aligned} E(b) = 1 - \left(\tilde{v}_f - \left(\mu_f - \frac{1}{2d_f}\right)\right) d_f - \left(\tilde{v}_m - \left(\mu_m - \frac{1}{2d_m}\right)\right) d_m \\ + \left(\tilde{v}_f - \left(\mu_f - \frac{1}{2d_f}\right)\right) d_f \left(\tilde{v}_m - \left(\mu_m - \frac{1}{2d_m}\right)\right) d_m. \end{aligned} \tag{29}$$

Given (9) and (10), the average fertility rate is a quadratic and concave function of the female cost share χ_f (i.e., the quadratic term has a negative sign). The derivative of average fertility with respect to χ_f is:

$$\begin{aligned} \frac{\partial E(b)}{\partial \chi_f} = \phi d_m \left[1 - \left((\chi_f + \alpha/2)\,\phi - \left(\mu_f - \frac{1}{2d_f}\right)\right) d_f\right] \\ - \phi d_f \left[1 - \left((1 - \chi_f + \alpha/2)\,\phi - \left(\mu_m - \frac{1}{2d_m}\right)\right) d_m\right], \end{aligned} \tag{30}$$

which simplifies to:

$$\frac{\partial E(b)}{\partial \chi_f} = \phi(d_m - d_f) + \phi d_f d_m \left[(1 - 2\chi_f)\phi + \mu_f - \mu_m + \frac{1}{2}\left(\frac{1}{d_m} - \frac{1}{d_f}\right)\right].$$

Equating the right-hand side to zero gives the cost share $\hat{\chi}_f$ at which fertility is maximized (assuming that the solution is interior):

$$\hat{\chi}_f = \frac{1}{2} + \frac{1}{2\phi}\left[\mu_f - \mu_m + \frac{1}{2}\frac{d_m - d_f}{d_f d_m}\right]. \tag{31}$$

Taking corner solutions into account, the fertility maximizing cost share is given by expression (14) in the statement of the proposition. Moreover, starting with (30), if there is an interior maximum we have:

$$\begin{aligned} \phi d_m \left[1 - \left((\hat{\chi}_f + \alpha/2)\,\phi - \left(\mu_f - \frac{1}{2d_f}\right)\right) d_f\right] \\ = \phi d_f \left[1 - \left((1 - \hat{\chi}_f + \alpha/2)\,\phi - \left(\mu_m - \frac{1}{2d_m}\right)\right) d_m\right], \end{aligned}$$

and hence:

$$\frac{d_f}{d_m} = \frac{1 - \left((\hat{\chi}_f + \alpha/2)\,\phi - \left(\mu_f - \frac{1}{2d_f} \right) \right) d_f}{1 - \left((1 - \hat{\chi}_f + \alpha/2)\,\phi - \left(\mu_m - \frac{1}{2d_m} \right) \right) d_m} = \frac{1 - F_f(\tilde{v}_f)}{1 - F_m(\tilde{v}_m)}.$$

Thus, as stated in the last part of the proposition, if the distributions of female and male child preferences have different densities, fertility is maximized if the ratio of densities is equal to the fraction of individuals agreeing to have a child for each gender. □

Proof of Proposition 4: The second period of the two-period model is formally identical to the static model analyzed in Proposition 2, and hence conditions (7) and (8) are applicable, which gives (16) and (17). The expected utilities in period 2 as a function of first-period utility are then given by:

$$\begin{aligned} V_g(b_1) = \int_{v_{f,2}} \int_{v_{m,2}} \Big[& w_g + \frac{\alpha}{2}\,(w_f + w_m) \\ & + I(v_{f,2} \geq \tilde{v}_{f,2}, v_{m,2} \geq \tilde{v}_{m,2}) \left(v_{g,2} - \left(\chi_g + \frac{\alpha}{2} \right) \phi \right) \Big] f(v_{f,2}, v_{m,2}|b_1)\, dv_{f,2}\, dv_{m,2}, \end{aligned} \quad (32)$$

where $f(v_{f,2}, v_{m,2}|b_1)$ is the joint density of fertility preferences in the second period given b_1. Given these utilities, the terms $EV_g(1) - EV_g(0)$ then represent the change in second period expected utility as a function of the initial fertility choice. From the perspective of deciding on fertility in the first period, these terms act like a constant that adds to (or subtract from) the benefit of children. Applying Proposition 2, the conditions for having a baby in the first period are then:

$$v_{f,1} + \beta\,(EV_f(1) - EV_f(0)) \geq \left(\chi_f + \frac{\alpha}{2} \right) \phi,$$
$$v_{m,1} + \beta\,(EV_m(1) - EV_m(0)) \geq \left(\chi_m + \frac{\alpha}{2} \right) \phi,$$

which gives (18) and (19). □

Proof of Proposition 5: Given that fertility preferences in the second period do not depend on the fertility realization in the first period, we have $EV_f(0) = EV_f(1)$ and $EV_m(0) = EV_m(1)$. Hence, given Proposition 4 the conditions for fertility in each period are the same as those for the single period model characterized in Proposition 2. We therefore obtain the same fertility rate in both periods, $E(b_1) = E(b_2)$, and Proposition 3 applies to each period separately. □

Proof of Proposition 6: We proceed by backward induction. If $b_1 = 1$, we have $v_{f,2} = v_{m,2} = 0$. Given (16) and (17), this guarantees that no additional child will be born in the second period, and second-period utilities are (given Nash bargaining):

$$EV_f(1) = w_f + \frac{\alpha}{2}(w_f + w_m),$$
$$EV_m(1) = w_m + \frac{\alpha}{2}(w_f + w_m).$$

Conversely, if we have $b_1 = 0$, the preference realizations $v_{g,2} = (\chi_g + \alpha)\phi$ guarantees that the conditions (16) and (17) are satisfied, so that $b_2 = 1$ for sure. We therefore have $b_2 = 1 - b_1$ and, in expectation:

$$E(b_2) = 1 - E(b_1),$$

which gives (20) and (21). Continuing, the resulting second-period utilities conditional on $b_1 = 0$ are:

$$EV_f(0) = w_f - \chi_f\phi + \frac{\alpha}{2}(w_f + w_m - \phi) + (\chi_f + \alpha)\,\phi,$$
$$EV_m(0) = w_m - \chi_m\phi + \frac{\alpha}{2}(w_f + w_m - \phi) + (\chi_m + \alpha)\,\phi,$$

which can be simplified to:

$$EV_f(0) = w_f + \frac{\alpha}{2}(w_f + w_m + \phi),$$
$$EV_m(0) = w_m + \frac{\alpha}{2}(w_f + w_m + \phi).$$

Given these utilities, the impact of having a child in the first period on continuation utility is:

$$EV_f(0) - EV_f(1) = \frac{\alpha}{2}\phi,$$
$$EV_m(0) - EV_f(1) = \frac{\alpha}{2}\phi.$$

We now move to the fertility decision in the first period. The conditions (18) and (19) are:

$$v_{f,1} \geq \left(\chi_f + \frac{\alpha}{2}\right)\phi + \beta\frac{\alpha}{2}\phi,$$
$$v_{m,1} \geq \left(1 - \chi_f + \frac{\alpha}{2}\right)\phi + \beta\frac{\alpha}{2}\phi.$$

which can be rewritten as

$$v_{f,1} \geq \left(\chi_f + (1+\beta)\frac{\alpha}{2}\right)\phi,$$
$$v_{m,1} \geq \left(1 - \chi_f + (1+\beta)\frac{\alpha}{2}\right)\phi.$$

With the change of variables

$$\tilde{\alpha} = (1+\beta)\alpha,$$

the conditions can be written as:

$$v_{f,1} \geq \left(\chi_f + \frac{\tilde{\alpha}}{2}\right)\phi,$$
$$v_{m,1} \geq \left(1 - \chi_f + \frac{\tilde{\alpha}}{2}\right)\phi.$$

The conditions therefore are of the form (7) and (8), so that the results in Proposition 3 apply with the transformed parameter $\tilde{\alpha}$. □

B.2 Correlated Child Preferences

We now show that results similar to those in Proposition 3 (which was established for the case of independent child preferences) also go through when we allow for correlation in child preferences between the spouses.

