The Career Costs of Children

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We estimate a dynamic life cycle model of labor supply, fertility, and savings, incorporating occupational choices, with specific wage paths and skill atrophy that vary over the career. This allows us to understand the trade-off between occupational choice and desired fertility, as well as sorting both into the labor market and across occupations. We quantify the life cycle career costs associated with children, how they decompose into loss of skills during interruptions, lost earnings opportunities, and selection into more child-friendly occupations. We analyze the long-run effects of policies that encourage fertility and show that they are considerably smaller than short-run effects.

I. Introduction

In almost all developed countries, despite significant improvements over the last decades, women still earn less than men (see Blau and Kahn [1996] and Weichselbaumer and Winter-Ebmer [2005] for evidence), they are often underrepresented in leading positions, and their careers develop

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at a slower pace (see, e.g., Catalyst 2009). Having children may be one important reason for these disadvantages, and the costs of children for women's careers and lifetime earnings may be substantial. One key question for investigation, therefore, is the magnitude of these costs and how they decompose into loss of skills during interruptions, lost earnings opportunities, and lower accumulation of experience. Another important question is how intended fertility, even before children are born, affects the type of career a woman chooses. Addressing these issues requires an understanding of the dynamics of women's choices, how unobserved fertility preferences and ability affect the sorting into different career paths, and how intermittency patterns, work decisions, savings decisions, and fertility choices interact with each other.

This paper addresses these questions by estimating a dynamic model that describes the labor supply, occupational choices, assets, marital status, and fertility decisions of women over the life cycle. Our model builds on the early work by Polachek (1981), Weiss and Gronau (1981), and Gronau (1988), which emphasizes the important connection between expected intermittency and occupational choice. Like Polachek, we allow different occupations to have different entry wages and different rates of atrophy (skill depreciation) and wage growth. In addition, we allow atrophy rates to vary over the career cycle and occupations to vary according to their amenity value with regard to children. We cast this in a dynamic setting that endogenizes occupational choice, human capital, wages, savings decisions, and fertility, and that allows for unobserved heterogeneity in ability and the taste for children. Hence, our model integrates occupational and fertility choices into a woman's life cycle plan, where women with different fertility plans opt for different occupations so as to balance a potentially higher wage path with higher atrophy rates during work interruptions. Further, it explicitly implements risk aversion and savings, thus taking account of the trade-off between building up assets early in the career and maternity during a woman's most fertile period.

While many papers have addressed the issues of female labor supply and fertility, most have dealt with them in isolation.[1] Early papers that

[1] Early papers by Becker (1960), Becker and Lewis (1973), and Willis (1973) study fertility decisions and their dependence on household background variables in a static context. Several authors, including Heckman and Willis (1976), Ward and Butz (1980), Rosenzweig and Schultz (1983, 1985), Wolpin (1984), Cigno and Ermisch (1989), Blackburn, Bloom, and Neumark (1990), Heckman and Walker (1990), Hotz and Miller (1993), Leung (1994), Arroyo and Zhang (1997), and Altug and Miller (1998), propose dynamic models of fertility but assume labor supply decisions as exogenous. On the other hand, a related literature on women's labor supply behavior takes fertility decisions as exogenous; see, e.g., Heckman and MaCurdy (1980), Blau and Robins (1988), Eckstein and Wolpin (1989), van der Klaauw (1996), Hyslop (1999), Attanasio, Low, and Sanchez-Marcos (2008), Keane and Sauer (2009), and Blundell et al. (2013); see Blundell and MaCurdy (1999) for a survey.

analyze female labor supply and fertility jointly use reduced-form models, such as Moffitt (1984) or Hotz and Miller (1988). More recent papers that use dynamic life cycle models to study these as joint decisions include Francesconi (2002), Gayle and Miller (2006), Sheran (2007), and Keane and Wolpin (2010). We extend this work in three significant ways. First, we incorporate occupational choices to better understand the interplay between job characteristics, such as skill atrophy or differential wage growth, and the planning of fertility, as well as the sorting that takes place both into the labor market and across occupations. Second, we allow for skill atrophy, which can differ not just between occupations but also over the career cycle. This is important to capture the trade-off between occupational choice and desired fertility, with possibly high atrophy rates at career stages where fertility is most desirable. Third, we allow for an intertemporal budget constraint and risk aversion, which adds to our understanding of the relationship between savings and fertility and is important when investigating the dynamic aspects of policies that incentivize fertility.

We study this for Germany, where individuals who choose to attend lower-track schools at age 10 (about 65 percent of each cohort) enroll after graduation (and at the age of 15–16) in a 2–3 year vocational training program in one of 360 occupations within the German apprenticeship system.[2] This unique setting enables us to observe initial occupational choices for these individuals before fertility decisions are made but conditional on individual preferences for future fertility. Our primary data set is administrative in nature and allows precise measurement of wages, career interruptions, labor supply, and occupations, including the initial occupational choice, for many cohorts across different regions over several decades. We combine these data with survey data to measure fertility, household formation, and savings decisions.

Our model and estimated parameters produce valuable insights into the different components of the career costs of children, the contribution of fertility to explaining the male-female wage differential, and the short-run and long-run impact of transfer policies on fertility. We estimate that about three-quarters of the career costs of children stem from lost earnings due to intermittency or reduced labor supply, while the remainder is due to wage responses, as a result of lost investments in skills and depreciation. More specifically, we show that skill depreciation rates are higher in midcareer and differ across occupations, as do the opportunity costs of raising children and the child raising value, so that differ-

[2] These occupations range from hairdresser to medical assistant to bank clerk, and two in three individuals of each birth cohort follow an apprenticeship-based career route. See Fitzenberger and Kunze (2005) for details on the occupational choices of males and females.

ent occupational choices lead to different costs of raising children and affect the timing of their birth. Our results highlight that the selection into different careers is based not only on ability but also on desired fertility, so that some costs of fertility incur well before children are born.

