The Quantitative Role of Child Care for Female Labor Force Participation and Fertility

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Abstract

I document that the labor force participation rate of West German mothers with children aged zero to two exceeds the corresponding child care enrollment rate, while the opposite is true for mothers whose children are older than two but below the mandatory schooling age. These facts also hold for a cross-section of EU countries. I develop a life-cycle model that explicitly accounts for this age-dependent relationship by including various types of non-paid and paid child care. I calibrate this model to data for West Germany and use the calibrated model for policy analysis. Increasing the supply of subsidized child care for children aged zero to two generates an increase in the maternal labor force participation rate consistent with empirical evidence from other settings; however, this increase is too small to conclude that the lack of subsidized child care accounts for the low labor force participation rate of mothers with children aged zero to two. The response along the intensive margin does suggest that a large fraction of part-time working mothers would work full-time if they had greater access to subsidized child care. Finally, making subsidized child care available to more women does not achieve one of the commonly stated goals of such reforms, namely to increase the fertility rate.

Keywords: Child Care, Fertility, Life-cycle Female Labor Supply

JEL classification: D10, J13, J22

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1 Introduction

At the Barcelona meeting in March 2002, the European Council recommended that its member states remove "barriers and disincentives for female labor force participation by, inter alia, improving the provision of child care facilities" (European Council (2002)). Specifically, the Council recommended that member states provide child care for 33% of all children younger than age three and for 90% of all children aged three to mandatory school age. In 2010 and 2013 Germany enacted two laws to accomplish the target for children younger than age three, with the additional hope to increase the birth rate, see e.g. Rani and Steiner (2008). The objective and contribution of this paper is to quantify the impact of these two reforms in West Germany with a quantitative, dynamic life-cycle model.[1]

As is common in the quantitative literature on female labor supply and fertility, see e.g. Francesconi (2002), the analysis focuses on women living in a continuous relationship (marriage or cohabitation) with the same partner, and is mainly based on the German Socioeconomic Panel (GSOEP) spanning the years 1983 to 2005.[2,3] Figure 1a shows the facts to be replicated by the life-cycle model developed in the paper. It plots the maternal labor force participation rate against the age of the youngest child of a woman, along with the corresponding enrollment rates in paid child care. The presentation here focuses on the extensive margin, which captures the essence of the data, whereas the quantitative model also has an intensive margin (part- vs. full-time).

The first key fact in Figure 1a is that mothers with children aged zero to two are less likely to work than mothers with children aged age three to mandatory school age, the latter being on average age six and a half (31% vs. 62%). The second key fact is that, among mothers with children aged zero to two, the labor force participation rate exceeds by far the paid child care enrollment rate (31% vs. 6%). Given the age of the children, this implies that most working mothers necessarily use some form of non-paid, non-maternal child care, which may be provided by the husband (although nearly all of them work-full time), grandparents, other family members or friends at no monetary costs.[4] The final key fact is that as the youngest child ages this ratio flips: among mothers with children aged three to six and a half, the labor force participation rate is lower than the paid child care enrollment rate (62% vs. 95%). Put differently, paid child care is used heavily by non-working mothers of children aged three to six and a half whereas a substantial fraction of mothers of children

[1] I restrict the analysis to West Germany because the provision rates of subsidized child care in East Germany, originating from the pre-unification period, exceed the level targeted by the two reforms.

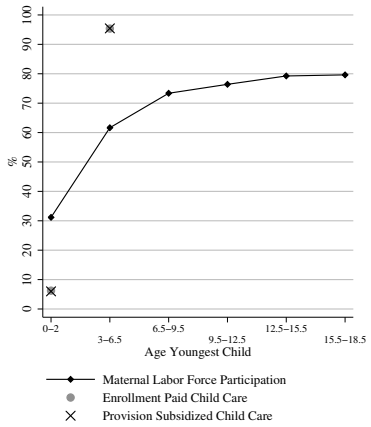
[2] The implied selection biases of focussing on this group of women may point in opposite directions. For example, the unobservables that produce long-term relationships could make women more desirable in the labor market (e.g., good communication and conflict management skills) but could also reflect preferences for non-market activities as household production. A more detailed discussion can be found in Francesconi (2002).

[3] The details on sample selection and the construction of the relevant variables, i.e. the maternal labor force participation and child care enrollment rates as well as the provision of subsidized care, are discussed in Section 3.1.

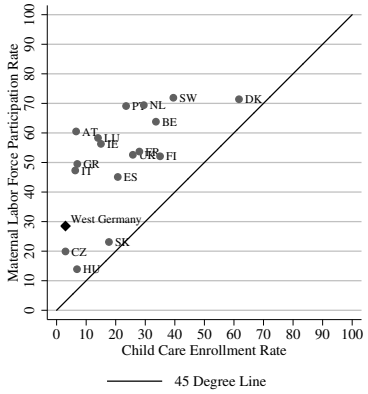
[4] These results are not driven by mothers working very few hours. Conditional on working, only 16% are working less than 10 hours per week and the average weekly hours worked amount to 24 hours.

Figure 1: Maternal Labor Force Participation and Child Care

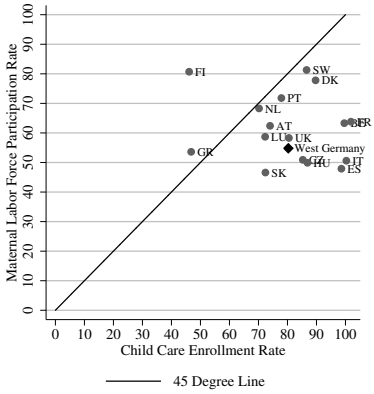
(a) West Germany



(b) EU: Ages 0 to 2



(c) EU: Ages 3 to 5



Sources Figure 1a: German Socioeconomic Panel (1983-2005), German Statistical Office (1986-2002)
Sources Figures 1b and 1c: OECD (2007), German Socioeconomic Panel (2005). The OECD data are not available up to mandatory school age, which is used in Figure 1a, but only up to age five.

aged zero to two work without using any paid child care. As Figures 1b and 1c show, none of these facts are specific to Germany. For the cross-section of EU countries which are also in the OECD, the labor force participation rate of mothers with children aged zero to two exceeds the corresponding enrollment rate in paid child care on average by 29 percentage points, whereas for mothers with children aged three to five the enrollment rate in paid child care exceeds the maternal labor force participation rate on average by 19 percentage points.

Prior to the European Council's 2002 declaration, the historical objective to subsidize child care in West Germany was to provide affordable, high quality pre-school education to children from age three onwards rather than enabling mothers of young children to work, see Kreyenfeld et al. (2002). For virtually all (96%) children aged three to six and a half a subsidized child care slot is available, compared to only 6% of children aged zero to two. From this perspective, the close proximity of the child care enrollment rate and provision rate for the age group zero to two shown in Figure 1a should not be regarded as an equilibrium outcome but rather as rationing. Indeed, Wrohlich (2008) estimates that a substantial fraction of women with children in this age group would like to use subsidized child care but do not get access to it; further, prices for subsidized child care are highly regulated rather than set to clear the market. Finally, non-subsidized child care plays only a negligible role. For children in the age group three to six and a half non-subsidized child care is hardly used. In contrast, among children aged zero to two enrolled in paid child care, 40.4% are enrolled in non-subsidized child care, either exclusively or in addition to subsidized child care. However, in absolute terms this is still negligible, amounting to 2.5% of all children aged zero to two. Non-subsidized child care comes at a substantially higher cost: the fees exceeds those for subsidized

slots by a factor of three to four.

These facts are crucial when thinking about the potential effect of extending the provision of subsidized child care for children aged zero to two. On the one hand, a substantial fraction of mothers already work without using any paid child care. On the other hand, a large fraction of women whose youngest child is between three to six and a half do not work but still use subsidized child care. It seems unlikely that subsidized child care will induce this latter group of women to work when their children are of ages zero to two.

In this paper I construct a model which simultaneously accounts for the three key facts presented in Figure 1a, taking as given the supply of subsidized child care slots and parental fees for subsidized and non-subsidized child care. I then use the model for policy analysis. The key contribution is to introduce non-paid, non-maternal child care into a *dynamic* setting alongside both subsidized and non-subsidized paid child care.

The observation that unpaid child care is commonly used has already been acknowledged in one of the earliest economic studies of child care by Heckman (1974) but has been ignored in many recent analyses. Blau and Currie (2006) summarize the results for 20 studies for the US (their Table 5) which employ *static* discrete choice models to investigate the interaction between child care and maternal labor force participation. Among those, only three, Ribar (1995), Blau and Hagy (1998), and Tekin (2007) include non-paid, non-maternal child care as a choice. However, Blau (2003) shows that the assumption that paid care is always the relevant non-maternal child care option leads to inconsistent preference parameter estimates which in turn affect any policy analysis.

