Cash transfers and fertility: from short to long run*

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November 6, 2022 –First draft: October 2022
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Abstract

Many developed countries are at risk of experiencing population decline due to low fertility rates, with potential negative economic effects. As a response, governments are deploying family policies to increase the number of children. In this paper, we propose a dynamic life-cycle model of fertility and female labour force participation to assess their effectiveness. We use the short-run fertility effects of a cash transfer policy from Spain to calibrate its parameters. Using the calibrated model, we find that the effects in the long run are half as large as in the short run. This is driven by differences in the responses of younger and older women at the time of implementation. The latter must react shortly after, as they cannot delay fertility much longer. The former anticipate their first birth. This generates additional births in the short run. We also study the effects of an alternative policy consisting of childcare subsidisation, and explore how the coexistence of temporary and permanent contracts in Spain, which have different earnings profiles, affects fertility and interacts with cash transfers, by raising the costs of career interruptions in crucial child-bearing years.

Keywords: cash transfers, fertility, female labour force participation, long-run, life-cycle

JEL Codes: J11, J13, J22

*We thank Andreś Erosa, Luisa Fuster, Nezih Guner, John Knowles, Zöe Kuehn, Matthias Kredler, Alessio Moro, Rachel Ngai, participants at seminars at University of Cagliari and Universidad Carlos III de Madrid, the Annual Conference of the European Society for Population Economics, the Brazilian Meeting in Family and Gender Economics, the CRENoS Workshop and the Symposium of the Spanish Economic Association for valuable feedback and helpful suggestions. Moreover, we thank the members of the Centre For Macroeconomics at LSE for their hospitality towards Javier and helpful conversations.

1 Introduction

In the developed world, the prevailing total fertility rates (TFR) have been well under the replacement level of 2.1 since the mid-1980s. This implies (in the absence of immigration) that the total population has already or will soon start to decline and that the share of old people will rise. These trends are expected to have deleterious effects on economic performance.[1] Governments worldwide, worried about demographic pressures and their effects on the economy, are deploying policies to boost fertility rates and slow down population decline and ageing. One reason to think there may be a margin for policy intervention is the fact that there is a positive gap between the desired and the realised number of children among recent cohorts of women. Can family policies indeed be effective in closing this gap and thus increasing the number of children born per woman?

To answer this question, we propose a dynamic life-cycle model featuring joint fertility and labour force participation decisions. For the calibration of the model we make use of a natural experiment involving a policy that gave one-shot cash transfers to women upon childbirth in Spain. We choose the parameters of the model to match its effects on fertility and labour force participation the year following implementation (the short run).[2] These responses contain invaluable information regarding the sensitivity of such decisions to family income. But they may also reflect changes in the timing of fertility (*tempo*) induced by the policy that do not necessarily translate into a different number of total children. We also make use of data on desired fertility to capture heterogeneity in preferences over the number of children, and match overall labour supply patterns for groups of women with children of different ages, as well as the average timing of first births right before the implementation of the policy.

We then use the calibrated model as a laboratory to perform quantitative experiments. First, we simulate the effects of the policy in the long run, i.e. after enough time has passed so that all women have been exposed to the cash transfers since the beginning of their child-bearing years. Thus, we quantify the effects on the overall number of children per woman (*quantum*). Then, we simulate the effects of an alternative policy involving childcare subsidies for children aged 0-3, with the same present value as the cash transfers. The cost of childcare

[1]Population aging and decline are associated in the literature with increasing burdens of social security systems (De Nardi et al., 1999), low interest rates (Krueger and Ludwig, 2007) and reduced output growth and investment (Aksoy et al., 2019). Jones (2022) explores the consequences of population decline in growth models. A disturbing possibility emerges: the Empty Planet result. This refers to a situation in which knowledge and living standards stagnate for a vanishing population, which can happen if society doesn't implement the optimal allocation fast enough. He concludes that policies related to fertility can determine whether we fall into this trap or converge to a balanced growth path with exponential growth ("Expanding Cosmos").

[2]See González (2013).

at these ages can play an important role for fertility and mothers' labour force participation decisions, since public schooling is usually not universally available yet for these children.[3] Finally, we explore the stand-alone effects and the interactions with the cash transfers arising from an important feature of Spanish labour markets: the coexistence of temporary and permanent contracts (duality). Most workers start their careers with temporary contracts, which generate lower yearly earnings (partly due to intermittent unemployment) and have lower returns to experience. Therefore, the costs of career interruptions may be particularly large in crucial child-bearing years, as women want to work, accumulate experience and increase the likelihood of transitioning to a permanent contract.

Our main result is that the long-run effects of cash transfers on fertility are about half as large in magnitude as the short-run effects (3% and 6%, respectively), the main reason being that in the short run there are additional births among older cohorts of women that only have a few periods to adjust their decisions after the policy is announced. Moreover, we find that childcare subsidies for parents of children aged 0-3, with the same present value as the cash transfers considered in the first exercise, have a long-run impact on fertility that is only slightly smaller than the latter. However, instead of reducing mothers' labour force participation, which the cash transfers do, they increase it (around 1 percentage point, while the unconditional transfers reduce it in a magnitude at least as large). Furthermore, we find that that eliminating the dual nature of Spanish labour markets (i.e. implementing a unique contract with earnings and returns to experience between the temporary and the permanent ones) has a long-run positive effect on fertility which is three times as large as that of the cash transfers (9% increase). Finally, we explore the interaction between labour market duality and cash transfers. We find that the effects of the latter on fertility in the long run are very similar both in a scenario with dual labour markets and in one where there is a single contract (which is more representative of the situation in other developed countries like the United States).

Taken together, our results imply that the impact of family policies may be smaller in the long than in the short run, since the mechanisms at work do not seem to be specific to the cash transfer policy we consider here. Moreover, they highlight the importance that interventions which make labour market interruptions less costly (as in the elimination of duality) and less necessary (as in childcare subsidisation) have for fertility outcomes when considering the decision jointly with labour force participation.

[3]This was indeed the case in Spain at the time when the cash transfers were introduced, see section 2 for details.

Related literature and contributions.— This paper is related to various lines of research that intersect with each other. First, it fits into the economics of fertility. Historically, fertility rates have fallen with income and with female labour force participation across countries and families. Economists stressed ideas like the quantity-quality trade-off of children (Becker, 1960; Becker and Lewis, 1973) and the role of the opportunity cost of women's time (Butz and Ward, 1979) to explain these empirical regularities.[4] However, neither of the aforementioned two relationships hold anymore in developed countries: the first one has flattened and the second one is now slightly positive. The new economics of fertility (Doepke et al., 2022) stresses the importance of compatibility between career and family as a major driver of fertility. As a result, it sees it as crucial to consider these decisions jointly with labour force participation, as this paper does.

In the literature addressing these issues, a large number of studies deals with them in isolation.[5] Moffitt (1984) and Hotz and Miller (1988) were some of the first to consider them jointly, in reduced form. Erosa et al. (2002) and Erosa et al. (2010) do so as well, but within structural models with exponential lives and in steady-state equilibrium. Francesconi (2002) is the pioneer study involving a dynamic life-cycle model with joint fertility and labour force participation decisions. Other papers that have featured such models since then include Da Rocha and Fuster (2006), Sheran (2007), Del Boca and Sauer (2009), Keane and Wolpin (2010), Erosa et al. (2016), Adda et al. (2017), Guner et al. (2020) and Guner et al. (2021). Our main contribution to this literature is the way we deal with heterogeneity in fertility preferences. We provide evidence that the desired number of children, as retrieved from fertility surveys, changes slowly across cohorts, does not heavily depend on income, and therefore provides a reasonable estimate of the lower bound for the potential fertility. Hence, we use desired fertility data to infer the distribution of preferences over the number of children. Moreover, efforts have been made recently to measure the impacts of maternity on labour market outcomes over different time spans, also known as child penalties (Kleven et al., 2019a). We use the event-study approach developed by these authors in our simulated data and contrast the resulting child penalties over time with the ones observed in the data.

This paper also contributes to the literature studying the impact of family policies on fertility and female labour force participation. There are broadly two branches in this body

[4] For a survey on what Doepke et al. (2022) call first-generation models of fertility, see Hotz et al. (1993)

[5] Early papers studying fertility in a static context include Becker (1960), Becker and Lewis (1973) and Willis (1973) Dynamic models of fertility that kept labour force participation constant include Ward and Butz (1980), Wolpin (1984), Rosenzweig and Schultz (1985), Cigno and Ermisch (1989), Heckman and Walker (1990), Blackburn et al. (1993), Arroyo and Zhang (1997) and Sommer (2016). Conversely, Heckman and Macurdy (1980), Blau and Robins (1988), Eckstein and Wolpin (1989), van der Klaauw (1996), Hyslop (1999), Attanasio et al. (2008), Keane and Sauer (2009) and Blundell et al. (2016) study labour supply decisions in a dynamic framework, while taking fertility decisions as exogenous.

of research, one empirical and one structural (model-based). The empirical literature most often uses difference-in-difference and regression discontinuity designs to exploit natural experiments created by policy implementation. This way, they are able to identify effects in a small window of time around it. In particular, Milligan (2005) and González (2013) study the impact of cash transfers in Canada and Spain, respectively.[6] The latter study provides the estimates for the short-run impact of this policy on fertility and mothers' labour supply that we use to calibrate our model. While they both find positive effects, the authors warn the the identified effects may include changes in timing, not just overall quantity. Cohen et al. (2013) use panel data on Israeli women and exploit variations in child subsidies to identify their effects on fertility. Interestingly, they find positive effects among older women, which they interpret as evidence in favour of an increase in the overall total of children and not just timing. In our own results, these same effects explain the larger fertility effects in the short run.

On the other hand, the models used by the structural branch of the literature provide a laboratory to perform counterfactual quantitative experiments. This is important for three reasons. First, long-run impacts can be assessed by simulating the long run. Second, the results from the empirical literature strongly suggest that the context in which family policies are implemented matters (Cascio et al., 2015; Olivetti and Petrongolo, 2017). Thus, it is crucial to understand how they interact with one another and with labour market institutions. Policies can be implemented separately and jointly in the model, allowing researchers to better understand the interactions that arise. Third, it is possible to experiment with policies that have never been implemented, which means they cannot be tested empirically yet. Notice that in this paper we do all three things. Examples of this kind of work include some papers mentioned earlier: Erosa et al. (2010) study parental leaves, while Adda et al. (2017) and Guner et al. (2020) study cash transfers. Moreover, Bick (2016) studies the effects of childcare subsidies in a structural model featuring decisions over total number of children and labour force participation, but no decisions on timing of fertility.

The main contribution of this paper is to connect the two branches of the literature studying the impacts of family policies on fertility and female labour force participation, in the sense that we make use of a structural model, but we calibrate its parameters using carefully identified results from the empirical literature. We believe that doing so is a powerful combination to understand better how family policies affect these outcomes. Indeed, there are direct appeals to this type of exercise in the literature, i.e.: "Combinations of clean

[6] Other family policies have been studied as well. Bettendorf et al. (2015), Geyer et al. (2015), Givord and Marbot (2015), Haeck et al. (2015), Nollenberger and Rodríguez-Planas (2015) and Müller and Wrohlich (2020) evaluate the effects of childcare subsidies, while Lalive and Zweimüller (2009) and Asai (2015) study parental leaves.

designs with structural models of the sort presented in this paper may therefore be an avenue that helps exploring the longer-term effects of policy interventions" (Adda et al., 2017).

The remainder of the paper is organised as follows. Section 2 discusses the setting and lays out some descriptive evidence. Section 3 describes the model. In section 4, we explain how we take the model to the data and show the calibration results. Section 5 presents the main quantitative experiments. Section 6 concludes.

2 Background and Descriptive Facts

In this section, we describe the cash transfer policy that originated the natural experiment which provides key moments we use as part of our calibration targets, and the demographic and institutional context in which it happened. Then, we present evidence on fertility preferences that points to a gap between desired and realised fertility, and discuss the robustness of these preferences to income and policy circumstances. Finally, we show evidence on changes in labour market behaviour associated to motherhood. The facts presented in this section inform important modelling choices that are fully explained in section 3.

2.1 The baby check

Since the beginning of the 1990s, Spain has consistently been one of the countries with the lowest fertility rates in the world.[7] Against this backdrop, on July 3 2007, the Spanish government unexpectedly announced the introduction of a one-time €2500 child benefit to be paid to mothers immediately after each birth. The policy came to be known in the Spanish media as "cheque bebé" (baby check, hereinafter). The projected ageing of the population is explicitly mentioned in the originating law as the motive behind the new benefit, with the implicit understanding that it would increase fertility and slow down that demographic trend. The mechanisms through which the government expected the baby check to stimulate fertility were also made explicit in the law: compensating the additional expenditures households incur upon the birth of a new child, and facilitating work-life balance. Lastly, the law mentions that the benefit was intended to maintain disposable income and welfare for low-income families that have a new child.[8]

The requirements to access the baby check were quite low, making it essentially universal. No income tests were stipulated, and the only real precondition was to have effectively resided in Spain for the two years before the birth[9]. This generated criticism to the benefit since

[7] See appendix A for an overview of Spain's and similar countries' past and future demographics.

[8] *LEY 35/2007*, November 15, 2007.

[9] Even this requirement was relaxed in 2009, making all women residing in Spain eligible for the benefit.

its inception, as opposition parties argued that it was unfair that high-income families were receiving an identical benefit as low-income ones.[10] Nevertheless, the first baby checks were rolled out in November 2007, and over the next year, the government reported paying almost half a million of them, at a cost of approximately €1.2 billion, around 0.8% of the projected public expenditure for 2008.[11]

The sharp cut-off established for baby-check eligibility constitutes a clear natural experiment, which was exploited by González (2013). Via a regression discontinuity analysis, she finds that mothers who received the benefit were 2-4 percentage points less likely to work twelve months after delivery. Moreover, she finds that the annual number of births increased by about 6 percent. These estimates provide invaluable information about the short-term sensitivity of households' fertility and female labour force participation decisions to unearned income.

The baby checks were phased out in 2010 as part of overall budget cuts implemented by the Spanish government after the 2008 financial crisis.[12] Nevertheless, the issue is not settled, neither in Spain nor elsewhere. OECD countries devote slightly more than 2% of GDP on average on family benefits public spending, with Spain actually devoting only around 1% of GDP (OECD, 2022).[13] Moreover, a new baby check was introduced by the regional government of Madrid in January 2022, this time geared towards young mothers (below 30 years old), means-tested (families with annual income below €30000) and much more generous (up to €14500, in €500 instalments).[14] The importance of assessing the effects of this kind of spending is therefore very much relevant.

2.2 Institutional background

The impact of family policies is mediated by the context in which they are implemented. Here, we discuss the institutional background in which the baby check was introduced in July 2007 in Spain.

Public childcare provision at this time in Spain was pretty typical for a high-income country. Despite mandatory schooling starting only at age 6, preschool between 9 am and 5 pm was offered to all parents of children aged 3 to 6 that requested it, and take-up was nearly universal. For children aged 0-3, however, the availability of places in public childcare

[10]"El Congreso aprueba el cheque-bebé". *El País*, October 18, 2007. https://elpais.com/elpais/2007/10/18/actualidad/1192695432_850215.html (in Spanish).

[11]"Presupuestos Generales del Estado, 2008". *Ministerio de Economía y Hacienda*, December 26, 2008.

[12]Montero, Vicky, 2010. "José Luis Rodríguez Zapatero dice adiós al cheque-bebé, su medida estrella en política social". *RTVE*, May 5. https://www.rtve.es/noticias/20100512/331041.shtml (in Spanish)

[13]Includes mainly child-related cash transfers, parental leaves and income support for sole parents, and services for families with children.

[14]*Boletín Oficial de la Comunidad de Madrid núm. 308*, December 27, 2021.

centres was quite limited, and parents therefore mostly had to pay for it out-of-pocket. Using the *Encuesta de Presupuestos Familiares* (Family Budget Survey, EPF henceforth) from the Spanish Institute of Statistics, we estimate that families with a child aged between 0 and 3 years old using full-time childcare spent on average €2000 a year in 2007.

Taxation has been pointed at by the literature as one of the factors affecting female labour supply. In particular, joint taxation has been identified as a strong disincentive to labour force participation among married women (LaLumia, 2008; Bick and Fuchs-Schündeln, 2017). Spain's system, however, allows couples to minimize their tax liabilities by filing jointly or separately, so it does not constitute an additional barrier to female labour participation.

