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► **To cite this version:**

Hippolyte d'Albis, Paula Gobbi, Angela Greulich. HAVING A SECOND CHILD AND ACCESS TO CHILDCARE: EVIDENCE FROM EUROPEAN COUNTRIES. *Journal of Demographic Economics*, 2017, 83 (02), pp.177 - 210. 10.1017/dem.2017.2 . hal-01726578

**HAL Id: hal-01726578**

**<https://hal.science/hal-01726578v1>**

Submitted on 6 Sep 2021

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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 of having a second child and the woman's potential wage, whereas (ii) in countries with easy access to childcare, this probability is positively related with the woman's potential wage. Data from the European Union Statistics on 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 access to formal and subsidized childcare.

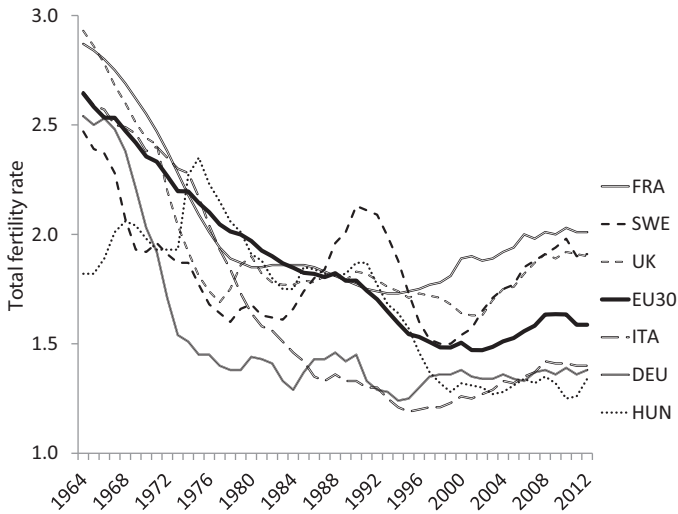
**Keywords:** childcare, education, fertility, female employment

**JEL Classification Numbers:** J11, J13, J16, O11

## 1. INTRODUCTION

Birth rates across European countries have been falling since the 1960s. Although total fertility rates (TFR) stagnate at very low levels in some European countries, they have started to pick-up in other European countries [Myrskylä et al. (2009); Luci-Greulich and Thévenon (2014); Hazan and Zoabi (2015)]. Figure 1 illustrates

This paper has benefited greatly from comments from the editor, David de la Croix, an anonymous referee, Aurélien Dasré, Laurent Toulemon, and participants of the CREA workshop at the University of Luxembourg. This research was supported by the European Research Council (ERC Starting Grant DU 283953) and the "Chaire Transitions démographiques, Transitions économiques". The data used in this study is from the World Bank World Development Indicators, the OECD Family Data Base and the European Commission, Eurostat, European Union Statistics on Income and Living Conditions, waves 2003 to 2011. The providers have no responsibility for the results and conclusions of the authors. Address correspondence to: Angela Greulich, Centre d'Economie de la Sorbonne, Université Paris 1 Panthéon-Sorbonne and Ined, 75013, Paris; e-mail: [angela.greulich@univ-paris1.fr](mailto:angela.greulich@univ-paris1.fr)



**FIGURE 1.** Evolution of total fertility rates from 1964 to 2012 in selected European countries.

1 that in some countries, TFR have shown signs of an upsurge, back to replacement  
 2 levels since the mid-1990s (notably in France, Sweden, Norway, Denmark, the  
 3 United Kingdom, and Belgium), whereas in others, fertility has continued to drop  
 4 below the European average, stagnating under 1.5 children per woman (as in Italy,  
 5 the Czech Republic, Germany, Hungary, and Poland). This paper contributes to a  
 6 better understanding of the factors that have made it possible for fertility rates to  
 7 recover in some countries but not in others.

8 This reversal of fertility trends in some countries is caused in part by the  
 9 end of the postponement of childbearing among younger generations [Goldstein  
 10 et al. (2009); Bongaarts and Sobotka (2012)]. Fertility levels fall initially because  
 11 women delay the age at which they have their first child, leading to a temporary  
 12 depression of overall fertility rates. As time elapses, however, the total number of  
 13 births recovers due to a catch up effect. Differences in the timing of births thus  
 14 may contribute to differences in fertility rates among European countries.

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

1 Although it has been argued that a below-replacement level fertility may reflect  
2 a general preference for low fertility among women and couples, most recent  
3 survey data for European countries suggest that there exist in fact barriers hin-  
4 dering parents from realizing their desired fertility levels, and these barriers seem  
5 more important in low-fertility countries. The surveys actually indicate stable  
6 preferences around a two-child family model for both women and men in all  
7 European countries, independent of national fertility level. Sobotka (2013) shows  
8 that the variation between countries in desired family size is generally low, center-  
9 ing around the two-child ideal in all European countries. Sobotka and Beaujouan  
10 (2014) show that the variance across cohorts of adults' responses to the question of  
11 "ideal family size" within European countries gets smaller over generations. Even  
12 low-fertility countries (as measured by completed fertility rates of women aged  
13 45+) such as Poland, the Czech Republic, Slovakia, Bulgaria, Spain, Portugal,  
14 Germany, and Italy affirm an average desired fertility of two children [(Euro-  
15 barometer 2006; 2011)]. The important and persisting gap that exists between  
16 intended and realized completed fertility in countries with fertility levels below  
17 replacement level suggests that there are institutional barriers that push couples  
18 towards a lower fertility regime.

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

29 In Section 3, we first use the cross-sectional wave of the European Union  
30 Statistics on Income and Living Conditions (EU-SILC) to show that differences  
31 in fertility levels between low- and high-fertility countries mainly emerge due to  
32 fewer women having two children in low-fertility countries, suggesting a barrier  
33 for the second child birth in low-fertility countries. The theory is then extended  
34 to better understand the transition from a first to a second child. Two implications  
35 derive from the theory. The first says that the probability of having a second child  
36 in low-fertility countries, which are characterized by difficult access to childcare,  
37 follows a U-shaped relationship with women's potential wage. The decreasing  
38 part of the U is driven by the behavior of couples who cannot afford to purchase  
39 childcare activities in the private market. For these couples, it is often the woman  
40 who performs childcare activities for the first child and the general trend of  
41 increasing female average wages naturally increases the opportunity cost of this  
42 personal childcare, and therefore decreases the probability of having a second  
43 child. This (substitution) effect, however, subsides after a certain level of income.  
44 Once couples are able to outsource childcare, a higher female wage level allows

1 the couple to buy more time from the market and encourages having a second  
 2 child (increasing part of the U-shaped relationship). The second prediction is that  
 3 in high-fertility countries, where childcare availability is generalized, only the  
 4 positive relationship between female wage and fertility is observed. This stems  
 5 from an income effect that can be seen in high-fertility developed countries, where  
 6 childcare services are more accessible, leading to a probability of having a second  
 7 child that is increasing with women's wage.

8 These theoretical implications are empirically corroborated in [Section 3.3](#) for  
 9 European countries. We estimate how the impact of women's education (used  
 10 as a proxy for potential wage) on the couple's probability of having a second  
 11 child differs with the access to formal childcare. We therefore use the longitudinal  
 12 module of the European Union Statistics on Income and Living Conditions (waves  
 13 2003–2011) in combination with the OECD Family Database. We find that in  
 14 countries where childcare coverage is low, there is a U-shaped pattern between  
 15 women's education level and her probability of having a second child, whereas this  
 16 relationship is continuously positive in countries with easier access to childcare.  
 17 We control hereby for various side effects such as partner characteristics.

18 Our findings are in line with recent studies that have looked at the link between  
 19 measures of female employment, education, and fertility interacting with child-  
 20 care. This paper relates mostly to Hazan and Zoabi (2015), who find that higher  
 21 wage inequalities in the United States lead highly educated women to outsource  
 22 childcare more, driving a U-shaped relationship between women's education and  
 23 fertility.<sup>1</sup> We differ from them by looking at European countries and focusing on  
 24 second child birth, as missing children of birth order two contribute most to the  
 25 fertility gap between low- and high-fertility countries. The large country cover-  
 26 age allows applying multilevel models, which take into account the institutional  
 27 context in terms of access to childcare.