Recent *dynamic* models on female labor supply with a focus on paid child care, including Attanasio et al. (2008), Haan and Wrohlich (2011), Domeij and Klein (2013), Fehr and Ujhelyiova (2012), and Guner et al. (2014) are prone to the same critique: all assume that each hour of maternal work requires one hour of paid child care, or each working mother has to pay a lump sum for child care. The paper by García-Morán and Kuehn (2014) constitutes an intermediate case: women choose between living close to their parents or in-laws where they do not have to pay for child care at all but face on average lower wages vs. not living close to them but having to buy for each hour of work one hour of child care. However, I document that in my sample the labor force participation rate of mothers with children aged zero to two and the respective child care enrollment rates do not significantly differ between women living close by or further away from their parents or in-laws. Finally, in contrast to the other studies featuring non-paid child care, my setup is dynamic and the number of children is a choice variable.[5] This allows me to address the commonly made claim by

[5] Haan and Wrohlich (2011), and Fehr and Ujhelyiova (2012) also endogenize fertility but, as already noted, ignore the option of non-paid, non-maternal child care. Del Boca (2002), and Del Boca and Sauer (2009) investigate the impact of child care provision as an "economy-wide factor" on fertility and maternal labor force participation without modeling child care as a choice or as a requirement for working mothers. Blau and Robins (1989), Blau and Robins (1991) for the US, Kravdal (1996) for Norway and Hank and Kreyenfeld (2003) for Germany conduct a reduced form analysis of the role of child care for fertility and partly maternal labor force participation. Lehrer and Kawasaki (1985) and Mason and Kuhlthau (1992) investigate in how far child care affects birth intensions.

politicians that the child care reforms may increase the fertility rate.

I use the calibrated model to simulate two policy reforms recently introduced in Germany. The first reform, implemented in October 2010, guarantees access to subsidized child care for all *working* mothers with children below age two. According to my results, this reform increases the labor force participation rate of mothers with children aged zero to two by 8.3 percentage points. This response is close to the empirical estimates by Baker et al. (2008) and Lefebvre and Merrigan (2008) for the late 1990s in Quebec after the introduction of a similar policy. Moreover, the implied elasticity of the participation rate with respect to the price of child care lines up with those estimated by Gathmann and Sass (2012) for the 2006 child care reform in the East German state Thuringia.

However, this increase of 8.3 percentage points is too small to conclude that the lack of subsidized child care accounts for the low labor force participation rate of mothers with children aged zero to two, relative to West German mothers with older children (see Figure 1a) or mothers with children aged zero to two in most European countries (see Figure 1b). While the change along the extensive margin is rather modest, the response along the intensive margin does suggest that a large fraction of part-time working mothers would work full-time if they had greater access to subsidized child care. Finally, the reform falls short of achieving one of the commonly stated goals of such reforms, namely to increase the fertility rate. While some women increase their number of children, the additional tax revenue generated by the increase in maternal labor force participation is not sufficient to cover the costs of expanding subsidized child care. Since the remaining costs have to be financed through higher labor income taxes, some women at the margin have less children, leaving the overall fertility rate unchanged.

The second reform, introduced in August 2013, is a natural extension of the previous reform and grants access to subsidized part-time child care for all children aged zero to two unconditional on the mother's labor force status. A large fraction of non-working women takes advantage of this and the resulting child care enrollment rate even exceeds the maternal labor force participation rate. This is similar to what we observe for the age group three to six and a half, where subsidized part-time child care is basically also universally available. The higher enrollment in subsidized child care for children aged zero to two requires a further increase in the tax rate, which induces more women to have less children, generating even a small decrease in the fertility rate.

In sum, both reforms fail to increase the fertility rate, and even decrease average welfare since only a subset of households benefits but the costs are shared among all households.

The structure of the paper is as follows: the next section introduces the model. Section 3 provides the details on the mapping between the model and the data along with the calibration strategy. Section 4 presents the results for the two policy reforms and Section 5 concludes.

2 The Model

This section introduces a stylized life-cycle model for married women featuring fertility, labor force participation and various child care choices.

2.1 Demographics

A woman lives for six periods, each lasting for three years, reflecting the distinctive stages of a child's adolescence. The first two periods correspond to pre-school ages, i.e. ages zero to two and ages three to mandatory school age. The subsequent periods cover the time until adulthood is reached. At the beginning of her life a woman is exogenously matched with a man and then chooses how many children to have. Both the husband and the children stay with her throughout her whole life. If a woman chooses to have more than one child, all children are born at the same time. This simplifying assumption allows me to avoid keeping track of the mother's age at first and every subsequent birth or alternatively the age distribution of children at a given mother's age. As a consequence, the model is not suitable to study the interactions between child care and the spacing and timing of birth.

2.2 Endowments

Women and their husbands are indexed by income shocks ϵ and ϵ^*, respectively, which determine the stochastic component of their market incomes. Asterisks refer to parameters for the husband. Both spouses are assigned initial, potentially correlated income shocks $(\epsilon_1,\ \epsilon_1^*)$, which subsequently evolve stochastically over time according to an AR(1) process:

$$\begin{array}{ll} \epsilon_t & = \rho\epsilon_{t-1} + \varepsilon_t \\ \epsilon_t^* & = \rho^*\epsilon_{t-1}^* + \varepsilon_t^* \end{array} \quad \text{with} \quad \begin{bmatrix} \varepsilon_t \\ \varepsilon_t^* \end{bmatrix} \sim N\left(\begin{array}{l} \mu \ = 0 \\ \mu^* = 0 \end{array} , \begin{bmatrix} \sigma_\varepsilon^2 & \varsigma \\ \varsigma & \sigma_{\varepsilon^*}^2 \end{bmatrix} \right), \tag{1}$$

where $\varsigma = cov(\varepsilon, \varepsilon^*)$. In the first two (pre-school) periods women can enroll their children in subsidized and/or non-subsidized child care. Both types of child care are perfect substitutes with the exception of the price and availability. In contrast to non-subsidized child care, I assume as in Wrohlich (2006) and Haan and Wrohlich (2011) that access to subsidized child care slots κ_t at a given age is rationed and randomly assigned to mothers by a lottery with age-dependent success probabilities $\pi_t(\kappa_t)$. These success probabilities are assumed to be independent of the maternal labor force participation status or number of children, as there is neither any information in the data that would allow me to identify such dependencies nor any official rules or documentation I could rely on.

2.3 Preferences

The woman is assumed to be the household's sole decision maker; alternatively, she has the full bargaining power. A childless woman ($n = 0$) receives an instantaneous utility from her share of household consumption, i.e. household consumption c_t deflated by the OECD equivalence scale $\psi(n) = 1.7 + 0.5n$, and leisure which is the time endowment of one less time worked in the market l_t:

$$u_{t,n=0} = \frac{(c_t/\psi(0))^{1-\gamma_0} - 1}{1-\gamma_0} + \delta_1 \frac{(1-l_t)^{1-\gamma_1} - 1}{1-\gamma_1}. \tag{2}$$

The utility function for a mother ($n > 0$) is different. Her leisure is further reduced by the time spent with her children (m_t). In addition she receives utility of the number of children ($\mathbf{N}$) and who takes care of them ($\mathbf{X}_t$):

$$u_{t,n>0} = \frac{(c_t/\psi(n))^{1-\gamma_0} - 1}{1-\gamma_0} + \delta_1 \frac{(1-l_t-m_t)^{1-\gamma_1} - 1}{1-\gamma_1} + \mathbf{N} + \mathbf{X}_t, \tag{3}$$

This general specification is relatively standard, see e.g. Greenwood et al. (2003) or Jones et al. (2010). Let me now explain the details of the two additional parts. The direct utility from having $n > 0$ children is given by

$$\mathbf{N} = \delta_2 \frac{(1+n)^{1-\gamma_2} - 1}{1-\gamma_2} - \zeta. \tag{4}$$

ζ only affects the $n = 0$ vs. $n = 1$ choice but not any other decision conditional on having children. Anticipating the calibration results, this additional degree of freedom is needed to generate the empirically observed fraction of childless women along with the remaining empirical fertility distribution. While there are other ways to replicate these facts, the alternative specifications would fail on other key dimensions.[6]

The function $\mathbf{X}_t$ introduces the main behavioral trade-offs to replicate the facts on maternal labor force participation and child care enrollment outlined in Section 1. Its specification is similar to Ribar (1995). Children have the following time constraint:

$$m_t + cc_{s,t} + cc_{ns,t} + cc_{np,t} = 1. \tag{5}$$

They either spend time with their mother (m_t), are taken care of in a paid child care arrangement, either subsidized ($cc_{s,t}$) or non-subsidized ($cc_{ns,t}$), or in a non-paid child care arrangement ($cc_{np,t}$).

[6] Greenwood et al. (2003) employ a very similar utility function without ζ and their model generates only women with children. While their setup features a time cost of having children that in principle may prevent (some) women from having children at all, the calibrated time costs are too small to generate such an outcome quantitatively. I experimented with a version without ζ but such a time cost. In order to match the fraction of women without children the time costs would have to be much larger than in Greenwood et al. (2003) with the counterfactual implication that essentially no mother would be willing to work full-time.

The usage of each mode of care affects maternal utility through $\mathbf{X}_t$ in the following way:

$$\mathbf{X}_t = \delta_3 \xi(t) m_t^{\gamma_3} - \delta_4 \mathbf{I}_{t \leq 2} (\underbrace{1 - m_t - cc_{s,t} - cc_{ns,t}}_{\equiv cc_{np,t}})^{\gamma_4}. \tag{6}$$

Specifically, spending time with the children exerts a positive effect whereas the usage of non-paid child care exerts a negative effect *relative* to using paid child care. Note that $\mathbf{X}_t$ does not represent investment in the children's human capital or child quality. The next paragraphs motivate and discuss the different elements of Equation (6) in more detail.