One important aspect of the Spanish labour market that needs to be discussed here is duality, i.e. the coexistence of temporary and permanent contracts. The former have higher firing costs, and moreover firms can effectively fire a temporary worker by not renewing her contract. Most young people start their careers in this situation, and with a probability that is initially low but increases with experience, become permanent. This causes job insecurity, loss of earnings caused by intermittent unemployment and lower returns to experience for young workers.[15] All these increase the cost of career interruptions early on for temporary workers, as they make it less likely that they can obtain a permanent contract. There is plenty of evidence that temporary contracts cause women to postpone and reduce their fertility (see see Adserà (2004), de la Rica and Iza (2005), Auer and Danzer (2016), Lopes (2020) and Guner et al. (2021)). A related problem is high unemployment. For example, Da Rocha and Fuster (2006) find that unemployment induces women to postpone and space births, which reduces fertility. However, the period prior to the policy implementation was one of low unemployment in Spain, and this is the period we use for our model calibration.[16]

2.3 Desired and realised fertility

One of the reasons policies like the baby check may affect fertility is that in all high-income countries women on average would like to have more children than they do. In this section, we use data from the *Encuesta de Fecundidad* (Fertility Survey, EdF henceforth) of the Spanish Statistics Institute to discuss the robustness of this fact for Spain.

There are two waves of the EdF, from 1999 and 2018. Crucially, women were asked in both of them about their desired fertility. The structure of the question, which is identical across years, is as follows: first, women declare the number of children they have. If they

[15] Dolado et al. (2021) argue that when the gap in firing costs is large between temporary and permanent contracts, as it is in Spain, workers under the former exert less effort and firms provide less training, which may explain this difference in returns to experience.

[16] Bentolila et al. (2012) look at the role of duality in the unemployment surge in Spain during the Great Recession.

are childless, they are asked whether they would like or would have liked children, and if so, how many. If they have children, they are asked whether the number they have coincides with the number they would like or would have liked to have. If it does not, they are asked how many children they would like or would have liked to have.

Table 1 shows the realised and desired fertility for women aged 40 to 44 in 2018, and the difference between them. We chose this age group because most of these women had already completed their fertility at this point, meaning that the difference with desired fertility is definitive. The main takeaway from this table is that there are many women whose completed fertility is lower than their ideal one. In particular, it shows that the fraction of childless women more than doubles the fraction of those who declare not wanting to have any children, while less than half the number of women that would have liked three or more children do. On average, the desired number of children for this cohort at this point in time was 2.04, while the actual number was 1.54, a gap of 0.5 children. This is very close to what is observed on average across OECD countries[17].

We think that the existence of this gap is evidence that pronatalist policies have some margin to increase fertility. It can be reasonably argued that the answers given by people in surveys like the EdF do not represent policy-invariant preferences, and that people respond by taking into consideration restrictions and incentives given by their current context. However, a pronatalist policy would very likely not diminish desired fertility by itself. Therefore, the gap between it and realised fertility can be seen as a conservative estimate of the maximum possible effect of such a policy. Nevertheless, in what follows we present some evidence that desired fertility would probably not change significantly in response to policies that alter decisions in the margin.

Table 1: Fraction of women aged 40 to 44 by desired and realised number of children, Spain (2018)

Number of children	**Desired**	**Realised**	**Gap**
0	7.90%	18.99%	-11.09%
1	15.20%	24.96%	-9.75%
2	49.75%	43.79%	5.95%
3 or more	27.15%	12.26%	14.89%

Source: *Encuesta de Fecundidad 2018, INE.*

An almost ideal way to test empirically whether the baby checks had any effect on desired fertility among the cohorts that were affected by it would be to use a RDD, similar to what

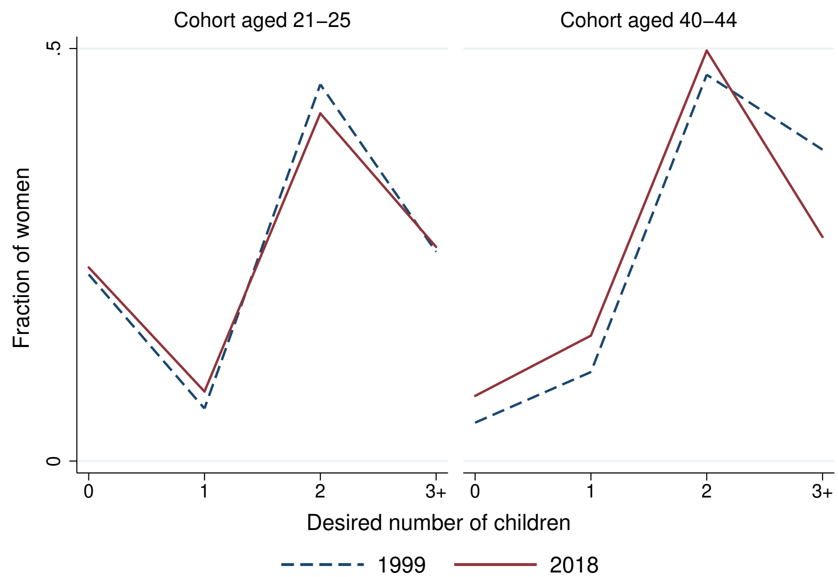
[17]See OECD Family Database https://www.oecd.org/els/family/database.htm.

González (2013) did for births and labour force participation. Unfortunately, we do not have data on desired fertility *right before* nor *right after* the announcement of the policy. We have two waves of the survey, which allows us to compare the same cohort's responses at different ages and cohorts at the same age. Figure 1 shows cohorts aged 21 to 25 and 40 to 44 in 1999 and 2018. Consider first the cohort aged 21-25 in 1999 and 40-44 in 2018. These women were aged 29-33 in 2007, when the baby check was introduced, and therefore were affected by it. Their fertility preferences are represented by the dashed blue line in the left panel and by the solid red line in the right one. Notice that desired fertility experienced some changes between those years. In particular, the fraction of women that declared not wanting children in 1999 (when they were young, e.g. before most of them made any fertility decisions yet) is significantly smaller than the fraction in 2018 (after fertility was completed). Almost all of the difference is due to a larger proportion of women declaring a desired fertility of one child. On the other hand, the fractions wanting 2 and 3 or more children are similar across years. In other words, there is a discrepancy in the extensive margin, but not so much in the intensive margin. Two (non-mutually exclusive and non-exhaustive) hypotheses to explain this are that the baby checks changed the fertility preferences in such a particular way for this cohort, or that some women change their preferences as they get older. The left panel shows that the desired fertility is almost identical across cohorts when aged 21 to 25, and very similar across cohorts when aged 40 to 44 in 1999 and 2018. This is evidence in favour of the second hypothesis. In a nutshell, figure 1 points to fertility preferences changing somewhat along the life-cycle, but slowly across cohorts (which are exposed to different policies and economic conditions).

Moreover, figure 2 shows the desired and realised fertility by household income for the same demographic as before. As discussed in the introduction, there's no clear relationship between fertility and income (if anything, there might be a small positive correlation, whereas in the past it was negative). Moreover, desired fertility also does not exhibit a clear pattern. Since it does not change a lot with differences in family income shown here, which go up to an order of 10, it seems reasonable to conclude that desired fertility barely reacts to a one-time cash transfer which is a fraction of that.

Taken together, the evidence presented here indicates that fertility preferences reported in the EdF reflect, albeit imperfectly, deep parameters regarding the maximum number of children women would be willing to have under reasonable changes in policy.

Figure 1: Fraction of women by desired number of children for selected cohorts, Spain (1999 and 2018)



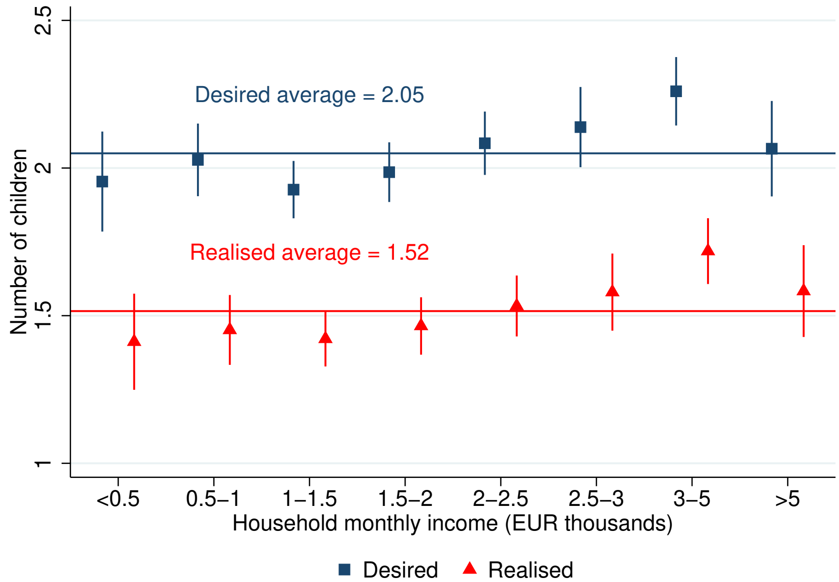
Source: Authors' work with data from *Encuesta de Fecundidad 2009 and 2018, INE.*

2.4 Labour force participation and motherhood

Motherhood is associated with important changes in women's labour market behaviour. In this subsection we use data from the *Encuesta de Condiciones de Vida* (Living Conditions Survey, ECV henceforth) of the Spanish Statistics Institute to provide some descriptive evidence for the magnitude of these changes among the cohorts of women affected by the baby check policy in the period immediately prior to its implementation. The ECV consists of a rotating panel, where households are interviewed for four consecutive years. There are 16000 households in the sample. Each year 4000 households leave, and 4000 new households replace them. We identified all births among women in the sample between 2004 (the first year of the sample) and July 2007 (that is, not eligible to receive the baby check). We kept all women for which there is labour force participation information for each of the 12 months preceding and succeeding the birth (24 months in total).

Figure 3 shows the fraction of women working full-time, part-time and not in the labour force in this period by parity (first and second births). There is a large drop in full-time participation that actually starts about six months before the birth of the first child. The difference in the rate twelve months before and after childbirth is more than 20 p.p. Conversely, the part-time rate and the fraction of women that are out of the labour force increase

Figure 2: Desired and realised fertility by household monthly income among women aged 40-44, Spain (2018)



Source: Authors' work with data from *Encuesta de Fecundidad 2018, INE.*

Note: Spikes represent 95% confidence intervals.

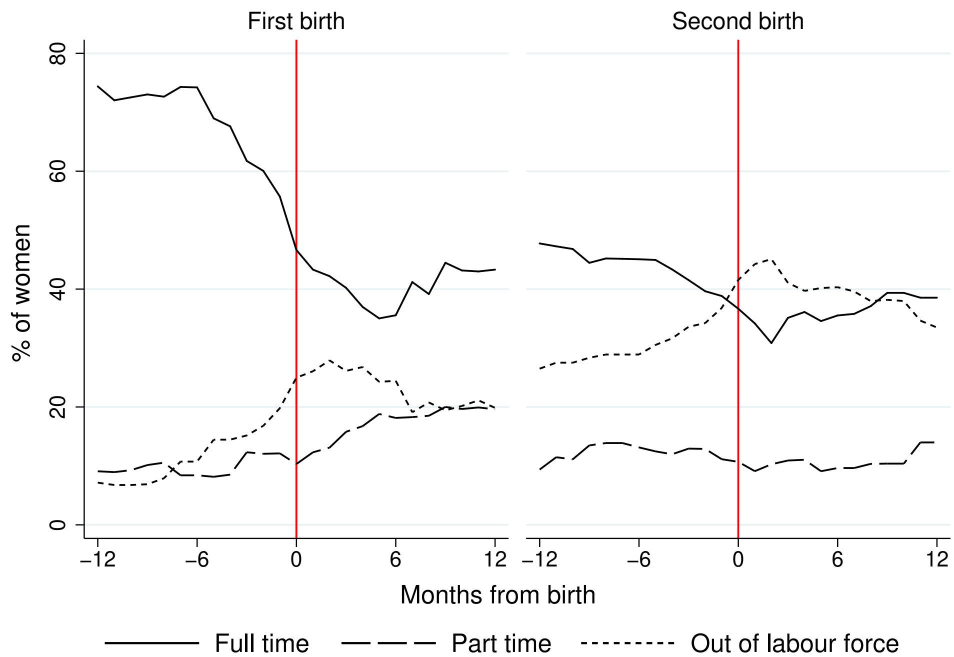
by about 10 p.p. each[18]. By the time women give birth to their second child, full-time participation has barely changed compared to one year after their first one. However, the part-time rate has gone back approximately to its pre-children level, while the fraction out of the labour force has inched upwards by between 5 and 10 p.p. The second childbirth is associated with another drop in full-time participation rates, this time of slightly less than 10 p.p.. This is not compensated at all with part-time, and therefore almost fully translates in a commensurate increase in non-participation over the next 24 months.

Taking stock, the first childbirth is associated with a large drop in full-time participation that is partially compensated with an increase in part-time, while the second birth is associated with a smaller drop that is, however, not compensated by an increase in part-time, and from a much lower baseline.

The previous analysis centres on the 24 months around childbirth and was performed on a balanced panel of women. To have an idea of the longer-term effects of maternity on labour market behaviour, we look at the cross-section of women present in the sample during the same period. Figure 4 plots the gap in participation, part-time and full-time

[18]The fractions of women don't add up to 1 as some are also unemployed (not shown in the graph).

Figure 3: Female labour force participation around the first and second births in Spain, 2004-2007



Source: Author's work using *Encuesta de Condiciones de Vida 2005-2008, INE.*

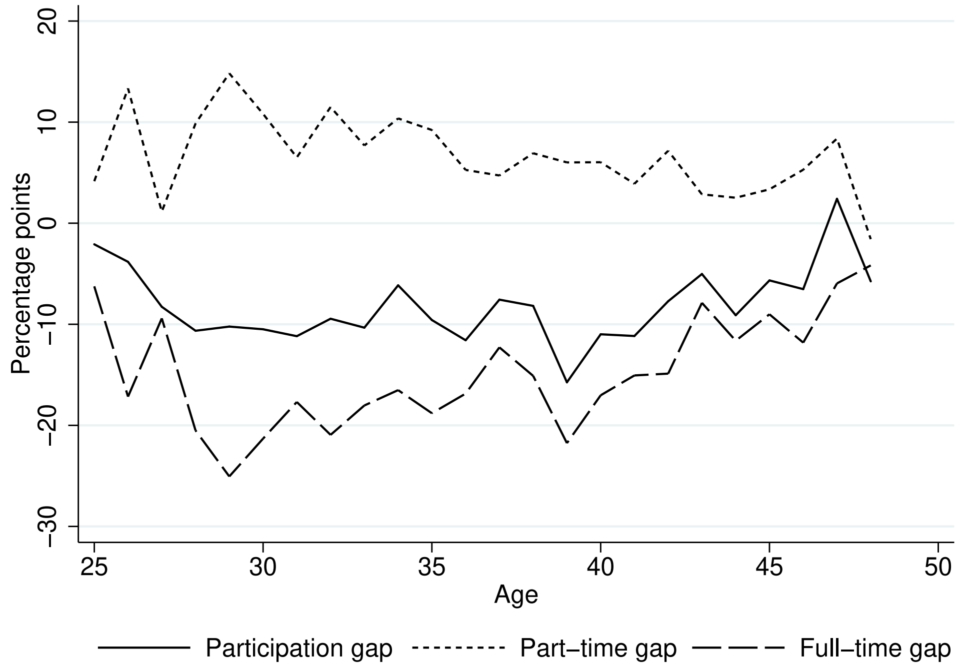
rates between mothers and childless women by age. In general, mothers are much less likely to work full-time, somewhat more likely to work part-time and less likely to work overall. The participation gaps close as women age and presumably their children grow up and start requiring less time, thus allowing them to work more easily. However, they persist between ages 30 and 40. Therefore, maternity is associated not only with a sudden drop in participation the year around childbirth, but also with lower participation rates for several years afterwards.

The main takeaway from the evidence presented here is that it is important to model the costs that children impose on mothers, especially time costs, in such a way that it generates the behavioral changes in the labour market associated to motherhood discussed above.