28 Relating the cost of childcare to female labor force participation, Blau and  
 29 Robins (1988) show that the price for outsourcing childcare services in the United  
 30 States is negatively correlated to women's decision to both enter the labor market  
 31 and to purchase childcare services. Attanasio et al. (2008) suggest that a decrease  
 32 in childcare costs could explain the increase in the labor force participation of  
 33 mothers of young children from the observed 0.47 rate for the cohort born in the  
 34 1940s to 0.68 for the cohort born in the 1950s in the United States. Schoonbroodt  
 35 (2016) provides estimates for childcare costs paid by parents in the United States.  
 36 She shows in particular that during traditional working hours, women spend three  
 37 times more of their time in childcare than men.

38 A series of studies confirm the positive relationship between female labor force  
 39 participation and access to childcare that has been found in the United States  
 40 for other countries. In Quebec, Baker et al. (2008) show that an increase in  
 41 female labor force participation followed the introduction of universal childcare.  
 42 Similarly, using data on Swedish households, Gustafsson and Stafford (1992)  
 43 show that public childcare led to higher female labor market participation and that  
 44 a lower cost of childcare services positively affects the use of of these services if

1 seats for children in these facilities are not rationed. For Germany, Bick (2016)  
 2 shows that a large fraction of part-time working mothers would work full-time  
 3 if they had better access to subsidized childcare and Wrohlich (2011) shows that  
 4 increasing the availability of childcare has a greater effect on maternal employment  
 5 than reducing the fees of these services.

6 Finally, some studies have looked at the relationship between childcare and  
 7 fertility. In a cross-country analysis for countries, Borck (2014) shows that cul-  
 8 tural differences with regard to perceived quality of external childcare can help  
 9 explaining cross-country differences in levels of female labor force participation,  
 10 childcare provision, and fertility. Baizán et al. (2015) find that in European coun-  
 11 tries, childcare coverage is positively related to individual-level completed fertility  
 12 for all educational groups, while this association is strongest for highly educated  
 13 women. In Western Germany, Hank and Kreyenfeld (2003) show that access to  
 14 informal care arrangements increase the probability of having a first birth. Aassve  
 15 et al. (2016) highlight that differences with regard to trusting someone outside the  
 16 household to care for the children might also explain cross-country differences in  
 17 fertility trends in developed countries.

18 This paper provides new elements to the literature. By using survey data cover-  
 19 ing a high number of countries, we show that socioeconomic differences in  
 20 fertility behaviour are not universal in Europe but depend on the institutional  
 21 context. More precisely, we first provide empirical evidence that having a second  
 22 child is the key difference in fertility behaviour between low- and high-fertility  
 23 countries in Europe. High-fertility countries also have a higher childcare coverage  
 24 for children aged 0–2. Second, we provide a theoretical framework that accounts  
 25 for the facts and outlines the mechanisms. Two implications derive from the theory,  
 26 and are robust in the data. First, in countries where childcare coverage is low, the  
 27 probability to have a second child is U-shaped with respect to female education.  
 28 And second, in countries where childcare coverage is high, female education  
 29 increases the probability of having a second child.

## 30 2. A GENERAL FRAMEWORK

31 In this section, we develop a microeconomic model that allows us discussing the  
 32 mechanisms relating female wages, access to childcare, and fertility.<sup>2</sup> We treat  
 33 fertility first as a continuous decision variable to derive the general mechanisms,  
 34 and then more specifically, in Section 3.2, as a discrete variable in order to show  
 35 the model's implications for the probability of having a second child.

### 36 2.1. The Model

37 The economy is populated by couples composed of a man and a woman, respec-  
 38 tively, denoted by  $i = m, f$ . Each parent is endowed with one unit of time that  
 39 is divided between childcare and work. A child needs  $\phi > \bar{\phi}$  units of childcare,  
 40 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.<sup>3</sup> 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 expected cost of outsourcing childcare is denoted by  $p$  and writes as

$$p = \epsilon p_s + (1 - \epsilon)p_m, \quad (1)$$

where  $\epsilon$  is the probability of having access to childcare services at a subsidized price  $p_s$  and  $(1 - \epsilon)$  is the converse probability of not having access to those childcare services, which implies having to orient towards services a higher market price,  $p_m > p_s$ . At the aggregate level, the probability of having access to subsidized childcare corresponds to the coverage rate of subsidized formal childcare. 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 [Thévenon (2015)]. The expected childcare cost will enter the budget constraint of the representative couple and we will perform comparative statics with respect to  $p$ . A increase in  $p$  should be understood as a decrease in childcare coverage. One may check that equation (1) implies that  $\partial p / \partial \epsilon < 0$ .

Denoting  $\beta \in (0, 1)$  as the parental preference for children relative to consumption, the maximization problem of a couple is the following<sup>4</sup>:

$$\max_{c, t_f, t_m, t_n, n} \ln c + \beta \ln n, \quad (2)$$

subject to (1),

$$c = [1 - (t_f + \bar{\phi})n] w_f + (1 - t_m n) w_m - p t_n n, \quad (3)$$

$$\phi = t_f + t_m + t_n, \quad (4)$$

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

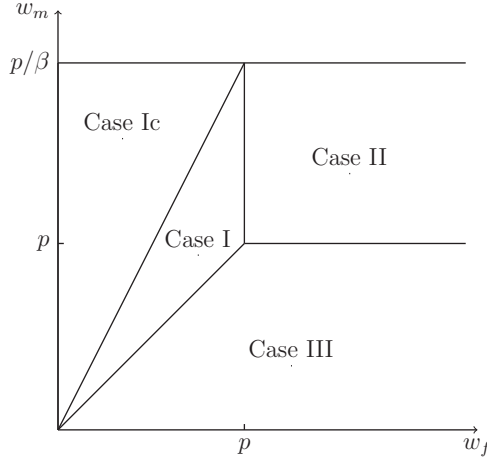
$$1 - t_m n \geq 0, \quad (6)$$

and  $t_f \geq 0, t_m \geq 0, t_n \geq 0$ .

The Lagrangian of this problem is as follows:

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

where  $(\lambda, \mu, \nu)$  are the Kuhn–Tucker multipliers associated to the nonnegativity constraints imposed on  $(t_f, t_m, t_n)$ , while  $(\varphi, \gamma)$  are those imposed on conditions



**FIGURE 2.** Possible cases with respect to  $w_f$ ,  $p$ , and  $w_m \in [0, p/\beta]$ . Moreover,  $\bar{\phi} > \phi\beta/(1 + \beta)$ .

1 (5) and (6). The first-order conditions with respect to  $(t_f, t_m, n)$  are as follows:

$$2 \quad -\frac{n(w_f - p)}{c} + \lambda - v - n\varphi = 0, \quad (8)$$

$$3 \quad -\frac{n(w_m - p)}{c} + \mu - v - n\gamma = 0, \quad (9)$$

$$4 \quad \frac{(t_f + \bar{\phi})w_f + t_m w_m + p(\phi - t_f - t_m)}{c} + \frac{\beta}{n} - \varphi(t_f + \bar{\phi}) - \gamma t_m = 0. \quad (10)$$

5 Moreover, the optimal solution satisfies

$$6 \quad \lambda t_f = \mu t_m = v t_n = \varphi [1 - (t_f + \bar{\phi})n] = \gamma [1 - t_m n] = 0, \quad (11)$$

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

8 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 to  $w_f$ ,  $w_m$ , and  $p$ .

9 *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  $n \leq 1/(\phi + \bar{\phi})$ . 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

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

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

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

In Case I, the wage of the woman is lower than both the wage of the man and the expected cost of outsourcing childcare. The woman reaches the maximal fertility level when her wage is lower than  $\beta w_m$ , 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  $v = \gamma = 0$  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,

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

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

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

A couple will outsource childcare when the expected 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

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

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

1 the female's wage,  $\partial n/\partial w_m > \partial n/\partial w_f$ . This is due to the fixed cost in terms of  
 2 childcare  $\bar{\phi}$  supported by the woman.