Both atrophy and prior selection into child-friendly occupations based on expected fertility therefore contribute to the career costs of children. We also provide evidence on dynamic selection, where fertility leads to changes in the ability composition of working women over the life cycle. Using a sample of comparable male cohorts who made similar educational choices, we run simulations to understand better the wage differences between women and men over the life course and how these are affected by fertility decisions. We find that fertility explains an important part of the gender wage gap, especially for women in their mid-30s.

Finally, we use our model to simulate the impact of pronatalist transfer policies. Most previous studies that investigate the effect of these policies on fertility are based on difference-in-difference (DiD) designs and focus on short-term impacts (see, e.g., Milligan 2005; Lalive and Zweimüller 2009; Cohen, Dehejia, and Romanov 2013; Laroque and Salanie 2014). In contrast, our model allows us to evaluate both short-term and long-term effects and to distinguish between responses through the timing of fertility in reaction to an announced policy versus a change in overall fertility. In doing so, we show not only that the long-run effect of a subsidy policy is considerably lower than the short-run effects estimated in the literature but that such policies may also have a long-run impact on skill accumulation, labor supply, and occupational choice. More importantly, we demonstrate that these policies are likely to have a far larger impact on younger women, as they can adjust many life course decisions older women have already made. These younger cohorts, however, are typically not considered in DiD-type studies as their fertility does not respond in a narrow window around the policy.

II. Background, Data, and Descriptive Evidence

A. *Institutional Background and Data*

Following fourth grade (at about age 10), the German education system tracks individuals into three different school types: low- and intermediate-track schools, which end after grades 9 and 10 (age 15/16), or high-track schools, which end after grade 13. About one-third of the cohorts studied here attend each of the three school types. Traditionally, only high-track schools qualify individuals for university entrance, while low- and intermediate-track schools prepare for highly structured 2–3-year apprenticeship training schemes that combine occupation-specific on-site training 3–4 days a week with academic training at state schools 1–2 days a week.[3] These programs, which train for both blue- and white-collar professions, cover many occupations that in the United States require college attendance (e.g., nurse, medical assistant, accountant). At the end of the training period, apprentices are examined on the basis of centrally monitored standards, and successful candidates are certified as skilled workers in the chosen profession.

In our analysis, we concentrate on women born in West Germany between 1955 and 1975 who attend lower- and intermediate-track schools and then enroll in an apprenticeship training scheme after school completion.[4] We follow these women throughout their careers for up to 26 years in the labor market. We draw on three main data sets (described in more detail in the online appendix): register-based data from the German social security records (IABS data) and survey data from the German Socio-Economic Panel (GSOEP) and the Income and Expenditure Survey (EVS). The IABS data cover a 2 percent sample of all employees in Germany that contributed to the social security system between 1975 and 2001 and provide detailed information on wage profiles, transitions in and out of work, occupational choice, education, age, and periods of apprenticeship training. The sample we construct contains about 2.7 million observations on wages and work spells. We use the GSOEP data to measure, for a sample from the same birth cohorts as in the register-based data set, women's fertility behavior over their careers, as well as family background and spousal information. Finally, we use the EVS data to compute savings rates.

All analyses concentrate on the German population. Because the register data exclude the self-employed and civil servants, we exclude these groups from our analysis, as well as all individuals who have ever worked in East Germany. We provide more detail about the sample construction in the online appendix.[5]

B. Occupation Groups

We allocate occupations to groups that reflect the trade-off between careers that offer a higher wage but punish interruptions and careers that imply lower profiles but also lower atrophy rates. To achieve that, we use information on the task content of occupations, drawing on the task-based framework introduced by Autor, Levy, and Murnane (2003). This results in an aggregation of the many occupations into three larger groups accord-

[3] For instance, training is provided only in recognized occupations, skilled training personnel must be present at the training site, and trainees must pass monitored exit examinations.

[4] Women born in East Germany experienced different conditions while growing up behind the Iron Curtain, and we do not observe them in administrative data until after German reunification.

[5] Earnings in all data sets we use have been deflated using Consumer Price Index data for private households (German Statistical Office) and converted into euros, with the base year being 1995.

ing to characteristics that are meaningful in the context we study, distinguishing between occupations in which tasks performed are mostly routine, occupations in which tasks are mostly analytic or interactive, and occupations in which tasks are mostly manual but not routine. We refer to these three occupational groups as routine, abstract, and manual occupations.[6]

Requirements in jobs with mainly abstract tasks are likely to change at a faster pace than those in routine dominated occupations, while those in manual occupations may take an intermediate position. For instance, shop assistants and sewers are classified as routine occupations and require a set of skills that are acquired in the early stages of the career (such as product knowledge and relational skills) but are unlikely to change much over time. On the other hand, bank clerks and medical assistants (classified as abstract) are likely to require constant updating of their skills because of rapidly changing information technologies or new financial products, while nurses and stewards (classified as manual occupations) may take an intermediate position. We show below that wage profiles, but also atrophy rates, are indeed higher in abstract occupations than in routine or manual occupations.