3 The model

We study fertility and labour force participation decisions over the life-cycle of married women. They derive utility from the number of children, consumption, and leisure. The model reflects the main trade-offs women face when making such decisions: each one has

Figure 4: Difference in labour force participation rates between mothers and childless women by age in Spain, 2004-2007



Source: Author's work using *Encuesta de Condiciones de Vida 2005-2008, INE.*

a target fertility level, but children negatively affect consumption and leisure time, so that desired fertility may not be achieved. The model captures dynamic career concerns as well. There are various costs and benefits of becoming a mother at a younger and at an older age. Moreover, once a baby is born, women face a trade-off between being a working mother or taking a costly career break. Labour market participation interruptions are costly because experience is not accumulated. Moreover, most women start working life under a temporary contract. To increase the chances of converting it to a permanent one, they must work to accumulate experience. However, there are costs of being a working mother. Each woman decides how many children to have and when to have them, considering all these constraints. The details of the model are covered in the rest of this section.

3.1 Demographics

We model women's life choices between the ages of 25 and 52. A model period corresponds to one year. We denote model periods with j, hence age 25 corresponds to $j = 1$ and age 52 to $j = J = 28$. Prior to $j = 1$, each woman is exogenously matched with a spouse/partner that is the same age as her, and draws a desired number of children $N^* \in \{0, 1, 2, 3\}$. There are no marital transitions (no separations or divorces), and N^* remains constant for their whole life.

From ages 25 to 39, in each period women must decide whether to try to have an additional child or not. We denote this decision by $b \in \{0, 1\}$. If she decides to do so ($b = 1$), she gives birth to a baby next period with probability α_j, which decreases with age. Therefore, women can give birth between the ages of 26 and 40. Each woman can have a maximum of three children, and we denote the total number of children by $N \in \{0, 1, 2, 3\}$.

After being born, each child transitions stochastically between four stages of life, based on the different kinds of costs children impose on mothers as they age. The first two stages are newborn (below one year old, thus born in the current period) and baby (between ages 1 and 3). The only difference between them is that newborns may come with a baby check. Children in these two stages entail the same consumption, leisure and childcare costs. The third stage represents school-age (between ages 3 to 12). As children move to this stage, they continue to impose consumption and leisure costs, although quantitatively not identical to those imposed by newborns and babies. However, full-time childcare for school-age children is free for the parents (we assume universal public provision). Finally, those in the fourth stage are teenagers/young adults (ages 12 and up), which are not costly at all for mothers in terms of leisure, but represent a larger burden on consumption. The exact mathematical form all these costs take is discussed in the next subsection.

We denote by $\mathbf{n} = [n_0, n_1, n_2, n_3]$ the vector indicating the number of newborns, babies, school-age children and teenagers, respectively (hence $N = n_0 + n_1 + n_2 + n_3$). A newborn becomes a baby with probability one after one period. A baby becomes a school-age child and a school-age child becomes a teen with probabilities $\lambda_1 = 1/2$ and $\lambda_2 = 1/11$, respectively. That is, in expectation, a child spends two years as a baby and eleven years in school-age. The teenage/young adult stage is absorbing: once a child reaches this stage, it remains there. We denote this structure by $\mathbf{n'} = \Lambda_j(\mathbf{n}, b)$.[19] The main advantage of modelling children's ageing in this way is that we avoid the necessity of carrying the age of each child as a state variable.

3.2 Preferences and constraints

Women are the sole decision-makers in the household. Alternatively, they hold all the bargaining power, and thus the household's preferences are perfectly aligned with hers. In each period, apart from their fertility decision, they must also decide their labour force participa-

[19]See appendix D for the exact functional form this structure takes.

tion $h \in \{0, 1/4, 1/2\}$, where $h = 0$ means no participation, and $h = 1/4$ and $h = 1/2$ stand for part-time and full-time work, respectively.[20]

In each period, utility is derived from consumption (c), leisure (l) and children ($\mathbf{n}$). The functional form for instantaneous utility is given by the sum of CRRA terms for the first two, and an additional term which is a function of the latter:

$$u(c, l, \mathbf{n}; N^*) = \frac{\left(\frac{c}{\psi(\mathbf{n})}\right)^{1-\gamma_c} - 1}{1 - \gamma_c} + \delta_l \frac{l^{1-\gamma_l} - 1}{1 - \gamma_l} + \Gamma[\mathbf{n}, h; N^*],$$

where:

$$\Gamma[\mathbf{n}, h; N^*] = -\delta_N(\mathbf{n}; N^*) \frac{\exp(j - \gamma_N)}{1 + \exp(j - \gamma_N)} |N - N^*| + \mathbb{1}_{\{N>0\}}\zeta + \mathbb{1}_{\{h=1/2\}}\kappa(\mathbf{n}).$$

Children affect utility directly and indirectly. The first two terms of the above expression depend purely on the number of children, and are, therefore, the direct effect. First, women experience a utility penalty from the difference between current (N) and desired or target number of children (N^*). This can be interpreted as craving for children among women that are still able to have them, and lifetime regret among those that cannot. Either way, it is the reason why women have children in the model.

The intensity of the penalty for not having the desired number of children depends on two terms. The first one, $\delta_N(\mathbf{n}; N^*)$ introduces a non-linearity:

$$\delta_N(\mathbf{n}; N^*) = \delta_{N1} \left[1 - \delta_{N2} \mathbb{1}_{\{N=2, N^*=3\}}\right],$$

i.e., we allow for the marginal disutility of not having a third desired child to be different from the marginal disutility of not having the first and the second.

The second one introduces age variation. In particular, it is a sigmoid function that increases with age and is asymptotic to 1. That is, younger women experience only a fraction of the utility penalty older women do, but this fraction increases with age. This can be interpreted in various ways. One is that it captures factors not included in the model that cause women to postpone fertility, such as housing and partner disposition. Another one is that it is a child-specific discount rate that decreases with age, as opportunities to

[20]Out of the 24 hours a day has, we assume 8 are used for sleeping and personal care, leaving 16 hours to be split between work, childcare and leisure. A full-time job (8 hours per day) therefore represents $\frac{1}{2}$ of the time endowment, while a part-time one (4 hours per day) represents $\frac{1}{4}$ of it.

have additional children diminish. Finally, there is a fixed (dis)utility of motherhood, ζ.

The functional forms described above allow the model to reflect aspects about the quantum and tempo of fertility. Anticipating the calibration, it should be apparent that ζ is crucial for the extensive margin of fertility (i.e. remaining childless or becoming a mother), δ_1 and δ_2 for the intensive margin (having 1, 2 or 3 children), and γ_N for the timing of births.

The third term in $\Gamma\left[\mathbf{n}, h; N^*\right]$, $\kappa(\mathbf{n})$ intends to capture the difficulties associated with working full-time while having kids. This includes schedule conflicts between full-time childcare and work, and disutility from not spending time with children.[21] We allow this cost to vary on the age of the youngest child:

$$\kappa(\mathbf{n}) = \begin{cases} \kappa_1 & \text{if } n_0 + n_1 > 0 \\ \kappa_2 & \text{if } n_0 + n_1 = 0 \text{ and } n_2 > 0 \\ 0 & \text{if } n_0 + n_1 + n_2 = 0, \end{cases}$$

that is, if there is a newborn or baby present in the household, the utility cost of working full time is κ_1, if there aren't any newborns or babies, but there are school-age children, it is κ_2, and if there aren't any children other than teenagers, the cost if zero.

Children are costly in terms of consumption (non-childcare), and older children more so. To reflect this, we use the OECD equivalence scale to adjust per-capita consumption in the household. It assigns a value of 1 to the household head, 0.7 to each adult and 0.5 to each child. Teenagers are counted as adults, hence:

$$\psi\left(\mathbf{n}\right) = 1.7 + 0.7 n_3 + 0.5(n_0 + n_1 + n_2).$$

Leisure time is also negatively affected by children. We assume that children require a minimum amount of time from the mother that increases sub-linearly to reflect economies of scale in the childcare production function (e.g. it doesn't take double the amount of time to prepare food for two children than it takes to prepare food for one). Moreover, we allow the minimum time required by children to vary on the age of the youngest. In particular:

[21]Childcare usually goes from 9 am to 5 pm, but a full-time job may not correspond to that schedule. The fact that parents with young children must drop off and pick up their children at determined hours themselves or have someone else do it introduces an additional cost to working full-time. Moreover, Guner et al. (2021) report on the unusual organization of the workday in Spain, with long lunch breaks that create split-shift schedules. For example, 50% of workers are still at work at 6 pm in Spain, compared to 20% in the UK.

$$\xi(\mathbf{n}) = \begin{cases} \xi_1\sqrt{n_0+n_1+n_2} & \text{if } n_0+n_1>0 \\ \xi_2\sqrt{n_2} & \text{if } n_0+n_1=0 \text{ and } n_2>0 \\ 0 & \text{if } n_0+n_1+n_2=0, \end{cases}$$

e.g., if there are two children in the household, the cost can be different depending on the ages. If both are school-age, the leisure cost for the mother is $\xi_2\sqrt{2}$, but if one is a baby, the cost is $\xi_1\sqrt{2}$. This provides flexibility for the model to reflect the needs children of different ages may have. Notice once again that teenagers do not impose any leisure costs.

With this, we can define leisure time for the mother, which is the residual of a time endowment of one unit minus hours at work h minus time required by children:

$$l = 1 - h - \xi(\mathbf{n}).$$

Finally, we assume that women in the labour force with newborns and babies are required to purchase childcare time for the same amount of time she works. Resources available for consumption at the household level are therefore the household's net income I minus childcare costs:

$$c = I - \lambda 2h\left(n_1+n_2\right),$$

where λ is the cost of full-time childcare (we assume part-time childcare costs half as much).[22]

3.3 Income

We seek to model income in a way that captures income risk faced by households, accounts for labour market duality, is capable of reflecting the degree of (after-tax) income inequality (across households and genders, i.e. reflects the gender wage gap) and accounts for the returns of experience at different ages. To this end, we model spouses' (gross) income as depending on a couple of correlated, persistent stochastic shocks, the type of contract available (temporary or permanent), and accumulated experience.

The stochastic shocks for the woman and her partner are given by ϵ^f and ϵ^m, respectively.

[22]It is possible that childcare costs do not increase linearly with the number of children (because of sibling discounts, etc.). However, we were not able to find good sources to determine the shape of the function.

The household draws a couple of initial shocks $\left(\epsilon_1^f, \epsilon_1^m\right)$ from an exogenous joint distribution, that subsequently evolves over time following an AR(1) process:

$$\begin{array}{l} \epsilon^{f\prime} = \phi^f \epsilon^f + \nu^f \\ \epsilon^{m\prime} = \phi^m \epsilon^m + \nu^m \end{array}, \quad \begin{bmatrix} \nu^f \\ \nu^m \end{bmatrix} \sim N\left(\begin{array}{c} \mu^f = 0 \\ \mu^m = 0 \end{array}, \begin{bmatrix} \sigma^2_{\nu^f} & \rho \\ \rho & \sigma^2_{\nu^m} \end{bmatrix} \right).$$

Experience is accumulated over time by working. We assume the partners always work full time, and therefore their experience in period j is $j-1$, $\forall j \in \{1, \ldots, J\}$. For women, experience changes from one period to the next according to:

$$x' = \begin{cases} x & \text{if } h = 0 \\ x \text{ w.p. } 1-\pi_z & \text{if } h = \frac{1}{4} \\ x+1 \text{ w.p. } \pi_z & \text{if } h = \frac{1}{4} \\ x+1 & \text{if } h = \frac{1}{2}, \end{cases}$$

that is, experience remains constant if she does not work, increases by one year if she works full time, and increases by one year with probability π_z if she works part-time. Notice that if $\pi_z = \frac{1}{2}$, half a year of experience is accumulated with one year of part-time work. However, we allow for $\pi_z \neq \frac{1}{2}$, possibly lower, to reflect a penalty of working part-time on experience accumulation. We denote this structure as $x' = \Pi_x(x, h)$.

We model labour market duality only for women. They draw an initial contract type $z_1 \in \{0, 1\}$, where 1 denotes permanent contracts and 0 temporary ones. In subsequent periods the probability of having an permanent contract depends on experience, the type of contract available in the previous period and whether she worked in the previous period:

$$z' = \begin{cases} 0 & \text{if } z = 0 \text{ and } h = 0 \\ 0 \text{ w.p. } 1-\pi_z(x) & \text{if } z = 0 \text{ and } h > 0 \\ 1 \text{ w.p. } \pi_z(x) & \text{if } z = 0 \text{ and } h > 0 \\ 1 & \text{if } z = 1, \end{cases}$$

that is, if a woman has a temporary contract and works, she becomes permanent with probability $\pi_z(x)$ (which depends on her accumulated experience). If she has a temporary contract and does not work, she will still only have a temporary contract available for her next period. If she already has a permanent contract, she will also have one in the next period (it is an absorbing state). We denote this structure as $z' = \Pi_z(x, h, z)$.

Putting all the elements together, full-time (potential) log income for the woman is:

$$\ln\left(y^f\right) = \eta_0^f + \Delta\eta_0^f \mathbb{1}_{z=1} + \left(\eta_1^f + \Delta\eta_1^f \mathbb{1}_{\{z=1\}}\right) x + \left(\eta_2^f + \Delta\eta_2^f \mathbb{1}_{\{z=1\}}\right) x^2 + \epsilon^f,$$

that is, the type of contract changes the baseline income level and the returns to experience. In particular, if $\Delta\eta_0^f > 0$, $\Delta\eta_1^f > 0$, $\Delta\eta_2^f < 0$ and $\pi_z(x)$ is increasing in x, women have an additional reason to work as much as possible at the beginning of their career, i.e. to increase the likelihood of getting an open-ended contract, under which expected income is higher.

Log income for the husband is given by:

$$\ln\left(y^m\right) = \eta_0^m + \eta_1^m (j-1) + \eta_2^m (j-1)^2 + \epsilon^m.$$

The household's net income is the sum of the gross incomes of both partners minus tax liabilities:

$$I = y^m + 2hy^f\left(1 - \mathbb{1}_{\{h=\frac{1}{2}\}}\phi\right) - T\left(y^m, y^f, h\right),$$

where ϕ is an earnings penalty on part-time work, and $T(.)$ is a tax liability function.

3.4 Timing, states, choice variables, and problem in recursive form

Upon entering the economy, women draw a fertility preference N^*, an initial contract type z_1, and initial income shocks for them and their partners $\left(\epsilon_1^f, \epsilon_1^m\right)$. Then, they enter period 1 with no experience and no children, i.e. $x_1 = 0$ and $\mathbf{n}_1 = [0, 0, 0, 0]$.

From period 1 on, women observe their state vector $\left[\epsilon^f, \epsilon^m, z, x, \mathbf{n}\right]$, and choose their labour supply h and whether or not to try to have an additional child next period $b \in \{0, 1\}$. This continues for every period, until they reach 3 children or age 39 ($j = 15$). After this happens, they cannot have any more children, and they choose only labour force participation in each period.

The dynamic problem women solve in period j is given by:

$$
\begin{aligned}
&V_j\left(\epsilon^f, \epsilon^m, z, x, \mathbf{n}; N^*\right) = \\
&\max_{\substack{h\in\{0,\frac{1}{4},\frac{1}{2}\} \\ b\in B_j(\mathbf{n})}} u\left(c, l, \mathbf{n}; N^*\right) + \beta\mathbb{E}\left[V_{j+1}\left(\epsilon^{f\prime}, \epsilon^{m\prime}, z', x', \mathbf{n}'; N^*\right) \mid \epsilon^f, \epsilon^m, z, x, \mathbf{n}\right] \\
&\text{s.t.} \\
&l = 1 - h - \xi(\mathbf{n}) \\
&c = I - \lambda 2h\left(n_1 + n_2\right) \\
&I = y^m + 2hy^f\left(1 - \mathbb{1}_{\{h=\frac{1}{2}\}}\phi\right) - T\left(y^m, y^f, h\right) \\
&\ln\left(y^f\right) = \eta_0^f + \Delta\eta_0^f \mathbb{1}_{z=1} + \left(\eta_1^f + \Delta\eta_1^f \mathbb{1}_{\{z=1\}}\right)x + \left(\eta_2^f + \Delta\eta_2^f \mathbb{1}_{\{z=1\}}\right)x^2 + \epsilon^f \\
&\ln\left(y^m\right) = \eta_0^m + \eta_1^m\left(j-1\right) + \eta_2^m\left(j-1\right)^2 + \epsilon^m \\
&\epsilon^{f\prime} = \phi^f\epsilon^f + \nu^f \\
&\epsilon^{m\prime} = \phi^m\epsilon^m + \nu^m \\
&\mathbf{n}' = \Lambda_j(\mathbf{n}, b) \\
&x' = \Pi_x\left(x, h\right) \\
&z' = \Pi_z\left(x, h, z\right),
\end{aligned}
$$

where the choice set for the birth decision is defined as:

$$
B_j(\mathbf{n}) = \begin{cases} \{0,1\} & \text{if } N < 3 \text{ and } j < 15 \\ \{0\} & \text{otherwise.} \end{cases}
$$

4 Calibration

We calibrate the model in two steps. First, there is a set of parameters that we take from previous literature or estimate without solving yet the model. These include the parameters of the income process, the pregnancy success probabilities by age, the distribution of women over the number of desired children, and the cost of childcare. The second set of parameters is chosen jointly by targeting a set of data moments concerning average labour force participation rates for women without children and mothers with children of different ages, the tempo and quantum of fertility, and the short-run response to the sudden introduction of a cash transfer policy. For these, we rely on the Method of Simulated Moments.