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

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

6 and,

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

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

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

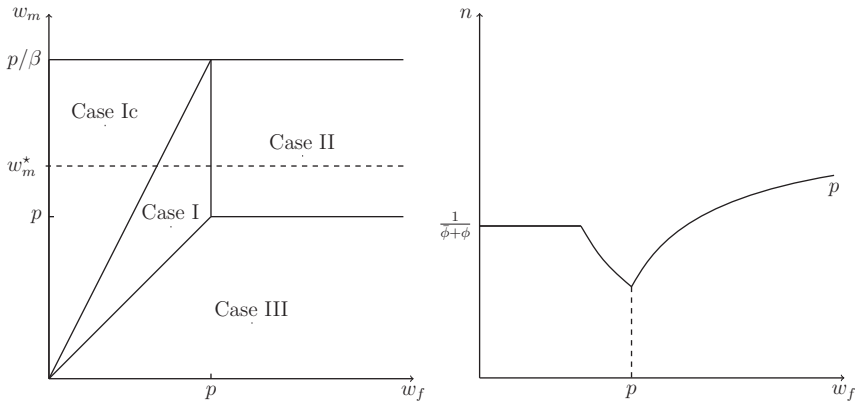
14 The next subsection looks at the implications of the theory and compares them  
 15 to cross-country evidence on how fertility relates to childcare coverage.

## 16 2.2. Theoretical Predictions and Discussion

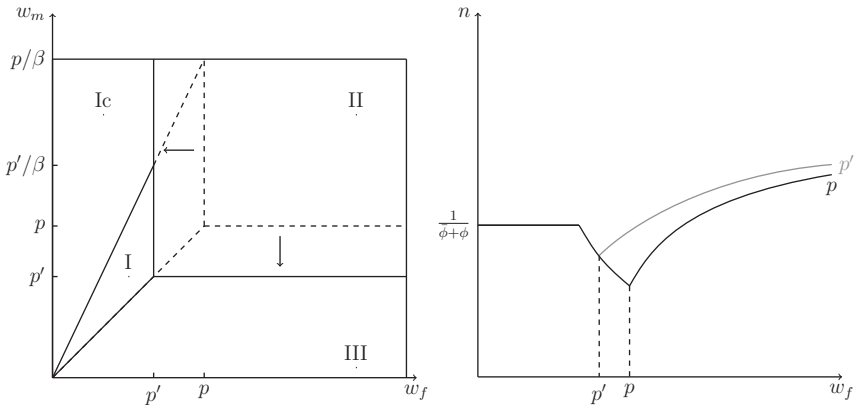
17 The right-hand side of Figure 3 shows the relationship between fertility and female  
 18 wage when  $w_m = w_m^* \in (p, p/\beta)$  (dashed line in the left-hand side). We see that  
 19 fertility is first flat with respect to female wage, as the couple is in Case Ic, then  
 20 fertility decreases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

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

28 Figure 4 shows the effect of decreasing  $p$  to  $p'$  on the relationship between  
 29 fertility and the wage of the woman. We see initially that fertility does not change  
 30 with the wage of the woman, corresponding to the constrained fertility of Case I.  
 31 But a lower expected price for childcare services (i.e., a larger share of individuals  
 32 who have access to the subsidized price  $p_s$ ) has, on average, a positive effect  
 33 on fertility. This is particularly true for middle-income women, for whom the



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



**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  $p > p'$ .

1 opportunity cost to raise children is large. For high female wages, the difference in  
 2 fertility when the price equals  $p$  compared to when the price equals  $p'$  gets  
 3 smaller as wages increase and fertility eventually converges to  $\beta/(1 + \beta)\bar{\phi}$ . The  
 4 U-shaped relationship is therefore less pronounced with a lower childcare price.

5 The theoretical prediction in Figure 4 is consistent with cross-country evidence  
 6 using data from the Family Database (FDB). Indeed, coverage of – and therewith  
 7 access to – childcare is larger in high-fertility countries.<sup>5</sup> Several studies suggest  
 8 that childcare coverage figures are a determinant rather than a consequence of  
 9 TFR,<sup>6</sup> as countries with low childcare coverage tend to have an excess demand  
 10 for childcare.<sup>7</sup> This is why we consider childcare coverage as a proxy for access

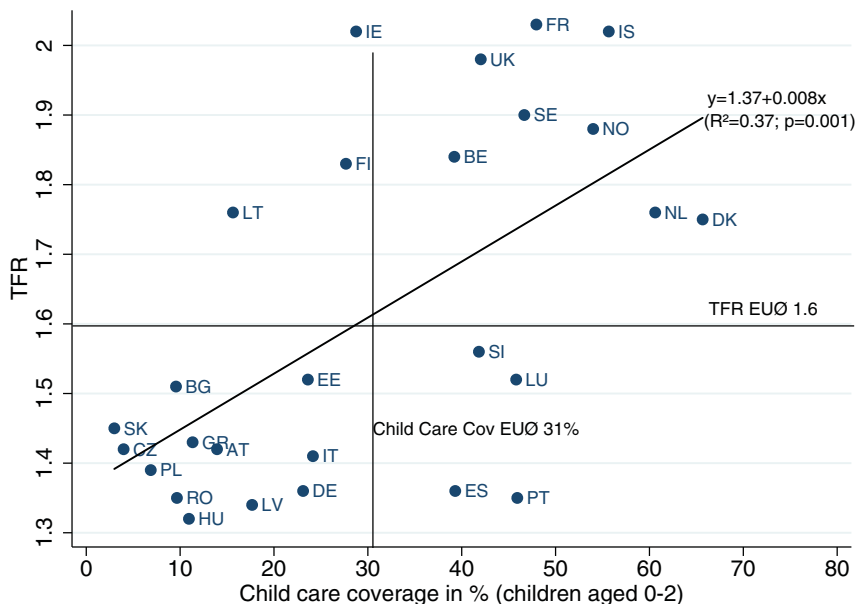


FIGURE 5. (Colour online) Total fertility rates with respect to childcare coverage (children aged 0–2).

1 to childcare for parents. The higher the coverage, the easier is generally the access  
 2 for parents to childcare.

3 Figure 5 plots the TFR in each European country against the average enrollment  
 4 rate of children under three years of age in formal childcare. We see that the  
 5 correlation is significantly positive. Low-fertility countries with a TFR below the  
 6 European average of 1.6 also tend to have a childcare coverage below the European  
 7 average of 31%, whereas high-fertility countries tend to have a coverage rate above  
 8 the average.

9 **3. EXPLAINING DIFFERENCES IN FERTILITY ACROSS EUROPEAN**  
 10 **COUNTRIES** Check LIST

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

1 where childcare coverage is low, whereas the probability of having a second child  
2 increases with female education in countries where childcare coverage is high.

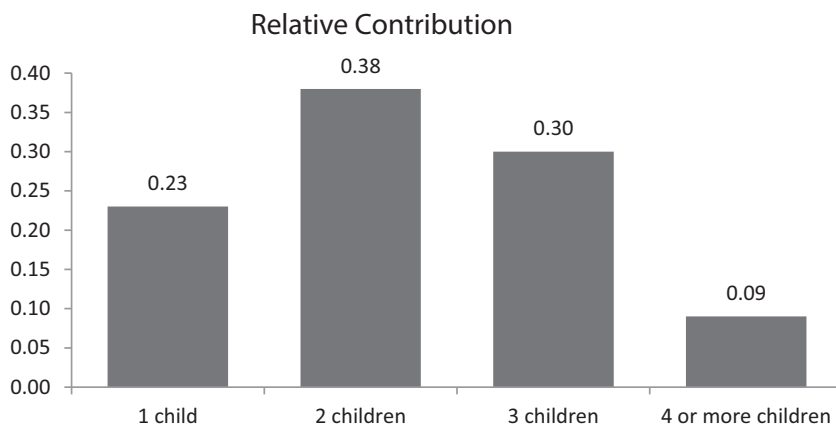
### 3 **3.1. The Birth Order that Matters**

4 We use the 2011 cross-sectional wave of the EU-SILC to understand whether  
5 fertility differences across 26 European countries are due to differences in starting  
6 a family or to enlarging the family size.<sup>8</sup>