Proposition 7 (Effect of Distribution of Child Cost with Correlated Preferences)**.** *Assume that the female and male child preferences follow uniform distributions with means μ_g and densities d_g for $g \in \{f, m\}$. With probability $\eta > 0$, the draw of a given woman and man are perfectly correlated in the sense that:*

$$v_f = \frac{d_m}{d_f}(v_m - \mu_m) + \mu_f.$$

With probability $1-\eta$, woman and man have independent draws from the their distributions. This implies that η is the correlation between the woman's and the man's child preference. Then expected fertility $E(b)$ is a concave function of the female cost share χ_f, and fertility is maximized at:

$$\hat{\chi}_f = \min\left\{1, \hat{\chi}_{f1}, \max\left\{0, \bar{\chi}_f, \hat{\chi}_{f2}\right\}\right\}, \tag{33}$$

where

$$\bar{\chi}_f = \frac{\left(d_m + \frac{\alpha}{2}(d_m - d_f)\right)\phi + \mu_f d_f - \mu_m d_m}{\phi(d_f + d_m)},$$

$$\hat{\chi}_{f1} = \frac{1}{2} + \frac{1}{2\phi}\left[\mu_f - \mu_m + \frac{1}{2}\left(\frac{\frac{1+\eta}{1-\eta}d_m - d_f}{d_f d_m}\right)\right],$$

$$\hat{\chi}_{f2} = \frac{1}{2} + \frac{1}{2\phi}\left[\mu_f - \mu_m + \frac{1}{2}\left(\frac{d_m - \frac{1+\eta}{1-\eta}d_f}{d_f d_m}\right)\right].$$

Hence, if women and men have the same preferences ($\mu_f = \mu_m$, $d_f = d_m$), fertility is maximized when the child care burden is equally shared, $\hat{\chi}_f = 0.5$. Moreover, if the distributions of female and male preferences have the same density ($d_f = d_m$), equal shares of men and women agree to having a child at the maximum fertility rate, even if $\mu_f \neq \mu_m$ (provided that $\hat{\chi}_f$ is interior). If $d_f \neq d_m$ and $\hat{\chi}_f \neq \bar{\chi}_f$, at $\hat{\chi}_f$ more individuals of the gender with the more concentrated distribution of preferences (higher d_g) agree to having a child than individuals of the gender with more dispersed preferences.

Proof of Proposition 7: Fertility preferences for gender $g \in \{f, m\}$ have uniform density on $\mu_g - (d_g)^{-1}/2, \mu_g + (d_g)^{-1}/2$. With probability η, the draws are perfectly correlated in the sense that we have:

$$v_f = \frac{d_m}{d_f}(v_m - \mu_m) + \mu_f,$$

and with probability $1 - \eta$ the draws are independent. The distribution function is given by (in the relevant range):

$$F(v_f, v_m) = \eta \min\left\{\left(v_f - \left(\mu_f - \frac{1}{2d_f}\right)\right)d_f, \left(v_m - \left(\mu_m - \frac{1}{2d_m}\right)\right)d_m\right\} + (1-\eta)\left(v_f - \left(\mu_f - \frac{1}{2d_f}\right)\right)d_f\left(v_m - \left(\mu_m - \frac{1}{2d_m}\right)\right)d_m.$$

The fraction of couples who have a child is given by:

$$E(b) = 1 - \eta \max\left\{\left(\tilde{v}_f - \left(\mu_f - \frac{1}{2d_f}\right)\right)d_f, \left(\tilde{v}_m - \left(\mu_m - \frac{1}{2d_m}\right)\right)d_m\right\} - (1-\eta)\left(\left(\tilde{v}_f - \left(\mu_f - \frac{1}{2d_f}\right)\right)d_f + \left(\tilde{v}_m - \left(\mu_m - \frac{1}{2d_m}\right)\right)d_m\right) + (1-\eta)\left(\tilde{v}_f - \left(\mu_f - \frac{1}{2d_f}\right)\right)d_f\left(\tilde{v}_m - \left(\mu_m - \frac{1}{2d_m}\right)\right)d_m.$$

Given (9) and (10), the average fertility rate as a function of the female cost share χ_f has a kink at the point where the two elements inside the max operator are equal, and is a quadratic and concave function of χ_f away from the kink. The kink is at the cost share that equates disagreement between men and women, given by:

$$\bar{\chi}_f = \frac{\left(d_m + \frac{\alpha}{2}(d_m - d_f)\right)\phi + \mu_f d_f - \mu_m d_m}{\phi(d_f + d_m)}.$$