4.1 Parameters chosen before solving the model

To estimate the parameters governing the household's gross income, we turn to Spanish administrative data. In particular, we use the *Muestra Continua de Vidas Laborales* (MCVL, Continuous Working Life Sample), which is a 4% random sample of all affiliates to Social Security in Spain. The first step is to estimate the following Mincer regression separately for men, women with temporary contracts and women with permanent contracts:

$$\ln(y_{it}) = \beta_0^s + \beta_1^s x_{it} + \beta_2^s (x_{it})^2 + \Theta_{it} + \epsilon_{it},$$

where x_{it} is experience for individual i at time t, Θ_{it} is a vector of controls and $s = \{m, ft, fp\}$ stands for men, women under temporary and women under permanent contracts, respectively.[23] From the results of these regressions, we obtain the constant term and the returns to experience for the gross income equations for each of the three groups. We then take the residuals obtained from this estimation and regress them on their time lags at the individual level, to obtain the persistence parameters of the AR(1) process for the stochastic shocks, and the variance of the innovations. For the correlation coefficient between spousal shocks, we follow Hyslop (2001) and set a value of 0.25.[24] The results of this procedure are shown in table 2.

For the numerical solution, we approximate the auto-regressive vector of stochastic shocks for the woman and her partner with a discrete-valued Markov chain using the method proposed by Tauchen (1986) and Tauchen and Hussey (1991). We use a 10 by 10 grid for the values of the shocks, where each point is calculated so that the income of the n-th point is the average income of the n-th decile for men and women at age 26. For the initial distribution of households over that grid, we identified all marriages without children and in which the woman was between 26 and 30 years old in the ECV between 2004 and 2007. Then, we computed hourly wages, and the deciles for each (separately for women and partners). Finally, we created a 10 by 10 matrix containing the fractions of couples by woman and partner decile.[25] This is the distribution from which the initial income shocks are drawn.

To estimate the probability of transitioning from a temporary to a permanent contract as a function of experience, we run a logit regression where the left-hand side variable is a dummy for being on a permanent contract, on experience and other controls. We then estimate the effect of one additional year of experience for the average individual, for each

[23] See the appendix for the exact specification.

[24] This was estimated for the United States. Replicating his work for Spain is beyond the scope of the paper.

[25] There is a small number of married, childless, non-working women in this age range, which we discard.

Table 2: Parametrisation of the income process

	η_0^f	$\Delta\eta_0^f$	η_1^f	$\Delta\eta_1^f$	$\Delta\eta_2^f$	η_2^f	ϕ^f	$\sigma^2_{\nu^f}$
Women	6.348	0.806	0.048	-0.007	-0.003	0.001	0.906	0.184
	η_0^m		η_1^m		η_2^m		ϕ^m	$\sigma^2_{\nu^m}$
Men	7.093		0.046		-0.001		0.900	0.184

level of experience (from zero to 25 years). As a final step to obtain all the necessary parameters for household net income, we use the parametric effective tax functions estimated for Spain by García-Miralles et al. (2019) to account for tax liabilities and credits.

The probabilities of pregnancy success conditional on age α_j are estimated following Sommer (2016), who fits an exponential function to point estimates of infertility by age from the medical literature (Trussell and Wilson, 1985). They imply a success probability of 0.85 at age 25, which drops slowly to 0.77 at age 30, somewhat more rapidly to 0.65 at age 35 and then to 0.48 at age 39.[26]

For the distribution from which women draw N^*, we use the fractions of women by desired number of children taken from the EdF reported in table 1. We are aware that these may be responsive to policy. However, in section 2, we discuss why it is unlikely that one like the baby check has a large effect on these answers, based on the small observed differences across average responses among people with different incomes in the cross-section, and the similarity of average responses across cohorts over time. In any case, we believe these answers capture relevant information about the heterogeneity in preferences among women in the population of interest and are useful in a calibration exercise.

Using the Spanish Family Expenditures Survey, we estimated that a family with a child aged 0-3 using full-time childcare spent in 2007 on average around €2000. Therefore, we use this number as the cost per child per period for full-time, and half the amount as the cost for part-time childcare. Finally, for the subjective discount factor we use $\beta = 0.96$ (Kydland and Prescott, 1982).

4.2 Parameters chosen via the Method of Simulated Moments

The remaining 12 parameters are calibrated by matching 12 moments from the data. The targets can be divided in three groups. The first one comprises labour force participation rates for women with and without children. The second one encompasses average quantum

[26] See appendix E for more details.

and tempo of fertility. The third group involves the response to the cash transfers identified by González (2013).

We include part and full-time participation rates for three groups of women (6 targets): childless, mothers whose youngest child is 0-3 (newborn or baby) and mothers whose youngest child is 3-12 (school-age). The data moments are taken from the 2004-2007 ECV. For each woman, we have information on participation by month. We compute an average yearly participation rate, counting each month worked full-time as 1, each month worked part-time as $\frac{1}{2}$, and dividing by 12. Following Bick (2016), we create a yearly participation status variable that falls into one of our three categories: if the average participation rate was above 0.75, we count the woman as having worked full-time that year, if it is between 0.75 and 0.25 we count her as having worked part-time and if it falls below 0.25 we count them as being out of labour force. For childless women, we target the average part-time and full-time yearly rates between ages 25 and 51. For mothers, we target the average rates for all women with children of the respective age.

To compute the fertility targets, we use the EdF. In particular, we computed the fraction of women aged 40-44 in 2018 that had 0, 1, 2 and 3 children, and the average age at which this group had their first child. We use this sample because these women were in all likelihood very close to their completed fertility, which is the outcome of interest in the long run. These are 4 targets in total.[27]

Finally, González (2013) states in the conclusions of her paper that she finds that the number of births increased by 6 percent, and that mothers were 2-4 percentage points less likely to be working 12 months later as a result of the baby checks. We take these numbers as her preferred estimates and target a 6 percent increase in births and a 3 percentage points reduction in participation. These are the last two targets. To simulate the announcement of the baby checks in the model, for each woman in each period we retrieve the policy function under the baseline scenario (no checks) and under an active policy scenario (baby checks announced, expected to stay in place forever). We store the decisions under both scenarios. We then calculate the average number of children born in a typical year without the policy, and the number of children that would be born with it, and compute the percent difference.

Although all parameters affect all model moments once we solve the model, some are more important than others for certain targets. The first two parameters, γ_c and γ_l govern how fast marginal utility from consumption and leisure falls, respectively. They are therefore important in determining how willing are women to substitute between consumption, leisure and children, and play an important role in the intensive margin of LFP decisions (part-time

[27] One of the fractions of women by the number of children is residual, and therefore there are really only three targets for quantum and one for the tempo of fertility.

versus full-time) and for the fertility and LFP responses to the baby checks. The parameter on the age-varying weight on the fertility gap regulates how early the craving for children starts in the women's life cycle, thus it is important for the average age at first birth. The weight on leisure δ_l plays an important role for extensive margin LFP decisions. For the distribution of women by number of children, δ_{N1}, δ_{N2} and ζ are crucial. The first one increases the penalty for not achieving the desired number of children, and therefore when it is higher every woman is more likely to be closer to her desired number of children. The second one diminishes the marginal penalty of not having a third child, and is thus important for the fraction of women that end up having 3 children. The last one is an additional utility from just being a mom, and plays an important role in the extensive margin of fertility, that is, the decision between remaining childless or having children. The next four parameters, ξ_1, ξ_2, κ_1 and κ_2 are relevant for the LFP decisions of mothers with children at different ages. The first two affect the extensive margin, while the last two the intensive one (by making full-time work costly). Finally, the part-time earnings penalty ϕ evidently has a direct impact on the likelihood of part-time work.

Table 3 shows calibrated parameters, with a description of their role in the utility function. Consumption utility is almost logarithmic, with γ_c very close to 1. The penalty for not having a third child is 27% lower than the penalty for not having the first two, while there is additional utility from the first child as given by the fixed utility from motherhood ζ being positive. This can be interpreted as the utility cost of remaining childless being larger than the cost of having children but fewer than desired, which seems reasonable. The time cost with younger children is larger, while the extra cost of full-time work is very similar independently of the age of the children. Finally, the model implies that working part-time entails a 20% penalty on hourly earnings compared to working full-time.

Table 4 shows the model's outcomes versus the data targets. In general, we achieve our objective of reproducing closely the data targets with the calibrated model. In particular, it is important that we were able to get the correct magnitude of the effect of the baby checks on fertility. We fall slightly short on the magnitude of the effect on LFP, but we are not too far from the lower range of 2 percentage points drop in González (2013). The effect is nevertheless small, and the model is qualitatively close.

4.3 Model evaluation: non-targeted moments

Here we discuss the model's results for a set of non-targeted moments. First, we would like to know how well the model replicates the long-term costs that motherhood imposes on women. Kleven et al. (2019a) propose an event-study specification around the birth of the

Table 3: Parameters calibrated with the method of simulated moments

Parameter	**Description**	**Value**
γ_c	Curvature of consumption	0.985
γ_l	Curvature of leisure	0.151
γ_N	Age-varying weight on fertility gap	26.500
δ_l	Weight on leisure	0.832
δ_{N1}	Base weight on fertility gap	0.364
δ_{N2}	Weight on fertility gap, 3rd child	0.270
ζ	Fixed utility of motherhood	0.115
ξ_1	Time cost, youngest child 0-3	0.349
ξ_2	Time cost, youngest child 3-12	0.211
κ_1	Cost of full-time work, youngest child 0-3	-0.030
κ_2	Cost of full-time work, youngest child 3-12	-0.040
ϕ	Part-time earnings penalty	0.200

first child to measure the effect of children on the labour market outcomes of the parents. This specification, originally applied on Danish data, has since been used by Kleven et al. (2019b) for Sweden, Germany, Austria, the UK and the US. More importantly for us, de Quinto et al. (2021) did it for Spain, using the MCVL (which is the same data that we use to estimate the parameters of our income process). They assess the impact of the first child on gross earnings, days of work, probability of part-time employment and probability of being on a temporary contract. The first and the last two of these outcomes have direct counterparts in our model. We implement the event-study specification on our simulated data. The results, together with the original estimates by de Quinto et al. (2021), are shown in figure 5.

Qualitatively, the model displays adequate behaviour in all three outcomes: the earnings and part-time penalties increase rapidly the first two years after giving birth to the first child, while the temporary penalty is close to zero at the beginning and then increases slowly with age. Moreover, the three outcomes show a long-term penalty, i.e. even 10 years after giving birth the gap is still present.

The reason why earnings and part-time probability increase immediately after the first birth is straightforward: after having their first child, many women switch to part-time employment or drop out of the labour force, which means they earn less or nothing at all (the earnings child penalty is estimated unconditional on employment status). The reason behind the shape of the penalty on the probability of being on a temporary contract is more subtle: women on permanent contracts are more likely to have children (in the data you can see it as a negative penalty for the first two years, in the model, there is only a very small

Table 4: The model vs. the data, baseline calibration targets

Moment	Model	Data	Difference
Labour force participation:			
Childless women:			
Part-time rate	0.190	0.194	-0.003
Full-time rate	0.732	0.717	0.015
Mothers, youngest child 0-3:			
Part-time rate	0.285	0.276	0.009
Full-time rate	0.539	0.537	0.002
Mothers, youngest child 3-12:			
Part-time rate	0.285	0.276	0.009
Full-time rate	0.579	0.583	-0.004
Fertility:			
Share of women with:			
0 children	0.190	0.190	0.000
1 child	0.240	0.250	-0.009
2 children	0.444	0.438	0.006
3 children	0.126	0.123	0.004
Average age at first birth	29.458	29.300	0.158
Effects of cash transfers on:			
Annual number of births	0.062	0.060	0.002
Mother's LFP over the first year	-0.016	-0.030	0.014

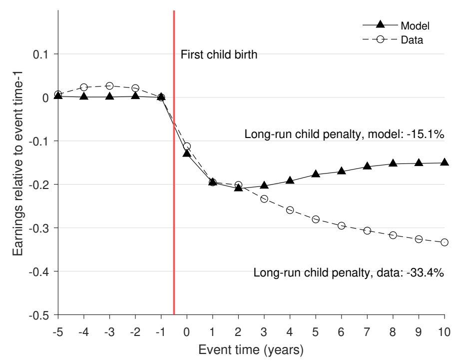
Note: The effect of the cash transfers is the number of births over the next year after the introduction of the policy. The effect on mothers' LFP over the first year is the difference between participation rates. Data points are the ones reported by González (2013) in the conclusions of her paper, which we take to be her preferred ones: 6 percent increase in the annual number of births, mothers 2-4 percentage points less likely to be working 12 months later.

effect the period the child is born). However, over time those that had children but were on temporary contracts convert them at a much lower rate than those who didn't have children, because many of the former take career breaks or switch to part-time.

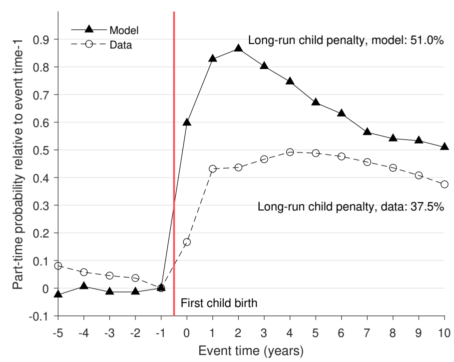
Quantitatively, the model's long-term part-time and temporary contract probability penalties are quite close to the data counterparts. The main discrepancies occur in the first 5 years of the part-time and the last 6 of the earnings penalties. We think this is due to the fact that there are a number of factors that the model does not feature that affect earnings among mothers, including occupational choice and loss of skills (Adda et al., 2017). During the first years after birth, the model gets the right earnings by overestimating the part-time penalty. After the fifth year, the part-time penalty falls very close to the one from the data. The earnings penalty reflects it by diverging from the one from the data.

Figure 5: Child penalties in the model and the data

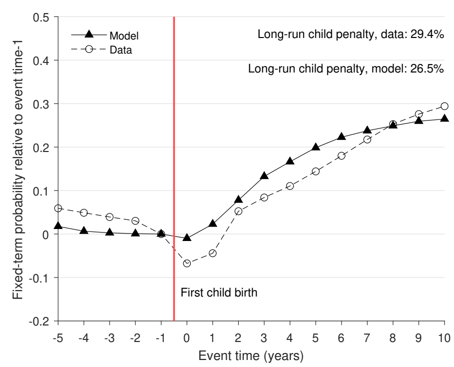
(a) Earnings



(b) Part-time work



(c) Fixed-term contract

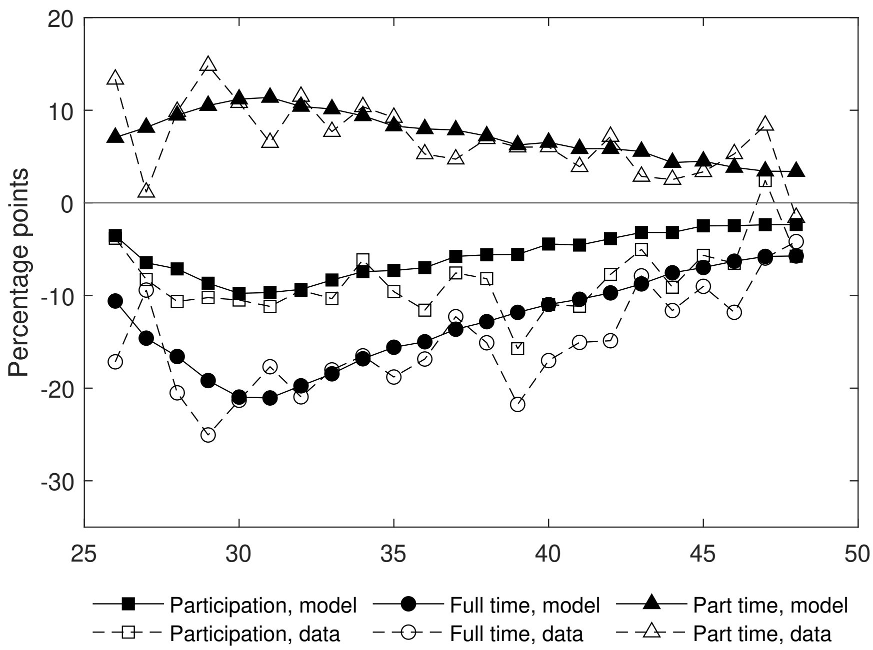


Source: Source: Author's work and data from de Quinto et al. (2021).