7 We base our calculations on the fertility rate for women aged 38 to 44 years old  
8 (i.e., the cohorts of 1967–1973). Women at younger ages are excluded in order to  
9 focus on completed fertility. Women at older ages are also excluded because the  
10 EU-SILC reports a decreasing number of children per woman for older ages, as  
11 these children move out of their parents' homes and can no longer be observed.  
12 Due to this partial capture of children that live in the household only, as reported in  
13 the EU-SILC, these calculated “approximate” completed fertility rates (ACFR) are  
14 somewhat downward biased. Despite this bias, this approximate measure provides  
15 a country ranking that is similar to the unbiased completed fertility measured  
16 by the Human Fertility Data Base (wave 2012, cohort 1970).<sup>9</sup> The EU-SILC is  
17 thus used for our fertility analysis because it provides a large country coverage,  
18 an international comparability of socioeconomic measures, and a follow-up of  
19 individuals (used later in [Section 3.3](#)).<sup>10</sup>

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

30 [Table B.1](#) in Appendix B shows that in both low- and high-fertility countries,  
31 having two children is the most frequent situation for women aged 38 to 44 years  
32 old (40% in low-fertility against 42% in high-fertility countries). Childlessness is  
33 higher in low-fertility countries, and the proportion of women having three and  
34 four children is higher in high-fertility countries. The absolute differences in the  
35 proportions give, however, no direct information about the birth order that is most  
36 responsible for fertility being low in the first group of countries. The proportion of  
37 women having three and four children might be higher in high-fertility countries,  
38 but at the same time, in both country groups, only a relatively small fraction of  
39 women is concerned. This lets us suggest that the weight of children of birth order  
40 three and four for explaining differences in fertility between the two groups is  
41 smaller than the absolute difference in the proportions lets expect. The same logic  
42 applies for childless women: The difference in the proportion of childless women



**FIGURE 6.** Relative contribution of fewer children of birth order  $i$  to the fertility gap between high- and low-fertility countries in the EU(26).

1 between high- and low-fertility countries is considerable, but the proportions itself  
 2 are relatively small in comparison to the proportion of women having one and two  
 3 children. At the same time, the proportion of women having two children is  
 4 important in the two country groups. Consequently, even if the difference between  
 5 the two groups for this proportion is small, it can lead to high differences in fertility  
 6 levels.

7 A decomposition of ACFR is thus needed to determine the contribution of  
 8 each birth order to the difference in fertility levels between the two groups of  
 9 countries. As detailed in Appendix 4, we first calculate for each group of countries  
 10 the proportion of women having at least  $i$  children (fertility rate of birth order  
 11  $i$ ). The sum of these cumulative frequencies actually yields the ACFR of each  
 12 country group. Then, we calculate the differences in each fertility rate of birth  
 13 order  $i$  between low- and high-fertility countries. These differences sum up to the  
 14 absolute difference in ACFR between the two country groups.

15 According to these calculations, the absolute difference of 0.27 children per  
 16 women between high- and low-fertility countries is composed as follows: 0.06  
 17 children are due to fewer children of birth order one in low-fertility countries, 0.10  
 18 children are due to fewer children of birth order two in low-fertility countries, 0.08  
 19 children are due to fewer children of birth order three in low-fertility countries,  
 20 and 0.02 children are due to fewer children of birth order four in low-fertility  
 21 countries. Therewith, the fertility gap is mainly explained by fewer children of  
 22 birth order two. [Figure 6](#) illustrates the relative contribution of each birth order  
 23 to the fertility gap. Fewer children of birth order one account for 23% of the gap in  
 24 ACFR between high- and low-fertility countries, fewer children of birth order two  
 25 for 38%, fewer children of birth order three for 30%, and fewer children of birth  
 26 order four for 9%.

1 Our calculations show that fertility differences between European countries  
 2 mainly emerge due to fewer children of birth order two, suggesting that in low-  
 3 fertility countries, most women have a first child, but fewer decide in favor of a  
 4 second one. Following the same calculation method, Breton and Prioux (2005)  
 5 find a somewhat higher contribution of children of birth order three in comparison  
 6 to children of birth order two to fertility differences between European countries.  
 7 This is due to the fact that they do not include Eastern European countries in their  
 8 sample and focus on a generation that is 10 years older. At the same time, their  
 9 study and ours consistently find that fewer children of birth order one (i.e., higher  
 10 childlessness) are not the main explanation for low-fertility levels.<sup>11</sup>

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

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

22 **Figure 7** plots each country's average probability of observed birth of a child  
 23 of birth order one, two, and three for women aged 15–44 years old against the  
 24 country's TFR. The probability to observe a child's birth is higher in high-fertility  
 25 countries for all birth orders. **Figure 7** reveals a separation of European countries in  
 26 two clearly distinguishable fertility regimes, low versus high ones, with low versus  
 27 high probabilities of a child's birth. The difference between the two regimes is  
 28 most striking for a second child birth (middle panel of **Figure 7**), which is not only  
 29 due to a level effect. In low-fertility countries, the probability of a second child  
 30 birth is 66% lower than in high-fertility countries, against 40% for the probability  
 31 of first and third child birth. Our finding that countries with low and high TFR  
 32 differ most in the transition to a second child underlines the importance of children  
 33 of birth order two that was revealed by the previous ACFR analysis focusing on  
 34 older cohorts only which already have completed their family size.

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

### 37 **3.2. The Decision of Having a Second Child in Theory**

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

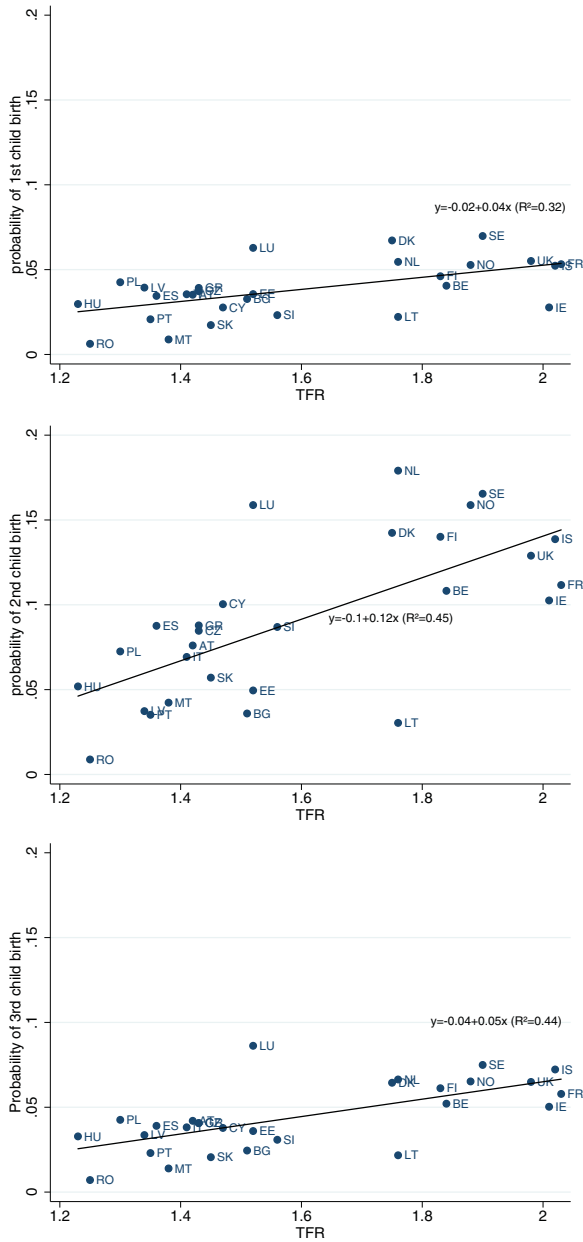


FIGURE 7. (Colour online) Probability of child birth of birth order 1 (top), 2 (middle), and 3 (bottom) vs. TFR.



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  $\kappa = \text{I}$  or  $\kappa = \text{II}$ . For  $w_f = p$ , we can check that  $\bar{u}_n^{\text{I}} = \bar{u}_n^{\text{II}}$ .