For $\chi_f < \bar{\chi}_f$, the derivative of fertility with respect to χ_f is given by:

$$\begin{aligned} \left.\frac{\partial E(b)}{\partial \chi_f}\right|_{\chi_f < \bar{\chi}_f} &= \eta\phi d_m + (1-\eta)\phi d_m \left[1 - \left(\left(\chi_f + \alpha/2\right)\phi - \left(\mu_f - \frac{1}{2d_f}\right)\right) d_f\right] \\ &\quad - (1-\eta)\phi d_f \left[1 - \left(\left(1 - \chi_f + \alpha/2\right)\phi - \left(\mu_m - \frac{1}{2d_m}\right)\right) d_m\right], \end{aligned} \tag{34}$$

which simplifies to:

$$\left.\frac{\partial E(b)}{\partial \chi_f}\right|_{\chi_f < \bar{\chi}_f} = \phi(d_m - (1-\eta) d_f) + (1-\eta)\phi d_f d_m \left[(1 - 2\chi_f)\phi + \mu_f - \mu_m + \frac{1}{2}\left(\frac{1}{d_m} - \frac{1}{d_f}\right)\right].$$

Equating the right-hand side to zero gives the cost share $\hat{\chi}_{f1}$ would be maximized fertility is maximized if the solution is interior and if we have $\hat{\chi}_{f1} < \bar{\chi}_f$:

$$\hat{\chi}_{f1} = \frac{1}{2} + \frac{1}{2\phi}\left[\mu_f - \mu_m + \frac{1}{2}\left(\frac{\frac{1+\eta}{1-\eta} d_m - d_f}{d_f d_m}\right)\right].$$

In the alternative case of $\chi_f > \bar{\chi}_f$, the derivative of fertility with respect to χ_f is given by:

$$\begin{aligned} \left.\frac{\partial E(b)}{\partial \chi_f}\right|_{\chi_f > \bar{\chi}_f} &= -\eta\phi d_f + (1-\eta)\phi d_m \left[1 - \left(\left(\chi_f + \alpha/2\right)\phi - \left(\mu_f - \frac{1}{2d_f}\right)\right) d_f\right] \\ &\quad - (1-\eta)\phi d_f \left[1 - \left(\left(1 - \chi_f + \alpha/2\right)\phi - \left(\mu_m - \frac{1}{2d_m}\right)\right) d_m\right], \end{aligned} \tag{35}$$

which simplifies to:

$$\left.\frac{\partial E(b)}{\partial \chi_f}\right|_{\chi_f > \bar{\chi}_f} = \phi((1-\eta) d_m - d_f) + (1-\eta)\phi d_f d_m \left[(1 - 2\chi_f)\phi + \mu_f - \mu_m + \frac{1}{2}\left(\frac{1}{d_m} - \frac{1}{d_f}\right)\right].$$

Equating the right-hand side to zero gives the cost share $\hat{\chi}_{f2}$ would be maximized fertility is maximized if the solution is interior and if we have $\hat{\chi}_{f2} > \bar{\chi}_f$:

$$\hat{\chi}_{f2} = \frac{1}{2} + \frac{1}{2\phi}\left[\mu_f - \mu_m + \frac{1}{2}\left(\frac{d_m - \frac{1+\eta}{1-\eta}d_f}{d_f d_m}\right)\right].$$

We have $\hat{\chi}_{f1} > \hat{\chi}_{f2}$. Three cases are possible. If $\hat{\chi}_{f2} \leq \bar{\chi}_f \leq \hat{\chi}_{f1}$, fertility is maximized at the kink $\bar{\chi}_f$, and equal numbers of men and women agree to have a child. If $\hat{\chi}_{f1} < \bar{\chi}_f$, fertility is maximized at $\hat{\chi}_{f1}$, and if $\hat{\chi}_{f2} > \bar{\chi}_f$, fertility is maximized at $\hat{\chi}_{f2}$. Taking also the possible corners at 0 and 1 into account, the fertility maximizing cost share $\hat{\chi}_f$ can be written as:

$$\hat{\chi}_f = \min\left\{1, \hat{\chi}_{f1}, \max\left\{0, \bar{\chi}_f, \hat{\chi}_{f2}\right\}\right\},$$

as stated in expression (33) in the proposition.

