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Having a Second Child and Access to Childcare: Evidence from European Countries*

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Abstract

This paper shows that differences in fertility across European countries mainly emerge due to fewer women having two children in low fertility countries. It further suggests that childcare services are an important determinant for the transition to a second child to occur. The theoretical framework we propose suggests that: (*i*) in countries where childcare coverage is low, there is a U-shaped relationship between a couple's probability to have a second child and female's wage, while ((*ii*)) in countries with easy access to childcare, this probability is positively related with the woman's potential wage. Data from the European Survey of Income and Living Conditions (EU-SILC) confirm these implications when estimating a woman's probability of having a second child as a function of education. This implies that middle income women are the most affected ones by the lack of childcare coverage.

Keywords: Childcare, Education, Fertility, Female Employment.
JEL Classification Numbers: J11, J13, J16, 011

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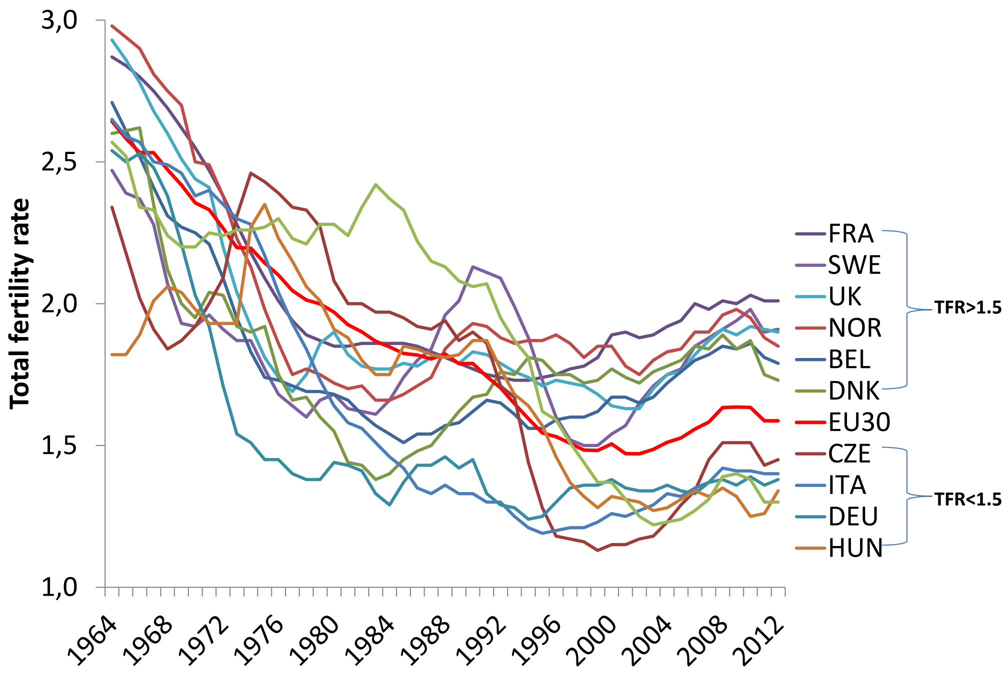
1 Introduction

Birth rates across European countries have been falling since the 1960s. Although this fall continues unabated in some of these countries today, total fertility rates in a growing number of other highly developed countries have already started to pick-up (Myrskyla, Kohler, and Billari (2009), Hazan and Zoabi (2015), Luci-Greulich and Thévenon (2014)). Figure 1 illustrates that particularly since the 1990s, total fertility rates in some European countries have shown signs of an upsurge, back to replacement levels (notably in France, Sweden, Norway, Denmark, the UK and Belgium), while in others fertility has continued to drop below the European average, stagnating under 1.5 children per woman (as in Italy, the Czech Republic, Germany, Hungary and Poland). This paper contributes to a better understanding of the factors that have made it possible for fertility rates to recover in some countries but not in others.



Data Source: World Bank World Development Indicators (WB WDI), 2014

Figure 1: Evolution of Total Fertility Rates from 1964 to 2012 in Ten European Countries

This reversal of fertility trends in some countries is caused in part by the end of the postponement of childbearing among younger generations (Goldstein, Sobotka, and Jasilioniene (2009) and Bongaarts and Sobotka (2012)). Fertility levels fall initially because women delay the age at which they have their first child, leading to a temporary depression of overall fertility rates. As time elapses, however, the total number of births recovers due to a catch up effect.

However, recent research suggests that fertility differentials across European countries can not be fully explained by differences in birth postponement only. Structural and cultural changes that come with economic development are also likely to affect fertility decisions, not only in terms of timing, but also in terms of quantum (Billari and Kohler (2004), Frejka (2008), Goldstein, Sobotka, and Jasilioniene (2009), and Lesthaeghe (2010)). Luci-Greulich and Thévenon (2013), for example, show that the rise in fertility rates back to replacement levels occurs only in those highly developed countries where female employment comes hand in hand with economic development, highlighting the importance of structural improvements that allow more and more parents, and particularly mothers, to combine work and family life.

While it has been argued that a below-replacement level fertility may reflect a general preference for low fertility among women and couples, survey data for European countries suggest that it is in fact mostly due to barriers that hinder parents from realizing their desired fertility levels. The surveys actually indicate stable preferences around a two-child family model for both women and men in all European countries, independent of national fertility level. Sobotka (2013) shows that the variation between countries in desired family size is generally low, centering around the two-child ideal in all European countries. Sobotka and Beaujouan (2014) show that the variance across cohorts of adults' responses to the question of "ideal family size" within European countries gets smaller over generations. Even low-fertility countries (as measured by completed fertility rates of women aged 45+) such as Poland, the Czech Republic, Slovakia, Bulgaria, Spain, Portugal, Germany and Italy also affirm the same average desired fertility of two children, in line with other European countries (Eurobarometer (2006) and Eurobarometer (2011)). This highlights the gap between intended and realized completed fertility even among low fertility countries, suggesting that there are institutional barriers that push couples towards a lower fertility regime.

This paper sheds light on these barriers. In Section 2, we first develop a theoretical framework in order to present the mechanism under which childcare availability positively affects fertility. This relationship is empirically documented. The theory assumes a unitary household decision problem in which couples choose their fertility levels, their labor supply, and the type of childcare they desire. Men and women can supply childcare out of their own labor time or purchase childcare services from the market at a given price. The mechanism put forward with this setup is that an easier access to childcare allows parents to purchase these services instead of providing them themselves. The generated income that can be maintained after child birth facilitates the couple's decision in favor of family enlargement.

In Section 3, we first use the cross-sectional wave of the European Survey of Income and Living conditions (EU-SILC) to show that differences in fertility levels between low and high fertility countries mainly emerge due to fewer women having two children in low fertility countries, suggesting a barrier for the second child birth in low fertility countries. The theory is then extended to better understand the transition from a first to a second child. Two implications derive from the theory. The first says that the probability of having a second child in low fertility countries, which are characterized by difficult access to childcare, follows a U-shaped relationship with women's potential wage. The decreasing part of the U is driven by the behavior of couples who cannot afford to purchase childcare activities in the private market. For these, it is often the woman who performs childcare activities for the first child and the gradual increase of female wage potential in the labor market naturally increases the opportunity cost of this personal childcare, and therefore decreases the probability of having a second child. This (substitution) effect, however, subsides after a certain level of income. Once couples are able to outsource childcare, a higher female wage level allows the couple to buy more time from the market and encourages having a second child (increasing part of the U-shaped relationship). The second prediction is that in high fertility countries, where childcare availability is generalized, only the positive relationship between female wage and fertility is observed. This stems from an income effect that can be seen in high-fertility developed countries, where childcare services are more accessible, leading to a probability of having a second child that is increasing with women's wage.

These theoretical implications are empirically corroborated in Section 3.3 for European countries. We estimate how the impact of women's education (used as a proxy for potential wage) on the couple's probability of having a second child differs with the access to formal childcare. We therefore use the longitudinal module of the European Survey of Income and Living Conditions (waves 2003-2011) in combination with the OECD Family Data Base. We find that in countries where childcare coverage is low, there is a U-shaped pattern between women's education level and her probability of having a second child, whereas this relationship is continuously positive in countries with easier access to childcare.

Our findings are in line with those of recent studies that have looked at the link between measures of female employment, education and fertility interacting with childcare. In a cross-country analysis for OECD countries, Borck (2014) showed that cultural differences on the perceived quality of external childcare can help explaining cross-countries differences in levels of female labor force participation, childcare provision and fertility. Blau and Robins (1988) showed that the price for outsourcing childcare services in the US is negatively correlated with women's decision to both enter the labor market and to purchase childcare services, providing at the same time a theoretical framework that can account for different family types including those who have alternative childcare possibilities. Attanasio, Low, and Sánchez-Marcos (2008) found that a decrease in childcare costs could explain the increase in the labor force participation of mothers of young children from the observed 0.47 rate for the cohort born in the 1940s to 0.68 for the cohort born in the 1950s. Baizán, Arpino, and Delclós (2015) found that in European countries, childcare coverage is positively related to individual-level completed fertility for all educational groups, while this association is strongest for highly educated women. Amuedo-Dorantes and Sevilla (2014) supported a causal effect of low-skilled immigration to the United States on the reductions in the time allocated to basic child care by college-educated mothers of non-school age children. Hazan and Zoabi (2015) also found that wage inequalities among US women lead to a U-shaped relationship between women's education and fertility. Wood, Neels, and Kil (2014) studied the education gradient for different parities in European countries showing that different groups of countries revealed different patterns.