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

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

where  $\lambda := (2^{\beta+1} - 1)/(2^\beta - 1)$ . 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:

$$\bar{u}_2 \geq \bar{u}_1 \Leftrightarrow w_f \leq W^{\text{I}}. \quad (20)$$

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

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

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

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

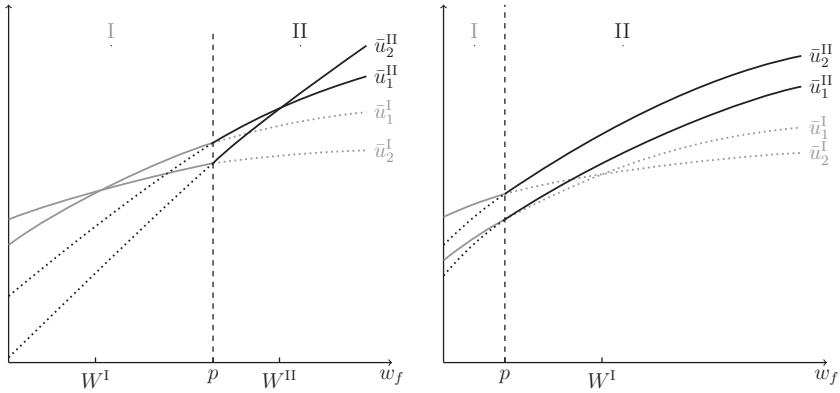
$$\bar{u}_2^{\text{II}} \geq \bar{u}_1^{\text{II}} \Leftrightarrow w_f \geq W^{\text{II}}. \quad (22)$$

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

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

Then, the condition to obtain  $\partial \bar{u}_2^{\text{II}}/\partial w_f > \partial \bar{u}_1^{\text{II}}/\partial w_f$  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 shows  $\bar{u}_1^{\text{I}}$ ,  $\bar{u}_2^{\text{I}}$ ,  $\bar{u}_1^{\text{II}}$ , and  $\bar{u}_2^{\text{II}}$  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  $w_f < W^{\text{I}}$ ,  $\bar{u}_2^{\text{I}} > \bar{u}_1^{\text{I}}$  so that the couple will have (at least) two children. When  $W^{\text{I}} \leq w_f < p$ ,  $\bar{u}_1^{\text{I}} \geq \bar{u}_2^{\text{I}}$  and the couple will have one child. This is because for a woman with low wage, being out of the labor



**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 a Small  $p$  (right).

1 market entails a low cost. As her wage increases, however, this cost increases and  
 2 as each child costs her  $\phi + \bar{\phi}$  units of time, it is optimal for the couple to have less  
 3 children.

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

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

22 The two panels of Figure 8 illustrate the differences in fertility patterns with re-  
 23 spect to female wage for low- (left panel) and high- (right panel) fertility countries.  
 24 The next section provides empirical evidence that the relation within European  
 25 countries between the probability of having a second child and female potential  
 26 wages is affected by the expected price of childcare, which will be proxied by  
 27 access to/coverage of 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 of aggregate childcare coverage. 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. We thus do not study completed fertility, but we analyze the childbearing behaviour of women who are currently at childbearing age. This allows us applying panel data techniques that serve to reduce endogeneity between fertility and socioeconomic characteristics. We hereby focus on second child birth, as this birth order is crucial for explaining fertility differences between European countries.

Our analysis is based on 26 European countries, which, as illustrated in [Figure 5](#), have either childcare coverage rates above or below the average of 0.31. 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 Statistics on 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 (at least one year old) in the beginning of the observed period, and their partners. The individual determinants of second child birth are observed during the year prior to the calendar year of potential second child birth. This helps reducing the risk of obtaining biased estimates due to reverse causality between the endogenous and the exogenous variables.

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 birth order two that occur during the calendar year of the second wave. The first wave gives information about individual characteristics observed during the year prior to the calendar 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 the calendar year of potential second child birth, as well as a dummy variable for second child birth.

For individuals who are observed for four waves, two calendar years of potential 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 cannot observe the individual characteristics in the year prior to the calendar year of potential second child birth. 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 individuals "at risk" of

1 second child birth in comparison to first child birth, and attrition does not differ  
2 by socioeconomic characteristics, as shown by Greulich and Dasre (2017).

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

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

8 where  $y \in \{0, 1\}$  is a dummy variable for second child birth,  $X$  denotes the mi-  
9 crolevel characteristics taken into account, and  $\beta$  the estimated coefficient of these  
10 variables.

11 Education of women and their partners are observed at the time of the survey  
12 of the year prior to the calendar year of potential second child birth. Only couples  
13 with completed education are considered (no pupils, students, trainees etc.). We  
14 construct three categories for the education level of women and their partners  
15 (by highest ISCED level attained), namely: *low education* for preprimary, pri-  
16 mary, and lower secondary education, *medium education* for upper secondary and  
17 postsecondary nontertiary education, and *high education* for tertiary education.  
18 Grouping the initial six education categories into three categories allows us to  
19 obtain a sufficiently large number of observations for each category.

20 Besides women's and their partners' education level, we include a series of  
21 control variables in order to isolate the impact of women's potential wage on the  
22 decision of having a second child from other determinants. We include information  
23 on women's and the partners' employment status. Information on employment  
24 status (self-declared) is available on a monthly basis in SILC, which allows us  
25 to observe the employment status during a certain period before the potential  
26 conception of a second child. In order to observe the same span of time for all  
27 individuals, we restrict this period to three months. For women, we distinguish  
28 between full-time employed (employed and self-employed), part-time employed  
29 (employed and self-employed), unemployed, and inactive. Those who experience a  
30 change in employment status during the observed period figure in an extra category,  
31 but this concerns only a minority of 2%. For partners, we distinguish only between  
32 full-time employed (employed and self-employed) and those who are not full-time  
33 employed, as those who are full-time employed represent the large majority of  
34 partners of women having one child (92%). Information on employment status  
35 is missing for only 1% of partners. The control for employment status allows  
36 us not only disentangling women's wage options (as proxied by education) from  
37 their actual labour market participation, but also taking into account country  
38 heterogeneity in terms of the labour market structure (prevalence of part-time  
39 employment for women, of unemployment etc.).

40 In addition, we control for the woman's age, the age and sex of the first child as  
41 well as for marital status. The model fits best when integrating age as a continuous

1 variable – modeling a nonlinear impact for woman's age and a linear impact for  
2 the age of the first child.

3 Information on individual-level access to formal childcare is not available in  
4 the longitudinal database of the SILC, which is why we have to limit our measure  
5 to cross-country variations. We use the aggregate measure of a country's childcare  
6 coverage for children aged 0 to 2 (see [Figure 5](#): OECD Family Database, 2012)  
7 as a proxy for parents' access to childcare. Childcare coverage rates represent  
8 participation rates for 0-to-2-year-old in formal childcare and preschool services.  
9 Data generally include children using center-based services (e.g., nurseries or day  
10 care centers and pre-schools, both public and private), organized family day care,  
11 and care services provided by (paid) professional childminders, and exclude those  
12 using unpaid informal services provided by relatives, friends, or neighbors. We  
13 use this measure in both an implicit and an explicit way in the regression models.

14 The implicit way consists of estimating the impact of education on the probabili-  
15 ty of second child birth by distinguishing between two groups of countries among  
16 the 26 European countries: a first group of countries with childcare coverage  
17 for children aged 0 to 2 years old that is below the European average of 31%,  
18 and a second group with childcare coverage above this average (as identified in  
19 [Figure 5](#)).<sup>12</sup>

20 The probability of having a second child varies considerably across countries,  
21 as already suggested in [Figure 7](#). The weighted average for the probability of  
22 second child birth in our first group of countries is 0.075, while it amounts to 0.15  
23 for the second group. For the first group of countries, we observe 18% of women  
24 with low education level, 60% with medium, and 22% with high education levels,  
25 whereas the distribution in the second group of countries is 20%, 42%, and 38%,  
26 respectively. As the distribution of women over education groups does not differ  
27 to a large extent in the two country groups, our estimation results are not too much  
28 sensitive to selection issues. Country-fixed effects capture, however, differences  
29 in the average returns to education between countries.

30 We group together all 26 countries while controlling for the country group and  
31 while interacting the country group dummy with woman's education. This avoids  
32 us dividing the sample in two subgroups. With this large sample size, we are able  
33 to analyze the effect of education on the probability of second child birth within  
34 countries of each group. To focus on these within-country variations, we introduce  
35 country-fixed effects besides the country group dummy. As some specific years  
36 may influence the probability of deciding for or against a second child, we also  
37 introduce year-fixed effects in all our regressions. The regressions are run with  
38 robust standard errors.