Note: The effects on (gross) earnings are estimated unconditional on employment status. The effects on part-time and fixed-term contracts are estimated conditional on working.

While we target average labour force participation by childless women and women with children of different ages, we would also like to have an idea of how well the model reproduces the participation gaps that exist between childless women and mothers at different ages. Figure 6 shows this, along with the data counterparts (which are the same series we showed in figure 4). The model reflects very well the general patterns: negative overall participation and full-time gaps and positive part-time gaps that are the largest around age 30 and close gradually as women age.

Figure 6: Labour force participation gap between mothers and childless women by age in the model

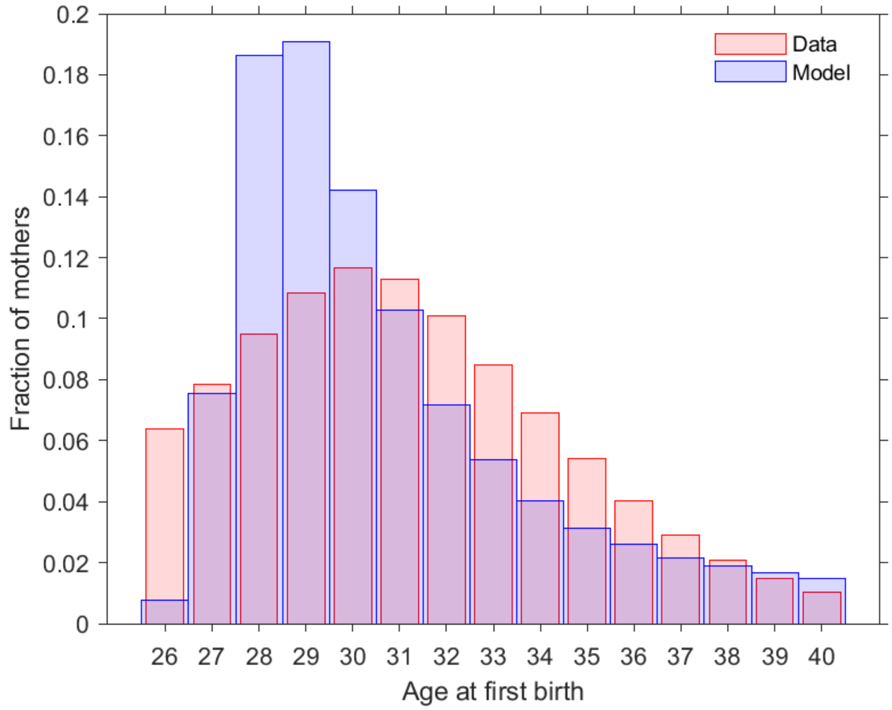


Source: Author's work and data from *Encuesta de Condiciones de Vida, 2004-2007, INE.*

Finally, although we target the average age at first birth, it is interesting to compare how its distribution looks with respect to the data. This is shown in figure 7. Again, qualitatively the model reproduces the main features: the fraction of women having their first child is positive for every age between 26 and 40, with the bulk of women having it in their late 20s and early 30s, and the fraction of first-time mothers decreasing slowly after that. The main discrepancies occur with women aged 26 and with women in their mid-thirties. However, the model displays a good amount of time variability in this dimension.

Overall, the fit of the model along non-targeted moments is satisfactory, and it seem

Figure 7: Distribution of mothers by age of first birth, model and data



Source: *Encuesta de Fecundidad 2018, INE.*

to be an adequate setting to perform the quantitative experiments necessary to answer the main research questions considered in this paper.

5 Quantitative experiments

One of the main advantages of having a structural model like the one we propose in this paper is that it allows us to perform quantitative experiments consisting of counterfactual simulations. In this section, we present the results of three such experiments. For the first one, we assess the long-run effects of cash transfers on fertility, by simulating the life-cycle of women that are eligible for the policy for the entire duration of their lives. Then, we analyse the effects of an alternative policy, consisting of the subsidisation of childcare for mothers of children aged 0-3, which is the one group for which there was no public universal coverage at the time the baby check was introduced. Finally, we explore the role that the duality of the Spanish labour markets play on fertility, its interplay with labour force participation, and the effects of the cash transfers themselves.

5.1 Short and long-run effects of the cash transfer

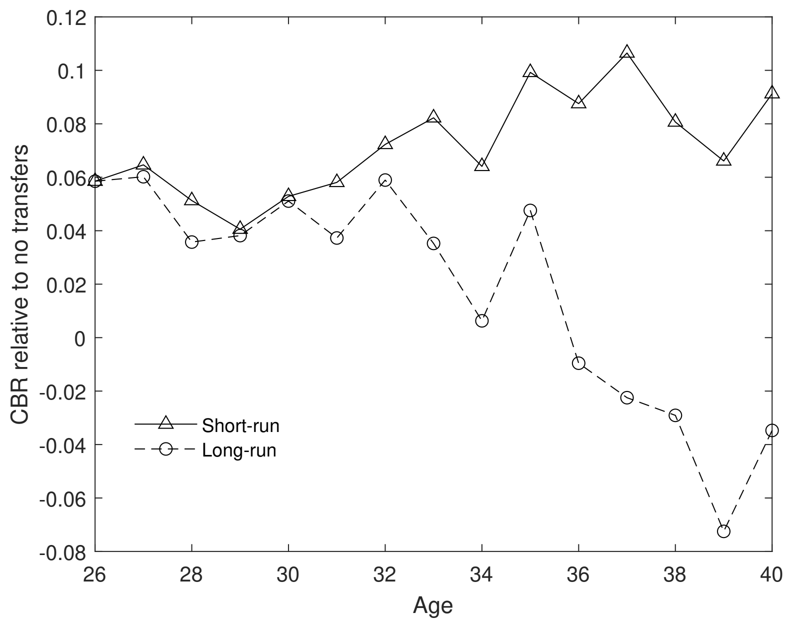
The main objective of this paper is to provide an estimate of the effects of a cash transfer policy on fertility in the long run. We are therefore interested on the *completed fertility rate* (CFR, the average total number of children women have) in the long-run. To obtain this number, we simulate the life-cycle fertility and labour force participation decisions of women using our model, with every one of them being eligible to receive the baby check in every period of their life, and having full knowledge of the fact. Then, we can compare the CFR of a cohort of women in such a situation with the CFR in the baseline scenario, with no cash transfers.

In our model baseline, the CFR was 1.553 children per woman. In our counterfactual exercise in which each woman is eligible to receive the baby check in every period, the CFR goes up to 1.599. This is a 2.95% difference, just short of half of the 6% effect in the short run.

To understand why the long-run effects are different from those in the short run, it is useful to think about the effect of the policy on women of different ages, and to think about children as durable goods. After a certain age (around 30), most women want to have them as soon as possible (because they provide a utility flow). The exact timing depends on individual conditions. However, if a new policy that makes it more favourable to have children (at any age) is introduced, the likelihood that a woman has one in the following period goes up for all of them. However, for younger women, the likelihood that they have them later may decrease. The profile of the crude birth rate (CBR, the fraction of women that have a baby in a certain period of time) by age therefore may look very different for a cross-section of women at the time the policy is introduced compared to a cross-section of women a few years later. The effect of the baby check on fertility found by González (2013) is on the total number of births in a short window of time after the policy was implemented. This effect depends directly on the former CBR profile. However, in the long-run, the CFR depends on the latter.

Figure 8 shows the effect of the cash transfer on the CBR by age in the short and the long-run. The short-run effect is the CBR by age of the cross-section of women living at the time of the policy relative to the baseline CBR by age. That is, it shows the average fertility response for women of every age between 26 and 40 the period following the policy announcement. The long-run effect is the CBR by age for women that were eligible for the baby check for all of their reproductive lives, i.e. for ages 25 to 39. Notice that the two lines are identical for the youngest women. This is because these women face identical horizons. The two lines remain close for a few periods, but start to diverge in the 30s. The short-run effect remains positive, and has a soft U-shape. The reason is that cash transfers have a larger effect on young women, who are poorer, and on older women, for whom the transfer represents an incentive to take one of the few last opportunities to close the gap between their realised and desired number of children. Women in their late 20s and early 30s were having children anyways, so the effect on them is smaller. The long-run effect starts to fall, and even becomes negative in the late 30s. That is because young women had time to plan the births of the children they wanted before, and there are no older women who are caught by surprise by the policy anymore.

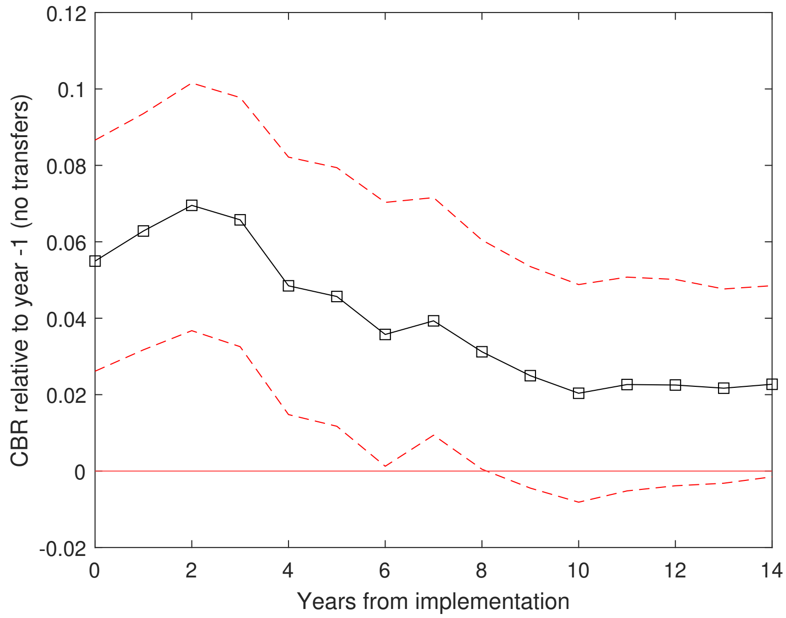
Figure 8: Effect of the cash transfers on the crude birth rate (CBR) by age



Note: The short-run effect of the cash transfers is the CBR by age for the cross-section of women living at the time of the implementation of the policy, relative to the baseline (without cash transfers). The long-run effect is the CBR by age among women that had access to the policy in every period in which they could have children, relative to the baseline.

To further understand how the effect of cash transfers on births changes over time, we simulate fifteen cohorts of women of different ages when the baby checks are announced. In year -1, the policy is announced. Then, in year 0, the overall crude birth rate depends on the responses of women aged 25-39 that were caught by surprise by the policy in the previous period and changed their decisions accordingly. In year 0, women aged 26-39 make fertility decisions conditional on their previous period choices, which affect the next period. The average decisions of each cohort in period 0 may be different from the average decisions of the previous cohort in period -1 (when they were the same age). This is because some women in the newer cohort had an additional child, and that lowers the likelihood that they will have one during this period. Figure 9 shows the crude birth rate by year after the implementation of the policy. The CBR in the period right after the implementation goes up by around 6%, but then it gradually falls to around 3%, as the CBR profile by age converges to the long-run one shown in figure 8.

Figure 9: Overall crude birth rate relative to no cash transfers by year after implementation

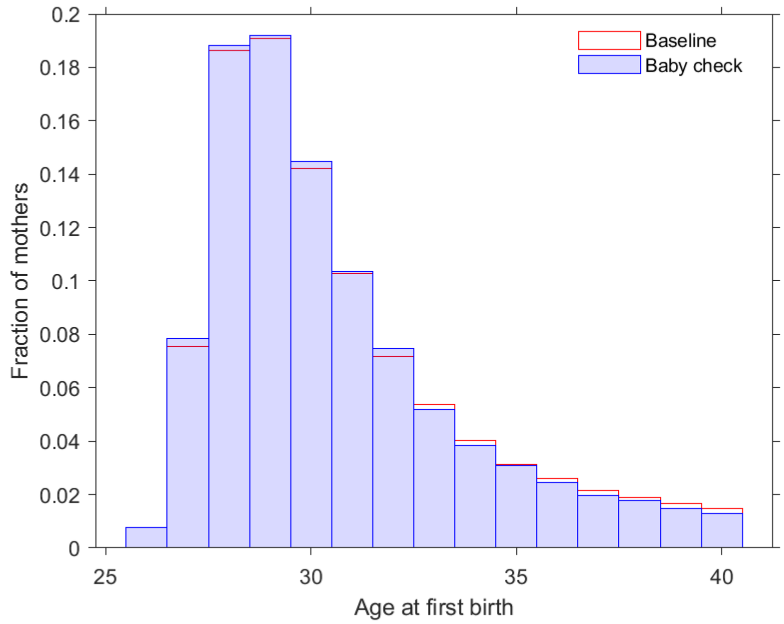


Note: Dashed red lines are 95% confidence intervals, constructed via bootstrapping.

By observing the shape of the long-run effects of cash transfers by age one concludes that timing must also change. In figure 10 we have plotted the fraction of women by age at first birth in the baseline and in our long-run counterfactual exercise. As expected, the distribution under the policy has more mass at younger and lower mass at older ages. In particular, there are more first-time mothers in their late 20s and fewer in their late 30s when cash transfers are in place. The average age at first birth is reduced with the transfers by 0.15 years (about two months), while the average spacing between children is also shortened, but the magnitude of the change is smaller (less than a month between the first and second and slightly more between second and third).

In a nutshell, the main reason why the short and long-run impacts of the cash transfers are different boils down to the difference between the fertility response that women in different stages of the life-cycle have to the surprise announcement and the response when they have had time to adjust the timing of their fertility. For younger women, that response is not that different. For older ones, it is, because they cannot go back in time and change their

Figure 10: Age at first birth in the model, baseline and with baby check



previous decisions and have only a few periods to adjust. Over time, this additional effect from older women having to adjust immediately goes away, as the women that become old have had time to adjust.

5.2 Childcare subsidies

Childcare availability (or lack thereof) is frequently cited as one of the reasons why fertility may be low. Subsidising childcare is a natural alternative to a universal cash transfer, such as the baby check. Here, we consider the effects of a subsidy for children aged 0-3, since schooling after that age is provided for free in Spain.

To be comparable in magnitude to the payment offered by the baby checks, we compute the proportional subsidy with a present discounted value equal to the baby check payment, i.e. €2500, for a full-time working mother. Such proportional subsidy is 43.34% of the yearly cost of full-time childcare (€2000), for the first three years of an infant's life. Since, in our model, women must buy childcare for the amount of time they work, an alternative way of seeing this policy is a cash transfer conditional on working.

Not surprisingly, the long-run fertility effects are smaller than the ones observed with the baby checks. Completed fertility increases by only 2.06%, compared with 3% with cash transfers. The two policies diverge in their effects on labour force participation: it drops by a little bit more than 1 percentage point with the cash transfers with respect to the baseline, but it increases by almost 1 percentage point with the childcare subsidies. This result, again, is hardly surprising since the latter is essentially a subsidy to working mothers. Moreover, part-time work remains unchanged, meaning that all of the effects operates through full-time.

Finally, in terms of the effect of the childcare subsidies on timing, again, they are a slightly more muted than with the cash transfers. The average age at first birth decreases by close to a month and a half, while the spacing between children remains unchanged.

5.3 Impact of labour market duality

Temporary contracts are associated with delayed and depressed fertility. While most of the literature exploring the effect of this type of working conditions on fertility centers on uncertainty and stability, we highlight another mechanism: returns to experience at critical ages. Most women start their careers under a temporary contract and anticipate that their labour market participation may be reduced after having their first child. Therefore, they have an additional incentive to work full-time, accumulate experience and postpone childbirth, i.e., obtain a permanent contract first.