With identical preferences, we have $\hat{\chi}_{f2} < \bar{\chi}_f = 0.5 < \hat{\chi}_{f1}$, so that $\hat{\chi}_f = 0.5$. When $d_f = d_m$, we still have $\hat{\chi}_{f2} < \bar{\chi}_f < \hat{\chi}_{f1}$, so that in an interior solution $\hat{\chi}_f = \bar{\chi}_f$ implying (by the construction of $\bar{\chi}_f$) that equal frictions of men and women agree to have a child. As the final case, consider the situation when $d_m > d_f$ (the case $d_m < d_f$ is parallel and omitted). We want to show that at the fertility maximizing cost share $\hat{\chi}_f$, at least as many men agree to having a child as women do. Because equal fractions agree at $\chi_f = \bar{\chi}_f$, we need to show that $\hat{\chi}_f \geq \bar{\chi}$. To construct a contradiction argument, assume to the contrary that $\hat{\chi}_f < \bar{\chi}$. If there is an interior maximum in this region it is given by $\hat{\chi}_{f1}$. The first order condition corresponding to this case gives:

$$(1-\eta)\phi d_f\left[1 - F(\tilde{v}_m)\right] = \eta\phi d_m + (1-\eta)\phi d_m\left[1 - F(\tilde{v}_f)\right],$$

which implies:

$$1 > \frac{d_f}{d_m} > \frac{1 - F(\tilde{v}_f)}{1 - F(\tilde{v}_m)}.$$

Thus, fewer women than men would agree to having a child; however, this is a contradiction because $\hat{\chi}_f < \bar{\chi}$ implies that more women than men agree to have a child. Hence, when $d_m > d_f$ we must have $\hat{\chi}_f \geq \bar{\chi}_f$, which establishes the last claim in the proposition.
$\square$

B.3 Fertility Choice with Partial Commitment

We now consider an extension of the basic setup that allows for partial commitment. In this version of the model, the cost shares χ_f and χ_m are not parameters, but choice variables. Before deciding on fertility, but after learning about their child preferences, the spouses can take an action that changes the ex-post distribution of the child care burden. Formally, the cost share χ_f is selected from a given feasible interval $[\chi_{f,\min}, \chi_{f,\max}]$, with $\chi_m = 1 - \chi_f$. There is also a default cost share $\chi_{f,0} \in [\chi_{f,\min}, \chi_{f,\max}]$. Intuitively, what we have in mind is that couples can commit to some long-term decisions that affect the ex-post child care burden. Examples are buying consumer durables that affect the cost of child care (such as household appliances) or moving into a house in an area where market-provided child care is available. Such decisions would lower the expected time cost of having children and turn those into monetary expenses, which implicitly lowers the child care burden on the spouse who ex post will be responsible for the majority of the time costs of raising children. However, the range in which the child care burden can vary is limited, which is the sense in which there is only partial commitment.

The time line of events and decisions is as follows.

1. The potential utilities from having a child v_f and v_m are realized.
2. The woman can offer to increase her child care burden χ_f above the default within the feasible range, $\chi_{f,0} < \chi_f \leq \chi_{f,\max}$.
3. The man can offer to increase his child care burden $1 - \chi_f$ above the default within the feasible range, $\chi_{f,\min} \leq \chi_f < \chi_{f,0}$.
4. Given the final χ_f arising from the previous stage, the couple decides on whether to have a child as before.
5. Given the decisions in the previous rounds, the couple decides on the consumption allocation as before.

Consistent with our treatment of fertility choice, we assume that agreement is necessary to move cost shares; the spouses can make voluntary offers to do more work, but they cannot unilaterally force the other spouse to do more. We can solve for the equilibrium by backward induction. Stages 4 and 5 are identical to the existing model; hence, we only need to characterize the decisions in Stages 2 and 3 of potentially altering ex-post child care arrangements, and hence bargaining power.