39 The explicit way for modeling access to childcare as a determinant of second  
40 child birth consists of applying a mixed-effects logistic regression. Multilevel  
41 models are useful when individuals are supposed to be nested into higher level  
42 structures [Snijders and Bosker (1999)] that may play a role in explaining events  
43 that occur at the individual level. This is of particular interest in international  
44 comparative research: We can indeed consider that individuals are nested in

1 countries, each country being characterized by specific national institutions, such  
 2 as childcare coverage, that may play a role on individual choices. Country effects  
 3 induce correlations across observations which need to be addressed; otherwise  
 4 standard errors risk to be downward biased. Multilevel models adjust for these  
 5 intracountry correlations. Moreover, multilevel models can deal with unbalanced  
 6 data sets [Skrondal and Rabe-Hesketh (2004)], which is important as our sample  
 7 sizes vary across countries.

8 We integrate the country-specific contextual variable “childcare coverage” as  
 9 a continuous variable in the model, and we interact childcare coverage with edu-  
 10 cation. This serves to test if the effect of education differs across countries  
 11 with different levels of childcare coverage, and if the effect of childcare cov-  
 12 erage differs among education groups (cross-level effects). We apply a two-level  
 13 random-intercept and random-coefficient model (by using the `meqlogit` command  
 14 in Stata), which fits mixed-effects models for binary responses. Country effects are  
 15 specified in terms of a country error variance and fixed effects of our country-level  
 16 predictor “childcare coverage.” The multilevel model is thus able to analyze the  
 17 impact of contextual variables on individual behavior without the assumption of  
 18 homogeneity-of-regression slopes. The slope is allowed to vary randomly; ran-  
 19 dom parameters have a different value for each group/country. In addition, with  
 20 the interaction terms (cross-level effects), we do not only allow the intercept of the  
 21 model but also the slope for the individual-level variable “education” to be random  
 22 and to possibly explain it with the macrolevel variable “childcare coverage.”<sup>13</sup>

23 **Table 1** presents the regression results of a partnered woman’s probability of  
 24 having a second child as a function of her education. Model 1 implicitly controls  
 25 for access to childcare by including a dummy variable for countries with childcare  
 26 coverage above the European average, and model 2 shows regression results of  
 27 the multilevel approach.

28 Model 1 shows that within countries with low childcare coverage, a woman’s  
 29 probability of having a second child is lowest among medium-educated women.  
 30 Women with high and low education levels have a significantly higher probability  
 31 of having a second child in comparison to women with middle education. This  
 32 result holds when controlling for partner education and woman’s as well as her  
 33 partner’s employment status. The estimated coefficient for low education is 0.228  
 34 and for high education 0.239 in model 1 for the first group of countries with  
 35 childcare coverage below the European average. Within countries with childcare  
 36 coverage above the European average, a woman’s probability of having a second  
 37 child is significantly increasing with education. This can be seen by combining the  
 38 estimated coefficients of education with the interaction terms. The estimated coef-  
 39 ficient for low education is  $-0.108$  ( $0.228-0.336$ ) and  $0.2638$  ( $0.229+0.0348$ ) for  
 40 high education in model 1 for the second group of countries. In countries with high  
 41 levels of childcare coverage, low-educated women have thus the lowest probability  
 42 of second child birth. The difference between middle- and high-educated women  
 43 is significant, as indicated by the p-value of joint significance at the bottom of the  
 44 table. In addition to the importance of women’s education (figuring as potential

**TABLE 1.** Estimated probability of second child birth

	Model 1	Model 2
Woman's education:		
Low education (primary, lower secondary)	0.228*	0.444**
Middle education (upper and postsecondary)	<i>Ref.</i>	<i>Ref.</i>
High education (tertiary)	0.229**	0.219+
Partner education:		
Low education (primary, lower secondary)	-0.0672	-0.078
Middle education (upper and postsecondary)	<i>Ref.</i>	<i>Ref.</i>
High education (tertiary)	0.307***	0.310***
Woman's employment status:		
Employed full-time	<i>Ref.</i>	<i>Ref.</i>
Employed part-time	-0.0704	-0.058
Unemployed	-0.178+	-0.180+
Inactive	-0.118+	-0.102
Changing employment status	0.295+	0.293*
Partner's employment status:		
Employed (full-time or part-time)	<i>Ref.</i>	<i>Ref.</i>
Not employed	-0.133	-0.136
No information	-0.0527	-0.051
Control for childcare coverage:		
Country group 2 (childcare coverage $\geq 0.31$ )	0.431*	-
Country group 2 * low education	-0.336*	-
Country group 2 * high education	0.0348	-
Childcare coverage (continuous)	-	0.026***
Childcare coverage * low education	-	-0.0114*
Childcare coverage * high education	-	0.0011
Demographic controls:		
Woman's age	0.579***	0.583***
(Woman's age) <sup>2</sup>	-0.0108***	-0.011***
Age of first child:	-0.119***	-0.122***
Sex of first child is female	-0.00636	-0.005
Couple is married	0.194**	0.185**
Intercept	-8.214***	-9.292***
Year-fixed effects	Yes	Yes
Country-fixed effects	Yes	Random
Control for number of person-years	Yes	Yes
Number of observations		22143
Proportion of second child arrival		0.11
Number of countries		26
Pseudo R <sup>2</sup>	0.2158	-
Test of joint significance:		
p(low educated in country group 2)	0.31	-
p(high educated in country group 2)	0.00	-

TABLE 1. Continued

	Model 1	Model 2
Random effects:		
Variance of the intercept	–	0.250
Variance of the variable “low educated”	–	0.007
Variance of the variable “high educated”	–	0.023

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

+p<0.1, \*p<0.05, \*\*p<0.01, \*\*\*p<0.001.

Group 1: Low childcare coverage (age 0–2)<0.31: HU GR RO BG AT SK CZ PL EE IT LV IE LT FI

Group 2: High childcare coverage (age 0–2)≥0.31: NL FR IS BE NO UK DK SE SI ES PT LU

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

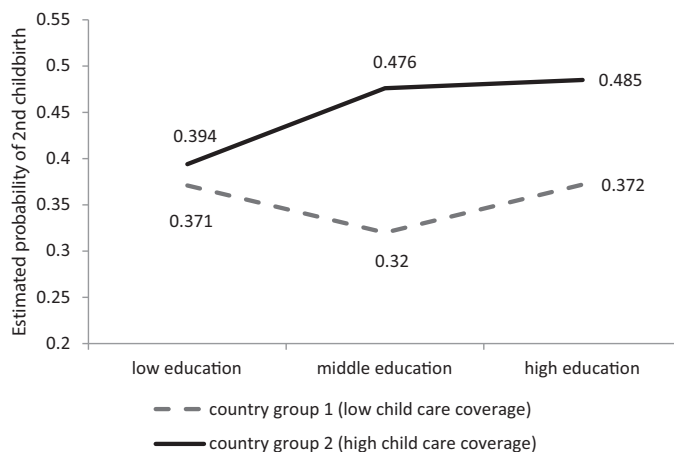
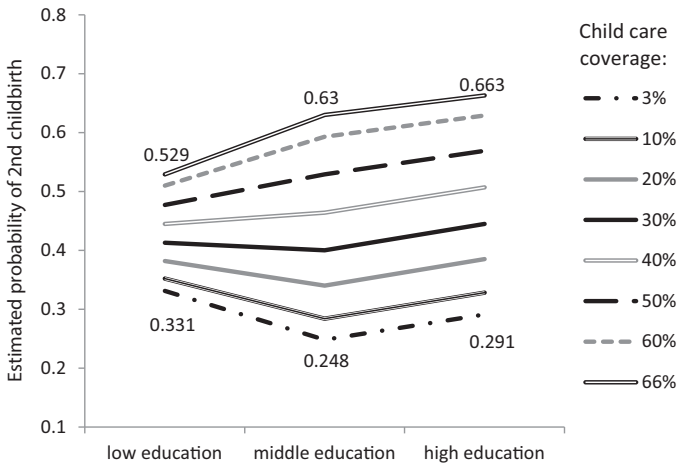


FIGURE 9. Estimated probabilities of second child birth according to woman’s education, countries with difficult vs. easy access to childcare.