2.3.1 Maternal Time m_t

Hotz and Miller (1988) assume that children impose a time cost on mothers which declines geometrically as the children get older to capture the different needs of children at different ages. In contrast, I assume that the utility mothers receive from spending time with their children varies with the children's age, reflecting that mothers perceive it to be more or less important/rewarding to spend with their children at different stages of their life. This in turn alters the incentives to participate in the labor market. I use a flexible form of time-dependence to replicate the participation behavior of mothers over time:

$$\xi(t) = \begin{cases} 1 & \text{if } t = 1 \\ \xi_2 & \text{if } t = 2 \\ \xi_3 - (\xi_3 - \xi_6)\frac{t-3}{3} & \text{if } t \in [3, 6] \end{cases}, \tag{7}$$

where the utility of time spent with the children is normalized to one in period one (ages zero to two), and in periods two, three and six given by the parameters ξ_2, ξ_3 and ξ_6, respectively. For periods four and five the values are linearly interpolated.

2.3.2 Non-Paid Child Care $cc_{np,t}$

Three comments are necessary to explain the role of non-paid child care in the model. First, with the focus being on pre-school child care, I assume that non-paid child care does not affect the mother's utility once children enter school, i.e. the indicator variable $\mathbf{I}_{t \leq 2}$ in Equation (6) equals one for $t \leq 2$ and zero afterwards.

Second, paid child care, whether subsidized or non-subsidized, does not exert a direct impact on the maternal utility. The impact is indirect: positively by reducing non-paid child care, and negatively by being costly and thus lowering consumption. In that sense, the effects of maternal time spent with the children and usage of non-paid child care on maternal utility are measured *relative* to the usage of paid child care. Therefore, non-paid child care needs to exhibit a negative impact on the mother's utility because otherwise no household in the model would use paid child

care.[7] Possible interpretations for the utility costs of non-paid child care are the effort to organize care by grandparents, other relatives or friends, the foregone joint leisure-time with the husband if he takes care of the children or the disutility of taking care of the children while working from home (e.g. as self-employed). Therefore, there is no reason to believe that families actually have direct negative preferences regarding non-paid child care. The approach is simply a flexible way to proxy for the direct costs of non-paid child care relative to the other forms of care, see also Ribar (1995).

Third, as in Ribar (1995), Blau and Hagy (1998), Wrohlich (2006) and Tekin (2007) I assume that every mother has access to non-paid child care. The remainder of this subsection provides evidence that most women in my sample do in fact have access to some form of non-paid child care. These statistics are obtained from a set of questions in the GSOEP which were asked only in a few survey years.[8]

Even though 95% of husbands work full time in the data, couples may co-ordinate their working times at least to some degree. In fact, among working women with children aged zero to two, 36% work non-standard shifts (after 7 p.m. or on weekends) at least every other week, and 22% work non-standard shifts less often than this. This may generate more flexibility for working mothers by allowing the father to take care of the children despite his working full-time. 38% of husbands with children aged zero to two provide care on a regular basis during the workday (including the evening) if the woman is working, and 57% if she is not, respectively.

In addition, the woman's parents or in-laws act as a regular provider of non-paid child care in 24% of households with a child aged zero to two if the woman is not working, and in 44% of households if the woman is working. In contrast to husbands, however, the parents or in-laws of a mother may not live close enough to provide non-paid child care. To assess the importance of the proximity to parents or in-laws, I compare the labor force and child care outcomes for mothers who live within an hour drive from their own parents or in-laws to mothers who live more than an hour drive from both their own parents and in-laws.

If we were to see a strong relationship between where the parents and in-laws live, the assumption of every household having access to non-paid child care could be easily rejected and used as criterion to distinguish between two types of households. This, however, is not the case: 89% of mothers in my sample with children aged zero to two live within one hour driving distance from their own parents and/or in-laws. The labor force participation rate of these mothers is only one percentage point higher (35.7% vs. 34.7%) and the child care enrollment rate only 2.5 percentage points lower (5.7% vs. 8.2%) than of those mothers with no parent and in-law living within one hour driving distance. Hence, in both cases the maternal labor force participation rate exceeds the corresponding

[7] Ribar (1995) proceeds similarly, but models it the other way around: paid child care exhibits a positive impact on maternal utility whereas non-paid child is excluded.

[8] All statistics only relate to the maternal labor force participation and child care enrollment status at the interview date. The information on when people are working is only available for the years 1995 and 2000; geographical closeness to the mother's own parents or in-laws for the years 1991, 1996 and 2001; and regular care providers for the years 1991 and 1996.

child care rate by a similar magnitude (30 vs. 26.5 percentage points). I also compare outcomes for mothers who live within the same city as their own parents or in-laws (64% of mothers with children aged zero to two) to mothers who live in different cities from both their own parents and in-laws. The respective differences are 2.3 percentage points for the maternal labor force participation rate and only 0.2 percentage points for the child care enrollment rate.

In sum, the relationships between the proximity of parents and in-laws and maternal employment and enrollment choices are extremely weak. In fact, on the individual level the correlations between the distance measure (here I use all five available categories: same house, same neighborhood, same city, within one hour driving distance, farther away including not alive) and maternal labor force participation and child care enrollment are near zero. Taken as a whole, these statistics suggests that most women have access to some form of non-paid child care, and firmly reject the notion that no mother uses non-paid child care.

2.3.3 Preference Heterogeneity

The basic model structure implies the standard result that female labor supply is decreasing in the husband's income, which qualitatively is consistent with the data. Previewing the calibration results, in quantitative terms this negative relationship is too strong compared to the data. In order to break this tight link, I modify women's preferences to make their labor force participation choice more sensitive to their own income shock ϵ_t by introducing preference heterogeneity. Adding preference heterogeneity/shocks is a common approach in structural labor models to fit moments of the data that otherwise could not be replicated, see e.g. Francesconi (2002) or Haan and Wrohlich (2011) in the context of female labor supply. Guner et al. (2012) introduce a fixed utility cost of working which varies systematically with the husband's education. I also introduce a fixed cost of working but instead let it vary with the woman's own income shock:

$$\tilde{u}_{t,n} = u_{t,n} - \theta \left(1 - e^{\epsilon_t}\right) \mathbf{I}_{l_t>0}, \tag{8}$$

where $u_{t,n}$ is the instantaneous period-specific utility described by Equations (2) and (3), and $\mathbf{I}_{l>0}$ is an indicator function which takes the value one if the woman is working and zero otherwise. For $\theta > 0$, women with below (above) mean realizations of the income shock ϵ_t receive a disutility (utility) of working, in addition to the effect on leisure. This could be interpreted as non-pecuniary aspects of a job/working which are linked to the monetary reward. Low paying jobs may be more repetitive, less interesting or less prestigious than high paying jobs. An alternative interpretation could be that low income shocks also reflect poor health, which in turn comes along with a higher disutility of working.

2.4 Budget Constraint

The per-period budget constraint is given by:

$$c_t = \tau\left[y_t(l_t, x_t, \epsilon_t), y_t^*(t, \epsilon_t^*)\right] - f_{cc}\left[n, t, cc_{s,t}, cc_{ns,t}, y_t, y_t^*\right] + \Upsilon\left[n, t, l_t\right]. \tag{9}$$

The function τ calculates the after tax household income from the woman's (y_t) and husband's (y_t^*) gross income. y_t^* depends on two components: a deterministic component in age (t) and a stochastic component represented by the husband's current period income shock (ϵ_t^*). In contrast, the woman's income depends on her labor supply (l_t), accumulated experience (x_t) through past labor force participation

$$x_t = x_{t-1} + l_{t-1}, \text{ with } x_1 = 0 \tag{10}$$

and her current period income shock (ϵ_t). Similar to the vast majority of structural models investigating labor supply and fertility choices of married women, e.g. Hotz and Miller (1988), Francesconi (2002) or Haan and Wrohlich (2011), I abstract from savings.[9] Child care fees f_{cc} depend on the number (n) and age (t) of the children, the utilized amount of subsidized ($cc_{s,t}$) and non-subsidized ($cc_{ns,t}$) child care as well as the gross household income. In addition, households receive transfers Υ conditional on the time period/age of the children (t) and choices (n, l_t). The functional forms for the gross incomes y and y^*, the tax schedule τ, the child care fees f_{cc} and transfers Υ are specified in Section 3.2.1.