Schoonbroodt (2014) provided estimates for childcare costs paid by parents in the United States, where she showed in particular that during traditional working hours, women spend three times more of their time in childcare than men. In Quebec, Baker, Gruber, and Milligan (2008) showed that an increase in female labor force participation followed the introduction of universal childcare. Similarly, using data on Swedish households, Gustafsson and Stafford (1992) showed that public childcare led to higher female labor market participation and that a lower cost of childcare services positively affects the use of of these services if seats for children in these facilities are not rationed. Finally, for Germany, Bick (2015) showed that a large fraction of part-time working mothers would work full-time if they had better access to subsidized childcare, Wrohlich (2011) showed that increasing the availability of childcare has a greater effect on maternal employment than reducing the fees of these services. In Western Germany, Hank and Kreyenfeld (2003) showed that access to informal care arrangements increased the probability of having a first birth. Counterbalancing these last findings, Aassve, Billari, and Pessin (2012) highlight that differences over trusting someone outside the household to care for the children might also explain cross-country differences in fertility trends in developed countries.

This papers provides new elements to literature. First, we empirically show that having a second child is the key difference in fertility behaviour between low and high fertility countries in Europe. High fertility countries also have a higher child care coverage for children aged 0-2. Second, we provide a theoretical framework that accounts for the facts and outlines the mechanisms. Two implications derive from the theory, and are robust in the data. First, in countries where childcare coverage is low, the probability to have a second child is U-shaped with respect to female education. And second, in countries where childcare coverage is high, education increases the probability of having a second child.

2 A General Framework

In this section we develop a micro-economic model which allows us to discuss the mechanisms relating female wages, access to childcare and fertility.[1] We treat fertility firstly as a continuous decision variable to derive the general mechanisms, and then more specifically, in Section 3.2, as a discrete variable in order to show the model's implications for the probability of having a second child.

2.1 The Model

The economy is populated by couples composed of a man and a woman, respectively denoted by $i = m, f$. Each parent is endowed with one unit of time that is divided between childcare and work. A child needs $\phi > \bar{\phi}$ units of childcare, that can be supplied by either of the parents or outsourced, and a fixed time cost $\bar{\phi} \geq 0$ that can only be supplied by the mother.[2] Parents differ in their wages, w_i. Consumption goods and children are public goods in the household. Couples, therefore, cooperatively choose consumption, c, the amount of childcare time supplied by each individual, t_i, the amount of childcare time that is outsourced, t_n, and the number of children to have, n.

The cost of outsourcing childcare is denoted by p. This includes the market cost of the service but also the time cost for the parent to search for the right person and replace this person in case of absence. The cost of outsourcing childcare writes as,

$$p = \epsilon p_s + (1 - \epsilon) p_m \tag{1}$$

where ϵ is the share of individuals who have access to childcare services at a subsidized price p_s and $(1 - \epsilon)$ as the remaining share that has access to a higher, market price $p_m > p_s$.

[1] See Himmelweit et al. (2013) for a discussion on the usefulness of formal modeling household decision making.

[2] In Appendix A, we show that the mechanisms made explicit in this benchmark model also hold if we introduce a good cost for children as well as a time cost.

This implies that $\partial p/\partial\epsilon < 0$. This allows the model to account for an excess demand of childcare services due to the limited access to subsidized childcare - which is often the case for European countries, especially those with low fertility rates.

Denoting $\beta \in (0,1)$ as the parental preference for children relative to consumption, the maximization problem of a couple is the following:

$$\max_{c,t_f,t_m,t_n,n} \ln c + \beta \ln n, \tag{2}$$

subject to (1),

$$c = \left[1-(t_f+\bar{\phi})n\right] w_f + (1-t_m n)w_m - pt_n n, \tag{3}$$

$$\phi = t_f + t_m + t_n, \tag{4}$$

$$1-(t_f+\bar{\phi})n \geq 0, \tag{5}$$

$$1-t_m n \geq 0, \tag{6}$$

and $t_f \geq 0$, $t_m \geq 0$, $t_n \geq 0$. The Lagrangian of this problem is:

$$L = \ln c + \beta \ln n + \lambda t_f + \mu t_m + \nu t_n + \varphi\left[1-(t_f+\bar{\phi})n\right] + \gamma\left[1-t_m n\right], \tag{7}$$

where (λ, μ, ν) are the Kuhn-Tucker multipliers associated to the non-negativity constraints imposed on (t_f, t_m, t_n) while (φ, γ) are those imposed on conditions (5) and (6). The first order conditions with respect to (t_f, t_m, n) are:

$$\begin{aligned}
-\frac{n\left(w_f-p\right)}{c} + \lambda - \nu - n\varphi &= 0, &(8)\\
-\frac{n\left(w_m-p\right)}{c} + \mu - \nu - n\gamma &= 0, &(9)\\
-\frac{(t_f+\bar{\phi})w_f + t_m w_m + p\left(\phi - t_f - t_m\right)}{c} + \frac{\beta}{n} - \varphi(t_f+\bar{\phi}) - \gamma t_m &= 0. &(10)
\end{aligned}$$

Moreover, the optimal solution satisfies:

$$\lambda t_f = \mu t_m = \nu t_n = \varphi\left[1-(t_f+\bar{\phi})n\right] = \gamma\left[1-t_m n\right] = 0, \tag{11}$$

as well as equations (3) and (4).

Depending on the values of (w_m, w_f, p), the optimal solution can belong to one of the three main cases described below. Figure 2 illustrates when each of these cases arise, with respect

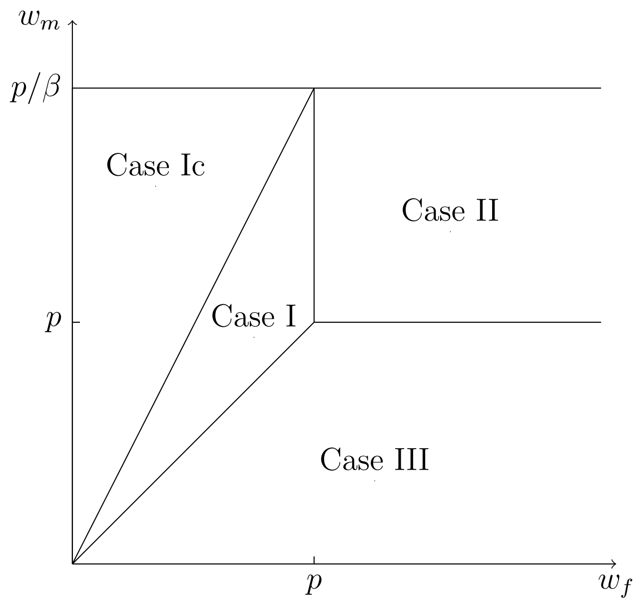


Figure 2: Possible Cases with Respect to w_f, p, and $w_m \in [0, p/\beta]$. Moreover, $\bar{\phi} > \phi\beta/(1+\beta)$.

to w_f, w_m, and p.

Case I. The woman supplies all the childcare: $t_f = \phi$ and $t_m = t_n = 0$. In this case, condition (11) implies $\lambda = \gamma = 0$ and $n \leq 1/\left(\phi + \bar{\phi}\right)$. The latter inequality means that either the woman is not working and reaches the maximal fertility level given by her time constraint or she is working part-time and chooses a lower fertility level. Using conditions (8), (9) and (10), we obtain,

$$n = \frac{1}{\left(\phi + \bar{\phi}\right)} \qquad \text{if} \qquad w_f \leq \beta w_m \leq p. \tag{12}$$

Conversely, fertility can have an interior solution that is equal to

$$n = \frac{\beta\left(w_f + w_m\right)}{(1+\beta)\left(\phi + \bar{\phi}\right)w_f} \qquad \text{if} \qquad \beta w_m \leq w_f \leq \min\left\{p, w_m\right\}. \tag{13}$$

In Case I, the wage of the woman is lower than both the wage of the man and the cost of outsourcing childcare. The woman reaches the maximal fertility level when her wage is lower than βw_m, whereas she chooses a lower level of fertility when it is above. Both the constrained and unconstrained cases (denoted Case Ic and Case I, respectively) are represented in Figure 2.

When the optimal fertility is interior, we notice that an increase in the wage of the man positively affects the couple's fertility ($\partial n/\partial w_m > 0$) while an increase in the woman's wage affects it negatively ($\partial n/\partial w_f < 0$).

Case II. All the childcare is outsourced: $t_n = \phi$ and $t_m = t_f = 0$. In this case, condition (11) implies $\nu = \gamma = 0$ and $n \leq 1/\bar{\phi}$. We notice that due to outsourcing possibilities, the maximal fertility level is higher than in Case I. Using conditions (8), (9) and (10), we obtain,

$$n = \frac{1}{\bar{\phi}} \qquad \text{if} \qquad p \leq \frac{\beta w_m - w_f}{(1+\beta)\,\frac{\phi}{\bar{\phi}}}. \tag{14}$$

Conversely, fertility can have an interior solution that is equal to

$$n = \frac{\beta\,(w_f + w_m)}{(1+\beta)\left(\bar{\phi} w_f + \phi p\right)} \qquad \text{if} \qquad \frac{\beta w_m - w_f}{(1+\beta)\,\frac{\phi}{\bar{\phi}}} \leq p \leq \min\left\{w_f, w_m\right\}. \tag{15}$$

A couple will outsource childcare when the cost of buying the service is not too high (below the wage of each spouse). If the cost is low, the maximal fertility level is then reached and when it increases, the fertility is more likely to be interior. In Figure 2, where it is assumed that $w_m \leq p/\beta$, only the unconstrained case is represented.

When the optimal fertility is interior, we notice that the wage of the man still has an income effect on fertility, $\partial n/\partial w_m > 0$. However, an increase in the wage of the woman has both income and substitution effects, due to the childbearing time, $\bar{\phi}$. We obtain:

$$\frac{\partial n}{\partial w_f} \geq 0 \Leftrightarrow \phi p - \bar{\phi} w_m \geq 0. \tag{16}$$

If $\bar{\phi}$ is relatively low compared to the time that is outsourced, then the income effect dominates the substitution effect and, then, $\partial n/\partial w_f > 0$. Note that a marginal increase in the male's wage increases fertility more than a marginal increase in the female's wage, $\partial n/\partial w_m > \partial n/\partial w_f$. This is due to the fixed cost in terms of childcare $\bar{\phi}$ supported by the woman.