Proposition 8 (Fertility Choice under Partial Commitment)**.** *Under partial of commitment, a birth takes place if and only if the conditions:*

$$v_f + v_m \geq (1+\alpha)\phi, \tag{36}$$

$$v_f \geq \left(\chi_{f,\min} + \frac{\alpha}{2}\right)\phi, \tag{37}$$

$$v_m \geq \left(1 - \chi_{f,\max} + \frac{\alpha}{2}\right)\phi. \tag{38}$$

are all satisfied. The first condition states that having a baby extends the utility possibility frontier for the couple, and the remaining conditions state that there is a χ_f in the feasible range such that both spouses benefit from having the baby. In terms of predictions for fertility, partial commitment nests the cases of no commitment when $\chi_{f,\min} = \chi_{f,\max}$, and full commitment when the conditions:

$$\chi_{f,\min} \leq \frac{\min(v_f)}{\phi} - \frac{\alpha}{2}, \tag{39}$$

$$\chi_{f,\max} \geq 1 - \frac{\min(v_m)}{\phi} + \frac{\alpha}{2} \tag{40}$$

are satisfied.

Proof of Proposition 8: For a given $\chi_f \in [\chi_{f,\min}, \chi_{f,\max}]$ that is negotiated in Stages 1–3, the outcome of the last two stages is as in the no commitment model analyzed in Proposition 2. Hence, the utilities $u_g(b, \chi_f)$ that each spouse attains are given by (24), (27), and (28):

$$u_f(0,\chi_f) = w_f + \frac{\alpha}{2}\left[w_f + w_m\right], \tag{41}$$

$$u_m(0,\chi_f) = w_m + \frac{\alpha}{2}\left[w_f + w_m\right], \tag{42}$$

$$u_f(1,\chi_f) = w_f + \frac{\alpha}{2}\left[w_f + w_m - \phi\right] + \left[v_f - \chi_f\phi\right] \quad \text{and} \tag{43}$$

$$u_m(1,\chi_f) = w_m + \frac{\alpha}{2}\left[w_f + w_m - \phi\right] + \left[v_m - \chi_m\phi\right]. \tag{44}$$

A child is born whenever both partners agree, i.e. as soon as

$$v_f \geq \left(\chi_f + \frac{\alpha}{2}\right)\phi \quad \text{and} \quad v_m \geq \left(1 - \chi_f + \frac{\alpha}{2}\right)\phi. \tag{45}$$

We first show that (36) to (38) are necessary for a birth to take place. Summing the two inequalities in (45) yields (36); hence, (36) is necessary for a child to be born. Intuitively,

(36) states that a baby can be born only if having a baby expands the couple's utility possibility frontier. Next, if (37) is violated, we have $u_f(1, \chi_{f,\min}) < u_f(0, \chi_{f,\min})$. Hence, the woman will be opposed to having a child even at her lowest possible cost share, and *a fortiori* for all other feasible cost shares as well. Hence, (37) is necessary for the woman to agree to having a child. The same argument implies that (38) is necessary for the man to agree to having a child.

Next, we want to show that (36) to (38) are sufficient for a birth to take place. Consider first the case where (36) is satisfied and we also have:

$$v_f \geq \left(\chi_{f,0} + \frac{\alpha}{2}\right)\phi \tag{46}$$

$$v_m \geq \left(1 - \chi_{f,0} + \frac{\alpha}{2}\right)\phi, \tag{47}$$

i.e., (7) and (8) are satisfied at the default cost share $\chi_{f,0}$ (this implies that (37) and (38) are also satisfied). Then, given Proposition 2, if neither spouse offers to bear higher cost, the couple will have the child, and both spouses will be better off compared to not having a child. Moreover, given (43) and (44), a spouse offering to bear higher cost could only lower her or his utility. Thus, the equilibrium outcome is that neither spouse offers to bear higher cost, and a birth takes place.

Now consider the case where (36) to (38) are satisfied, but we have:

$$v_f < \left(\chi_{f,0} + \frac{\alpha}{2}\right)\phi. \tag{48}$$

Subtracting both sides of this equation from (36) gives:

$$v_m > \left(1 - \chi_{f,0} + \frac{\alpha}{2}\right)\phi,$$

that is, (36) and (48) imply that (47) holds with strict inequality. If neither spouse offers to bear a higher than the default cost share, the couple will not have a baby because of (48) (i.e., the woman will not agree). Also, the woman has no incentive to offer to bear higher cost share, because then she would want a baby even less, hence the outcome would be unchanged. Hence, to prove that in this situation a baby will be born as claimed in the proposition, we have to show that the man will offer to bear a sufficiently high cost for the woman to agree to having the baby. Hence, consider the decision of the man to bear a higher than the default cost share. Conditional on having the child, given (44) the man's utility is strictly decreasing in his cost share. Hence, the only possibilities are that the man does not make an offer, in which case no birth takes place and the man gets utility (42), or the man offers to bear just enough cost to make the woman indifferent between having the baby and not having the baby. The required cost share satisfies