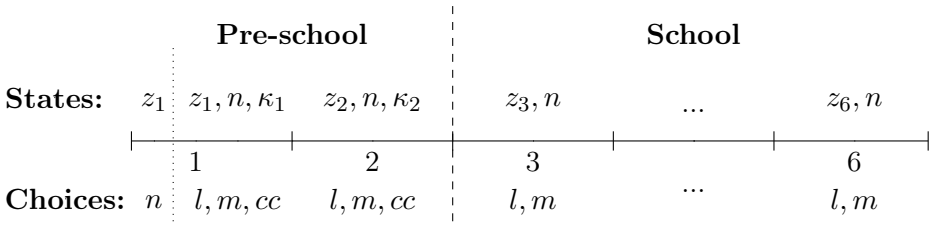
2.5 Choice Variables

All choices are assumed to be discrete. While the presentation of the stylized facts in Section 1 focused on the extensive margin, the model also features an intensive margin. Specifically, labor supply l_t can take on three values, zero for not working, 1/4 for part-time and 1/2 for full-time work. If the non-sleeping time endowment, normalized to one in the model, is 16 hours, then part-time work corresponds to four hours and full-time work to eight hours. Subsidized $cc_{s,t}$ and non-subsidized child care $cc_{ns,t}$ can take on the same three values, zero for no paid child care, 1/4 for part-time and 1/2 for full-time paid child care. The actual choice of subsidized child care, however, is restricted by the access κ_t to a subsidized child care slot:

$$cc_{s,t} \leq \kappa_t \;\forall\; t = 1, 2. \tag{11}$$

[9] Attanasio et al. (2005) analyze the role of female labor supply as an insurance mechanism against idiosyncratic earnings risk within the family. The paper shows that the female labor force participation rate is virtually identical up to age 50 whether households are able to save or not. The reason is that households accumulate relatively little savings up to the mid 40s (if given the opportunity). Only in the last years prior to retirement the female labor force participation rate in the economy without savings is higher than in the economy with savings. In the latter setting households use their savings to smooth out low income realizations, whereas in the former female labor force participation is used more heavily as an insurance mechanism. The difference, however, does not exceed five percentage points (60% vs. 55% at age 60).

Figure 2: Life Cycle



κ_t equals zero if the woman has no access to subsidized child care, 1/4 for access to part-time and 1/2 for access to full-time subsidized child care. As already mentioned, the access to a subsidized child care slot is determined by a lottery with age- and type-dependent, i.e. part- $[\pi_t(\kappa_t = 1/4)]$ or full-time $[\pi_t(\kappa_t = 1/2)]$, success probabilities. Paid child care in subsidized and non-subsidized arrangements is restricted to

$$cc_{s,t} + cc_{ns,t} \leq \frac{1}{2} \; \forall \; t = 1, 2, \tag{12}$$

i.e. child care facilities are only open in the morning and early afternoon. A mother can potentially spend time with her children at any time throughout the day, i.e. $m_t \in \left\{0, \frac{1}{4}, \frac{1}{2}, \frac{3}{4}, 1\right\}$. However, while she is working and/or the children are in paid child care or mandatory schooling (s_t), she cannot spend any time with her children:[10]

$$m_t \leq \begin{cases} 1 - \max\{l_t, cc_{s,t} + cc_{ns,t}\} & \forall \; t \leq 2 \\ 1 - \max\{l_t, s_t\} & \forall \; 3 \leq t \leq 6. \end{cases} \tag{13}$$

2.6 Dynamic Problem

Figure 2 presents the timing of events during a woman's life, with $z_t = (\epsilon_t, \; \epsilon_t^*, \; x_t)$ and $x_1 = 0$. The first period is split up in two stages with different state and decision variables. In the first stage the initial income shocks are assigned and the woman chooses the optimal number of children (n), taking into account the uncertainty with respect to the access to subsidized child care $\pi_1(\kappa_1)$:

$$\max_n \left\{ \sum_{\kappa_1 \in \left\{0, \frac{1}{4}, \frac{1}{2}\right\}} \pi_1(\kappa_1) V(1, z_1, n, \kappa_1), \; n = 0, 1, 2, ..., N \right\}, \tag{14}$$

with $V(\cdot)$ being the woman's value function specified further below. Once the optimal number of children (n) is chosen, n becomes a state variable as the children stay with the mother. After access to subsidized child care is determined by the lottery, a mother chooses her labor supply (l_1), how

[10] I assume that children attend school part-time ($s_t = \frac{1}{4}$) in periods three and four, i.e. for ages seven to 12.5, and full-time ($s_t = \frac{1}{2}$) in periods five and six, i.e. for ages 13 to 18.5.

much time to spend with her children (m_1) and on her children's enrollment in subsidized child care ($cc_{s,1}$), possibly restricted by κ_1, and non-subsidized child care ($cc_{ns,1}$). Childless women only have one choice to make in each period, l_t. Therefore, I only discuss the Bellman equations for a mother's optimization problem. In the second stage of period one this is given by:

$$\begin{aligned} V(1, z_1, n, \kappa_1) = &\max_{m,l,cc_s,cc_{ns}} \tilde{u}_{1,n>0} + \beta \sum_{\kappa_2 \in \left\{0, \frac{1}{4}, \frac{1}{2}\right\}} \pi_2(\kappa_2) E_{\epsilon,\epsilon^*} V(2, z_2, n, \kappa_2) \\ &\text{subject to (9), (10), (11), (12) and (13).} \end{aligned} \tag{15}$$

$\tilde{u}_{1,n>0}$ is the period-specific utility function (Equation (8)) and β is the discount factor. At the beginning of period two, the new income shocks (ϵ_t, ϵ_t^*) realize according to the AR(1) process specified in Equation (1) and access to child care (κ_2) is drawn from a new lottery. The set of choice variables in period two is identical to the second decision stage in period one and the value function is given by

$$\begin{aligned} V(2, z_2, n, \kappa_2) = &\max_{m,l,cc_s,cc_{ns}} \tilde{u}_{2,n>0} + \beta E_{\epsilon,\epsilon^*} V(3, z_3, n, 0) \\ &\text{subject to (9), (10), (11), (12) and (13).} \end{aligned} \tag{16}$$

From period three onwards, children attend mandatory school and women do not need to use child care anymore ($\kappa_t = 0$ for $t \geq 3$). Hence, a woman only decides on how much to work and how much time to spend with her children:

$$\begin{aligned} V(t, z_t, n, 0) = &\max_{m,l} \tilde{u}_{t,n>0} + \beta E_{\epsilon,\epsilon^*} V(t+1, z_{t+1}, n, 0) \;\forall\; 3 \leq t \leq 6 \\ &\text{subject to (9), (10) and (13)} \\ &\text{and } V(7, \dots) = 0. \end{aligned} \tag{17}$$

2.7 Maternity Leave

An important element affecting the labor force participation decisions of women with children aged zero to two is the German maternity leave regulation. It permits every mother who worked until the birth of a child to return to her pre-birth employer at her pre-birth wage within three years after giving birth. Since in the model life starts with the birth decision, there is no pre-birth labor supply and I therefore grant all women the right to go on maternity leave.[11] Relevant in this setup is the stochastic part of income. By construction, part- and full-time working mothers work at their initial or pre-birth wage income shock in period one. Hence, the maternity leave regulation has only to be modeled explicitly for mothers who do not work in the first period, i.e. if $l_1 = 0$. I assume that they draw a new income shock at the beginning of the second period according to Equation (1) (e.g.

[11] In the sample investigated here, 94% of all mothers work prior to the first birth.

an offer for a new position) but can opt for the pre-birth income shock (i.e. return to the pre-birth position) such that the offered wage in the second period is given by $y_2(l_2, x_2 = 0, \max\{\epsilon_1, \epsilon_2\})$. The third period income shock is then determined by

$$\epsilon_3 = \begin{cases} \rho \max\{\epsilon_1, \epsilon_2\} + \varepsilon_3 & \text{if } n > 0,\ l_1 = 0,\ l_2 > 0 \\ \rho\epsilon_2 + \varepsilon_3 & \text{else,} \end{cases}$$

where ε_3 is correlated with the husband's shock realization ε_3^*.

3 Taking the Model to the Data

3.1 Data

The analysis in this paper is based on the German Socioeconomic Panel (GSOEP), an annual household panel comparable in scope to the American PSID (for a detailed description of the GSOEP see Wagner et al. (2007)). The data are drawn from the first wave in 1984 through 2006 spanning the years 1983 to 2005 because the variables on labor force participation and income I use refer to the year prior to each interview.

Sample Selection: Since there is no divorce in the model, following the common practice in the literature on female labor supply and fertility, see e.g. Francesconi (2002), only women living in a continuous relationship (marriage or cohabitation) with the same partner are included in the sample. I include only the most recent relationship and require that it is still intact at the last interview and that the current partner is the father of all children of the woman, if she has some. The analysis focuses entirely on West German women and therefore only women who lived there throughout the whole observation period are included. Finally, given a trade-off between sample size and potential cohort effects women born between 1955 and 1975 are included. Splitting the sample at age 65 into two cohorts displays hardly any differences in the facts reported in Section 1. The number of individuals satisfying the respective selection criteria are shown in Table A.1 in the Online Appendix A.1.

Period Definition: The data are mapped into the model periods as follows. The first period corresponds to ages zero to two, whereas the second period spans age three until a child enters elementary school which is age six and a half on average. Thus, the overlap with the model period two is not exact. To keep the remaining periods at a similar length, the subsequent age brackets cover three years (as the first period) until adulthood is reached. Table A.2 in the Online Appendix A.2 presents the final number of observations for each period grouped by the current number of children and provides some more details. Given the low number of observations for women with four or more children, the analysis in this paper focuses on women with one to three children only. Merging the "4+ children" observations with the "3 children" observations into one category (3+)

does not affect the presented facts.