Case III. The man supplies all the childcare: $t_m = \phi$ and $t_n = t_f = 0$. In this case, conditions (11) and $\phi > \bar{\phi}$ imply $\mu = \varphi = 0$ and $n \leq 1/\phi$. Conditions (8), (9) and (10) can be used to obtain,

$$n = \frac{1}{\phi} \qquad \text{if} \qquad w_m \leq \left[\beta - (1+\beta)\,\frac{\bar{\phi}}{\phi}\right] w_f \leq p, \tag{17}$$

and,

$$n = \frac{\beta \left(w_f + w_m\right)}{(1+\beta)\left(\bar{\phi} w_f + \phi w_m\right)} \qquad \text{if} \qquad \left[\beta - (1+\beta)\frac{\bar{\phi}}{\phi}\right] w_f \leq w_m \leq \min\left\{w_f, p\right\}. \tag{18}$$

Case III is exactly symmetric to Case I for $\bar{\phi} = 0$. By adding the fixed cost specific to women, we see that the constrained case is less likely.

In Case III, an increase in the wages of both the woman and the man entails income and substitution effects. If the childbearing time is larger than the childrearing time, then an increase in the man's wage has a positive effect on fertility whereas an increase in the woman's wage has a negative effect. The opposite case is seen when childbearing time is less than childrearing time.

The next subsection looks at the implications of the theory and compares them to cross country evidence on how fertility relates to childcare coverage.

2.2 Theoretical predictions and discussion

The right hand-side of Figure 3 shows the relationship between fertility and female wage when $w_m = w_m^\star \in (p, p/\beta)$ (dashed line in the left hand-side). We see that fertility is first flat with respect to female wage, as the couple is in Case Ic, then fertility decreases with female wage (Case I), and once the couple is rich enough to buy childcare services, fertility increases with respect to the wage of the woman. This implies an overall U-shaped relationship between fertility and female wage.

Figure 4 illustrates the effect of increasing the childcare coverage rate ϵ, which as implied by Equation (1) leads to lowering the average price of childcare, p, on the appearance of each case (left) and on fertility (right). A lower price increases the region in which Case II appears, where all childcare is outsourced, because couples can more easily purchase childcare.

Figure 4 shows the effect of decreasing p to$p\prime$ on the relationship between fertility and the wage of the woman. We see initially that fertility does not change with the wage of the woman, corresponding to the constrained fertility of Case I. But a lower price for childcare services (or a share of individuals who have access to the subsidized price p_s) has, on average, a positive effect on fertility. This is particularly true for middle-income women, for whom the opportunity cost to raise children is large. For high female wages, the difference in fertility when the price equals p compared to when the price equals $p\prime$ gets smaller as wages increase

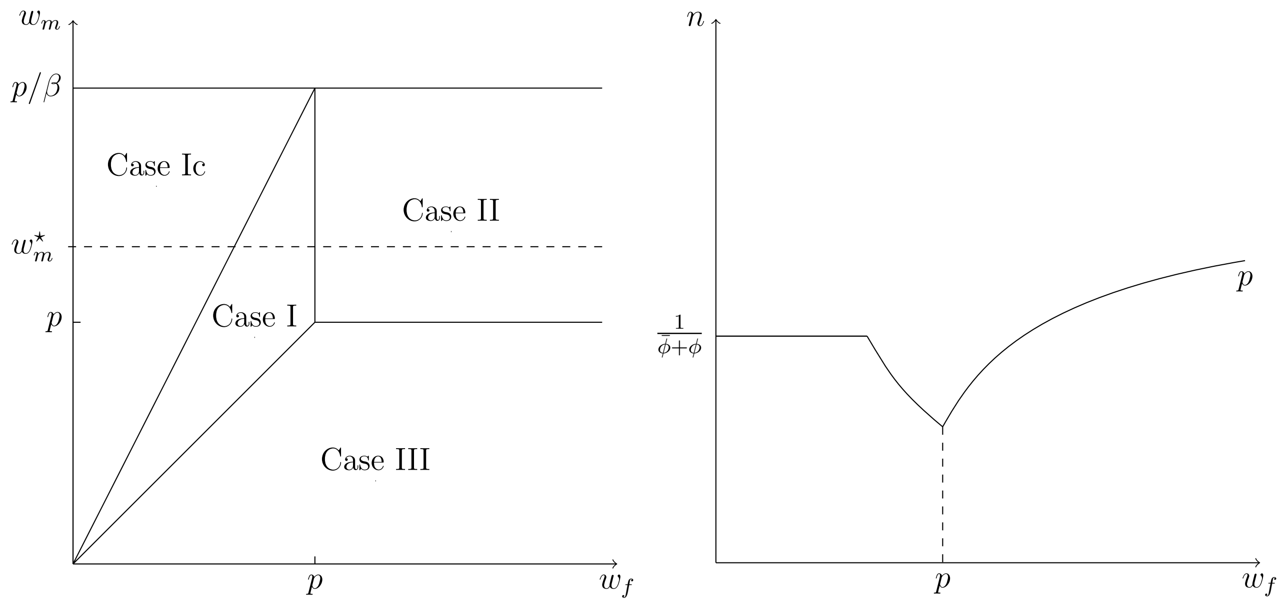


Figure 3: Left: Possible Cases with Respect to w_f, p, and $w_m \in [0, p/\beta]$; Moreover, $w_m^\star \in (p, p/\beta)$ and $\bar{\phi} > \phi\beta/(1+\beta)$. Right: Relationship between n and w_f for $w_m = w_m^\star$.

and fertility eventually converges to $\beta/(1+\beta)\,\bar{\phi}$. The U-shaped relationship is therefore less pronounced with a lower childcare price.

The theoretical prediction in Figure 4 is consistent with cross-country evidence using data from the OECD Family Database (FDB). Indeed, access to childcare is larger in high fertility countries.[3] Figure 5 plots the total fertility rate (TFR) in each European country against the average enrollment rate of children under three years of age in formal childcare. We see that the correlation is significantly positive. Low fertility countries with a TFR below the European average of 1.6 also tend to have a child care coverage below the European average of 31%, while high fertility countries tend to have a coverage rate above the average.

Several studies suggest that childcare coverage figures are a determinant rather than a consequence of total fertility rates,[4] as countries with low childcare coverage tend to have an excess demand for childcare.[5] This is why we consider childcare coverage as a proxy for access to child care for parents. The higher the coverage, the easier is generally the access for parents to childcare.

[3]Differences across childcare systems in Europe are explained in detail in Del Boca (2015).

[4]See Thévenon (2015) for a litterature review of the causal link between fertility levels and childcare coverage.

[5]See for example Wrohlich (2008) for Germany, Kawabata (2014) for Japan and the European Commission (2014) for Hungary.

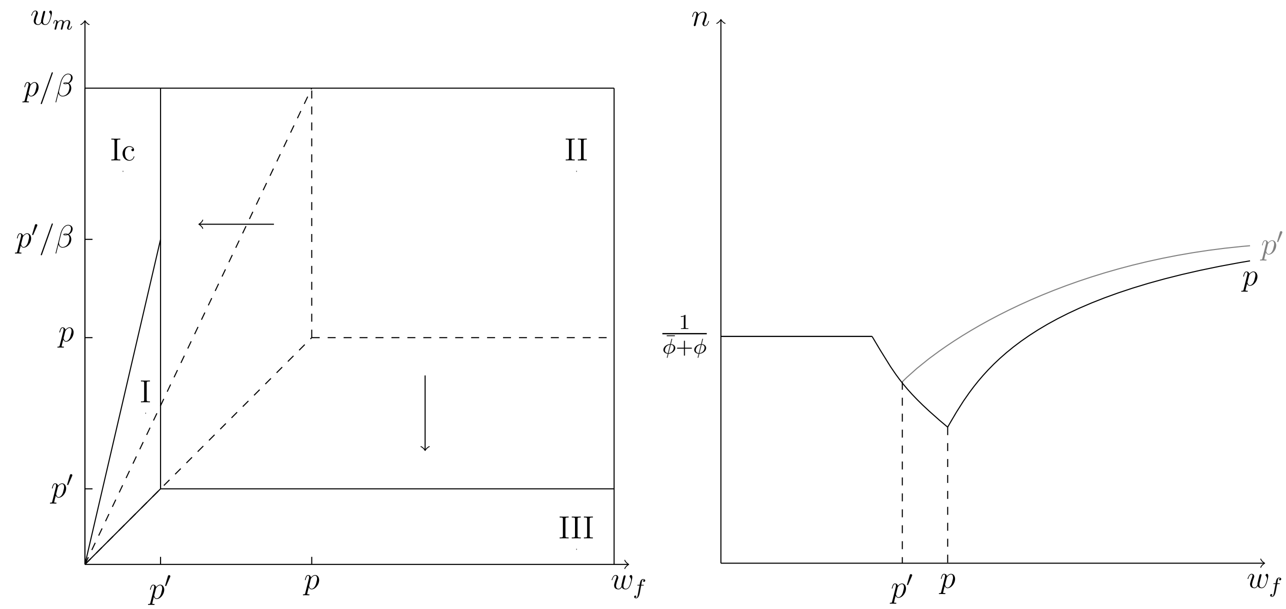


Figure 4: Left: Possible Cases with Respect to w_f, p, and $w_m \in [0, p/\beta]$; Moreover, $\bar{\phi} > \phi\beta/(1+\beta)$. Right: Relationship between n and w_f for $w_m \in (p, p'/\beta)$ and $p > p'$.