$$v_f = \left(\chi_f + \frac{\alpha}{2}\right)\phi$$

and is therefore given by:

$$\chi_f = \frac{v_f}{\phi} - \frac{\alpha}{2}.$$

Given that (37) holds, this is a feasible offer, i.e., $\chi_f \geq \chi_{f,\min}$. We still need to show that offering this cost share and having the baby makes the man weakly better off compared to not making an offer. The man's utility with cost share χ_f and a baby being born is:

$$\begin{aligned}
u_m(1,\chi_f) &= w_m - (1-\chi_f)\phi + \frac{\alpha}{2}\left[w_f + w_m - \phi\right] + v_m \\
&= w_m - \left(1 - \frac{v_f}{\phi} + \frac{\alpha}{2}\right)\phi + \frac{\alpha}{2}\left[w_f + w_m - \phi\right] + v_m \\
&= w_m - (1+\alpha)\phi + \frac{\alpha}{2}\left[w_f + w_m\right] + v_f + v_m.
\end{aligned}$$

We therefore have $u_m(1,\chi_f) \geq u_m(0,\chi_f)$ if the following condition is met:

$$w_m - (1+\alpha)\phi + \frac{\alpha}{2}\left[w_f + w_m\right] + v_f + v_m \geq w_m + \frac{\alpha}{2}\left[w_f + w_m\right]$$

or:

$$v_f + v_m \geq (1+\alpha)\phi,$$

which is (36) and therefore satisfied. Hence, it is in the interest of the man to make the offer, and a birth will take place. The outcome for the remaining case where (36) to (38) are satisfied, but we have:

$$v_m < \left(1 - \chi_{f,0} + \frac{\alpha}{2}\right)\phi$$

(the man does not want the child given the default cost share) is parallel: the woman will offer to bear just enough cost for the birth to take place. Hence, (36) to (38) are also sufficient for a birth to take place, which completes the proof.

Regarding the last part of the proposition, if (39) and (40) are satisfied, (37) and (38) are never binding. Hence, (36) is the only condition for a birth to take place, which is also the condition that characterizes fertility under full commitment in Proposition 1. □

Let us now consider, parallel to the analysis in Section 3.2, how the distribution of the child care burden affects fertility under partial commitment. We consider an economy with a continuum of couples, with wages and cost shares identical across couples. Child preferences are heterogeneous in the population. We focus on the case of independent distributions $F_f(v_f)$ and $F_m(v_m)$ for female and male child preferences. Define $\tilde{v}_f$ and $\tilde{v}_m$ in the partial commitment case as:

$$\tilde{v}_f = \left(\chi_{f,\min} + \frac{\alpha}{2}\right)\phi,$$
$$\tilde{v}_m = \left(1 - \chi_{f,\max} + \frac{\alpha}{2}\right)\phi.$$

Given Proposition 8, the fertility rate for the economy will be given by:

$$\begin{aligned} E(b) &= \text{Prob}\left(v_f \geq \tilde{v}_f \ \wedge \ v_m \geq \tilde{v}_m \ \wedge \ v_f + v_m \geq (1+\alpha)\phi\right) \\ &= \text{Prob}\left(v_f \geq \tilde{v}_f \ \wedge \ v_m \geq \tilde{v}_m\right) - \text{Prob}\left(v_f \geq \tilde{v}_f \ \wedge \ v_m \geq \tilde{v}_m \ \wedge \ v_f + v_m < (1+\alpha)\phi\right). \end{aligned}$$

Writing this out in terms of the distribution functions gives:

$$\begin{aligned} E(b) = 1 - F_f\left(\tilde{v}_f\right) - F_m\left(\tilde{v}_m\right) + F_f\left(\tilde{v}_f\right) F_m\left(\tilde{v}_m\right) \\ - \int_{v_m=\tilde{v}_m}^{\infty} \max\left\{F_f((1+\alpha)\phi - v_m) - F_f(\tilde{v}_f), 0\right\} \, dF_m(v_m). \end{aligned}$$

Here the first line is analogous to (12) in the case without commitment, and the second line subtracts the probability that having a baby lowers the utility possibility frontier, i.e., (36) is violated, even though both individual conditions (37) and (38) are satisfied.