Variable Definitions: The construction of the *period* labor force participation status is similar to Francesconi (2002): I assign a 0 to each month in which the woman does not work, 0.5 to each month in which she works part-time and 1 to each month in which she works full-time. The *monthly* labor force participation status is based on the retrospective information for the year prior to each interview. For the classification of part- and full-time work in each month I follow the convention outlined in the GSOEP documentation (http://www.diw.de/documents/dokumentenarchiv/17/60055/pgen.pdf). The *period* labor force participation status is then defined by the mean over all months. Period means below 0.25 correspond to not working, between 0.25 and 0.75 to part-time working, and above 0.75 to full-time working. To give a concrete example, a woman working part-time in each month of a period, and one not working in the first half of a period but full-time in the second half have the same period labor force participation status, namely part-time working. In line with the objective of this paper, this definition reflects how much a woman has worked in total during certain stages of her children's adolescence.

The GSOEP asks for enrollment in paid child care, distinguishing between two different categories, namely daycare centers and nannies, and whether the child is enrolled part- (during the morning or afternoon) or full-time (morning and afternoon). Since virtually all daycare centers receive public subsidies, I use this category for publicly provided child care, henceforth called subsidized child care. During the observation period parents could claim financial support for hiring a nanny only in special circumstances, e.g. severe illness. Accordingly, I label nanny care as non-subsidized child care. The corresponding period enrollment status for subsidized and non-subsidized child care is then calculated in the same way as the labor force participation status. Since the child care enrollment status is only known for the interview month, I impute them for the remaining months of a year as described in the Online Appendix A.3.

Finally, aggregate *annual* statistics on the provision of subsidized part- and full-time child care by age groups (zero to two and three to six and a half) are available from the Germans Statistical Office. The Online Appendix A.4 describes how I calculate the *period* provision rates of subsidized child care such that they are consistent with the definition of the period labor force participation and child care enrollment status as discussed before.

3.2 Calibration

In the following paragraphs, I specify the functional forms for the exogenous model inputs. In the model all variables are transformed appropriately to align with the model period's length of three years. All monetary values are expressed in real terms in 2008 €. Afterwards, I present the set of target moments to pin down the preference parameters.

Table 1: Income Process

	$\eta_0^{(*)}$	$\eta_1^{(*)}$	$\eta_2^{(*)}$	$\rho^{(*)}$	$\sigma_{\varepsilon^{(*)}}$
Men*	11.590	0.055	-0.006	0.815	0.273
Women	11.291	0.068	-0.006	0.815	0.273

3.2.1 Functional Forms

Income: In the model all husbands are assumed to work full-time, which is the case for 95% of husbands in the data, and thus to accumulate full-time experience. I assume that their log gross income y_t^* is a concave function of experience and hence of time in the model or, respectively, of the youngest child's age in the data:

$$\ln y_t^* = \eta_0^* + \eta_1^*(t-1) + \eta_2^*(t-1)^2 + \epsilon_t^*. \tag{18}$$

The gross full-time income $y_t(l_t, x_t, \epsilon_t)$ of a woman is given by a classical Mincer (1974) earnings equation with returns to experience, where part- and full-time work $l_t = 1/4$ and $1/2$, respectively. As a normalization $x_t = \sum_{i=1}^{t-1} l_i$ is multiplied by two ($\tilde{x}_t = 2x_t$) such that part-time work increases $\tilde{x}$ by $1/2$ and full-time work by 1:

$$\ln y_t = \eta_0 + \eta_1 \tilde{x}_t + \eta_2 \tilde{x}_t^2 + \epsilon_t. \tag{19}$$

I assume that there is no part-time penalty, i.e. the gross part-time income is half of the gross full-time income for the same level of experience and the same income shock. Table 1 lists the parameters used for Equations (18) and (19), with the details of the estimation process given in the Online Appendix B.1. For the numerical solution of the model, the AR(1) process for the income shock (Equation (1)) is discretized into 20 states using the method proposed by Tauchen and Hussey (1991). Following, Attanasio et al. (2008) the AR(1) process for the income shock has the same persistence and variance for both gender, and the correlation coefficient between subsequent spousal income shocks is set equal to 0.25.[12] Matching is assortative and as in Heathcote et al. (2010) the correlation of the initial spousal income shocks is set equal to the correlation between spousal education levels in my sample. These are taken from the 1997 ISCED classification provided in the GSOEP and comprise six different levels. The implied correlation for my sample is 0.43.

[12]This estimate is by Hyslop (2001) for US data. Unfortunately, no corresponding estimate for Germany exists and replicating the work by Hyslop (2001) is beyond the scope of this paper. Since it is not clear in how far the choice of 0.25 applies to my sample, I conducted the analysis for a correlation coefficient of zero and of 0.5 (at the calibrated preference parameters). While there are small quantitative changes in the participation and fertility choices in the baseline setting, the main conclusions from the policy experiments are unchanged.

Taxes and Transfers: The tax code implemented in the model incorporates the key elements of the German tax system. First, household have to make mandatory contributions to several public insurance programs. These are proportional to individual earnings up to certain earning limits; beyond these limits no additional contributions occur. In the model I use the averages for each type of insurance over the years 1983 to 2005. For the pension system and unemployment insurance the monthly earning limits amount to 4798 € and the linear tax rates to 10.32% and 3.53%, respectively. For the health and long term care insurance the monthly earning limits amount to 3546 € and the linear tax rates to 7.30% and 0.38%, respectively.

Second, I apply the statutory labor income tax code for married couples as stated on the website of the German Federal Ministry of Finance (https://www.abgabenrechner.de/). For each household income level I first calculate the tax burden for all years from 1983 to 2005 and then take the average. In a second step, I approximate the household tax burden by fitting a polynomial to these averages for all incomes between the smallest tax-exempted income allowance across all years and an upper threshold from which onwards the marginal tax rate is constant, for details see the Online Appendix B.2.

The transfers include the average monthly child benefits over the the years 1983 through 2005 which amount to 90 € for one child, 204 € for two children and 374 € for three children. Based on the description in Ludsteck and Schoenberg (2014) in period one non- and part-time working mothers receive a maternity benefit of 2437.04 € which comprises the maternity benefits paid during the first six months after a child is born if the mother does not work.

Paid Child Care: The total child care fees $f_{cc}\left[n, t, cc_{s,t}, cc_{ns,t}, y_t, y_t^*\right]$ are the sum of the per-child fees for subsidized and non-subsidized child care times the number of children. I estimate the per-child fees with the individually reported fees in the GSOEP, and then use the predicted values in the model. For subsidized child care these are based on a Tobit-regression with censoring at 0 € and at 447.72 €, the lowest and highest observed monthly fee for subsidized child care, and the following set of regressors: an intercept (53.79), a full-time dummy (50.20), a dummy for ages zero to two (21.90), number of further siblings enrolled in subsidized child care (-29.56), and household income (-0.02), where the numbers in parentheses state the respective coefficient estimates. The sibling discount and income dependence are part of the regulations for subsidized child care. The per-child fees for non-subsidized child care are the predicted values from an OLS-regression on an intercept (236.49) and a full-time dummy (177.52), the only two statistically significant regressors. Table B.3 in the Online Appendix B.3 shows the predicted fees for a few cases.

The probability to draw a part-time subsidized child care slot in the first period (ages zero to two) is 4.3% and 1.7% for a full-time child care slot. The respective numbers for the second period (ages three to six and a half) are 71.8% and 23.7%, respectively. These are directly computed from the data, see the Online Appendix A.4.

3.2.2 Data Targets

The discount factor β is set to $\left(\frac{1}{1.04}\right)^3$ as in Kydland and Prescott (1982). The remaining 14 preference parameters are calibrated by matching 14 moments. With regard to the fertility outcomes, I target the fraction of women without, with one, and with two children.[13] Ten of the remaining eleven targets are chosen to reflect main patterns in terms of labor force participation and child care enrollment. First, I target the average labor force participation rates (part- plus full-time) of childless women.[14] Second, I aim to replicate the life-cycle profile of maternal labor force participation with a stronger emphasis on the part-time than the full-time rates. Specifically, I target the part-time maternal labor force participation rates in periods one, two, three and six as well as the full-time maternal labor force participation rates in periods one and six. Third, the set of targets includes the part-time child care enrollment rates in periods one and two as well as the full-time child care enrollment in period two. In the Online Appendix B.4 I discuss in how far these moments are informative about the model parameters.

While the previous moments are cross-sectional averages (in a given period), the last targeted moment addresses cross-sectional heterogeneity and deserves more explanation. I target the difference in the period one maternal labor force participation rate between women whose husband's income falls in the first quintile and whose husband's income falls in the fifth quintile.[15] The model structure naturally predicts that the female labor force participation rate is decreasing in the husband's income, which is also true in the data. The parameter θ, governing the strength of the preference heterogeneity in Equation (8), determines the slope of this relationship by amplifying the effect of the woman's income shock relative to the husband's income shock on her labor force participation choice.