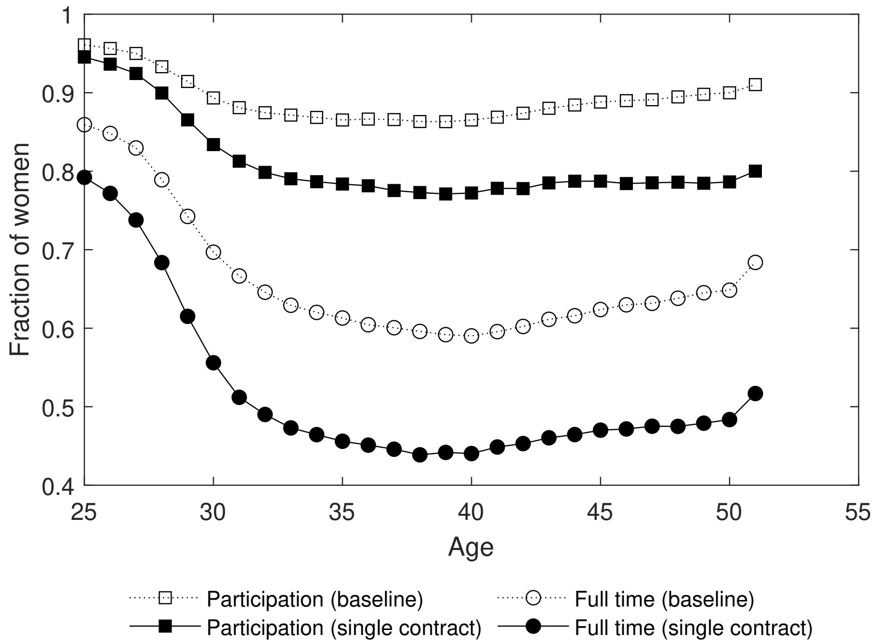
In our model, the difference between temporary and permanent contracts is reflected in the parameters of the income process. In particular, the constant term is larger for the permanent one, reflecting the fact that temporary workers experience unemployment spells during the year. Moreover, the returns to experience are larger for permanent workers, which could reflect firm or tenure-specific skill accumulation that temporary workers do not accrue.

The counterfactual we propose here is to have a single contract represented by a unique income process with parameters estimated from pooling all female workers. Among younger workers, this contract offers full-time earnings that are lower than the permanent contract, but higher than the temporary one in the baseline scenario. Therefore, the returns to experience are not as large at the beginning of women's careers.

We re-compute the model solution under the new parametrisation for the income process, simulate the life-cycle for cohorts of women that live under these labour market conditions, and compare it to the baseline scenario (with dual labour markets and no cash transfers). Our main result is a 9.6% increase in completed fertility rates, which is three times as much as the long-run increase we found with cash transfers. Moreover, the first age at birth is anticipated by 5 months, and the timing between births is slightly shortened.

To understand better what is driving these effects, figure 11 shows the average overall and full-time labour force participation in the baseline and under the single contract. The former is not very different early in women's working lives, but there is a gap in full-time participation early on. This gap widens as women get children (which happens earlier in the single contract scenario).

Figure 11: Female labour force participation through the life cycle, baseline and single contract



Finally, the last experiment we carry out is to implement the cash transfers on top of the single contract, and repeat the simulations. The completed fertility rate increases by 2.6% with respect to the scenario with a single contract but no transfers. This is very close but slightly lower than the effect the transfers had in the economy with dual labour markets. In terms of timing, the average age at first birth is further reduced by 0.12 years, or about a month and a half, with further smaller reductions in spacing, again very close to the effect on timing on the economy with temporary and permanent contracts. These results imply that the results of our first experiment, i.e. that the effects on fertility of giving cash transfers upon birth are smaller in the long-run than in the short-run, and modest in magnitude, were not heavily dependent on that feature of the model and the Spanish economy.

5.4 Discussion: bargaining and the role of fathers

One important assumption we make in our model is that women are the sole decision makers in the household. Moreover, the explicit behaviour of fathers is not analysed. Here we discuss the potential implications of accounting for bargaining and allowing for a more active role for fathers.

In heterosexual partnerships like the ones considered in this paper, both sides must participate in the making of a baby, and therefore there needs to be some sort of agreement for it to occur. This decision has two dimensions: the overall number of children and the timing of births. In a standard bargaining framework, both preferences enter as inputs, and the resulting outcomes should be a sort of weighted average of the preferences of the husband and the wife, with the weights depending on the relative threat points and bargaining power. Indeed, that is what the literature finds. In developing countries, the disagreement over the total desired number of children is larger, with men preferring to have more of them and their preferences taking precedence, likely because they tend to have more bargaining power in these contexts.[28] In industrialised countries, women's preferences are, at the very least, as important as men's, and each partner enjoys veto power when deciding whether to have additional children.[29] Doepke and Kindermann (2019) account for this using a quantitative model of household bargaining, and conclude that fertility responds highly to interventions that lower the childcare burden of women.

Accounting for bargaining may have some implications for our results. While there is no particular reason to think cash transfers lower the burden of women, childcare subsidies may. Therefore, this latter policy may have additional effects to the ones found by our model. Moreover, there is evidence that the disagreement over the desired overall number of children is small in developed countries. In particular, we find very similar preferences in this respect in Spain.[30]This suggests that using women's total desired number of children is not unreasonable in our context. However, the scope for disagreement on the timing of births may be important. As a rejoinder, two features of the model could be represented as a reduced form for the veto power that husbands may have on the timing of births: the age-dependent weight on utility from children and the taste shock we add for the computational solution.[31] Naturally, there may be interactions between policies like the cash transfers here and men's willingness to have children at different stages of life that the model, unfortunately, is unable to capture.

Whether or not one considers bargaining, it seems evident that fathers' behaviour can

[28] Westoff (2010) surveys desired fertility among men and women in African countries and finds differences of up to 5 children. Bankole (1995) and Gipson and Hindin (2009) provide evidence on the relative importance of men's fertility preferences in Nigeria and Bangladesh, respectively. Rasul (2008) develops and tests a model of household bargaining over fertility using Malaysian data. He finds that couples bargain without commitment and that fertility outcomes depend on the relative threat points, which vary across ethnic groups.

[29] Thomson (1997), Thomson and Hoem (1998), Testa et al. (2014) and Hener (2015) find evidence on this using data from the United States, Sweden, Italy and Germany, respectively

[30] See the appendix for details.

[31] See the computational appendix for more details.

affect the effect of family policies on fertility. The presence of a more cooperative partner, who, for example, is more willing and able to pick up kids from school, attend school meetings or cook meals, would relax the time costs children impose on mothers and their willingness to have more of them. Some of these effects could be similar to the effects of lowering the values of the parameters ξ_1 and ξ_2, which govern the time cost children of different ages impose on mothers and on κ_1 and κ_2, which represent the costs of being a full-time working mother. As an additional exercise, we lower by 5% the values of these parameters to assess how much this affects fertility decisions. The completed fertility rate increases by 10% in response to these changes. However, the effect of cash transfers becomes more muted. Partly this is due to fewer women being away from their desired fertility levels. There is no good reason to think that cash transfers would increase father's willingness to do childcare and housework, and their modest effects on fertility are consistent with this. Other policies, like paternal leaves, may have this effect.[32]

6 Conclusions

A natural experiment involving cash transfers upon birth took place in Spain in 2007. The experiment was exploited by González (2013) via a DiD-RDD design to estimate its effects on fertility and mothers' labour force participation. The causal relationship identified thus is best interpreted as short-run, around the policy intervention.

In this paper, we develop a life-cycle model of fertility and labour force participation, and calibrate its parameters using these cleanly identified short-run effects, along with other aggregate moments for Spain in the period right before the implementation of the policy. Using the model, we explore the longer-run effects of the transfers, as well as the effects of alternative policy interventions, and their interactions with an important feature of the Spanish labour markets: the coexistence of temporary and permanent contracts (duality).

We find that the long-run effect of cash transfers on fertility is about half as large as it is in the short-run. The main reason is that in the short run there are additional births by older women that do not have time to adapt their previous fertility choices and have to adjust soon. Moreover, we find that a childcare subsidisation policy that gives women the same amount in present value as the cash transfers do brings about an increase in long-run fertility that is only slightly lower, but increases labour force participation instead of decreasing it. Furthermore, we find that the duality in the Spanish labour markets has a large effect on

[32]Ekberg et al. (2013) find no effect on parental leave-taking on household work, but only using as a measure for it the share of leave taken for care of sick children. Bünning (2015) and Tamm (2019) do find long-lasting effects of leave-taking on childcare and housework. Farré and González (2019) interestingly find that paternity leave reduces fertility using data from Spain.

fertility, about three times as big as the effect of the transfers, driven by an increase in returns to experience during crucial years for child-rearing. However, labour market duality does not seem to be driving our results regarding the short versus long-run effects of cash transfers on fertility, as evidenced by the fact that the results change very little when we implement the policy in a scenario where only a single contract is available.

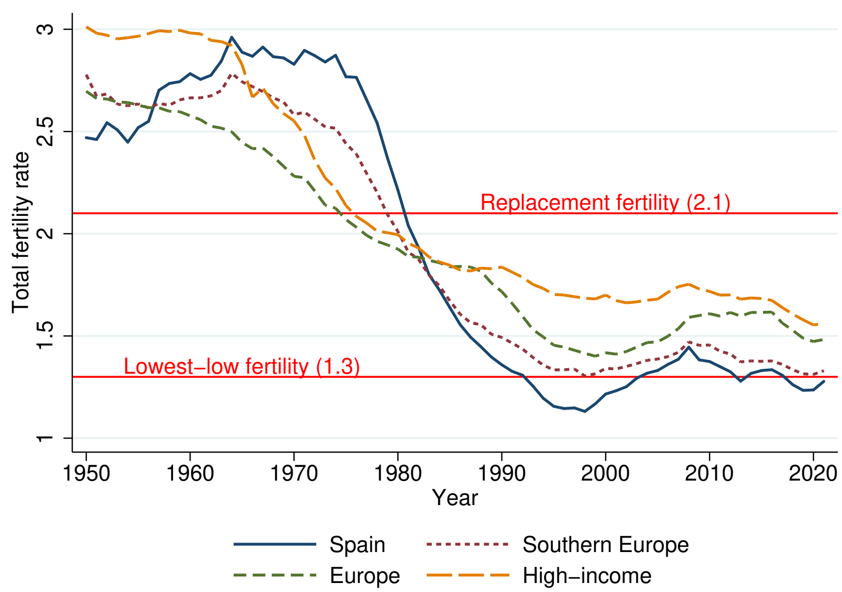
Our results highlight the importance of policy interventions that make labour market interruptions less costly (elimination of duality) and less necessary (childcare subsidies). This is in line with the main idea of the new economics of fertility, i.e. a crucial driver of it nowadays is the compatibility between career and family Doepke et al. (2022).

Appendices

A Spain's demographics

In the early 1990s, Spain became one of the first countries in the world to attain what demographers call lowest-low fertility, i.e. a total fertility rate (TFR, from now onwards) below 1.3 (Kohler et al., 2002). A group of countries, mostly in Southern, Central and Eastern Europe, followed. Figure 12 shows how Spain experienced a relatively late baby boom in the 1960s and 1970s, during which its TFR increased above that of others in its geographic proximity and that of the rest of high-income countries[33]. However, it fell rapidly in the 1980s, dipping below the lowest-low fertility threshold for a good deal of the three decades between 1990 and 2022, and below that of its peers for the entirety of that period.

Figure 12: Total fertility rate, selected countries (1950-2022)



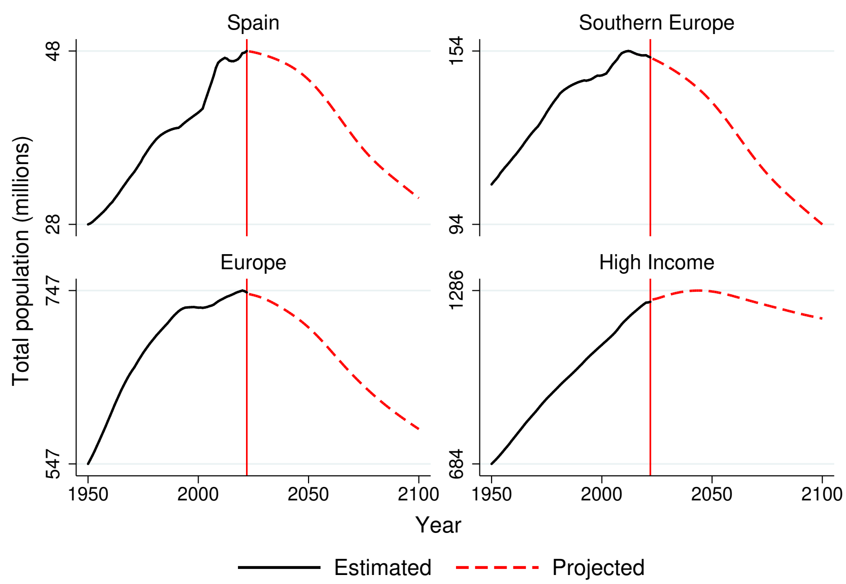
Source: United Nations, Department of Economic and Social Affairs, Population Division (2022).

Moreover, since the early 1980s, most of the developed world has had a TFR below the replacement rate of 2.1. This means, in the absence of immigration, that population will eventually decline. Figure 13 shows the estimated and projected population in the countries for the same group of countries. In all of them, population peak is likely very close or has

[33] This Spanish baby-boom occurred later than that of other high-income countries, like the United States, where the baby-boom took place right after WWII and lasted until the mid-1960s.

already passed. In the case of Spain, it is apparent that population would have already peaked if it were not for the large influx of immigrants (mainly from Latin America) it received in the 2000s. In fact, considering the very low fertility levels, in the absence of large-scale immigration, it is all but certain that most of the countries considered here will see population decline soon.

Figure 13: Total population, selected countries (1950-2022)



Source: United Nations, Department of Economic and Social Affairs, Population Division (2022).

Note: Projections account for fertility, mortality and migration, and we use the medium scenario.

All said, Spain's demographic situation, while a bit more extreme than that of other similar countries, is still comparable in broad terms: TFR below replacement in all likelihood will lead to population ageing and decline.

B Calibration appendix

B.1 Labour income process

The parameters of the labour income process together with the persistence of the income shock and the variance of the residual of it were estimated from the Spanish Continuous Working Life Sample (MCVL). In particular, we regress gross log monthly income by sex on experience and experience square. We also control by age, education, year, province, occupation, sector, tenure, a dummy for part-time jobs and the interaction between age and part-time jobs. After this, we estimate the residuals of both regressions assuming that they follow an AR(1) process as it is described in the model.

In this appendix we summarize the main variables and sample restrictions that we made for the income process estimation. We use STATA codes from Roca and Puga (2017). [34]

1. **Main variables:**

    - **Gross monthly income:** refers to a very approximate measure of all labour income received by a person except pensions, prizes from games like the National Lottery and non-levied income. Therefore it does not include unemployment benefits. It is extracted from the tax codes because they are uncensored. Earnings are expressed in real terms using the consumer price index of 2009.
    - **Education.** It is divided into three educational levels: less than secondary education, secondary education and university education.

2. **Sample restrictions:**

    - We restricted the sample for the years 1998-2017. The main reason for this is that the specification over the type of contract (open-ended vs fixed-term contracts) is available after this year.
    - We keep the individuals who entered the labour market after 1998.
    - We dropped:
        (a) Individuals older than 55 years old. This eliminates who receive an early retirement pension.
        (b) Unemployed individuals
        (c) Immigrants.
        (d) Public sector employees.

[34]We are responsible for the possible computational mistakes.