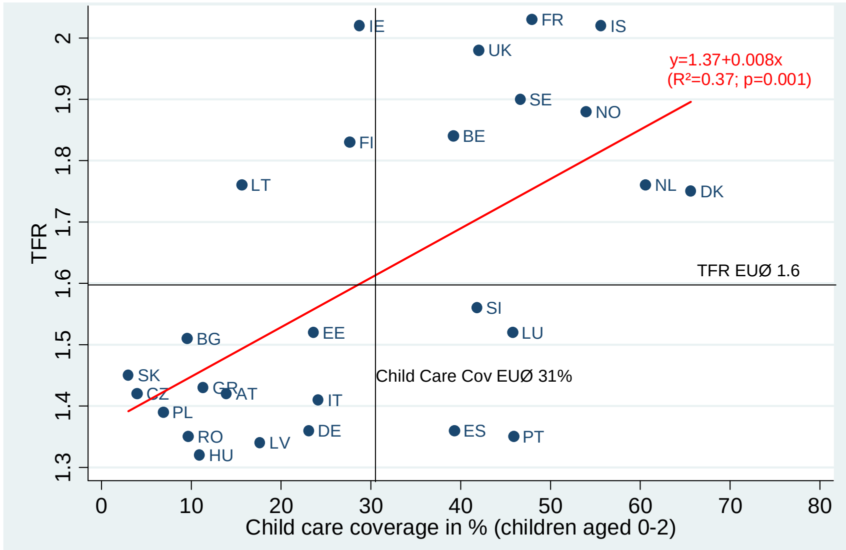
3 Explaining Differences in Fertility across European Countries

We first show that, among European countries, the difference in fertility rates between low and high fertility countries is mostly due to fewer women having a second child in low fertility countries. Then we extend the theoretical analysis of Section 2 to study the decision to have a second child, for women with different wages and facing different possibilities of accessing childcare. To do so, we treat fertility as a discrete variable. Finally, we provide empirical support to some implications from the theory: The probability of having a second child is U-shaped related to female education (as a proxy of women's potential wage) in countries where childcare coverage is low, while the probability of having a second child increases with female education in countries where childcare coverage is high.

3.1 The Rank that Matters

We use the 2011 cross-sectional wave of the EU-SILC to understand whether fertility differences across 26 European countries are due to differences in starting a family or to enlarging the family size.[6]

[6]Both of these factors can can lead to fertility differences across countries. Fertility levels significantly below replacement level can be due to difficulties in starting a family for certain women, resulting in one



Data sources: TFR: WB WDI (2011) and child care coverage: OECD Family Data Base (2012).

Figure 5: Total Fertility Rates with respect to Child Care Coverage (children aged 0-2).

We base our calculations on the fertility rate for women aged 38 to 44 years old (i.e. the cohorts of 1967-1973). Women at younger ages are excluded in order to focus on completed fertility. Women at older ages are also excluded because the EU-SILC reports a decreasing number of children per woman for older ages, as these children move out of their parents' homes and can no longer be observed. Due to this partial capture of children that live in the household only, as reported in the EU-SILC, these calculated "approximate" completed fertility rates (ACFR) are somewhat downward biased. Despite this bias, this approximate measure provides a country ranking that is similar to the unbiased completed fertility measured by the Human Fertility Data Base (wave 2012, cohort 1970).[7] The EU-SILC is thus used for our fertility analysis because it provides a large country coverage, an international comparability of socioeconomic measures and a follow-up of individuals (used later in Section 3.3).[8]

important group of women staying childless while another group of women have around two children (dichotomous fertility behavior). However, low fertility can also be a result of difficulties in increasing the family size rather than in starting a family, which would imply that, from a certain age on, most women are indeed mothers (i.e. childlessness is low), but few women have more than one child (homogeneous fertility behavior).

[7]For the majority of countries, the classification into high or low fertility regimes also stays the same when using the period measure of total fertility rates (World Bank World Development Indicators, 2011). Exceptions include some Eastern European countries (Czech Republic, Slovenia, Hungary, Slovakia, Poland), which have completed fertility rates above the EU average and total fertility rates below EU average, suggesting the importance of birth postponement for younger women (tempo effect). Schmertmann et al. (2014) predict that the quantum measure of completed fertility rate will be below average for cohorts born after 1970 in these countries.

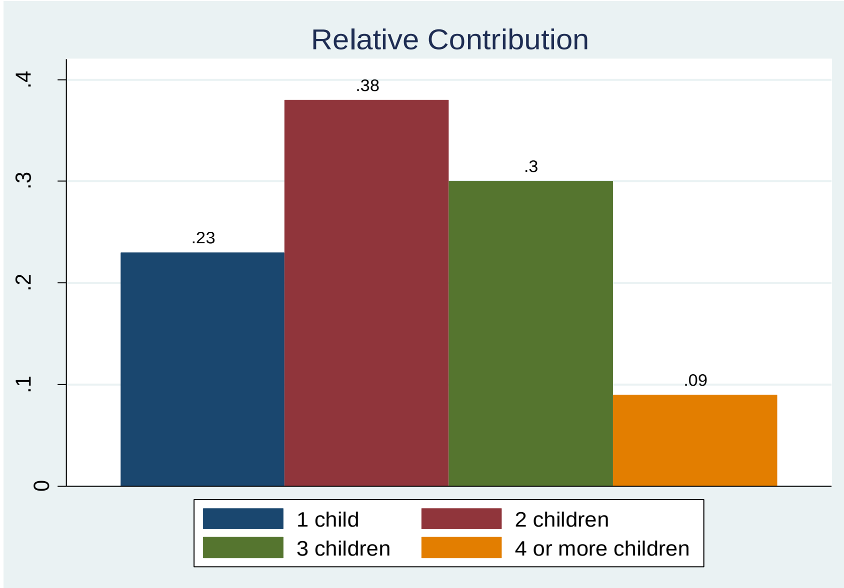
[8]For a detailed discussion of measurement biases of fertility with SILC, see Dasre and Greulich (2015).

The data shows an weighted average ACFR of 1.61 children per woman across the 26 European countries covered by the 2011 cross-sectional wave of EU-SILC. The 12 countries with rates below this average are Germany, Spain, Italy, Switzerland, Bulgaria, Portugal, Luxembourg, Belgium, Latvia, Greece, Austria and Estonia. The 14 countries above this average rate are: the United Kingdom, the Netherlands, Lithuania, Denmark, France, Norway, the Czech Republic, Finland, Poland, Slovenia, Slovakia, Sweden, Hungary and Iceland. The weighted average ACFR in high fertility countries equals 1.73 whereas it is 1.46 in low fertility countries; the absolute fertility difference between the two groups is thus 0.27 children.

Table 2 in Appendix B shows that in both low and high fertility countries, having two children is the most frequent situation for women aged 38 to 44 years old (40% in low fertility against 42% in high fertility countries). Childlessness is higher in low fertility countries, and the proportion of women having three and four children is higher in high fertility countries. The absolute differences in the proportions give, however, no direct information about the rank that is most responsible for fertility being low in the first group of countries. The proportion of women having three and four children might be higher in high fertility countries, but at the same time, in both country groups, only a relatively small fraction of women is concerned. This lets us suggest that the weight of children of rank three and four for explaining differences in fertility between the two groups is smaller than the absolute difference in the proportions lets expect. The same logic applies for childless women: the difference in the proportion of childless women between high and low fertility countries is considerable, but the proportions itself are relatively small in comparison to the proportion of women having one and two children. At the same time, the proportion of women having two children is important in the two country groups. Consequently, even if the difference between the two groups for this proportion is small, it can lead to high differences in fertility levels.

A decomposition of ACFR is thus needed to determine the contribution of each rank to the difference in fertility levels between the two groups of countries. As detailed in Appendix B, we first calculate for each group of countries the proportion of women having at least i children ("fertility rate of rank i"). The sum of these cumulative frequencies actually yields the ACFR of each country group. Then, we calculate the differences in each fertility rate of rank i between low and high fertility countries. These differences sum up to the absolute difference in ACFR between the two country groups.

According to these calculations, the absolute difference of 0.27 children per women between high and low fertility countries is composed as follows: 0.06 children are due to fewer children of rank one in low fertility countries, 0.10 children are due to fewer children of rank two in low fertility countries, 0.08 children are due to fewer children of rank three in low fertility



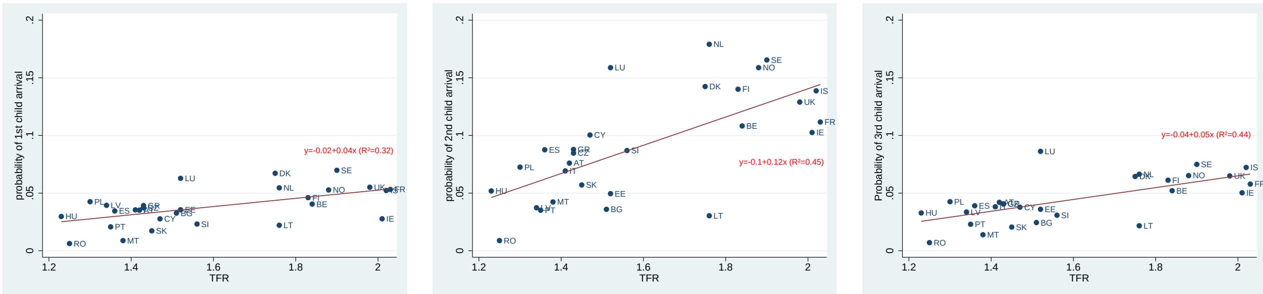
Data Source: EU-SILC CS 2011

Figure 6: Relative Contribution of Fewer Children of Rank i to the Fertility Gap between High and Low Fertility Countries in the EU(26)

countries and 0.02 children are due to fewer children of rank four in low fertility countries. Therewith, the fertility gap is mainly explained by fewer children of rank two. Figure 6 illustrates the relative contribution of each rank to the fertility gap. Fewer children of rank one account for 23% of the gap in ACFR between high and low fertility countries, fewer children of rank two for 38%, fewer children of rank three for 30% and fewer children of rank four for 9%.