1 wage) for family enlargement, we find that – in line with our argument that it is  
 2 economic resources that are important for family enlargement – unemployed and  
 3 inactive women have a lower probability of second child birth in comparison to em-  
 4 ployed women. Results are similar when running a probit instead of a logit model.<sup>14</sup>

5 We now quantify the estimation results of model 1 by transforming the logit  
 6 coefficients into estimated probabilities.<sup>15</sup> Comparing the two country groups,  
 7 Figure 9 illustrates the estimated probabilities for the reference category of women  
 8 who are married to a middle-educated partner, who are 28 years old and who have a  
 9 first child who is male and aged four. Within countries of the the first country group,  
 10 there is a U-shaped pattern between women’s education and the birth of the second  
 11 child, while the relation is positive for the second group of countries. With 0.371  
 12 and 0.394, the estimated probabilities are quite similar for low-educated women  
 13 in the two country groups. At the same time, middle-educated women have a





**FIGURE 10.** Estimated probabilities of second child birth according to woman’s education, by levels of childcare coverage (children aged 0–2).

1 lower probability of second child birth in country group 1 (0.320) in comparison  
 2 to low educated women, but a higher probability in country group 2 (0.476). The  
 3 probability is highest for high-educated women in country group 2 (0.485). In  
 4 country group 1, high-educated women have, with 0.372, a higher probability of  
 5 second child birth than middle-educated women, but this probability is low in  
 6 comparison to high-educated women in countries of group two.

7 Results of the multilevel analysis are shown in column 2. They show three main  
 8 results. First, childcare coverage is significantly positively linked to women’s prob-  
 9 ability of having a second child, independent of their educational level. Second, the  
 10 interaction terms confirm that the impact of education on the probability of second  
 11 child birth is influenced by the level of childcare coverage: For countries without  
 12 formal childcare, women with low and high education have a higher probability  
 13 of second child birth than middle-educated women. Increasing childcare coverage  
 14 reduces the positive impact of low education and reinforces the positive impact of  
 15 high education. Third, the interaction terms also suggest that the positive impact  
 16 of childcare coverage on the probability of second child birth is lower for low-  
 17 educated women and higher for high-educated women in comparison to middle-  
 18 educated women. Education (at the individual level) and childcare coverage (at the  
 19 macrolevel) thus both have a positive impact on the probability of having a second  
 20 child and the positive impact is reinforced when these two features are combined.  
 21 Results are similar when running a multilevel-probit instead of a multilevel-logit  
 22 model.<sup>16</sup>

23 **Figure 10** illustrates the estimated probabilities of the multilevel model for  
 24 different levels of childcare coverage, varying between 3% (Slovakia) and 66%  
 25 (Denmark), again for the reference category of women who are married to a

1 middle-educated partner, who are 28 years old and who have a first child who is  
2 male and aged four. For low levels of childcare coverage below 31%, the relation  
3 between education and the probability of second child birth is U-shaped, while the  
4 relation gets positive for higher levels of childcare coverage. In addition, [Figure 10](#)  
5 shows that in countries with high levels of childcare coverage, the probability of  
6 second child birth is generally higher for all levels of education in comparison to  
7 those countries with lower childcare coverage.

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

17 The model presented in [Section 2.1](#) and the extended model in [Section 3.2](#) allow  
18 us developing some intuitions for a better understanding of the patterns that are  
19 revealed by our empirical analysis. The empirical results correspond to the model's  
20 prediction of a U-shaped relationship between a couple's probability of having a  
21 second child and the woman's potential wage in countries with difficult access to  
22 childcare. The model also predicts that an easier access to childcare leads to the  
23 the fact that the probability of having a second child is increasing with woman's  
24 education. In countries with difficult access to childcare, middle-educated women  
25 face high opportunity costs and therefore tend to decide against second child  
26 birth, while high-educated women succeed in overcoming the substitution effect.  
27 An easier access to childcare reinforces the income effect, which explains that  
28 middle- and high-educated women have more facilities to enlarge the family than  
29 low-educated women.

30 Our results have to be interpreted with care, however, as the country-specific  
31 childcare levels can also capture other factors that might explain differences in  
32 the transition to second child birth between European countries. For example,  
33 countries might not only differ in access to childcare, but also in general wage  
34 levels for men and women. The higher the wages, the easier it may be for parents  
35 to decide in favor of an additional child. To test the robustness of our findings, we  
36 therefore run an additional specification where the country-specific wage level,  
37 gender wage inequality, and their interaction terms with education groups are also  
38 included.

39 To measure the wage level, we use median gross hourly wages for all employees  
40 (excluding apprentices), expressed in Euros, and in purchasing power standard  
41 (Eurostat Structure and Earnings Survey, 2010). The gender pay gap is calculated  
42 based on this measure and represents the difference between gross hourly earnings  
43 of male paid employees and of female paid employees as a percentage of gross  
44 hourly earnings of male paid employees.

1 The results of this robustness check (model 3) are presented in [Table C.1](#) of  
2 Appendix C.

3 Even though childcare coverage itself is no longer significant, the results confirm  
4 that for low levels of childcare coverage, low-educated women have a significantly  
5 higher probability of having a second child than middle-educated women. The sig-  
6 nificantly negative interaction term “childcare coverage  $\times$  low education” shows  
7 that the higher childcare coverage, the smaller gets the coefficient of low educa-  
8 tion. Combining information of the estimated coefficients of “low education” and  
9 the interaction term “childcare coverage  $\times$  low education,” we find that from a  
10 childcare coverage level of 47% on, low-educated women have a lower probability  
11 of having a second child than middle-educated women.

12 The general wage level is found to be significantly positively related to second  
13 childbirth, whereas the impact does not significantly differ between education  
14 groups.

15 The results of model 3 confirm that childcare coverage shapes the educational  
16 gradient of second childbirth: In countries with high levels of childcare cover-  
17 age, the educational gradient is positive, whereas in countries with low childcare  
18 coverage, the educational gradient is U-shaped. However, model 3 suggests also  
19 that general level-differences between European countries in terms of transition  
20 to second childbirth are not, or at least not only, linked to differences in childcare  
21 coverage. The general wage level seems to be an important driver for parents’  
22 decisions in terms of family enlargement. This holds for all education groups. The  
23 higher a country’s wage level, the easier it seems for families to bear the financial  
24 burden of a second child.

25 The importance of childcare coverage, should, however, not be rejected, as  
26 results of model 3 risk being biased by multicollinearity between the wage level  
27 and childcare coverage. Richer countries tend to have both higher wage levels  
28 and higher public investments in formal childcare. One might also think of other  
29 country-specific unobserved factors that are correlated with both childcare cov-  
30 erage and income levels, such as gender and family norms, for example. Recent  
31 research has shown that the re-increases in TFR, that can be observed since the  
32 early 2000s, are strongest in those developed countries which have the most experi-  
33 enced changing gender relationships towards more gender equality, as measured,  
34 for example, by gender-equitable attitudes towards female employment, by an  
35 increasing number of out-of-wedlock births reflecting modern family norms or  
36 by increasing men’s involvement in the home [Balbo et al. (2013); Neyer et al.  
37 (2013); Arpino and Esping-Andersen (2015); Goldscheider et al. (2015)].

#### 38 4. CONCLUSION

39 This paper shows that fertility differences across European countries are mainly  
40 due to fewer women having two children in low-fertility countries. It suggests  
41 that in high-fertility countries, the possibility to outsource childcare has a positive

1 effect on the transition from the first to the second child for a household. This  
2 transition is facilitated especially for middle- and high-educated women.

3 Our theoretical framework illustrates the mechanism behind this idea, robust to  
4 European survey data. In countries with low childcare coverage, the relationship  
5 between female education, as a proxy for potential wage, and having a second  
6 child is U-shaped, while in countries with high childcare coverage, the probability  
7 of second child birth is increasing with education. In countries with low childcare  
8 coverage, the probability of second child birth is thus reduced in particular for  
9 middle- and high-educated women in comparison to countries with high childcare  
10 coverage. Fertility differences between European countries thus emerge in important  
11 parts due to the fact that in countries with high childcare coverage, middle-  
12 and high-educated women have a higher probability of having a second child in  
13 comparison to countries with low childcare coverage.

14 Our intuition behind the finding that access to childcare plays an important  
15 role in particular for middle- and high-educated women is that middle- and high-  
16 educated women have a higher opportunity cost in terms of foregone labor income  
17 when they have to provide childcare themselves. An easier access to childcare  
18 services reduces this cost and therefore increases fertility.