Since no closed form solution of the corresponding model moments is available, I simulate 100,000 individuals.[16] The initial income shocks are drawn from the stationary distribution implied by the estimated parameters of Equation (1).

Table 2a lists the calibrated preference parameters with a reference to the corresponding components in the utility function. Let me briefly comment on a few of the resulting parameter values. First, the curvature of consumption (γ_0=2.26) is in the range of usually cited values. Second, the

[13] Recall that I allow for a maximum of three children per woman. I have adjusted the fertility distribution for the fact that around 3.5% of all couples are unable to get children at all, see Robert Koch Institut and German Statistical Office (2004).

[14] Specifically, I use the average labor force participation rate of childless women in my sample between their ages 34 and 51 which is the oldest observed age (the oldest cohort is born in 1955 and the last year included in the analysis is 2005.) As for mothers, I calculate the respective labor force participation status over three year intervals resulting in six periods.

[15] In the model the age profile of income is deterministic for men. The only source of heterogeneity are the income shocks. For the data, I therefore use the empirical residuals from the log earnings regression for men described in the Online Appendix B.1 to construct the income quintiles.

[16] I used for the calibration of the model parameters the asynchronous parallel pattern search algorithm APPSPACK described in Kolda (2005), and Gray and Kolda (2006).

Table 2: Calibration Results

(a) Calibrated Preference Parameters

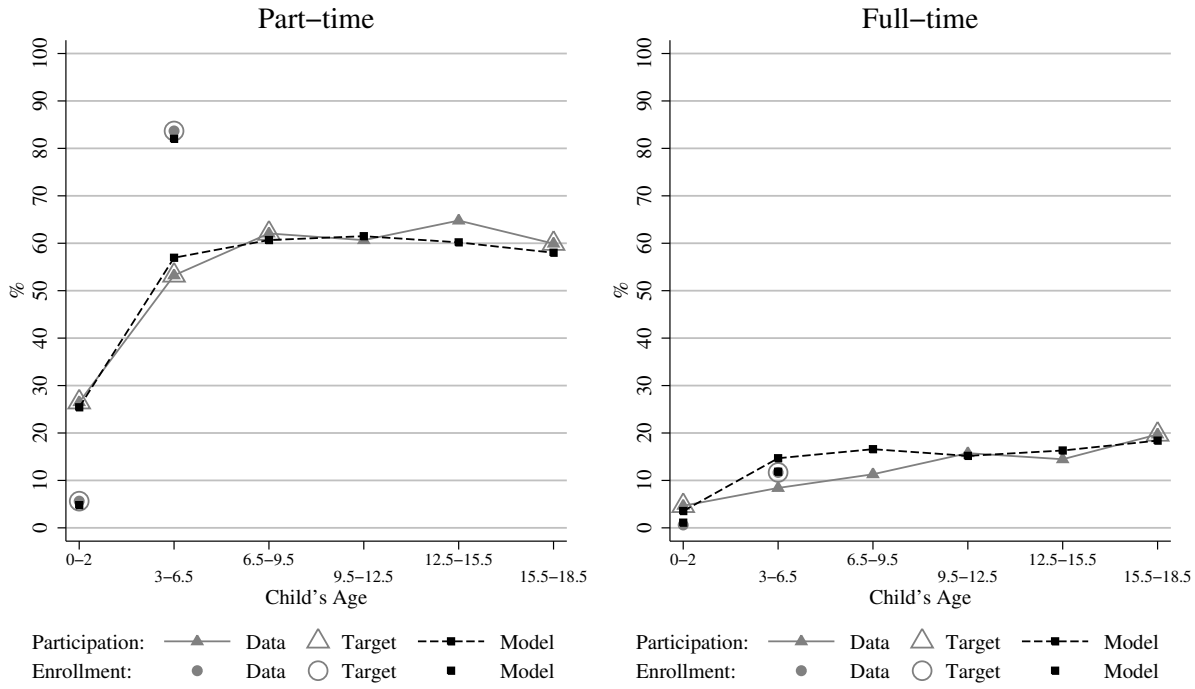
Consumption		γ_0=2.26			
Leisure	δ_1=0.30	γ_1=1.99	θ=1.08		
Children	δ_2=1.48	γ_2=1.47	ζ=0.82		
Maternal time	δ_3=2.27	γ_3=0.45	ξ_2=1.18	ξ_3=0.49	ξ_6=0.45
Non-paid child care	δ_4=0.76	γ_4=2.36			

(b) Targets: Data vs. Model

Target	**Data**	**Model**	$\Delta_{\textbf{Data-Model}}$
Fraction of Women			
without children	10.7	10.6	0.1
with one child	21.0	22.1	−1.1
with two children	50.4	50.5	−0.1
Labor Force Participation Rates			
Childless (Life-cycle Average)			
Part- plus Full-time	90.5	90.5	0.0
Mothers			
Part-time			
$t = 1$	26.5	25.4	1.1
$t = 2$	53.2	56.9	−3.7
$t = 3$	62.1	60.7	1.4
$t = 6$	60.0	58.0	2.0
Full-time			
$t = 1$	4.7	3.5	1.2
$t = 6$	19.7	18.4	1.3
Part- plus Full-time by Husband's Income Quintile			
$t = 1 : \ \Delta_{Q1-Q5}$	17.9	18.9	1.0
Child Care Enrollment Rate			
Part-time			
$t = 1$	5.6	4.8	0.8
$t = 2$	83.7	82.0	1.7
Full-time			
$t = 2$	11.6	11.8	−0.2

positive value for θ indicates that women with below mean income shocks receive a disutility of working (on top of enjoying less leisure), whereas women with above mean income shocks receive a

Figure 3: Data vs. Model



positive utility of working (clearly, they enjoy less leisure as well). Third, as previously indicated, a value of $\zeta > 0$ is required to make some women choose to not have children. Nevertheless, having children is always associated with a positive utility, i.e. $\mathbf{N} > 0$. Fourth, the values for ξ_2, ξ_3 and ξ_6 imply that the utility from time spent with children increases in the second period relative to the first period and subsequently decreases. This implies that mothers find it more valuable to spend time with their children while they are of age three to six and a half compared to zero to two. Nevertheless, the average time spent with children in the model is still higher in period one than in period two.[17]

Table 2b shows the data moments along with the simulated model moments for the calibrated model version. All targets are close to their empirical counterparts but not matched exactly.

Table 3: Conditional Child Care Enrollment Rates

	Ages 0 to 2		Ages 3 to 6.5	
Enrollment Rate in	**Data**	**Model**	**Data**	**Model**
At least Part-time Care if				
Mother Not Working	2.9	3.8	93.2	89.3
Mother Working	13.7	10.5	96.7	95.7
Full-time Care if				
Mother Working Full-time	3.9	7.3	32.4	32.3
Non-Subsidized Care if				
Enrolled in Child Care	40.4	24.8	0.8	0.2

3.2.3 Model Evaluation

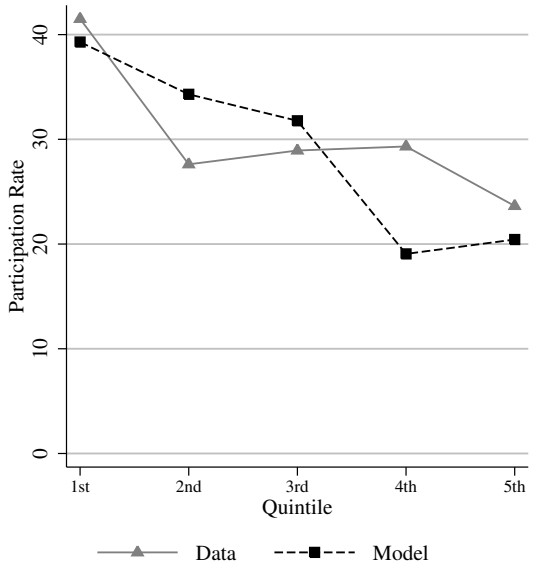
This subsection discusses the model's predictions for a set of non-targeted moments. Figure 3 shows the life-cycle patterns for maternal labor force participation and child care enrollment. The model overpredicts the full-time maternal labor force participation rate in periods two and three. The full-time child care enrollment rate in period one is 1.1% in the model and 0.6% in the data. Table 3 shows that the model successfully replicates a set of conditional child care enrollment rates in the data. The biggest deviations occur for the child care enrollment rate of children aged three to six and a half whose mothers are not working (93.2% vs. 89.3%) and for the fraction of children aged zero to two enrolled in non-subsidized child care among all children enrolled in paid child care (40.4% vs. 24.8%). However, in absolute terms this latter mismatch is actually small. In the data 2.5% of all children aged zero to two are enrolled in non-subsidized child care, whereas in the model this number amounts to 1.5%.