Our calculations show that fertility differences between European countries mainly emerge due to fewer children of rank two, suggesting that in low fertility countries, most women have a first child, but fewer decide in favor of a second one. Following the same calculation method, Breton and Prioux (2005) find a somewhat higher contribution of children of rank three in comparison to children of rank two to fertility differences between European countries. This is due to the fact that they do not include Eastern European countries in their sample and focus on a generation that is 10 years older. At the same time, their study and ours consistently find that fewer children of rank one are not the main explanation for low fertility levels.[9]

[9]Furthermore, we find a somewhat higher difference between our two country groups for the transition probability from a second to a third child (women aged 38 to 44) in comparison to the one from a first to a second child, while differences in the transition to a first child are relatively small. As the transition to a third child requires having two children, and as we find that fewer children of rank two are the main



Data sources: birth probabilities EU-SILC LT 2003-2011; TFR WB WDI 2011

Figure 7: Probability of Child Birth of Rank 1 (left), 2 (center) and 3 (right) vs. TFR

Additional evidence that fertility differences between European countries mainly result from differences in second child birth can be obtained when including younger cohorts in our analysis. We therefore look at the transition probabilities of women aged 15 to 44 old. To observe the probabilities of child birth by rank, we use the longitudinal database of the EU-SILC (waves 2003 to 2011). The rotational panel with a follow-up of individuals for a maximum period of four years allows identifying child births that occur during the observed period.[10]

We observe that among women aged 15-44 years who are childless in the beginning of the observed period, 5% have a first child during the observed period. Among women having one child, 10% have a second child and among women having two children, 5% have a third child during the observed period.

Figure 7 plots each country's average probability of observed birth of a child of rank one, two and three for women aged 15-44 years old against the country's total fertility rates (TFR). The probability to observe a child's birth is higher in high fertility countries for all ranks. Figure 7 reveals a separation of European countries in two clearly distinguishable fertility regimes, low versus high ones, with low versus high probabilities of a child's birth. The difference between the two regimes is most striking for a second child birth (middle panel of Figure 7), which is not only due to a level effect. In low fertility countries, the probability of a second child birth is 66% lower than in high fertility countries, against 40% for the probability of first and third child birth. Our finding that low and high fertility countries differ most in the transition to a second child underlines the importance of children of rank two that was revealed by the previous ACFR analysis focusing on older cohorts only.

explanation for low fertility levels, our following section 3.2. focusses on the decision of having a second child.

[10] Appendix C confirms the results for a period measure of fertility, based on the EU-SILC cross-sectional database (2011).

The following subsection depicts the mechanisms behind a couple's decision of having a second child.

3.2 The Decision of Having a Second Child in Theory

To focus on the transition from the first to the second child, we modify the general model as structured above by considering that n is discrete rather than continuous. As the utility function is increasing and concave with respect to n, a couple will have two or more children if the indirect utility when $n = 2$ is higher than the indirect utility when $n = 1$.

Let us assume that the parameter restrictions are such that we are either in Case I, where the woman supplies all the childcare, or in Case II where all the childcare is outsourced ($w_m > p$ and $w_f > p$), and that the fertility is interior ($w_f > \beta w_m$). Let $\bar{u}_n^\kappa$ denote the indirect utility of having n children and being in Case $\kappa = \mathrm{I}$ or $\kappa = \mathrm{II}$. For $w_f = p$, we can check that $\bar{u}_n^{\mathrm{I}} = \bar{u}_n^{\mathrm{II}}$.

Moreover, let us define W^{I} and W^{II} the female wage thresholds such that $\bar{u}_1^{\mathrm{I}} = \bar{u}_2^{\mathrm{I}}$ and $\bar{u}_1^{\mathrm{II}} = \bar{u}_2^{\mathrm{II}}$ respectively. We have,

$$W^{\mathrm{I}} := \frac{w_m}{(\phi + \bar{\phi})\lambda - 1} \qquad \text{and} \qquad W^{\mathrm{II}} := \frac{w_m - \lambda p \phi}{\bar{\phi}\lambda - 1}, \tag{19}$$

where $\lambda := \left(2^{\beta+1} - 1\right)/(2^\beta - 1)$. We saw that in the case where the woman supplies all the childcare, fertility decreases with the woman's wage. In this discrete variable setting, this relationship is given through the following inequality,

$$\bar{u}_2^{\mathrm{I}} \geq \bar{u}_1^{\mathrm{I}} \Leftrightarrow w_f \leq W^{\mathrm{I}} \tag{20}$$

Moreover, provided that fixed costs are sufficiently large, and more precisely provided that,

$$(\bar{\phi} + \phi) \in \left(\frac{1}{\lambda}, \frac{1+\beta}{\beta}\frac{1}{\lambda}\right), \tag{21}$$

the threshold W^{I} is larger than βw_m. This implies that $\bar{u}_2^{\mathrm{I}} > \bar{u}_1^{\mathrm{I}}$ if the woman's wage belongs to $\left(\beta w_m, W^{\mathrm{I}}\right)$. Since $\partial \bar{u}_1^{\mathrm{I}}/\partial w_f > \partial \bar{u}_2^{\mathrm{I}}/\partial w_f$ for all $w_f > 0$, $\bar{u}_2^{\mathrm{I}}$ and $\bar{u}_1^{\mathrm{I}}$ will cross once for $w_f = W^{\mathrm{I}}$.

In the case where childcare is outsourced, fertility increases with the woman's wage, which could be expressed here as,

$$\bar{u}_2^{\mathrm{II}} \geq \bar{u}_1^{\mathrm{II}} \Leftrightarrow w_f \geq W^{\mathrm{II}} \tag{22}$$

Provided that $\bar{\phi}\lambda < 1$, the condition for $W^{\mathrm{II}} > W^{\mathrm{I}}$ becomes,

$$p > \frac{w_m}{(\bar{\phi} + \phi)\lambda - 1} \tag{23}$$

Then, the condition to obtain $\partial \bar{u}_2^{\mathrm{II}}/\partial w_f > \partial \bar{u}_1^{\mathrm{II}}/\partial w_f$ is $\phi p > w_m \bar{\phi}$, which (as we have seen in the previous section) implies that fertility increases with the woman's wage. This latter condition is compatible with the previous one provided that p is sufficiently large.

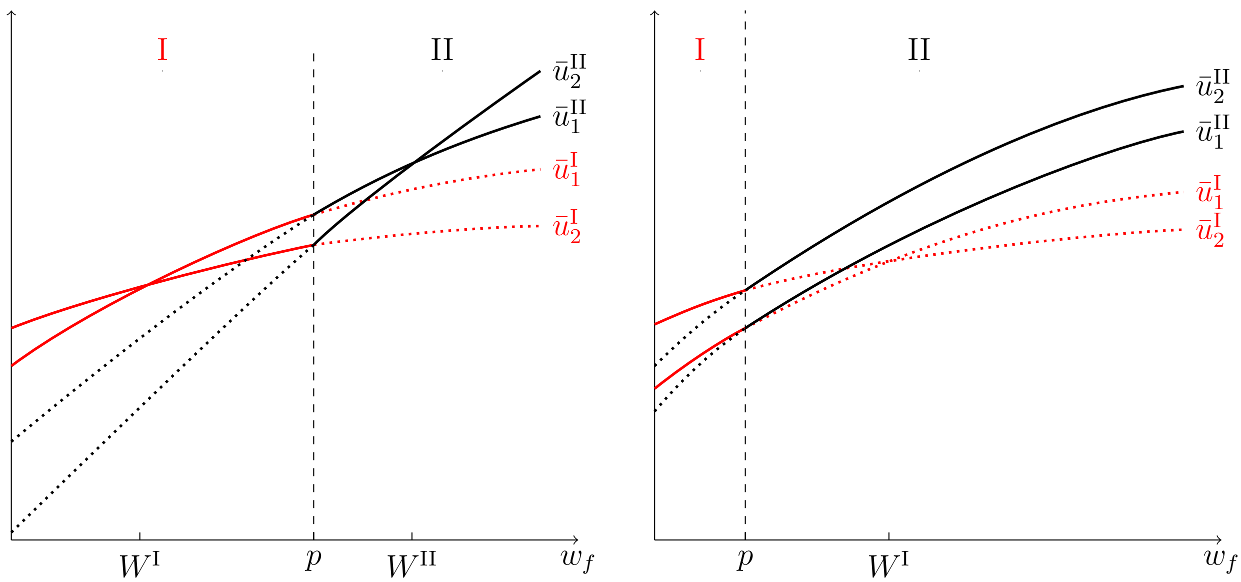


Figure 8: Indirect Utilities of Having One or Two Children, case I in red and case II in black, with a Large p (left) and and a Small p (right).

Figure 8 shows $\bar{u}_1^{\mathrm{I}}$, $\bar{u}_2^{\mathrm{I}}$, $\bar{u}_1^{\mathrm{II}}$ and $\bar{u}_2^{\mathrm{II}}$ with respect to w_f and for a large p (left panel) and a small p (right panel). The left panel of Figure 8 illustrates a situation in which the utility of having two children is larger for women with low or high wages than the utility of having only one child. Conversely, women with middle wages have one child. For $w_f < p$, the couple is in Case I in which the woman supports all the childrearing. For $w_f < W^{\mathrm{I}}$, $\bar{u}_2^{\mathrm{I}} > \bar{u}_1^{\mathrm{I}}$ so that the couple will have (at least) two children. When $W^{\mathrm{I}} \leq w_f < p$; $\bar{u}_1^{\mathrm{I}} \geq \bar{u}_2^{\mathrm{I}}$ and the couple will have one child. This is because for a woman with low wage, being out of the labor market entails a low cost. As her wage increases, however, this cost increases and as each child costs her $\phi + \bar{\phi}$ units of time, it is optimal for the couple to have less children.

For $w_f \geq p$, the couple has enough income to be in Case II where it outsources childrearing. For $p \leq w_f \leq W^{\mathrm{II}}$ the couple has one child ($\bar{u}_1^{\mathrm{II}} \geq \bar{u}_2^{\mathrm{II}}$) because the marginal cost of an extra child is larger than the utility gains. The cost of an extra child includes an increase in the opportunity cost of childbearing for the woman and a higher amount to pay for childrearing services. For $w_f > W^{\mathrm{II}}$; $\bar{u}_2^{\mathrm{II}} > \bar{u}_1^{\mathrm{II}}$ and the couple will have at least two children. This is due to the income effect of the increase that allows for the purchase of more childcare services in the market.