Table 5: Labor income process by sex and contract

	Male	Female FT	Female OE
Experience	0.0457***	0.0475***	0.0409***
	(316.07)	(163.13)	(195.67)
$Experience^2$	-0.00140***	-0.00267***	-0.00134***
	(-184.87)	(-123.99)	(-127.33)
Age (years)	0.0225***	0.0538***	0.0166***
	(94.28)	(134.25)	(51.41)
Age^2	-0.000320***	-0.000763***	-0.000233***
	(-89.42)	(-123.33)	(-51.06)
Secondary education	0.0633***	0.0116***	0.0461***
	(181.66)	(17.27)	(94.46)
Tertiary education	0.135***	0.0498***	0.169***
	(255.74)	(63.61)	(285.64)
Part-time contract	-0.554***	-0.393***	-0.441***
	(-172.55)	(-139.73)	(-165.01)
Constant	7.093***	6.348***	7.154***
	(1770.06)	(883.34)	(1229.60)
Observations	8846471	2996927	5327129
Month FE	Yes	Yes	Yes
Province	Yes	Yes	Yes
Occupation	Yes	Yes	Yes
Sector	Yes	Yes	Yes
Tenure	Yes	Yes	Yes
Age*Part_time_contract	Yes	Yes	Yes
Fixed-term_contract	Yes	No	No

t statistics in parentheses

Source: MCVL 1980-2016, FT:Fixed-term contract, OE: Open-ended contract

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: Persistance AR(1) process by sex

	Male	Female
resid_male_lag	0.900***	
	(2489.44)	
resid_female_lag		0.906***
		(2683.50)
Observations	17170526	17170526

t statistics in parentheses

Source: MCVL 1980-2016

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Residual income shock by sex

	Male	
	mean	variance
Residual Male	-.0065449	.0348526
Residual Female	.009062	.0344275
Observations	17170526	

Source: MCVL 1980-2016

C Computation of the model

C.1 Computation with taste shocks

All of the decisions that women make in the model are discrete in nature. Unfortunately, this type of models tend to generate jerky aggregate response to parameter changes, since individuals tend to change their decisions all at once, unless there are vast amounts of heterogeneity.

To facilitate the numerical solution of the model, we include a taste shock to women's utility in every period. This helps by smoothing out the labour force participation and fertility decisions. The shocks can be interpreted as unobserved state variables that add noise to the women's decisions. Moreover, the calibration and results are robust to their inclusion. For an in depth discussion of this computational method, see Iskhakov et al. (2017).

Thus, we assume that in every period women receive a vector of additive-separable taste shocks μ. In periods when they can still have children and need to choose on pregnancy $b \in \{0, 1\}$ in addition to labour force participation $h \in \{0, \frac{1}{4}, \frac{1}{2}\}$, they receive a vector of six shocks, one for every element in $\{0, \frac{1}{4}, \frac{1}{2}\} \times \{0, 1\}$. In periods when they cannot have any more children and need only to choose labour force participation, they receive a vector of three shocks, one for every element in $\{0, \frac{1}{4}, \frac{1}{2}\}$:

$$\mu = \begin{cases} \left(\mu_{0,0}, \mu_{\frac{1}{4},0}, \mu_{\frac{1}{2},0}, \mu_{0,1}, \mu_{\frac{1}{4},1}, \mu_{\frac{1}{2},1}\right) & \text{if } j < 15 \text{ and } N(\mathbf{n}) < 3 \\ \left(\mu_0, \mu_{\frac{1}{4}}, \mu_{\frac{1}{2}}\right) & \text{otherwise} \end{cases}$$

All of these shocks are i.i.d, drawn from an Extreme Value Type I distribution with scale parameter σ_μ.

The modified value function in states $\left(\epsilon^f, \epsilon^m, z, x, \mathbf{n}; N^*\right)$ is:

$$W_j\left(\epsilon^f, \epsilon^m, z, x, \mathbf{n}, \mu; N^*\right) =$$
$$\begin{cases} \max\{W_j^{h,b}\left(\epsilon^f, \epsilon^m, z, x, \mathbf{n}; N^*\right) + \sigma_\mu \mu_{h,b}\}_{h\in\{0,\frac{1}{4},\frac{1}{2}\}, b\in\{0,1\}} & \text{if } j < 15 \text{ and } N(\mathbf{n}) < 3 \\ \max\{W_j^{h}\left(\epsilon^f, \epsilon^m, z, x, \mathbf{n}; N^*\right) + \mu_h\}_{h\in\{0,\frac{1}{4},\frac{1}{2}\}} & \text{otherwise,} \end{cases}$$

where $W_j^{h,b}$ and W_j^h represent the value, ex-taste shock, of choosing labour force participation h and pregnancy status b for a woman in period j, or just labour force participation h, in states $\left(\epsilon^f, \epsilon^m, z, x, \mathbf{n}; N^*\right)$:

$$W_j^{h,b}\left(\epsilon^f,\epsilon^m,z,x,\mathbf{n};N^*\right)=u^{h,b}\left(c,l,\mathbf{n};N^*\right)+\beta\mathbb{E}^{\sigma_\mu}\left[W_{j+1}\left(\epsilon^{f\prime},\epsilon^{m\prime},z',x',\mathbf{n}',\mu;N^*\right)\right]$$
$$W_j\left(\epsilon^f,\epsilon^m,z,x,\mathbf{n};N^*\right)=u^{h}\left(c,l,\mathbf{n};N^*\right)+\beta\mathbb{E}^{\sigma_\mu}\left[W_{j+1}\left(\epsilon^{f\prime},\epsilon^{m\prime},z',x',\mathbf{n}',\mu;N^*\right)\right],$$

where $\mathbb{E}^{\sigma_\mu}$ denotes the expectations over future taste shocks and in both cases, choice and states variables need to be retrieved from the constraints and laws of motion:

$$\begin{aligned}
&l=1-h-\xi(\mathbf{n})\\
&c=I-\lambda 2h\left(n_1+n_2\right)\\
&I=y^m+2hy^f\left(1-\mathbb{1}_{\{h=\frac{1}{2}\}}\phi\right)-T\left(y^m,y^f,h\right)\\
&\ln\left(y^f\right)=\eta_0^f+\Delta\eta_0^f\mathbb{1}_{z=1}+\left(\eta_1^f+\Delta\eta_1^f\mathbb{1}_{\{z=1\}}\right)x+\left(\eta_2^f+\Delta\eta_2^f\mathbb{1}_{\{z=1\}}\right)x^2+\epsilon^f\\
&\ln\left(y^m\right)=\eta_0^m+\eta_1^m\left(j-1\right)+\eta_2^m\left(j-1\right)^2+\epsilon^m\\
&\epsilon^{f\prime}=\phi^f\epsilon^f+\nu^f\\
&\epsilon^{m\prime}=\phi^m\epsilon^m+\nu^m\\
&\mathbf{n}'=\Lambda_j(\mathbf{n},b)\\
&x'=\Pi_x\left(x,h\right)\\
&z'=\Pi_z\left(x,h,z\right).
\end{aligned}$$

The main consequence of introducing the taste shocks is that the policy function becomes probabilistic. Given the distribution assumed for them, the probability that a woman chooses pregnancy decision b and labour force participation h in states $\left(\epsilon^f,\epsilon^m,z,x,\mathbf{n};N^*\right)$ when $j<15$ and $N(\mathbf{n})<3$ is the logit probability:

$$P_j\left(h,b\mid\epsilon^f,\epsilon^m,z,x,\mathbf{n};N^*\right)=\frac{\exp\left(\frac{W_j^{h,b}\left(\epsilon^f,\epsilon^m,z,x,\mathbf{n};N^*\right)}{\sigma_\mu}\right)}{\sum_{i\in\{0,1,2,3\}}\sum_{k\in\{0,1\}}\exp\left(\frac{W_j^{i,k}\left(\epsilon^f,\epsilon^m,z,x,\mathbf{n};N^*\right)}{\sigma_\mu}\right)}.$$

Otherwise, the probability that a woman chooses labour force participation h in states $\left(\epsilon^f,\epsilon^m,z,x,\mathbf{n};N^*\right)$ is the logit probability:

$$P_j\left(h \mid \epsilon^f, \epsilon^m, z, x, \mathbf{n}; N^*\right) = \frac{\exp\left(\frac{W_j^h\left(\epsilon^f, \epsilon^m, z, x, \mathbf{n}; N^*\right)}{\sigma_\mu}\right)}{\sum_{i\in\{0,1,2,3\}} \exp\left(\frac{W_j^i\left(\epsilon^f, \epsilon^m, z, x, \mathbf{n}; N^*\right)}{\sigma_\mu}\right)}.$$

One additional benefit of using Extreme Value Type I shocks is that the expected value function is given by the tractable log-sum formula from (McFadden, 1973):

$$\mathbb{E}^{\sigma_\mu}\left[W_{j+1}\left(\epsilon^{f\prime}, \epsilon^{m\prime}, z', x', \mathbf{n}', \mu; N^*\right)\right] =$$
$$\begin{cases} \sigma_\mu \log\left(\sum_{i\in\{0,1,2,3\}} \sum_{k\in\{0,1\}} \exp\left(\frac{W_j^{i,k}\left(\epsilon^f, \epsilon^m, z, x, \mathbf{n}; N^*\right)}{\sigma_\mu}\right)\right) & \text{if } j < 15 \text{ and } N(\mathbf{n}) < 3 \\ \sigma_\mu \log\left(\sum_{i\in\{0,1,2,3\}} \exp\left(\frac{W_j^{i}\left(\epsilon^f, \epsilon^m, z, x, \mathbf{n}; N^*\right)}{\sigma_\mu}\right)\right) & \text{otherwise.} \end{cases}$$

Using backward induction starting in period J, one can easily retrieve the expected value functions and the probabilistic policy functions.

D Stochastic structure for children's ageing

In this appendix we show how to retrieve the stochastic structure that governs the transition probabilities for the vector state of number of children at different ages takes, which we denote by $\mathbf{n}' = \Lambda_j(\mathbf{n}, b)$.

We denote by λ_1 and λ_2 the probabilities that an individual baby becomes a school-age child, and that an individual school-age child becomes a teen in a given period, respectively. Moreover, we assume that the ageing event is independent across children. Notice that $b\alpha_j$ is the probability that there is a newborn in the next period. Denote by $P_i(x \mid n_i)$ the probability that x children in stage $i \in \{1, 2\}$ (babies, school-age) move on to the next stage the next period (school-age, teenager), conditional on there being n_i children in that stage in the current period. Table 8 shows these, for babies and school-age children.

Table 8: Probabilities of ageing by number of children, $P_i(x \mid n_i)$

n_i	Number of children ageing			
	0	1	2	3
0	1	0	0	0
1	$1-\lambda_i$	λ_i	0	0
2	$(1-\lambda_i)^2$	$\lambda_i(1-\lambda_i)$	λ_i^2	0
3	λ_i^3	$\lambda_i(1-\lambda_i)^2$	$\lambda_i^2(1-\lambda_i)$	λ_i^3

To compute the whole set of probabilities of transition from state $\mathbf{n} = [n_0, n_1, n_2, n_3]$, we follow the algorithm:

for $x_1 \in \{0, 1, 2, 3\}$ **do**
    for $x_2 \in \{0, 1, 2, 3\}$ **do**
        if $n_0 = 1$ **then**
            $\mathbf{n}' = [0, n_1 - x + 1, n_2 + x - y, n_3 + y]$ w.p. $(1 - b\alpha_j)P_1(x_1 \mid n_1)P_2(x_2 \mid n_2)$
              or $\mathbf{n}' = [1, n_1 - x + 1, n_2 + x - y, n_3 + y]$ w.p. $b\alpha_j P_1(x_1 \mid n_1)P_2(x_2 \mid n_2)$;
        else
            $\mathbf{n}' = [0, n_1 - x, n_2 + x - y, n_3 + y]$ w.p. $(1 - b\alpha_j)P_1(x_1 \mid n_1)P_2(x_2 \mid n_2)$ or
              $\mathbf{n}' = [1, n_1 - x, n_2 + x - y, n_3 + y]$ w.p. $b\alpha_j P_1(x_1 \mid n_1)P_2(x_2 \mid n_2)$;
        end
    end
end

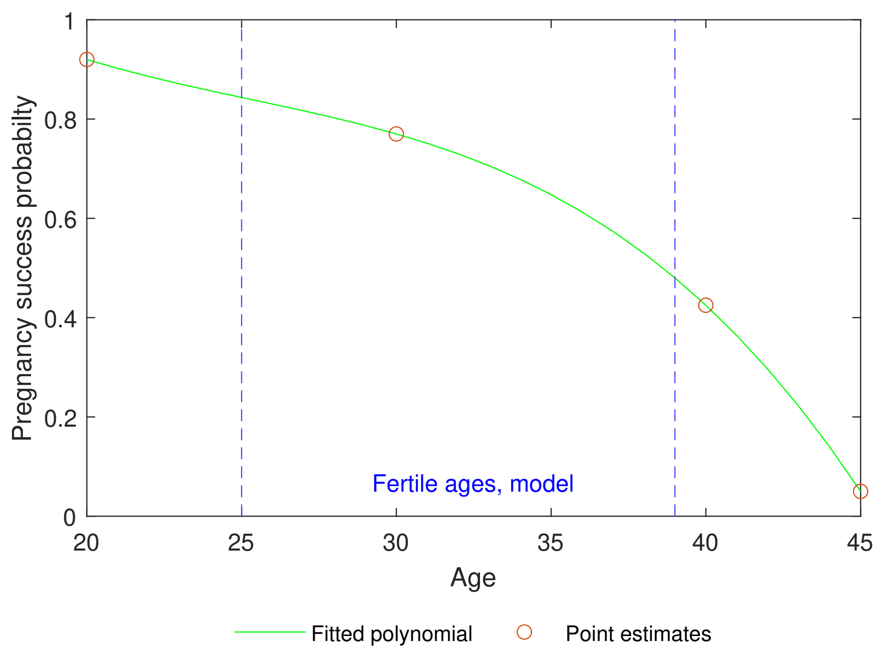
E Pregnancy success probabilities

We follow Sommer (2016) in estimating the probability of pregnancy success by age α_j. We use the following point estimates of natural infertility from Trussell and Wilson (1985):

$$\text{Infertility probability} = \begin{cases} 0.080 & \text{at age 20} \\ 0.230 & \text{at age 30} \\ 0.575 & \text{at age 40} \\ 0.950 & \text{at age 45,} \end{cases}$$

and then fit a polynomial through (the inverse of) them, as shown in figure 14. Notice that we only have women having children in the model between ages 25 and 39.

Figure 14: Pregnancy success probability conditional on age

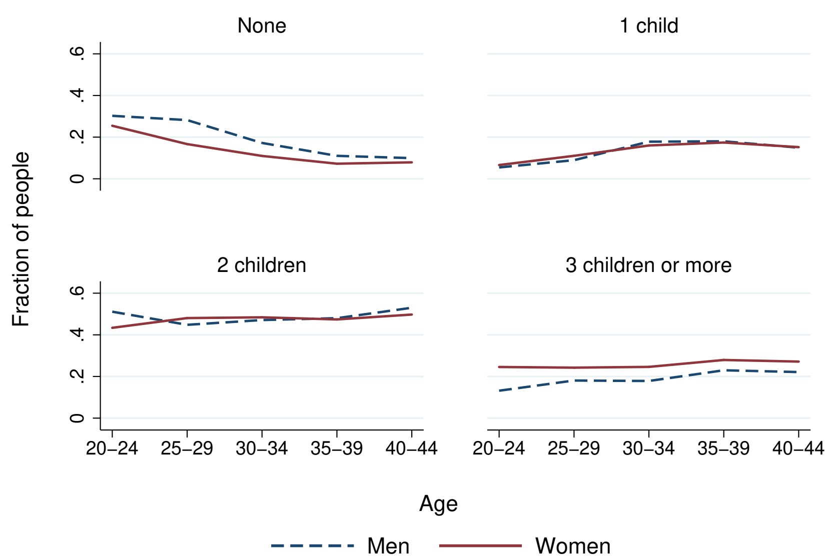


Source: Author's work, point estimates by Trussell and Wilson (1985).

F Men's fertility preferences

While the first wave of the Spanish Fertility Survey in 1999 sampled only women, the second one did collect responses on fertility preferences of men. A disadvantage is that the samples are separate, i.e. the survey collected basic data on the spouses of the sampled individuals, but it did not collect data in their preferences. Nevertheless, it stands to reason that one of the characteristics that people sort on in marriage markets is desired overall number of desired children. Figure 15 shows fertility preferences by sex and age in 2018. The largest discrepancies are the fractions of people that want no children (higher for men) and the fractions that want 3 or more (higher than women). However, in aggregate terms the disagreement is small, and decreases with age.

Figure 15: Desired fertility by gender and age in Spain, 2018



Source: *Encuesta de Fecundidad 2018, INE.*

References

Adda, Jérôme, Christian Dustmann, and Katrien Stevens, "The Career Costs of Children," *Journal of Political Economy*, 2017, *125* (2), 293–337.

Adserà, Alícia, "Changing Fertility Rates in Developed Countries. The Impact of Labor Market Institutions," *Journal of Population Economics*, 2004, *17* (1), 17–43.