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

34 While childcare coverage is found to shape the educational gradient of transition  
35 to second child, our study also reveals the importance of the general wage level  
36 for explaining differences in progression probabilities between European countries.  
37 Other studies point to modern gender and family norms. Combining this  
38 information with our results, it seems thus that institutions encouraging parental  
39 employment and an egalitarian share of house and care work among partners  
40 emerge as policies that are likely to facilitate family enlargement in European  
41 countries. Childcare coverage plays here an important role, as well as access to  
42 secure employment and decent income for both partners.

43 This work can be extended in several directions. In particular, extending the  
44 analysis to births of other orders and improving the measures for individual access

1 to different types of formal and informal childcare seem to be fruitful ways of  
2 future research.

### 3 NOTES

4 1 Amuedo-Dorantes and Sevilla (2014) also support a causal effect of low-skilled immigration to  
5 the United States on the reductions in the time allocated to basic childcare by college-educated mothers  
6 of nonschool age children.

7 2 See Himmelweit et al. (2013) for a discussion on the usefulness of formal modeling household  
8 decision making. Jones et al. (2011) also provide a clear discussion on different theoretical models  
9 that can explain the negative relationship between fertility and income.

10 3 In Appendix A, we show that the mechanisms made explicit in this benchmark model also hold  
11 if we introduce a good cost for children as well as a time cost.

12 4 The problem could have been written as an expected utility maximisation problem but this would  
13 not have changed the theoretical results.

14 5 Differences across childcare systems in Europe are explained in detail in Del Boca (2015).

15 6 See Thévenon (2015) for a literature review of the causal link between fertility levels and childcare  
16 coverage.

17 7 See, for example, Wrohlich (2008) for Germany, Kawabata (2014) for Japan, and the European  
18 Commission/European Commission (2014) for Hungary.

19 8 Both of these factors can lead to fertility differences across countries. Fertility levels sig-  
20 nificantly below replacement level can be due to difficulties in starting a family for certain women,  
21 resulting in one important group of women staying childless while another group of women have  
22 around two children (dichotomous fertility behavior). However, low fertility can also be a result of  
23 difficulties in increasing the family size rather than in starting a family, which would imply that, from a  
24 certain age on, most women are indeed mothers (i.e., childlessness is low), but few women have more  
25 than one child (homogeneous fertility behavior).

26 9 For the majority of countries, the classification into high- or low-fertility regimes also stays  
27 the same when using the period measure of total fertility rates (World Bank World Development  
28 Indicators, 2011). Exceptions include some Eastern European countries (Czech Republic, Slovenia,  
29 Hungary, Slovakia, Poland), which have completed fertility rates above the EU average and total  
30 fertility rates below EU average, suggesting the importance of birth postponement for younger women  
31 (tempo effect). Schmertmann et al. (2014) predict that the quantum measure of completed fertility rate  
32 will be below average for cohorts born after 1970 in these countries.

33 10 For a detailed discussion of measurement biases of fertility with SILC, see Greulich and Dasre  
34 (2017).

35 11 Furthermore, we find a somewhat higher difference between our two country groups for the  
36 transition probability from a second to a third child (women aged 38 to 44) in comparison to the one  
37 from a first to a second child, while differences in the transition to a first child are relatively small. As  
38 the transition to a third child requires having two children, and as we find that fewer children of birth  
39 order two are the main explanation for low-fertility levels, our following Section 3.2 focuses on the  
40 decision of having a second child.

41 12 The first group consists of Hungary, Greece, Romania, Bulgaria, Austria, Slovakia, Czech  
42 Republic, Poland, Estonia, Italy, Ireland, Lithuania, Finland, and Latvia (note that Germany is not  
43 covered by the longitudinal data base), whereas the second group consists of the Netherlands, France,  
44 Iceland, Belgium, Norway, the United Kingdom, Denmark, Slovenia, Spain, Portugal, Luxembourg,  
45 and Sweden.

46 13 Other macrolevel variables such as unemployment, public spending on family policies, parental  
47 leave duration and cash transfers towards families have also been integrated in the intercept equation  
48 besides childcare coverage. The effect of childcare coverage remains positive and significant, and the  
49 other macrolevel variables are less significantly correlated to second child birth than childcare coverage  
50 (results available on request). Our preferred model is thus the multilevel model with childcare coverage

1 as only macrolevel variable. This avoids problems caused by multicollinearity. Moreover, having a low  
 2 number of countries implies that we have limited degrees of freedom at the country level, which also  
 3 speaks in favor of integrating the country-level variables one by one instead of simultaneously.

4 14 Probit estimation coefficients: 0.11 for low education (90% significance level), 0.12 for high  
 5 education (99% significance level), 0.26 for childcare coverage higher than 31% (99% significance  
 6 level),  $-0.18$  for the interaction of low education with high childcare coverage (95% significance  
 7 level),  $0.04$  for the interaction of high education with high childcare coverage.

8 15 Probability of second child birth:  $P(Y = 1|X) = e^L / (1 + e^L)$ , where  $L$  contains the estimated  
 9 coefficients and  $e$  is Euler's constant.

10 16 Multilevel-probit estimation coefficients:  $0.22$  for low education (95% significance level),  $0.11$   
 11 for high education (90% significance level),  $0.01$  for childcare coverage (99.9% significance level),  
 12  $-0.007$  for the interaction of low education with childcare coverage (95% significance level),  $0.001$   
 13 for the interaction of high education with childcare coverage.

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## 7 APPENDIX A: EXTENSION WITH GOODS COST FOR CHILDREN

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

10 Assuming all else equal as in [Section 2.1](#), the budget constraint faced by couples can  
 11 now be written as

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

12 where  $\alpha$  represents the share of consumption that each child needs.

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

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

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

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

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

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

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

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



**TABLE B.1.** 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

	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 <sub>1</sub>	FR <sub>2</sub>	FR <sub>3</sub>	FR <sub>4</sub>	FR <sub>5</sub>
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 ≥ 1.6.

1 **APPENDIX B: DETAILS ON SECTION 3.1**

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

$$FR_i = \sum_{i=1}^N p_i,$$

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

4 Approximate completed fertility rate (women aged 38–44), ACFR <sub>$i$</sub> :

$$ACFR_i = \sum_{i=1}^N FR_i.$$

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

$$FR_i^{hf} - FR_i^{lf}.$$

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

$$\Delta ACFR = \sum_{i=1}^N (FR_i^{hf} - FR_i^{lf}).$$

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

$$\frac{FR_i^{hf} - FR_i^{lf}}{\sum_{i=1}^N (FR_i^{hf} - FR_i^{lf})}.$$

## 1 APPENDIX C: ROBUSTNESS CHECK

**TABLE C.1.** Estimated probability of second child birth – robustness check

	Model 3
Woman's education:	
Low education (primary, lower secondary)	0.612+
Middle education (upper and post-secondary)	<i>Ref.</i>
High education (tertiary)	0.125
Partner education:	
Low education (primary, lower secondary)	-0.0794
Middle education (upper and post-secondary)	<i>Ref.</i>
High education (tertiary)	0.307***
Woman's employment status:	
Employed full-time	<i>Ref.</i>
Employed part-time	-0.0649
Unemployed	-0.176+
Inactive	-0.109
Changing employment status	0.289*
Partner's employment status:	
Employed (full-time or part-time)	<i>Ref.</i>
Not employed	-0.130
No information	-0.0589
Aggregate level variables:	
Childcare coverage (continuous)	0.00778
Childcare coverage * low education	-0.0130*
Childcare coverage * high education	0.000305
Wage level (continuous)	0.110***
Wage level * low education	0.00984
Wage level * high education	0.00369
Gender wage gap (continuous)	0.0210
Gender wage gap * low education	-0.0191
Gender wage gap * high education	0.00521
Demographic controls:	
Woman's age	0.580***
(Woman's age) <sup>2</sup>	-0.0108***
Age of first child	-0.121***
Sex of first child is female	-0.00477
Couple is married	0.184**
Intercept	-10.13***
Year-fixed effects	Yes
Country-fixed effects	Random
Control for number of person-years	Yes
Number of observations	22143

**TABLE C.1.** Continued

	Model 3
Proportion of second child arrival	0.112
Number of countries	26
Random effects:	
Variance of the intercept	0.114
Variance of the variable "low educated"	0.000
Variance of the variable "high educated"	0.022

+p<0.1, \*p<0.05, \*\*p<0.01, \*\*\*p<0.001

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