The right panel of Figure 8 shows the effect of decreasing the price of external childcare on the indirect utilities. In such configuration $\bar{u}_2^{\mathrm{II}} > \bar{u}_1^{\mathrm{II}}$ for all w_f. A lower female wage will allow the couple to reach Case II, where they can outsource childcare. Moreover, the figure also shows that couples will enter Case II before the substitution effect of the female wage becomes too large. This explains why the indirect utility of having two children always dominates the indirect utility of having one. As already present in Figure 4, Figure 8 also shows that women at the middle of the wage distribution are the most affected by changes in the price of childcare services.

The two panels of Figure 8 illustrate the differences in fertility patterns with respect to female wage for low (left panel) and high (right panel) fertility countries. The next section provides empirical evidence that the relation within European countries between the probability of having a second child and female potential wages is affected by access to formal childcare.

3.3 Empirical Application

We estimate the probability of having a second child for partnered women as a function of individual, partner and household characteristics as well as access to childcare. Our main determinant of interest is the woman's education level, which serves as a proxy for her potential wage, and we analyze how the impact of education on the probability of second child birth differs with access to formal childcare.

Our analysis is based on European countries which have distinct patterns in terms of aggregate fertility and access to childcare for young children. These 19 countries, identified in figure 5, have either both relatively high or both relatively low total fertility rates and child care coverage. To model the impact of education and other individual characteristics on women's probability of second child birth, we mobilize the longitudinal data set of the EU-Survey of Income and Living Conditions, covering survey years 2003 to 2011. Figure 7 in Section 3.1 illustrates each country's average of the probability of second child birth calculated with this data base. The longitudinal database is a rotational panel with individuals followed up for a maximum period of four years (individuals are observed from wave one to four). We select women aged 15 to 45, who already have a first child in the beginning of the observed period, and their partners. The individual determinants of second child birth are observed at the time of the survey that takes place in the year prior to potential second child birth. This allows reducing endogeneity.

To allow for this time delay, individuals have to be observed for at least three consecutive waves: The third wave is needed to identify all births of rank two that occur during the calendar year of the second wave. The first wave gives information about individual characteristics observed at the time of the survey that takes place during the year prior to the year of potential birth of a second child. Consequently, individuals who are observed for three waves have only one person-year in our compiled data base: this person-year contains information of the individual characteristics (education etc.) observed in the year prior to potential second child birth, as well as a dummy variable for second child birth.

For individuals who are observed for four waves, two potential years of second child birth can be identified. Consequently, those who do not have a second child in the first period enter our sample with two person-years.

Individuals who are observed for only one or two waves are dropped. For these individuals, we can not observe the individual characteristics in the year prior to the year of potential second childbirth. The panel contains individuals who are observed for less than four waves mainly due to the rotational design of the panel. Attrition in SILC is relatively small for second child birth in comparison to first child birth, as identified by Dasre and Greulich (2015).

As the panel is short, our sample contains only either one or two person-years for each individual. This allows us applying a simple logit model, with a control for the number of person-years. We use a binary logit regression model while taking into account the characteristics of women, their partners and the general household, as follows,

$$P(y = 1|X) = \frac{\exp\{\beta X'\}}{1 + \exp\{\beta X'\}} \tag{24}$$

where $y \in \{0, 1\}$ is a dummy variable for second child birth, X denotes the micro-level characteristics taken into account and β the estimated coefficient of these variables.

Besides women's education level, we include a series of control variables in order to isolate the impact of women's potential wage on the decision of having a second child from other determinants. Most importantly, we include information on women's partners in our model. We observe the partner's education level as well as the couple's joint labor income in the year previous to the potential birth of the second child,[11] and we control for the couple's

[11] We do not control for activity status in order to reduce multicollinearity.

marital status.

For education and income, we create several categories in order to capture non-linear impacts. We construct three categories for the education level of women and their partners (by highest ISCED level attained), namely: *low education* for pre-primary, primary and lower secondary education, *medium education* for upper secondary and post-secondary non-tertiary education and *high education* for tertiary education. Grouping the initial six education categories into three categories allows us to obtain a sufficiently large number of observations for each category. Household labor income contains the woman's plus, if in a couple, the partner's gross employee income, as well as their benefits from self-employment, observed for the whole year before the potential birth of a second child. Three categories are created for household wage income, collating terciles created separately for each country.

In addition, we control for the woman's age and the age and sex of the first child. The model fits best when integrating age as a continuous variable - modeling a non-linear impact for woman's age and a linear impact for the age of the first child.

Information on individual-level access to formal child care is not available in the longitudinal database of the SILC, which is why we have to limit our measure to cross-country variations. We use the aggregate measure of a country's child care coverage for children aged 0 to 2 (see Figure 5: OECD Family Data Base, 2012) as a proxy for parents' access to childcare. We use this measure in both an implicit and an explicit way in the regression models.

The implicit way consists of estimating the impact of education on the probability of second child birth by distinguishing between two groups of countries among the 19 European countries: a first group of countries with childcare coverage for children aged 0 to 2 years old that is below the European average of 31%, and a second group with childcare coverage above this average (as identified in Figure 5).[12]

The probability of having a second child varies considerably across countries, as already suggested in Figure 7. The weighted average for the probability of second child birth in our first group of countries is 0.08, while it amounts to 0.22 for the second group. For the first group of countries, we observe 14% of women with low education level, 59% with medium and 27% with high education levels, whereas the distribution in the second group of countries is 15%, 49% and 36% respectively. As the distribution of women over education groups is

[12]The first group consists of Hungary, Greece, Romania, Bulgaria, Austria, Slovakia, Czech Republic, Poland, Estonia, Italy and Latvia (note that Germany is not covered by the longitudinal data base), while the second group consists of the Netherlands, France, Iceland, Belgium, Norway, the United Kingdom, Denmark and Sweden.

quite similar in the two country groups, our estimation results are likely to be unaffected by selection issues.

We group together all 19 countries while controlling for the country group and while interacting the country group dummy with woman's education. This avoids us dividing the sample in two sub-groups. With our large sample size, we are able to analyze the effect of education on the probability of second child birth within countries of each group. To focus on these within-country variations, we introduce country-fixed effects besides the country group dummy. As some specific years may influence the probability of deciding for or against a second child, we also introduce year-fixed effects in all our regressions. The regressions are run with robust standard errors.

The explicit way for modeling access to childcare as a determinant of second child birth consists of applying a mixed-effects logistic regression. Multilevel models are useful when individuals are supposed to be nested into higher level structures (Snijders and Bosker 1999) that may play a role in explaining events that occur at the individual level. This is of particular interest in international comparative research: we can indeed consider that individuals are nested in countries, each country being characterized by specific national institutions, such as child care coverage, that may play a role on individual choices. Country effects induce correlations across observations which need to be addressed; otherwise standard errors risk to be downward biased. Multi-level models adjust for these intra-country correlations. Moreover, multi-level models can deal with unbalanced data sets (Skrondal and Rabe-Hesketh 2004), which is important as our sample sizes vary across countries.

We integrate the country-specific contextual variable 'child care coverage' as a continuous variable in the model, and we interact child care coverage with education. This serves to test if the effect of education differs across countries with different levels of child care coverage, and if the effect of childcare coverage differs among education groups (cross-level effects). We apply a two-level random-intercept and random-coefficient model (by using the meqlogit command in Stata), which fits mixed-effects models for binary responses. Country effects are specified in terms of a country error variance and fixed effects of our country-level predictor 'child care coverage'. The multilevel model is thus able to analyze the impact of contextual variables on individual behavior without the assumption of homogeneity-of-regression slopes. The slope is allowed to vary randomly; random parameters have a different value for each group/country. In addition, with the interaction terms (cross-level effects), we do not only allow the intercept of the model but also the slope for the individual-level variable 'education' to be random and to possibly explain it with the macro-level variable 'child care coverage'.[13]

[13]Other macro-level variables such as unemployment, public spending on family policies, parental leave

	Model 1	Model 2	Model 3
Woman's education:			
Low education (primary, lower secondary)	0.235*	0.239*	0.347+
	(1.99)	(2.02)	(1.73)
Middle education (upper and post secondary)	*Ref.*	*Ref.*	*Ref.*
High education (tertiary)	0.233**	0.220*	0.213+
	(2.58)	(2.43)	(1.66)
Partner education:			
Low education (primary, lower secondary)	-0.168+	-0.162	-0.158+
	(-1.87)	(-1.79)	(-1.75)
Middle education (upper and post secondary)	*Ref.*	*Ref.*	*Ref.*
High education (tertiary)	0.290***	0.270***	0.293***
	(4.19)	(3.78)	(4.24)
Couple's joint labour income:			
First tercile	-	0.00893	-
		(0.13)	
Second tercile	-	*Ref.*	-
Third tercile	-	0.0892	-
		(1.26)	
Control for child care coverage:			
Country group 2 (child care coverage ≥0.31)	0.549**	0.552**	-
	(2.68)	(2.69)	
*Country group 2 * low education*	-0.593**	-0.590**	-
	(-3.07)	(-3.06)	
*Country group 2 * high education*	0.0736	0.0749	-
	(0.61)	(0.62)	
Child care coverage (continuous)	-	-	0.0260***
			(4.75)
*Child care coverage * low education*	-	-	-0.0114*
			(-2.14)
*Child care coverage * high education*	-	-	0.00196
			(0.60)
Demographic controls:			
Woman's age	0.588***	0.586***	0.595***
	(9.25)	(9.19)	(9.22)
(Woman's age)²	-0.0110***	-0.0110***	-0.0111***
	(-10.91)	(-10.88)	(-10.77)
Age of first child:	-0.117***	-0.118***	-0.120***
	(-11.41)	(-11.41)	(-11.62)
Sex of first child is female	0.00534	0.00677	0.00718
	(0.10)	(0.12)	(0.13)
Couple is not married	-0.204**	-0.203**	-0.204**
	(-2.97)	(-2.96)	(-2.98)
Intercept	-8.630***	-8.586***	-9.644***
	(-8.23)	(-8.13)	(-9.12)
Year fixed effects	*yes*	*yes*	*yes*
Country fixed effects	*yes*	*yes*	*random*
Control for number of person-years	*yes*	*yes*	*yes*
Number of observations		16342	
Number of events		1831	
Proportion of 2nd child arrival		0.112	
Number of countries		19	
Pseudo R²	0.2049	0.2050	-
Test of joint significance:			
p(low educated in country group 2)	0.0215	0.0241	-
p(high educated in country group 2)	0.0006	0.001	-
Random effects:			
Variance of the intercept	-	-	0.206
Variance of the variable 'low educated'	-	-	0.015
Variance of the variable 'high educated'	-	-	0.017

t-statistics in parentheses; + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Group 1: Low child care coverage and low fertility: TFR<1.6 & child care coverage (age 0-2)<0.31:
HU GR RO BG AT SK CZ PL EE IT LV