C. *Occupational Choice, Labor Supply, Fertility, and Savings*

In table 1, we present descriptive statistics for the whole sample and by current occupation. About 45 percent of all women in our sample choose an initial (training) occupation with more abstract tasks, while 25 percent and 30 percent, respectively, choose routine or manual occupations. The second row of the table illustrates that current occupational proportions are similar to those for initial occupations, indicating that few women switch occupations over their careers. This is confirmed by the transition rates across groups in panel A of the table, illustrating that 98.6 percent of individuals remain in the same occupational group in two consecutive years.

In panel B, we report initial wages at age 20 and real wage growth in each of the three occupation categories after 5, 10, and 15 years of potential experience. Women in more abstract occupations not only earn higher wages than those in the two other groups at the start of their ca-

[6] Autor et al. (2003) distinguish between (i) nonroutine analytic, (ii) nonroutine interactive, (iii) routine cognitive, (iv) routine manual, and (v) nonroutine manual jobs. These are often combined into abstract (i, ii), routine (iii, iv), and manual (v) jobs. We follow Dustmann, Ludsteck, and Schoenberg (2009), Black and Spitz-Oener (2010), and Gathmann and Schonberg (2010), who allocate two-digit occupations to these three groups, using data from the German Qualification and Career Survey 1985/86, which includes survey information on tasks performed on the job. The construction of the task indicators and the classification of occupations across the three groups are detailed in the online appendix.

TABLE 1
Descriptive Statistics, by Occupation

	Routine	Abstract	Manual	Whole Sample
Initial occupation	25.0%	44.8%	30.3%	100%
Occupation of work	25.4%	52.7%	21.9%	
A				
Annual occupational transition rates:				
If in routine last year	97.9%	1.5%	.5%	
If in abstract last year	.7%	99.0%	.2%	
If in manual last year	.9%	.8%	98.3%	
B				
Log wage at age 20	3.598	3.742	3.470	3.634
	(.297)	(.301)	(.386)	(.337)
Log wage growth, at potential experience = 5 years	.0485	.0551	.0450	.0510
	(.187)	(.156)	(.196)	(.175)
Log wage growth, at potential experience = 10 years	.0181	.0240	.0152	.0208
	(.187)	(.206)	(.223)	(.206)
Log wage growth, at potential experience = 15 years	.00995	.0147	.0127	.0133
	(.206)	(.195)	(.211)	(.200)
C				
Total work experience after 15 years	11.55	12.81	12.14	12.34
	(3.273)	(2.624)	(2.880)	(2.909)
Full-time work experience after 15 years	10.32	11.92	10.86	11.29
	(3.907)	(3.348)	(3.570)	(3.617)
Part-time work experience after 15 years	1.229	.889	1.274	1.056
	(2.187)	(1.828)	(2.125)	(1.997)
D				
Total log wage loss, after interruption = 1 year	−.0968	−.147	−.105	−.121
	(.560)	(.636)	(.633)	(.613)
Total log wage loss, after interruption = 3 years	−.152	−.253	−.223	−.216
	(.604)	(.639)	(.619)	(.625)
E				
Age at first birth	27.27	28.39	25.94	27.56
	(4.138)	(3.783)	(3.517)	(3.943)
No child (%) at age 38	14.39	20.08	14.86	17.58
	(3.067)	(2.544)	(4.164)	(1.787)
One child (%) at age 38	25.00	28.92	18.92	26.15
	(3.783)	(2.879)	(4.584)	(2.063)
Two or more children (%) at age 38	60.61	51.00	66.22	56.26
	(4.269)	(3.174)	(5.536)	(2.328)

Note.—Occupation of work is defined conditional on working. Log wage growth is defined for all consecutive work spells after apprenticeship training. Total log wage loss after interruption is the change in log real daily earnings between return to work and the last quarter before interruption. The total wage loss has been purged of a change in occupation, in firm size (if change of firm) and changes in hours of work. Standard deviations are in parentheses

reers but also have a higher wage growth at each level of experience. Panel C reports the accumulation of total labor market experience, broken down by part-time and full-time work and by occupational category and evaluated after 15 years of potential labor market experience. Women who have chosen an occupation with predominantly abstract tasks accumulate 1.2 years (or 10 percent) more total work experience and about 1.6 more full-time work experience over this period than women in routine task-dominated occupations. Finally, panel D reports changes in daily wages after an interruption of 1 or 3 years, where changes in work hours, firm size, and occupation are conditioned out. The overall log wage loss for a 1-year (3-year) interruption is about 0.12 (0.21) log points. Wage losses are highest in abstract and lowest in routine occupations.

Thus, the costs of interruptions in terms of both forgone earnings and atrophy differ between occupational groups and are highest in occupations dominated by abstract tasks. This is reflected by different fertility patterns, as shown in panel E, where women in abstract jobs are more likely to remain childless or to have only one child, while being less likely to have two or more children, and being older at the birth of their first child. While these figures suggest sizable differences between women who choose different occupational careers at an early point in their life cycle, they cannot be interpreted causally because of selection of women into occupations, fertility behavior, and labor supply patterns based on fertility preferences and labor market abilities.