The model also replicates the cross-sectional heterogeneity in the data fairly well. Figure 4a shows that the model closely resembles the maternal labor force participation rate for the first, third and fifth husband's income quintile in period one and is somewhat off for the second and fourth income quintile. As can be seen from Figure 4b, the model provides a decent fit for the difference in the labor force participation rate between mothers married to a husband in the first and fifth income quintile for the second to fourth model period, but is further off in periods five and six. The model also captures the main patterns in the relationship between the child care enrollment rate and the husband's income in periods one and two, see Figure B.1a in the Online Appendix B.5. Focusing on the women's income, the aggregate female labor supply elasticity implied by the

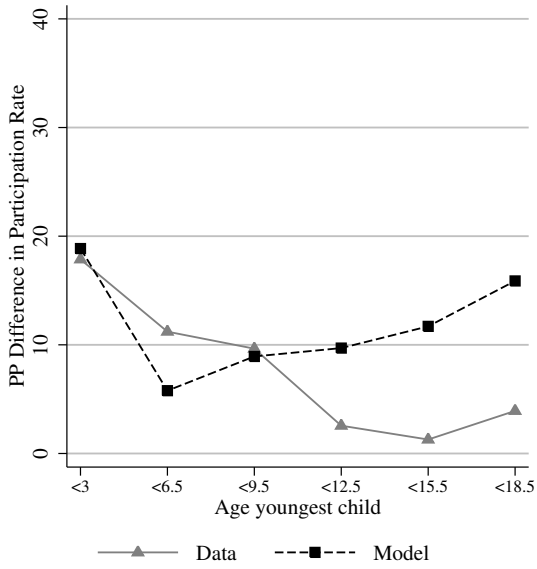
[17] In a previous version of the paper without preference heterogeneity the implied value of ξ_2 was smaller than one and larger than ξ_3. Hence, the utility of time spent with the children decreased continuously as these got older. The introduction of preference heterogeneity amplifies the value of exercising the maternity leave option for any woman (who did not work in period one) with an "above mean" period one income shock. To keep too many of those mothers from working in period two the utility of spending time with children in this period has to be sufficiently high.

Figure 4: Maternal Labor Force Participation Rate by Husband's Income

(a) Ages zero to two



(b) Difference between 1st & 5th Quintile



model is 0.77. This is closely in line with the survey of empirical estimates in the Handbook of Labor Economics chapter by Blundell and MaCurdy (1999). The mean (median) elasticity across the studies stated in Table 2 in there for married women is 0.71 (0.79). The model further closely tracks the life-cycle profile of accepted earnings in the data which suggests that the model captures well the selection into employment, see Figure B.1b. Most of the patterns of maternal labor force participation and child care enrollment are qualitatively replicated when I split the sample between households with below and above the mean household incomes, see Figure B.2. Quantitatively the fit is particularly good for the first period, which is the most relevant one for the policy experiments. Figures B.1b and B.2 are shown in the Online Appendix B.5, which also explains how the labor supply elasticity, the accepted earnings and household income are calculated, as the measurement of women's earnings in the data is not as straightforward as one may think.

Finally, a large literature evaluates how changes/differences in taxes or in transfers tied to the presence of children affect the fertility rate, see Gauthier (2007) for an extensive survey. While most of these findings are difficult to compare directly to my setup, Gauthier and Hatzius (1997) report one statistic that is straightforward to compute in the model. Exploiting variation in family allowances and maternity benefits for 22 OECD countries over the years 1970 through 1996, they calculate the long-run response of the fertility rate to a 25% increase of the child benefits for the first and second child. Their estimates imply an increase of 0.07 children per woman, or a 4.2% increase in the fertility rate. Conducting the same experiment in my model yields an increase of

0.10 children per woman, or a 5.7% increase in the fertility rate.

4 Policy Experiments

In April 2008 the German Federal government passed the Kinderförderungsgesetz [Kifög]. I analyze the impact of the major parts of this law which extend the provision of subsidized child care for children aged zero to two.

4.1 Setup of the Reforms

Reform 1: *For all children younger than age three a subsidized child care slot shall be provided from October 2010 onwards if both parents are working.* (§24 I 2 and §24a III Sozialgesetzbuch 8)

The bill on the Kifög was introduced with the following statement: "Many parents do not realize their desired fertility level, because of the incompatibility of family and working life ... Therefore it is necessary to improve the compatibility of family and working life. To achieve this, we need more high quality child care for children younger than age three.", see German Federal Parliament (2008). The reform is straightforward to implement in the context of the model by conditioning access to subsidized child care (κ_1) on the labor force participation status (l_1). While full-time working women can always use subsidized part-time or full-time child care under the new policy, I maintain the assumption that non-working women rely on the lottery from the *Baseline* setup to have access to subsidized child care as described in Section 3.2.1. Part-time working women are in-between because now they can always use subsidized part-time child care, but they get access to full-time subsidized child care only via the lottery.

Reform 2: *From August 2013 onwards all children of age one and two are entitled to a subsidized child care slot.* (§24 II Sozialgesetzbuch 8)

This passage can be seen in the tradition of providing subsidized child care as a means of affordable, high quality pre-school education also for children aged one to two. For example, Rani and Steiner (2008) pointed out the beneficial aspects of the enrollment in high-quality child care for infantile education in the Kifög. The entitlement refers to part-time subsidized child care. The actual law applies to all children of age one and two, whereas the first model period includes an additional year, i.e. age zero. Given the definition outlined in the Online Appendix A.4, access to a subsidized part-time child care slot for only two years in the data still corresponds to access to a subsidized part-time child care slot for the whole model period. Hence, Reform 2 will be implemented such that all mothers of children aged zero to two have at least access to a subsidized part-time child care slot for their children independent of their labor force participation status. Non-working and part-time working mothers might still draw from the lottery a subsidized full-time child care slot with the success probability from the *Baseline* setup.

Table 4: Fertility

	Fraction with n children				Fertility
	0	**1**	**2**	**3**	**Rate**
Baseline	*10.6*	*22.1*	*50.5*	*16.8*	*1.74*
Reform 1–*Baseline*	−0.5	+1.4	−1.5	+0.7	0.00
Reform 2–*Baseline*	−0.5	+4.1	−3.1	−0.4	−0.04

The parental fees for subsidized and non-subsidized child care are kept at the values of the *Baseline* setup. Each reform is modeled as being revenue neutral, also accounting for changes in maternity leave benefits and child benefits, and financed via a proportional tax on labor earnings. Kolvenbach et al. (2004) report that the subsidies cover on average around 75% of operating expenses per subsidized child care slot or alternatively, on average the parental fees correspond to 25% of operating expenses. Therefore, I use as an estimate for the costs for each type of subsidized child care slot (distinguished by age group and part- or full-time) four times the corresponding average reported fee in the GSOEP. The total costs of the reform, which are financed by the proportional labor earnings tax, correspond to the costs for all used child care slots less the total parental fees paid.[18]

4.2 Fertility

I start with the effect of the two reforms on fertility. Table 4 shows the fraction of women with zero to three children and the fertility rate for *Baseline* setup in the first row. The second and third row show the difference between Reform 1 or Reform 2 and the *Baseline* setup, respectively.

Reform 1 induces some women to increase their number of children or to have children at all – the fraction of childless women decreases by 0.5 percentage points – but also induces some women to have fewer children. This latter effect stems from the tax imposed on households to finance Reform 1. Since children are costly, households at the margin decide to a have fewer children. The increase and decrease offset each other such that the overall fertility rate is left unchanged. Reform 2 even causes a small decrease in the fertility rate since more women reduce their number of children from two to one in response to the higher taxes imposed. Given these results, the Reforms fall short of one the declared goals, namely to increase the fertility rate.

[18] In general one may expect that the large expansion of the child care sector puts upward pressure on the wages paid to child caretakers and thus increase the cost of subsidized child care provision. Most child caretakers, at least in daycare centers, are paid according to the general public pay schedules and are placed in certain salary groups according to their qualification along with other public employees of the same qualification level. This system makes it very unlikely that a larger demand for child caretakers translates into higher wages, at least in the short- to medium-run.

4.3 Maternal Labor Force Participation and Child Care Enrollment

Table 5 compares the maternal labor force participation and child care enrollment rates under Reforms 1 and 2 with the *Baseline* scenario.

4.3.1 Reform 1

Under Reform 1, all part-time (full-time) working mothers with children aged zero to two have access to a part-time (full-time) subsidized child care slot. Part-time working mothers may still gain access to a full-time slot through the *Baseline* lottery whereas non-working women entirely rely on the *Baseline* lottery. This policy increases the maternal labor force participation rate by 8.3 (=−6.0+14.3) percentage points. This change in the maternal labor force participation rate is very similar to the difference-in-differences estimates from a drastic increase of subsidized child care in the late 1990's in the Canadian province of Quebec. Baker et al. (2008) estimate for two-parent families an increase of the maternal labor force participation rate of 7.7 percentage points and Lefebvre and Merrigan (2008) estimate for all mothers an increase of up to 8.1 percentage points. Gathmann and Sass (2012) conduct an empirical analysis of the 2006 child care reform in the East German state Thuringia. Their estimates of the elasticity of maternal labor force participation with respect to the costs of paid child care range from -0.1 to -0.3. The corresponding price elasticity implied by Reform 1 in the model is -0.34.