Group 2: High child care coverage and high fertility: TFR≥1.6 & child care coverage (age0-2)≥0.31:
NL FR IS BE NO UK DK SE

Control for number of person-years: dummy for the second person-year for individuals with two person-years in the panel

Data Source: EU-SILC LT 2003-2011 (women aged 15 to 45)

Table 1: Estimated Probability of Second Child Birth.

Table 1 presents the regression results of a partnered woman's probability of having a second child as a function of her education. Model 1 and 2 implicitly control for access to childcare by including a dummy variable for countries with child care coverage above the European average, and model 3 shows regression results of the multi-level approach.

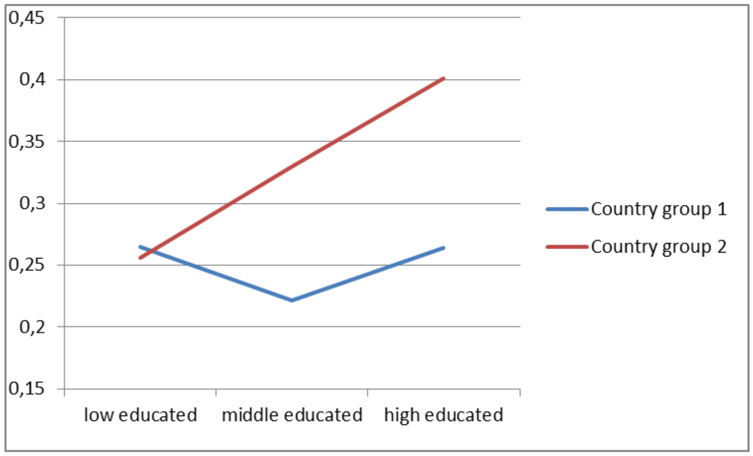
Model 1 shows that within countries with low child care coverage, a woman's probability of having a second child is lowest among medium-educated women. Women with high and low education levels have a significantly higher probability of having a second child in comparison to women with middle education. This result holds when controlling for partner education. Model 2 further confirms the robustness of this finding by controlling for household labor income. The estimated coefficient for low education is 0.235 and for high education 0.233 in model 1 for the first group of countries with child care coverage below the European average. Within countries with child care coverage above the European average, a woman's probability of having a second child is significantly increasing with education. This can be seen by combining the estimated coefficients of education with the interaction terms. The estimated coefficient for low education is -0.358 (0.235-0.593) and 0.301 (0.233 +0.0736) for high education in model 1 for the second group of countries. Low-educated women have thus the lowest probability of second child birth. The differences between the three education groups are significant, as indicated by the p-values of joint significance at the bottom of the table.

We now quantify the estimation results of model 1 by transforming the logit coefficients into estimated probabilities.[14] Comparing the two country groups, Figure 9 illustrates the estimated probabilities for the reference category of women who are married to a middle educated partner, who are 28 years old and who have a first child who is male and aged four). Within countries of the the first country group, there is a U-shaped pattern between women's education and the birth of the second child, while the relation is positive for the second group of countries. With 0.264 and 0.256, the estimated probabilities are quite similar for low educated women in the two country groups. At the same time, middle educated women have a lower probability of second child birth in country group 1 (0.221) in comparison to low educated women, but a higher probability in country group 2 (0.33).

duration and cash transfers towards families have also been integrated in the intercept equation besides child care coverage. The effect of childcare coverage remains positive and significant, and the other macro-level variables are less significantly correlated to child birth than child care coverage (results available on request). Our preferred model is thus the multi-level model with child care coverage as only macro-level variable. This avoids problems caused by multicollinearity. Moreover, having a low number of countries implies that we have limited degrees of freedom at the country level, which also speaks in favor of integrating the country-level variables one by one instead of simultaneously.

[14] Probability of second child birth: $P(Y=1|X) = e^L/(1+e^L)$ where L contains the estimated coefficients and e is Euler's constant.

The probability is highest for high educated women in country group 2 (0.4). In country group 1, high educated women have, with 0.264, a higher probability of second child birth than middle educated women, but this probability is low in comparison to high educated women in countries of group one.



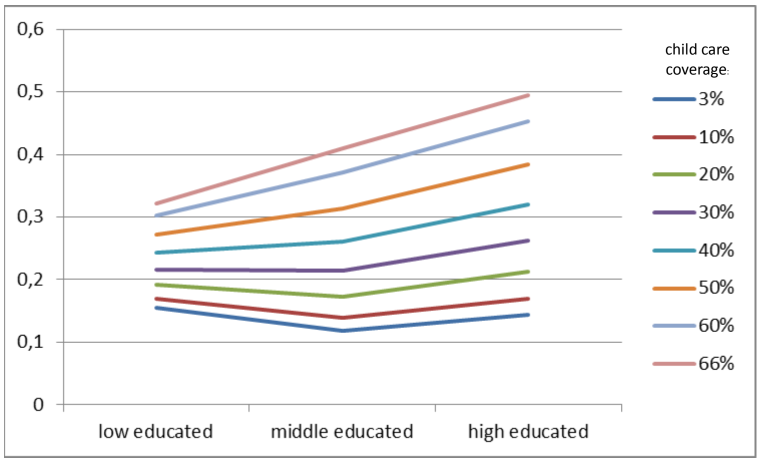
Country group 1: Low child care coverage and low fertility: TFR<1.6 & child care coverage (age 0-2)<0.31: HU GR RO BG AT SK CZ PL EE IT LV
Country group 2: High child care coverage and high fertility: TFR≥1.6 & child care coverage (age0-2)≥0.31: NL FR IS BE NO UK DK SE

Data source: EU-SILC LT (2003-2011), women aged 15-45.

Figure 9: Estimated probabilities of second child birth according to woman's education, countries with difficult vs. easy access to childcare.

Results of the multi-level analysis are shown in column 3. They show three main results. First, child care coverage is significantly positively linked to women's probability of having a second child, independent of their educational level. Second, the interaction terms confirm that the impact of education on the probability of second child birth is influenced by the level of child care coverage: For countries without formal childcare, women with low and high education have a higher probability of second child birth than middle educated women. Increasing child care coverage reduces the positive impact of low education and reinforces the positive impact of high education. Third, the interaction terms also suggest that the positive impact of child care coverage on the probability of second child birth is lower for low educated educated women and higher for high educated women in comparison to middle educated women. Education (at the individual level) and child care coverage (at the macro level) thus both have a positive impact on the probability of having a second child and this is even more true when these two features are combined.

Figure 10 illustrates the estimated probabilities of the multi-level model for different levels of child care coverage, varying between 3% (Slovakia) and 66% (Denmark), again for the reference category of women who are married to a middle educated partner, who are 28 years old and who have a first child who is male and aged four. For low levels of child care coverage below 30%, the relation between education and the probability of second child birth is U-shaped, while the relation gets positive for higher levels of child care coverage.[15] In addition, Figure 10 shows that in countries with high levels of child care coverage, the probability of second child birth is generally higher for all levels of education in comparison to those countries with lower child care coverage.



Data source: EU-SILC LT (2003-2011), women aged 15-45.

Figure 10: Estimated probabilities of second child birth according to woman's education, by levels of childcare coverage (children aged 0-2).

Access to child care facilitates thus the birth of a second child for all levels of female education. However, our results also suggest that in countries with high child care coverage, the birth of a second child seems thus to be facilitated in particular for middle and high educated women, while in countries with low child care coverage, it is in particular the middle educated women who face barriers to second child birth. Given the fact that the transition to a second child is an important determinant for a country's aggregate fertility level, it seems that fertility levels are higher in countries with high child care coverage mainly because more high educated women pass from one to two children.

The model presented in Section 2.1 and extended in Section 3.2 allows us developing some intuitions for a better understanding of the patterns that are revealed by our empirical analysis. The empirical results correspond to the model's prediction of a U-shaped relationship

[15] To see if the differences between the education groups for each level of childcare coverage are significant, we calculate, for each estimated probability illustrated in Figure 10, the respective confidence intervals. An overlap in terms of the confidence intervals indicates that predictions are not significantly different, whereas non-overlap reflects that they are significantly different. Based on these calculations, we find that the difference in the probability of second child birth between high and low educated women gets significant from a childcare coverage level of 60% onwards.

between a couple's probability of having a second child and the woman's potential wage in countries with difficult access to childcare. The model also predicts that an easier access to child care leads to the probability of having a second child being increasing with woman's education.

4 Conclusion

This paper shows that fertility differences across European countries are mainly due to fewer women having two children in low fertility countries. It suggests that in high fertility countries, the possibility to outsource childcare has a positive effect on the transition from the first to the second child for a household. This transition is facilitated especially for middle and high educated women.