In figure 1 we plot the average household savings rates as a function of the age of the woman. Savings rates have a hump-shaped profile, at least

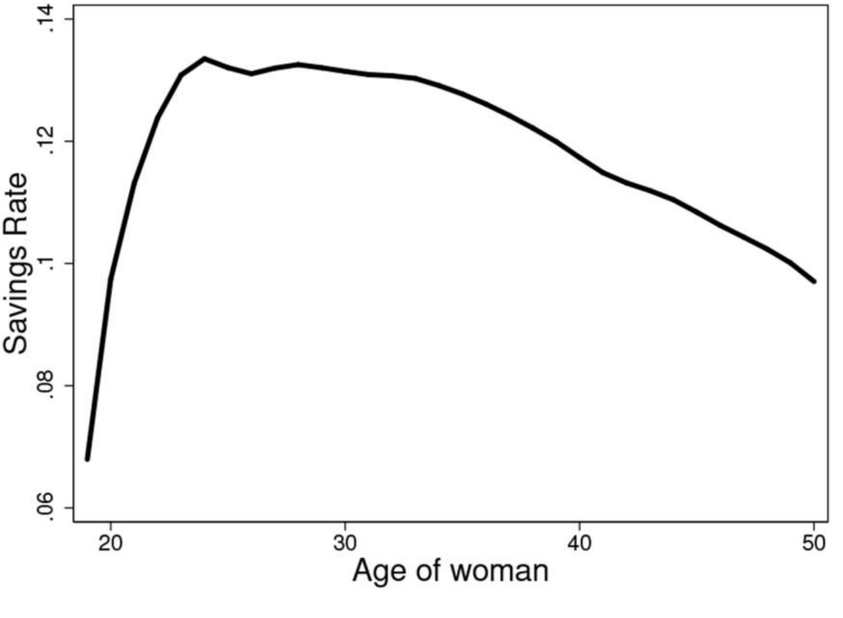

Fig. 1.—Savings rates and age: evidence from EVS data set. Computed from EVS data, by pooling the waves 1993–2008.

until age 50, starting at about 7 percent at age 20 and reaching a peak at age 28, after which they decrease. The figure suggests that savings are built up before the arrival of children, indicating that savings are an important element in the fertility decision and that parents are smoothing consumption over the life cycle and in response to the added expenditures linked to children. Building up a sufficient stock of assets could therefore be an important reason to delay pregnancy, in addition to career considerations.

III. A Life Cycle Model of Fertility and Career Choice

Our objective is to develop an estimable life cycle model to assess the career costs of children. To achieve that, our model has to be able to evaluate the costs of fertility by considering all associated decisions. There are at least three elements that determine the career costs of children. First, children may require intermittency periods of unearned wages during which women cannot work. Second, during intermittency, there will be no skill accumulation, and existing skills may depreciate. Third, depending on ability and expected fertility, women may sort into occupations that minimize the expected career costs of children. In particular, occupations may differ in terms of opportunity costs of raising children and in how skills depreciate. To understand how these different determinants of the costs of fertility operate, we need to understand how fertility is planned. This requires, in addition to the above components, modeling of the evolution of assets over a woman's work career, which in turn will interact with both fertility and career decisions. Thus, consideration of savings decisions is an important building block in our model. In the next section, we describe the main components of our model. We provide a more detailed description in the Appendix and in the online appendix.

A. *The Setup*

In each period, individuals choose consumption (and savings), whether to have an additional child, labor supply, and the type of occupation they work in. Frictions in the labor market imply that individuals have to wait for offers to adjust their labor supply. In the first period, around the age of 15, they decide on a particular training occupation and enroll in a 2–3-year apprenticeship training scheme. Time is discrete, a period lasts for 6 months, and we consider women in the age range 15–80, thus starting at the age when occupational decisions are made. We first present the building blocks of our model and then show how decisions are made.

Ex ante heterogeneity.—We allow for ex ante heterogeneity, which we model in terms of discrete mass points, along four dimensions: labor market productivity—or ability—(f_i^P), taste for leisure (f_i^L), taste for children (f_i^C), and potential infertility (f_i^F). We collect these characteristics in the vector f_i. As four-dimensional heterogeneity is very demanding in terms of identification and computation, we place some restrictions on how these characteristics vary across individuals. We group together ability and the taste for leisure. While individuals with high ability can have a different taste for leisure than low-ability individuals, we do not allow for heterogeneity in the taste for leisure, conditional on ability. We allow for unobserved heterogeneity in the "taste for children" to be correlated with ability and the taste for leisure, and we estimate this correlation. Further, we assume that potential infertility is orthogonal to the first three characteristics, meaning that, while women know the first three characteristics, they do not anticipate infertility, and they do not learn from unsuccessful conception attempts. On the basis of medical evidence, we fix the proportion of infertile women at 5 percent.[7]

Occupation and labor supply.—In our model, several features describe an "occupation" o_{it} (which takes three values denoting whether an occupation is "routine," "abstract," or "manual"). First, each occupation has a particular wage path, characterized by different log wage intercepts and different returns to work skills (denoted x_{it}). Second, occupations are characterized by the pace with which skills depreciate through intermittency (atrophy). Third, arrival rates of offers when out of work differ across occupations. Finally, occupations differ in their amenity value with regard to children, as in some occupations, women can better vary their work hours to care for their children. By allowing for occupational choices, we build into our model an important aspect of women's career decisions, which has first been emphasized by Polachek (1981). We extend Polachek's formulation by allowing these choices to be made in conjunction with fertility choices and by considering the "child raising value" of occupations.[8]

In any occupation, individuals can work either full-time (FT) or part-time (PT). They can also choose to be unemployed (U) or out of the labor force (OLF), and we record the choice in the variable l_{it}. We assume that offers for alternative occupations and working hours arrive at random but that arrival rates differ according to current occupation and labor supply status. We refer the reader to the Appendix for further detail on functional forms. Furthermore, women who are working face an exogenous and constant probability of layoff δ.