Aksoy, Yunus, Henrique S. Basso, Ron P. Smith, and Tobias Grasl, "Demographic Structure and Macroeconomic Trends," *American Economic Journal: Macroeconomics*, January 2019, *11* (1), 193–222.

Arroyo, Cristino R. and Junsen Zhang, "Dynamic Microeconomic Models of Fertility Choice: A Survey," *Journal of Population Economics*, 1997, *10* (1), 23–65.

Asai, Yukiko, "Parental leave reforms and the employment of new mothers: Quasi-experimental evidence from Japan," *Labour Economics*, 2015, *36*, 72–83.

Attanasio, Orazio, Hamish Low, and Virginia Sánchez-Marcos, "Explaining Changes in Female Labor Supply in a Life-Cycle Model," *American Economic Review*, September 2008, *98* (4), 1517–52.

Auer, Wolfgang and Natalia Danzer, "Fixed-Term Employment and Fertility: Evidence from German Micro Data," *CESifo Economic Studies*, 07 2016, *62* (4), 595–623.

Bankole, Akinrinola, "Desired Fertility and Fertility Behaviour among the Yoruba of Nigeria: A Study of Couple Preferences and Subsequent Fertility," *Population Studies*, 1995, *49* (2), 317–328.

Becker, Gary S., "An Economic Analysis of Fertility," in "Demographic and Economic Change in Developed Countries" NBER Chapters, National Bureau of Economic Research, Inc, August 1960, pp. 209–240.

_ and H. Gregg Lewis, "On the Interaction between the Quantity and Quality of Children," *Journal of Political Economy*, 1973, *81* (2), S279–S288.

Bentolila, Samuel, Pierre Cahuc, Juan J. Dolado, and Thomas Le Barbanchon, "Two-tier labour markets in the great recession: France versus Spain," *The Economic Journal*, 2012, *122* (562), F155–F187.

Bettendorf, Leon J.H., Egbert L.W. Jongen, and Paul Muller, "Childcare subsidies and labour supply — Evidence from a large Dutch reform," *Labour Economics*, 2015, *36*, 112–123.

Bick, Alexander, "The quantitative role of child care for female labor force participation and fertility," *Journal of the European Economic Association*, 2016, *14* (3), 639–668.

_ and Nicola Fuchs-Schündeln, "Quantifying the Disincentive Effects of Joint Taxation on Married Women's Labor Supply," *American Economic Review*, May 2017, *107* (5), 100–104.

Blackburn, McKinley L., David E. Bloom, and David Neumark, "Fertility Timing, Wages, and Human Capital," *Journal of Population Economics*, 1993, *6* (1), 1–30.

Blau, David M. and Philip K. Robins, "Child-Care Costs and Family Labor Supply," *The Review of Economics and Statistics*, 1988, *70* (3), 374–381.

Blundell, Richard, Monica Costa Dias, Costas Meghir, and Jonathan Shaw, "Female labor supply, human capital, and welfare reform," *Econometrica*, 2016, *84* (5), 1705–1753.

Butz, William P and Michael P Ward, "The Emergence of Countercyclical U.S. Fertility," *American Economic Review*, June 1979, *69* (3), 318–328.

Bünning, Mareike, "What Happens after the 'Daddy Months'? Fathers' Involvement in Paid Work, Childcare, and Housework after Taking Parental Leave in Germany," *European Sociological Review*, 07 2015, *31* (6), 738–748.

Cascio, Elizabeth U., Steven J. Haider, and Helena Skyt Nielsen, "The effectiveness of policies that promote labor force participation of women with children: A collection of national studies," *Labour Economics*, 2015, *36*, 64 – 71.

Cigno, Alessandro and John Ermisch, "A microeconomic analysis of the timing of births," *European Economic Review*, 1989, *33* (4), 737–760.

Cohen, Alma, Rajeev Dehejia, and Dmitri Romanov, "Financial Incentives and Fertility," *The Review of Economics and Statistics*, 2013, *95* (1), 1–20.

Da Rocha, José María and Luisa Fuster, "Why Are Fertility Rates and Female Employment Ratios Positively Correlated across O.E.C.D. Countries?," *International Economic Review*, 2006, *47* (4), 1187–1222.

de la Rica, Sara and Amaia Iza, "Career Planning in Spain: Do Fixed-term Contracts Delay Marriage and Parenthood?," *Review of Economics of the Household*, November 2005, *3* (1), 49–73.

De Nardi, Mariacristina, Selahattin İmrohoroğlu, and Thomas J. Sargent, "Projected U.S. Demographics and Social Security," *Review of Economic Dynamics*, 1999, *2* (3), 575–615.

de Quinto, Alicia, Laura Hospido, and Carlos Sanz, "The child penalty: evidence from Spain," *SERIEs: Journal of the Spanish Economic Association*, December 2021, *12* (4), 585–606.

Del Boca, Daniela and Robert M. Sauer, "Life cycle employment and fertility across institutional environments," *European Economic Review*, 2009, *53* (3), 274–292.

Doepke, Matthias and Fabian Kindermann, "Bargaining over Babies: Theory, Evidence, and Policy Implications," *American Economic Review*, September 2019, *109* (9), 3264–3306.

_ , Anne Hannusch, Fabian Kindermann, and Michèle Tertilt, "The Economics of Fertility: A New Era," Working Paper 29948, National Bureau of Economic Research April 2022.

Dolado, Juan J., Etienne Lalé, and Nawid Siassi, "From dual to unified employment protection: Transition and steady state," *Quantitative Economics*, 2021, *12* (2), 547–585.

Eckstein, Zvi and Kenneth I. Wolpin, "Dynamic Labour Force Participation of Married Women and Endogenous Work Experience," *The Review of Economic Studies*, 1989, *56*

(3), 375–390.

Ekberg, John, Rickard Eriksson, and Guido Friebel, "Parental leave — A policy evaluation of the Swedish "Daddy-Month" reform," *Journal of Public Economics*, 2013, *97*, 131–143.

Erosa, Andres, Luisa Fuster, and Diego Restuccia, "A General Equilibrium Analysis of Parental Leave Policies," *Review of Economic Dynamics*, October 2010, *13* (4), 742–758.

_ , _ , and _ , "A quantitative theory of the gender gap in wages," *European Economic Review*, 2016, *85*, 165–187.

Erosa, Andrés, Luisa Fuster, and Diego Restuccia, "Fertility Decisions and Gender Differences in Labor Turnover, Employment, and Wages," *Review of Economic Dynamics*, 2002, *5* (4), 856 – 891.

Farré, Lídia and Libertad González, "Does paternity leave reduce fertility?," *Journal of Public Economics*, 2019, *172*, 52–66.

Francesconi, Marco, "A Joint Dynamic Model of Fertility and Work of Married Women," *Journal of Labor Economics*, Part 2002, *20* (2), 336–380.

García-Miralles, Esteban, Nezih Guner, and Roberto Ramos, "The Spanish personal income tax: facts and parametric estimates," *SERIEs: Journal of the Spanish Economic Association*, November 2019, *10* (3), 439–477.

Geyer, Johannes, Peter Haan, and Katharina Wrohlich, "The effects of family policy on maternal labor supply: Combining evidence from a structural model and a quasi-experimental approach," *Labour Economics*, 2015, *36*, 84–98.

Gipson, Jessica D. and Michelle J. Hindin, "The effect of husbands' and wives' fertility preferences on the likelihood of a subsequent pregnancy, Bangladesh 1998–2003," *Population Studies*, 2009, *63* (2), 135–146. PMID: 19536696.

Givord, Pauline and Claire Marbot, "Does the cost of child care affect female labor market participation? An evaluation of a French reform of childcare subsidies," *Labour Economics*, 2015, *36*, 99–111.

González, Libertad, "The Effect of a Universal Child Benefit on Conceptions, Abortions, and Early Maternal Labor Supply," *American Economic Journal: Economic Policy*, 2013, *5* (3), 160–188.

Guner, Nezih, Ezgi Kaya, and Virginia Sánchez Marcos, "Labor Market Institutions and Fertility," 2021. BSE Working Paper 1297, available at: https://bse.eu/research/working-papers/labor-market-institutions-and-fertility.

—, Remzi Kaygusuz, and Gustavo Ventura, "Child-Related Transfers, Household Labour Supply, and Welfare," *The Review of Economic Studies*, 03 2020, *87* (5), 2290–2321.

Haeck, Catherine, Pierre Lefebvre, and Philip Merrigan, "Canadian evidence on ten years of universal preschool policies: The good and the bad," *Labour Economics*, 2015, *36*, 137–157.

Heckman, James and James Walker, "The Relationship between Wages and Income and the Timing and Spacing of Births: Evidence from Swedish Longitudinal Data," *Econometrica*, 1990, *58* (6), 1411–41.

Heckman, James J. and Thomas E. Macurdy, "A Life Cycle Model of Female Labour Supply," *The Review of Economic Studies*, 1980, *47* (1), 47–74.

Hener, Timo, "Do Couples Bargain over Fertility?," *Annals of Economics and Statistics*, 2015, (117/118), 211–231.

Hotz, V. Joseph and Robert A. Miller, "An Empirical Analysis of Life Cycle Fertility and Female Labor Supply," *Econometrica*, 1988, *56* (1), 91–118.

—, Jacob Alex Klerman, and Robert Willis, "The economics of fertility in developed countries," in M. R. Rosenzweig and O. Stark, eds., *Handbook of Population and Family Economics*, 1 ed., Vol. 1, Part A, Elsevier, 1993, chapter 07, pp. 275–347.

Hyslop, Dean R., "State Dependence, Serial Correlation and Heterogeneity in Intertemporal

Labor Force Participation of Married Women," *Econometrica*, 1999, *67* (6), 1255–1294.

— , "Rising U.S. Earnings Inequality and Family Labor Supply: The Covariance Structure of Intrafamily Earnings," *American Economic Review*, September 2001, *91* (4), 755–777.

Iskhakov, Fedor, Thomas H. Jørgensen, John Rust, and Bertel Schjerning, "The endogenous grid method for discrete-continuous dynamic choice models with (or without) taste shocks," *Quantitative Economics*, 2017, *8* (2), 317–365.

Jones, Charles I., "The End of Economic Growth? Unintended Consequences of a Declining Population," *American Economic Review*, November 2022, *112* (11), 3489–3527.

Keane, Michael P. and Kenneth I. Wolpin, "The role of labor and marriage markets, preference heterogeneity, and the welfare system in the life cycle decisions of black, hispanic, and white women," *International Economic Review*, 2010, *51* (3), 851–892.

— and Robert M. Sauer, "Classification Error in Dynamic Discrete Choice Models: Implications for Female Labor Supply Behavior," *Econometrica*, 2009, *77* (3), 975–991.

Kleven, Henrik, Camille Landais, and Jakob Egholt Søgaard, "Children and Gender Inequality: Evidence from Denmark," *American Economic Journal: Applied Economics*, October 2019, *11* (4), 181–209.

— , — , Johanna Posch, Andreas Steinhauer, and Josef Zweimüller, "Child Penalties across Countries: Evidence and Explanations," *AEA Papers and Proceedings*, May 2019, *109*, 122–26.

Kohler, Hans-Peter, Francesco C. Billari, and José Antonio Ortega, "The Emergence of Lowest-Low Fertility in Europe during the 1990s," *Population and Development Review*, 2002, *28* (4), 641–680.

Krueger, Dirk and Alexander Ludwig, "On the consequences of demographic change for rates of returns to capital, and the distribution of wealth and welfare," *Journal of Monetary Economics*, 2007, *54* (1), 49–87.

Kydland, Finn E and Edward C Prescott, "Time to build and aggregate fluctuations," *Econometrica: Journal of the Econometric Society*, 1982, pp. 1345–1370.

Lalive, Rafael and Josef Zweimüller, "How Does Parental Leave Affect Fertility and Return to Work? Evidence from Two Natural Experiments*," *The Quarterly Journal of Economics*, 08 2009, *124* (3), 1363–1402.

LaLumia, Sara, "The effects of joint taxation of married couples on labor supply and non-wage income," *Journal of Public Economics*, 2008, *92* (7), 1698–1719.

Lopes, Marta, "Job Security and Fertility Decisions," 2020. Available at SSRN: https://ssrn.com/abstract=3543204 or http://dx.doi.org/10.2139/ssrn.3543204.

McFadden, D, "Conditional logit analysis of qualitative choice behavior.," in P. Zarembka, ed., *Frontiers in Econometrics*, Academic Press, New York, 1973.

Milligan, Kevin, "Subsidizing the Stork: New Evidence on Tax Incentives and Fertility," *The Review of Economics and Statistics*, 2005, *87* (3), 539–555.

Moffitt, Robert, "Profiles of Fertility, Labour Supply and Wages of Married Women: A Complete Life-Cycle Model," *The Review of Economic Studies*, 1984, *51* (2), 263–278.

Müller, Kai-Uwe and Katharina Wrohlich, "Does subsidized care for toddlers increase maternal labor supply? Evidence from a large-scale expansion of early childcare," *Labour Economics*, 2020, *62*, 101776.

Nollenberger, Natalia and Núria Rodríguez-Planas, "Full-time universal childcare in a context of low maternal employment: Quasi-experimental evidence from Spain," *Labour Economics*, 2015, *36*, 124–136.

OECD, "Family benefits public spending (indicator)," 2022. doi: 10.1787/8e8b3273-en.

Olivetti, Claudia and Barbara Petrongolo, "The Economic Consequences of Family Policies: Lessons from a Century of Legislation in High-Income Countries," *Journal of Economic Perspectives*, February 2017, *31* (1), 205–230.

Rasul, Imran, "Household bargaining over fertility: Theory and evidence from Malaysia," *Journal of Development Economics*, 2008, *86* (2), 215–241.

Roca, Jorge De La and Diego Puga, "Learning by working in big cities," *The Review of Economic Studies*, 2017, *84* (1), 106–142.

Rosenzweig, Mark R. and T. Paul Schultz, "The Demand for and Supply of Births: Fertility and its Life Cycle Consequences," *The American Economic Review*, 1985, *75* (5), 992–1015.

Sheran, Michelle, "The career and family choices of women: A dynamic analysis of labor force participation, schooling, marriage, and fertility decisions," *Review of Economic Dynamics*, 2007, *10* (3), 367–399.

Sommer, Kamila, "Fertility choice in a life cycle model with idiosyncratic uninsurable earnings risk," *Journal of Monetary Economics*, 2016, *83*, 27–38.

Tamm, Marcus, "Fathers' parental leave-taking, childcare involvement and labor market participation," *Labour Economics*, 2019, *59*, 184–197. Special Issue on "European Association of Labour Economists, 30th annual conference, Lyon, France, 13-15 September 2018.

Tauchen, George, "Finite state markov-chain approximations to univariate and vector autoregressions," *Economics Letters*, 1986, *20* (2), 177–181.

_ and Robert Hussey, "Quadrature-Based Methods for Obtaining Approximate Solutions to Nonlinear Asset Pricing Models," *Econometrica*, 1991, *59* (2), 371–396.

Testa, Maria Rita, Laura Cavalli, and Alessandro Rosina, "The Effect of Couple Disagreement about Child-Timing Intentions: A Parity-Specific Approach," *Population and Development Review*, 2014, *40* (1), 31–53.

Thomson, Elizabeth, "Couple Childbearing Desires, Intentions, and Births," *Demography*, 1997, *34* (3), 343–354.

_ and Jan M. Hoem, "Couple Childbearing Plans and Births in Sweden," *Demography*, 1998, *35* (3), 315–322.

Trussell, J. and C. Wilson, “Sterility in a population with natural fertility,” *Population Studies*, 1985, *39* (2), 269 – 286. Cited by: 60.

United Nations, Department of Economic and Social Affairs, Population Division, “World Population Prospects,” 2022. Online Edition.

van der Klaauw, Wilbert, “Female Labour Supply and Marital Status Decisions: A Life-Cycle Model,” *The Review of Economics Studies*, 1996, *63* (2), 199–235.

Ward, Michael P and William P Butz, “Completed Fertility and Its Timing,” *Journal of Political Economy*, October 1980, *88* (5), 917–940.

Westoff, Charles F., “Desired Number of Children: 2000-2008,” Comparative Reports 25, DHS 2010.

Willis, Robert J., “A New Approach to the Economic Theory of Fertility Behavior,” *Journal of Political Economy*, 1973, *81* (2), S14–S64.

Wolpin, Kenneth I., “An Estimable Dynamic Stochastic Model of Fertility and Child Mortality,” *Journal of Political Economy*, 1984, *92* (5), 852–874.