Our theoretical framework illustrates the mechanism behind this idea, robust to European survey data. In low fertility countries with low childcare coverage, the relationship between female education, as a proxy for potential wage, and having a second child is U-shaped, while in high fertility countries with high childcare coverage, the probability of second child birth is increasing with education. In countries with low child care coverage, the probability of second child birth is thus reduced in particular for middle and high educated women in comparison to countries with high childcare coverage.

Hence, access to childcare seems to play an important role in particular for middle and high educated women. Our intuition behind this finding is that middle and high educated women have a higher opportunity cost in terms of foregone labor income when they have to provide childcare themselves. An easier access to childcare services reduces this cost and therefore increases fertility.

The U-shaped pattern implies that it is particularly the middle educated women who decide against second child birth in countries with difficult access to childcare. A second child would urge women to stop or reduce their working activities, which makes it likely that they decide against a second child in order to maintain the family income. In these countries, high educated women have a somewhat higher probability of second child birth, probably because the household can afford either that the woman stops or reduces her working activities or that the household purchases child care from the private market (nannies etc.) Low educated women have a higher probability of having a second child in comparison to middle educated women in countries with low child care coverage, as they have relatively low opportunity cost in terms of foregone income (indirect costs of children). In contrast, in countries with high child care coverage where parents, and especially mothers, do not have to chose between work and child care, the probability of second child birth increases with woman's education, as education as proxy for income allows to bear the direct costs of children more easily (income effect).

This work can be extended in several directions. In particular, extending the analysis to births of other ranks and improving the measures for income and individual access to child-care seem to be fruitful ways of future research.

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A Extension with Goods Cost for Children

Here we show that introducing a good cost for children in the budget constraint does not change the qualitative predictions of the theory.

Assuming all else equal as in Section 2.1, the budget constraint faced by couples can now be written as,

$$(2+\alpha n)c = (1-(t_f+\bar{\phi})n)w_f + (1-t_m n)w_m - pt_n n$$

where α represents the share of consumption that each child needs.

The three cases that were identified are then modified as shown below. In particular, we derived the optimal interior n in each case.

I. The woman supplies all the childcare. If $\mu, \nu > 0$ and $\lambda = 0$; $t_m, t_n = 0$,

$$n^{\mathrm{I}} = \frac{\alpha(\beta-1)(w_f+w_m) - 2(1+\beta)(\bar{\phi}+\phi)w_f}{2\alpha\beta\left(\bar{\phi}+\phi\right)w_f} + \frac{\sqrt{\left((2(\bar{\phi}+\phi)+\alpha)w_f+\alpha w_m\right)\left(\alpha(\beta-1)^2(w_f+w_m)+2(1+\beta)^2(\bar{\phi}+\phi)w_f\right)}}{2\alpha\beta\left(\bar{\phi}+\phi\right)w_f}$$

II. All of the childcare is outsourced. If $\lambda, \mu > 0$ and $\nu = 0$; $t_f, t_m = 0$, $t_n = \phi$,

$$n^{\mathrm{II}} = \frac{\alpha(\beta-1)(w_f+w_m) - 2(1+\beta)(\bar{\phi}w_f+\phi w_m)}{2\alpha\beta\left(\bar{\phi}w_f+\phi w_m\right)} + \frac{\sqrt{\left((2\bar{\phi}+\alpha)w_f+(2\phi+\alpha)w_m\right)\left(\alpha(\beta-1)^2(w_f+w_m)+2(1+\beta)^2(\bar{\phi}w_f+\phi w_m\right)}}{2\alpha\beta\left(\bar{\phi}w_f+\phi w_m\right)}$$

III. The man supplies all the childcare. If $\lambda, \nu > 0$ and $\mu = 0$; $t_f, t_n = 0$, $t_m = \phi$,

$$n^{\mathrm{III}} = \frac{(\beta-1)\alpha(w_f+w_m) - 2(1+\beta)(\bar{\phi}w_f+p\phi)}{2\alpha\beta\left(\bar{\phi}w_f+p\phi\right)} + \frac{\sqrt{\left(2\bar{\phi}w_f+(w_f+w_m)\alpha+2p\phi\right)\left((\beta-1)^2\alpha(w_f+w_m)+2(1+\beta)^2(\bar{\phi}w_f+p\phi)\right)}}{2\alpha\beta\left(\bar{\phi}w_f+p\phi\right)}$$

For the parameter values given above, and $\alpha = 0.4$ the mechanisms suggested in Section 2.1 and the relationship between fertility and female wage shown in Figure 4 do not change when adding a cost of children in terms of goods.

B Details on Section 3.1

Proportion of women with at least $i \in (0, N)$ children ("fertility rate of rank i"), FR_i:

$$\mathrm{FR}_i = \sum_{i=1}^{N} p_i$$

with N is five or more children and p_i is the proportion of women with i children.

Approximate completed fertility rate (women aged 38-44), ACFR_i:

$$\mathrm{ACFR}_i = \sum_{i=1}^{N} \mathrm{FR}_i$$

Difference in fertility rates of rank i between high fertility countries (hf) and low fertility countries (lf):

$$\mathrm{FR}_i^{hf} - \mathrm{FR}_i^{lf}$$

Absolute difference in the ACFR between high fertility countries (hf) and low fertility countries (lf):

$$\Delta\mathrm{ACFR} = \sum_{i=1}^{N} \left(\mathrm{FR}_i^{hf} - \mathrm{FR}_i^{lf}\right)$$

Proportion of the difference in ACFR between high and low fertility countries that is explained by fewer children of rank i in low fertility countries:

$$\frac{\mathrm{FR}_i^{hf} - \mathrm{FR}_i^{lf}}{\sum_{i=1}^{N} \left(\mathrm{FR}_i^{hf} - \mathrm{FR}_i^{lf}\right)}$$

C Period fertility using the EU-SILC cross-sectional database

Based on the EU-SILC cross-sectional database, wave 2011, we calculate the number of children per woman for women aged 15 to 44 years old by distinguishing between low fertility countries (where total fertility rate is < 1.5 and high fertility countries (where total fertility rate is > 1.8). This allows us to see examine how the probability of staying childless, or with

	ACFR	p_0	p_1	p_2	p_3	p_4	p_5
Low fertility countries (lf)	1.46	0.22	0.27	0.40	0.09	0.03	0.02
High fertility countries (hf)	1.73	0.15	0.23	0.42	0.15	0.05	0.02
Difference ($hf - lf$)	0.27	-0.06	-0.04	0.02	0.06	0.02	0.00
			FR$_1$	FR$_2$	FR$_3$	FR$_4$	FR$_5$
Low fertility countries (lf)			0.78	0.52	0.12	0.03	0.02
High fertility countries (hf)			0.85	0.62	0.20	0.05	0.02
Difference ($hf - lf$)			0.06	0.10	0.08	0.02	0.00

Data Source: EU SILC CS 2011; women aged 38-44
Low fertility countries (lf): ACFR<1.6
High fertility countries (hf): ACFR$\geq$1.6

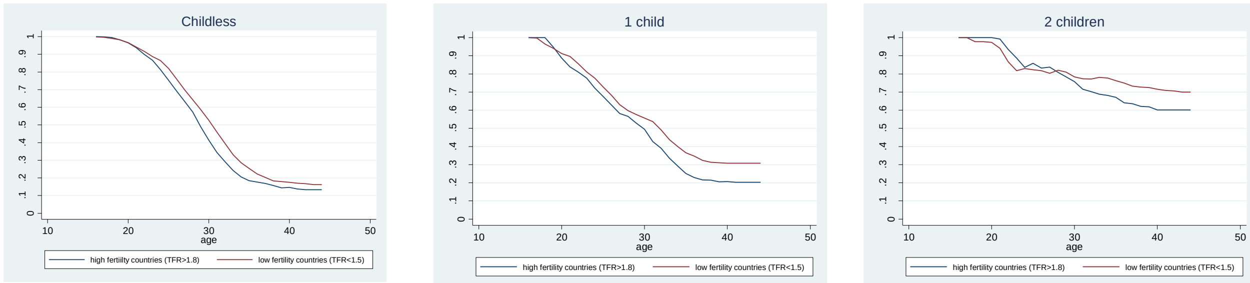
Table 2: Approximate completed fertility rate (women aged 38-44), proportion of women with i children and proportion of women with at least i children for high and low fertility countries.

one child or two children, decreases more rapidly in high fertility countries compared to low ones[16].

Figure 11 shows the Kaplan Meier survival curves for the two groups of countries[17]. We see firstly and not surprisingly that the survival probabilities of staying childless, or with only one child or with only two children decrease with the womans's age. In accordance with the previous results, we see that at the end of their childbearing period, women in low fertility countries have a higher probability to stay either childless, or with only one child or with only two children in comparison to high fertility countries. These differences increase with the woman's age, in particular for the second and third panel, but the differences are present also for much younger ages. In high fertility countries, the woman's probability of staying childless and of staying with one child only is lower for all ages from the age 20 onwards, while women have a lower probability to stay with only two children from age 28 onwards. The highest relative difference between low and high fertility countries is found for

[16] Note that the age-specific probabilities are not calculated retrospectively for a specific cohort that has already completed family formation. As we observe different cohorts at a given period of time, the probabilities could be biased due to tempo effects.

[17] In order to construct the Kaplan-Meier survival curves, we proceed in four steps. First, we compute the probability of having 1, 2, 3, 4^+ children for women aged 15-44 years. Second, we recover the transition probabilities (weighted means for high and low fertility countries). Third, we construct the survival probabilities (1-transition probabilities). And fourth, we compute a 3-year moving average on the survival probabilities to smooth out fluctuations between age groups.



Data sources: survival probabilities EU-SILC 2011; TFR WB WDI 2011

TFR<1.5*: CZ, HU, IT, PT, DE, SK, GR, AT, PL, ES and LV*

TFR≥ 1.8*: IS, FR, BE, SE, UK, NO and FI*

Figure 11: Kaplan Meier Survival Curves, Women Aged 15-44

the survival probability of staying with only one child.