[7] Data from the United States indicate that about 8 percent of women aged 15–29 have impaired fecundity (see Centers for Disease Control and Prevention 2002), although some may give birth after treatment for infertility.

[8] Goldin (2014) stresses this point as an important aspect of occupational choice.

Budget constraint.—The budget constraint of the household is given by

$$A_{it+1} = (1 + r)A_{it} + \text{net}(GI_{it}; h_{it}, n_{it}) - c_{it}^{HH} - \kappa(\text{age}_{it}^{K}, n_{it})I_{l_{it}=FT,PT,n_{it}>0}, \tag{1}$$

where A_{it} is the stock of assets and r the interest rate (which we assume as fixed and set at 4 percent). In our model, assets are accumulated for precautionary motives as individuals are risk averse and face shocks to wages, labor market participation, and household size. Assets are used to finance periods out of the labor force, fluctuations in household earnings, and costs associated with children and retirement. Households cannot borrow against future income to finance the costs induced by having children and need to delay fertility to accumulate sufficient assets (see also Heckman and Mosso [2014] for a discussion of imperfect borrowing in a model of parenting). Total household consumption is denoted as c_{it}^{HH}, which is equal to the woman's own consumption, c_{it}, scaled by the number of adults and children in the household.[9] Further, we denote by GI_{it} the gross income of the household, which consists of the labor earnings of the husband, the labor earnings of the wife if she works, unemployment benefits or maternity leave benefits if eligible, and government transfers according to the number of children.[10] If children are present but the father has left the household, the father contributes to the household budget through child support.[11] During retirement, women receive retirement benefits, which are a fraction of their last earnings. Net income net$(GI_{it}; h_{it}, n_{it})$ is derived from gross income, using institutional features of the German tax code, and is a function of the number of children and the presence of a husband (where $h_{it} = 1$ if a husband is present), as tax rates vary between singles and couples. Finally, κ is a cost incurred if children are present and the mother decides to work and includes the cost of child care. We assume it depends on the age of the youngest child (denoted age_{it}^{K}) and the number of children, n_{it}. We estimate this cost along with the parameters of the model.

[9] We use a scale similar to the "OECD modified scale," where the "number of adult equivalent" is equal to one plus 0.5 for a second adult and 0.3 for each child; see Hagenaars, de Vos, and Zaidi (1994). As these consumption weights are derived for the average household in OECD countries, they may not be pertinent for the population we study. We therefore estimate the weight of children while holding constant the weight of adults.

[10] Unemployment benefits depend on past earnings, which in turn are functions of the previous occupation, accumulated skills, and unobserved productivity. Individuals are eligible for benefits if they had been working prior to becoming unemployed. Maternity benefits consist of two components, a fixed one and a variable one, that depend on former labor market status.

[11] The father's compulsory contribution is 15 percent of his income for each child; see Oberlandesgerichts Düsseldorf (2005) for more detail.

Skills and wages.—While working, individuals accumulate skills. Skills are increased by one unit for each year of full-time work and by 0.5 unit for each year of part-time work.[12] When out of work, skills depreciate, and the rate of atrophy $\rho(x_{it}, o_{it}) < 1$ depends on the occupation and the previous level of skills:

$$\begin{aligned} x_{it+1} &= x_{it}\rho(x_{it}, o_{it}), \\ \rho(x_{it}, o_{it}) &= \rho_1(o_{it})I_{x_{it}\in[0,5[} + \rho_2(o_{it})I_{x_{it}\in[5,7[} + \rho_3(o_{it})I_{x_{it}\in[7,\infty[}, \end{aligned} \tag{2}$$

where ρ_1, ρ_2, and ρ_3 are vectors of parameters, specific to each occupation, and I_j is an indicator variable taking the value of one if j is true (i.e., if the level of skills x_{it} falls in the interval in brackets). We thus allow for career interruptions being more detrimental at career stages in which learning is intense or individuals compete for key workplace positions, a potentially important factor to understand the timing of fertility.[13]

Female full-time daily wages depend on skills, x_{it}, occupation, o_{it}, and individual productivity f_i^P:

$$\ln w_{it} = f_i^P + \alpha_O(o_{it}) + \alpha_X(o_{it})x_{it} + \alpha_{XX}(o_{it})x_{it}^2 + \eta_{it}, \tag{3}$$

where η_{it} is an independent and identically distributed (iid) shock to log wages. The wage profile is specific to a given occupation, with different intercepts and different returns to skills.[14]

Marriage, divorce, and husbands' earnings.—Women's probability of getting married in each period depends on their age, skills, and taste for children (f_i^C). Conditional on being married, women face a probability of divorce that depends on their age and the presence of children. The functional forms for these probabilities are shown in the Appendix, Section A. Our model therefore allows for the age of marriage to vary with unobserved characteristics, where women with a higher taste for fertility may marry at younger ages. To the extent that unobserved heterogeneity such as differences in productivity, taste for children, or leisure affect labor market attachment, these characteristics will also influence marital status through the effect on skills.

We model the earnings of the husband, earn_{it}^h, which capture both their wages and labor supply. We assume that earnings depend on observed characteristics of the woman, as in van der Klaauw (1996) or Sheran (2007),

[12] We do not consider occupation-specific skills as in the data we observe very few individuals switching occupation during the life cycle.

[13] This extends the empirical literature that assumes constant depreciation rates across occupations or career stages; see, e.g., Kim and Polachek (1994) and Albrecht et al. (1999). We chose the nodes of 5 and 7 on the basis of results from reduced-form regressions.