The labor force participation rate of mothers with children aged zero to two under Reform 1 is still substantially lower than for mothers with children aged three to six and a half. Why is the response not larger? First, subsidized child care for children aged zero to two is more expensive than for children aged three to six and a half, e.g. for a couple with one child earning the median income the mark up is 30%. Second, 40% of mothers whose youngest child is of age three to six and a half are not working but use subsidized child care. It is hard to see why these women should start working when more expensive subsidized child care becomes available for children age zero to two. Third, already 30% of women with children aged zero to two already work prior to the reform. This leaves only a potential target group affected by Reform 1 of 30% of mothers. On top of this, non-working mothers of children aged zero to two are granted the right to work in period two at their period one income shock if that exceeds their period two draw, a potentially valuable option.

Focusing only on the change in the labor force participation rate does mask one important aspect: the full-time maternal labor force participation rate increases by 14.3 percentage points. Hence, while increasing the provision of subsidized child care will have a modest effect on the extensive margin, the response along the intensive margin suggests that a large fraction of part-time working mothers would work full-time if they had greater access to subsidized child care.

The 16.3 and 17.5 percentage points increases in the part- and full-time child care enrollment rates induced by Reform 1 are much larger. This is because mothers who worked in the *Baseline*

Table 5: Maternal Labor Force Participation and Child Care Enrollment Ages Zero to Two

	Participation		**Enrollment**	
	Part-time	**Full-time**	**Part-time**	**Full-time**
Baseline	*25.4*	*3.5*	*4.8*	*1.1*
Reform 1–*Baseline*	−6.0	+14.3	+16.3	+17.5
Reform 2–*Baseline*	−6.8	+14.3	+46.0	+17.4

setup without using paid child care now substitute non-paid with subsidized child care. The overall child care enrollment rate of 39.7% under Reform 1 exceeds the target rate of 33% set by the European Council.

Finally, the increase in maternal labor force participation when children are age zero to two has virtually no impact on the average maternal labor force participation rate afterwards. All women who begin working under Reform 1 in the first period were already participating in the labor market in the second period prior to Reform 1.

4.3.2 Reform 2

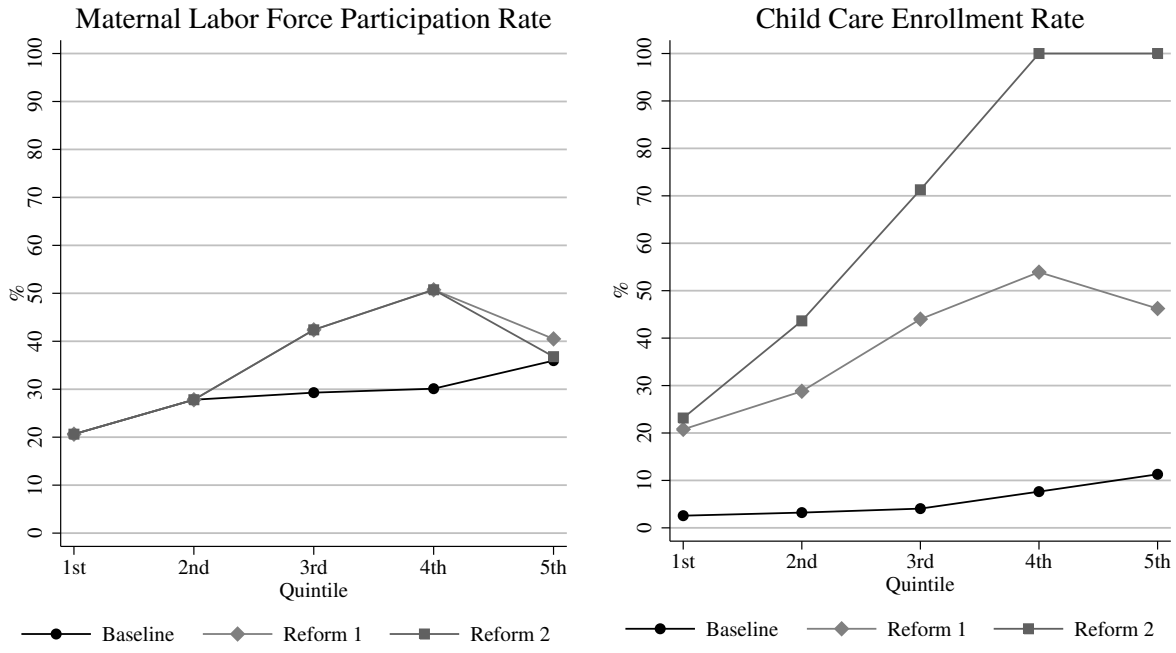
Reform 2 is targeted at non-working mothers. Relative to Reform 1, they also gain access to a subsidized part-time child care slot resulting in a stark increase in the child care enrollment rate. With Reform 2 an additional 29.7 (=46.0–16.3) percentage points of mothers use subsidized part-time child care, while the maternal labor force participation rate hardly changes. Under Reform 2 the availability of subsidized child care is similar for the two age groups. As for children aged three to six and a half, the fraction of working mother with children aged zero to two is now lower than the fraction of children enrolled in paid child care.

4.4 Welfare

The expansion of subsidized child care in both Reforms is partially financed by the additional revenue through the increases in maternal labor force participation. This, however, is not sufficient to cover the costs. An additional linear labor income tax on gross household income of 0.3% (0.7%) is levied to keep the government's budget balanced under Reform 1 (Reform 2). Figure 5 compares the maternal labor force participation rates (left panel) and child care enrollment rates (right panel) under the *Baseline* scenario and Reforms 1 and 2 by potential income quintiles. Potential income refers to the period one, gross joint income of couples with children assuming the woman would be working full-time.[19] This measure has two advantages over the actual gross joint

[19] Note that these quintiles are different from the husband's income quintiles used to construct one of the targeted moments. The line for the maternal labor force participation rate in the left panel of Figure 5 is therefore also not comparable to the maternal labor force participation rate depicted in Figure 4a.

Figure 5: Policy Effects by Potential Household Income



income. First, it allows me to compare quintiles of the *Baseline* scenario to those under Reforms 1 and 2; using actual joint gross would not, due to the change in the labor force participation choices.[20] Second, one and two earner couples with the same actual joint gross (or even net) income might have very different incentives to use paid child care because of the different female labor force participation statuses. Figure 5 shows that mostly women whose potential household's income falls into the third and fourth quintile increase their labor supply. While under Reform 1 all working mothers who use subsidized child care benefit from the new policy, women from potential income low households benefit the least because they have the lowest labor force participation rate. The richer the households in potential income, the more they take advantage of Reform 2. Hence, under both Reforms the poorest households benefit the least. Since every household contributes to financing the reforms via the additional tax, neither reform is welfare improving. In terms of consumption equivalent variation, ex-ante average welfare decreases by -0.2% under Reform 1 and by -0.8% under Reform 2. Note that this does not necessarily mean that the reforms are bad policies if there are other positive effects, which are not part of the analysis such as a beneficial influence on the children themselves.

[20] An even cleaner comparison would be to hold the fertility choices fixed at the pre-reform level which however does not affect the conclusions drawn from Figure 5.

5 Conclusion

At its Barcelona meeting in March 2002, the European Council recommended that its member states improve the provision of child care and even set explicit target levels. The intention of the initiative was to increase female labor force participation and to possibly foster fertility. In compliance with this initiative, the German government introduced two laws to increase the provision of subsidized child care for children age zero to two. The first reform gives all working mothers access to subsidized child care, while the second reform extends this entitlement to non-working mothers.

This paper asks how quantitatively important the provision of child care is for female labor force participation and fertility. To address this issue I endogenize these choices within a quantitative, dynamic life-cycle model that distinguishes between maternal care, paid child care provided in public (subsidized) and market (non-subsidized) arrangements as well as non-paid child care (e.g. by grandparents). The option of non-paid, non-maternal child care is crucial to explain a key fact for my sample of married women which also holds in aggregate data for a cross-section of EU countries: the maternal labor force participation rate is substantially larger than the child care enrollment rate for children aged zero to two, whereas the opposite is the case for children aged three to six and a half. This point is neglected by the majority of studies analyzing child care and female labor force participation, in particular by all that feature an endogenous fertility choice.

I use a calibrated version of the model to evaluate the two policy reforms passed by the German government in 2008. The results can be summarized as follows. Increasing the provision of subsidized child care generates a modest increase of the maternal labor force participation rate while children are of ages zero to two. The implied maternal labor supply responses and elasticity with respect to the cost of child care are consistent with other empirical estimates. This increase, however, is too small to conclude that the lack of subsidized child care accounts for the low labor force participation rate of mothers with children aged zero to two relative to mothers with children aged three to six and a half, or to mothers with children aged zero to two in most European countries as depicted in Figure 1b in the introduction. While the change along the extensive margin is rather modest, the response along the intensive margin does suggest that a large fraction of part-time working mothers would work full-time if they had greater access to subsidized child care. Finally, making subsidized child care available to more women does not achieve one of the commonly stated goals of such reforms, namely to increase the fertility rate. Welfare actually decreases since only a subset of households benefits but the costs are shared among all households.

To sum up, the results of the evaluated reforms suggest that increasing the provision of child care may not be sufficient for West Germany to catch up with the high maternal labor force participation and fertility rates in Western and Northern Europe. Differences along other dimensions, in particular aspects of taxation, might matter much more, see e.g. Manuelli and Seshadri (2009) or Bick and Fuchs-Schündeln (2014).

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