We now would like to assess how a change in the distribution of the child care burden affects fertility under partial commitment. Consider the case where parents are able to move away from the default cost share $\chi_{f,0}$ up to a maximum change of $\xi > 0$, so that $\chi_{f,\min} = \chi_{f,0} - \xi$, $\chi_{f,\min} = \chi_{f,0} + \xi$. If the distribution functions are differentiable at $\tilde{v}_f$ and $\tilde{v}_m$, the marginal effect of a change in the default female cost share $\chi_{f,0}$ on fertility in the case of partial commitment is:

$$\begin{aligned} \frac{\partial E(b)}{\partial \chi_f} &= \phi F_m'\left(\tilde{v}_m\right)\left[1 - F_f\left(\tilde{v}_f\right)\right] - \phi F_f'\left(\tilde{v}_f\right)\left[1 - F_m\left(\tilde{v}_m\right)\right] \\ &- \phi F_m'\left(\tilde{v}_m\right)\left(F_f\left((1+\alpha)\phi - \tilde{v}_m\right) - F_f\left(\tilde{v}_f\right)\right) + \phi F_f'\left(\tilde{v}_f\right)\left(F_m\left((1+\alpha)\phi - \tilde{v}_f\right) - F_m\left(\tilde{v}_m\right)\right). \end{aligned}$$

or:

$$\frac{\partial E(b)}{\partial \chi_f} = \phi F_m'(\tilde{v}_m)\left[1 - F_f\left((1+\alpha)\phi - \tilde{v}_m\right)\right] - \phi F_f'(\tilde{v}_f)\left[1 - F_m\left((1+\alpha)\phi - \tilde{v}_f\right)\right]. \quad (49)$$

The first (positive) term represents the increase in the number of men who agree to have a child if the default female cost share χ_f increases (and hence the male cost share declines), and the second (negative) term is the decline in agreement on the part of women. The first term has two components: $F_m'(\tilde{v}_m)$ is the density of the distribution of male child preferences at the cutoff, which tells us how many men switch from disagreeing to agreeing with having a child as χ_f rises. The second component $1 - F_f((1+\alpha)\phi - \tilde{v}_m)$ is the probability that the woman will also agree, conditional on the man being just at the cutoff. In the same way, the negative impact of a decline in female agreement on fertility, measured by $F_f'(\tilde{v}_f)$, is weighted by the share of men agreeing to have a child conditional on the woman being at the cutoff, $1 - F_m((1+\alpha)\phi - \tilde{v}_f)$.

Comparing the expression under partial commitment (49) with the corresponding condition under no commitment (13), we see that the impact of shifts in the burden of childcare on fertility has the same form, except that under partial commitment the relevant agreement shares are conditional on the other spouse being just at the indifference threshold. As long the gender that is more likely to be opposed to having a baby in general is also more likely to be opposed on the margin (which is not guaranteed for arbitrary distributions of child preferences, but is true under intuitive regularity conditions), the general intuition from the no commitment case (namely, that fertility can be raised by favoring the gender more likely to be opposed to a baby and with a more dense distribution of fertility preferences) carries over to the partial commitment case.

Since we observe only a binary variable on fertility preferences, our data does not allow us to identify agreement shares conditional on the other spouse being close to indifference. Hence, we cannot make direct use of the additional implications of the partial commitment model, which is why we use the simpler no commitment model for our quantitative analysis. However, a different way to generate richer implications from the partial commitment model would be to distinguish different groups in the population with different commitment technologies. For example, the exploratory results reported in Table 13 suggest that married couples are more likely to agree on childbearing, which may be due to the commitment benefits of marriage. Exploring differences in the ability to commit across couples in relation to fertility choice is a promising direction for future research. In addition, the partial commitment model also suggests that another avenue for raising fertility would be to design policies that increase couples' ability to commit (i.e., raising ξ, resulting in a wider interval of feasible ex-post allocations of child care shares). Policies in areas such as marital property law, divorce law, and child custody law could be analyzed from this perspective using the partial commitment framework.