[14] As wage profiles are flat after 15 years of accumulated work experience, we assume that there exists a threshold, $\bar{x}$, beyond which the marginal effect of skills on wages is zero. We estimate this threshold along with the other parameters.

which in our case include age and occupation. We extend these papers by allowing earnings to depend also on her unobserved ability, f_i^p:

$$\text{earn}_{it}^h = \alpha_0^h + \alpha_{a1}^h \text{age}_{it}^M + \alpha_{a2}^h \text{age}_{it}^{M^2} + \sum_j \alpha_j^h I_{o_{it}=j} + \alpha_P^h f_i^P + \eta_{it}^h, \tag{4}$$

where $I_{o_{it}}$ is an indicator variable equal to one if the wife is working in occupation j, and η_{it}^h is a shock assumed to be iid and normally distributed with mean zero.[15] As we allow for a rich set of characteristics, both observed and unobserved, to influence marital status and husbands' earnings, our model captures essential ingredients of a marriage market with assortative matching and differential marriage rates across women, while at the same time remaining tractable.[16] Husbands contribute to the income of the household, providing resources and insurance against income or labor market shocks.

Conception.—If a woman decides to conceive a child, a child is born in the next period with a probability $\pi(\text{age}_{it}^M, f_i^F)$. This probability takes into account potential infertility, although women do not know or learn about it. Drawing on medical evidence, we allow the probability of conception to decline with age.[17] Note that a child can be conceived out of wedlock, although this is uncommon in Germany during the period we consider.[18]

Dynamic choice.—At the start of each period, individuals take as given the variables that form their state space Ω_{it}:

$$\Omega_{it} = \{l_{it-1}, o_{it-1}, A_{it-1}, h_{it-1}, \text{age}_{it}^M, x_{it}, n_{it}, \text{age}_{it}^K, \Upsilon_{it}, f_i\}.$$

The state space is composed of variables set at the end of the previous period: labor supply l_{it-1}, occupation o_{it-1}, assets A_{it-1}, and marital status (presence of a husband) h_{it-1}. It also comprises variables updated at the start of the period: age (age_{it}^M), skills x_{it}, number of children (including any newborn child) n_{it}, and the age of the youngest child age_{it}^K. The state space includes a vector of iid shocks to preferences affecting labor market status, occupation, and conception as well as income or earning shocks

[15] We estimate the variance of η_{it}^h using data on earnings for the spouses, including nonemployment spells, so that η_{it}^h takes into account unemployment shocks as well. We assume that the shock to the husband's earning is orthogonal—conditional on observables and a fixed effect specified in eqq. (3) and (4)—to the shock to the woman's wage. In the data, the wage/earnings residuals within a household are weakly correlated with a coefficient of −0.04 and a standard deviation of 0.001.

[16] Dynamic models of marriage markets and schooling or labor supply have been derived by, e.g., Chiappori, Iyigun, and Weiss (2009) and Eckstein and Lifshitz (2015).

[17] Khatamee and Rosenthal (2002) estimate that a woman has a 90 percent chance of conceiving within a year at age 20, a 70 percent chance at age 30, and a 6 percent chance at age 45. After age 50, the probability of conception is almost zero.

[18] We do not allow for conception errors, as in Sheran (2007), as we do not have such information. But our model allows for shocks to preferences regarding conception, so that two seemingly similar women may differ in their decision to conceive.

(which we collect in a vector Υ_{it}), and the different dimensions of ex ante heterogeneity, collected in the vector f_i.

The value function for individual i in period t is given by

$$V_t(\Omega_{it}) = \max_{\{b_{it}, c_{it}, o_{it}, l_{it}\}} u(c_{it}, o_{it}, l_{it}; n_{it}, h_{it}, \text{age}^K_{it}, \Upsilon_{it}, f_i) + \beta E_t V_{t+1}(\Omega_{it+1}), \tag{5}$$

where β is a discount factor, and E_t is the expectation operator conditional on information in period t. The expectation of the individual is over the vector of future preference and income shocks Υ_{it+1} and future shocks to marital status.

In each period the individual chooses whether to conceive or not (denoted by the indicator variable b_{it}), her consumption (or equivalently household consumption), occupation o_{it}, and labor market status l_{it}. The choice of occupation and labor market status becomes effective at the end of the period.

Utility is derived from her own consumption c_{it}, labor market status l_{it} (which reflects the amount of leisure time available), the amenity value of an occupation o_{it}, and the number of children n_{it} (we abstract from modeling the quality of children). We write the utility function as

$$u_{it} = u_1(c_{it}, l_{it}; n_{it}, f_i^L) + u_2(n_{it}; f_i^C, \text{age}^K_{it}, l_{it}, o_{it}, h_{it}) + u_3(b_{it}, \Upsilon_{it}). \tag{6}$$

The utility function has three parts. The first subfunction is the utility derived from consumption and leisure. We allow for curvature in the utility function over consumption to allow for risk aversion by specifying a constant relative risk-averse function. The utility of consumption is interacted with leisure (labor supply), as in Attanasio et al. (2008), the taste for leisure, as well as the number of children.

The second subutility is the utility of children. The utility a woman derives from children depends on her taste for children and on four further factors: the age of the youngest child, age^K_{it}, labor supply, l_{it}, occupation, o_{it}, and her marital status, h_{it}. The age of the youngest child reflects that leisure may be particularly valuable when children are young. The specification also allows for complementarity between children and leisure. These features help explain why many mothers take time off from the labor market.[19] Occupation may affect the marginal utility of children as some occupations may be more demanding and impose con-

[19] We do not model child quality, as the goal of our analysis is the study of the careers of women and not the production of child quality per se. See Del Boca, Flinn, and Wiswall (2014) for a model of child quality and parental inputs, which, however, does not consider fertility choices, savings, occupational choices, and depreciation of skills. With data on labor supply and fertility, our formulation is observationally equivalent to models in which mothers derive utility over child quality, which is produced with parental time inputs.

straints for working mothers. Finally, marital status is part of the utility function to allow for the possibility that raising children imposes less of a utility cost if a partner is present.

The third subutility collects preference shocks pertaining to the choice of conception (b_{it}). We describe in the Appendix, Section C, in detail the functional form for the subutility functions.

Labor market choices are made until 60, at the age at which women retire and live an additional 20 years, deriving utility from consumption, leisure, and children. During that period, they finance consumption from retirement benefits and by decumulating assets. Choices are made under the constraints detailed above, as well as some additional institutional constraints, which we describe in the Appendix, Section D. For instance, women who are out of the labor force cannot apply for unemployment benefits, and pregnant women in employment have the option to return to their previous occupation after their maternity leave (although not necessarily at the same wage, as skills depreciate when out of work).

Initial choice of occupation.—At time $t = 0$, women enter apprenticeship training, typically around age 15 or 16, and decide on a specific training occupation o_{i0} by comparing the expected flow of utility for each occupational choice with the current cost, which depends on the region of residence R_i and the year of labor market entry (Year_i), as well as a preference shock, ω_{io}, drawn from an extreme value distribution and specific to each possible occupation o. These costs arise from temporary or local shortages of training positions in particular occupations, and we use those as instruments to identify the choice of occupation. The apprenticeship training lasts 3 years, so the payoff is received six periods later (as a period in our model lasts for half a year):

$$o_{i0} = \arg\max_{o}[\beta^6 E_0 V_6(\Omega_{i6}) - \text{cost}(o, R_i, \text{Year}_i) - \omega_{io}]. \tag{7}$$

We do not model choices during the training periods. Training regulations in Germany commit firms to fulfilling the entire period of the apprenticeship contract, so individuals cannot be fired. We assume that women begin making choices about fertility once they have completed their training.[20]

B. Estimation: Method and Moments

The model is estimated using the method of simulated moments (see Pakes and Pollard 1989; Duffie and Singleton 1993), which allows us to

[20] Teenage pregnancy rates are very low in Germany. For instance, in 1998, only 1.3 percent of women between 15 and 19 gave birth, compared to 5.2 percent in the United States (see UNICEF 2001) and 4.7 percent between 15 and 18 in the United Kingdom (see http://www.fpa.org.uk/professionals/factsheets/teenagepregnancy).

combine information from different data sources on career choices, wages, savings, and fertility decisions over the life cycle. The method also allows us to address time aggregation, through simulations, as the sample frames of our data sets vary, from semiannual (in the IAB data) to annual frequencies (in the GSOEP).

In this approach, the model is solved by backward induction (value function iterations) on the basis of an initial set of parameters and then simulated for individuals over their life cycles.[21] The simulated data provide a panel data set used to construct moments that can be matched to moments obtained from the observed data. Using a quadratic loss function, the parameters of the model are then chosen such that the simulated moments are as close as possible to the observed moments. Because our model focuses on describing life cycle choices, we remove regional means and an aggregate time trend from all our moments.[22]

The method of simulated moments yields consistent estimates. However, as shown by Eisenhauer, Heckman, and Mosso (2015), its finite distance properties depend on the choice of moments, the number of simulations, and the weighting matrix; we follow their suggestion and choose both static and dynamic moments. To obtain a smoother criterion function, we weight the moments with a diagonal matrix that contains the variances of the observed moments.

The full list of moments used to identify the model is displayed in table 2, grouped by the choices they identify, that is, labor supply and occupational choices, wages, savings, fertility, and marital status. In each of these categories, we rely on simple statistics that ensure that the model reproduces the basic trends and levels in the real data. These moments include variables such as the proportion of women in each occupation, average wages, hours of work, number of children, and savings rates, all computed at different ages ranging from 15 to 55.[23] We further describe fertility choices by ages at first and second births and their heterogeneity by including centiles of the age at first and second births in our list of moments.

[21] We refer the reader to the online appendix for a discussion on the numerical solution of the model.

[22] Removing regional and aggregate effects when calculating moments implies that we are relying on DiD variations to identify our model. In other words, the model is not identified from pure cross-sectional variations or time-series variations that could introduce spurious correlation. An alternative choice would be to model regional differences together with a choice of residence, which would be infeasible within our framework. Kennan and Walker (2011) model location choices in a simpler setting.

[23] We follow the cohorts in our main data from age 15 to 40. To completely characterize their life cycle, however, we also use supplemental data from slightly older cohorts to construct moments that describe wages and labor supply at ages 45, 50, and 55. We verify that at age 40, the labor supply and wages of these older cohorts are very similar to those of the younger ones.

TABLE 2
MOMENTS USED IN THE ESTIMATIONS

Moments	Data Set	No. Moments
	A. Labor Supply and Occupational Choice	
Proportion of full-time work, by age and initial occupation	IAB	25
Proportion of part-time work, by age and initial occupation	IAB	20
Proportion of out of labor force, by age and initial occupation	IAB	20
Work experience, by age	IAB	5
Annual transition rate between occupations	IAB	9
Transition rates between labor market status, by occupation	IAB	48
Proportion work, by number of children	GSOEP	15
Proportion part-time work, no child	GSOEP	5
Proportion in each occupation, initial and at all ages	IAB	6
Initial choice of occupation, by region and time period	IAB	440
	B. Wages	
Wage by age and initial occupation	IAB	21
OLS regression of log wage on experience, by occupation	IAB	9
OLS regression of log wage on age, number of children, occupation	GSOEP	12
OLS regression of log wage on past and future wages	IAB	3
OLS regression of log wage for interrupted spells on duration and experience	IAB	14
OLS regression of wage growth around interrupted work spells by occupation	IAB	10
OLS regression of husbands' log earnings on women's characteristics	GSOEP	6
Variance of residual of log wage on occupation, age, work hours	GSOEP	1
Proportion of women with log wage residual < 1 standard deviation	GSOEP	1
	C. Savings	
OLS regressions savings rate on age, occupation, number of children	EVS	24
	D. Fertility and Marriage	
Proportion with no children, by age	GSOEP	5
Proportion with one child, by age	GSOEP	5
Centiles of age at first birth	GSOEP	10
Centiles of age at second birth	GSOEP	10
Number of children at age 38	GSOEP	3
Average age at first birth, by current occupation	GSOEP	3
Proportion of childbirth within marriage	GSOEP	1
OLS regression of fertility on age and initial occupation	GSOEP	5
Instrumental variable regression of fertility on age and initial occupation (instrumented)	GSOEP	5
Mean of residual of number of children on age, by wage residual	GSOEP	2
Proportion married, by age	GSOEP	5
OLS regression marriage on age, experience, past marital status, occupation, and fertility residual	GSOEP	15
Total		763

NOTE.—IAB: Institut fuer Arbeitsmarkt-und Berufsforschung. GSOEP: German Socio-Economic Panel. EVS: Einkommens- und Verbrauchsstichprobe. Instruments for initial occupation in instrumental variable regressions are the interactions between region of residence at age 16 with year of birth.

In addition, we add conditional moments, which relate the main outcome variables to other endogenous variables, for either the same period or adjacent periods. Eisenhauer et al. (2015) argue that such moments are crucial to identify the parameters of dynamic models such as ours.[24]

Information contained in regressions of log wages on career interruptions contribute to the identification of the atrophy rate parameters in equation (2), as in Polachek (1981). More specifically, we use information from regressions of the change in log wages for individuals who interrupt their career on the duration of the interruption, dummies for experience levels, occupational groups, and the interaction of duration and experience. This information alone is not sufficient to identify the atrophy parameters because of the nonrandom selection into maternity and more generally into nonworking spells. However, by matching the simulated moments to those obtained from the observational data, our model, which specifies the process through which these choices are made, allows us to identify the underlying structural parameters. We follow here similar identification schemes that have been used in previous literature (see, e.g., Del Boca et al. 2014).

Our model also allows for unobserved heterogeneity in the level of wages (ability), as in equation (3), and in the utility derived from children.[25] We model the heterogeneity as a mass point distribution and allow for a correlation between both dimensions. We use discrete mass points, which are estimated together with the relative proportion in the sample in a similar way as in Heckman and Singer (1984). To identify the proportion of individuals in each ability "type," we proceed in several steps. We first regress log wages on experience and occupation and compute wage residuals for each individual. This residual contains information on unobserved ability, f_i^P. We then use the cross-sectional variance of these wage residuals as a moment. We also regress the number of children on age to compute a fertility residual, which contains information about the unobserved taste for children, f_i^C, and we correlate it with the wage residual to provide information on the correlation between ability and desired fertility.

We construct these conditional moments from different data sets and use for each moment the data set that contains the most precise information. For instance, moments pertaining to wages and labor supply are computed from the administrative IAB data. Information on fertility is gathered from the GSOEP and information on savings rates from the EVS. In total, we rely on 763 moments to identify our model. The online appendix provides further evidence on the identification of the model.

[24] For instance, dynamic moments we use link current wages to past and future wages, or past labor supply or fertility decisions, current labor supply to previous labor supply, and current savings with past fertility decisions.

[25] As explained earlier, we group together heterogeneity in ability and taste for leisure.

C. Model Fit

Overall, the model fits the sample moments well in an economic sense. However, because of our very large sample (we observe 2.7 million work spells and earnings), our moments are estimated with very high precision, which leads, not surprisingly, to statistical rejection of global equality of estimated and simulated moments. For instance, the proportion of women working full-time at age 30 is 37.5 percent in the data, while the model prediction is 37.1 percent. Statistically, the equality of these two moments is nonetheless rejected, with a t-statistic of 3.8.[26] Locally, however, we cannot reject the equality of the observed and simulated moments at the 95 percent confidence level in 53 percent of the cases, despite our large sample. Furthermore, the model matches trends in labor supply and work hours well, as well as the number of children and spacing of births by age. It is also able to match wage profiles by age and initial occupation, the savings rate by age, and the coefficients of a regression of log wage on work experience by occupation. The model also replicates closely the dynamic moments. For instance, a regression of our simulated data for log wages on the lead and lagged log wages gives results very similar to the ones in the data (respectively, 0.51 vs. 0.53 and 0.48 vs. 0.46; see table A8 in the online appendix). To economize on space in the main text, we refer the reader to the online appendix for a detailed presentation of the model fit and an extended set of tables.

IV. Results

A. Estimated Parameters

To describe wages, hours of work, occupational choices, the number of children, the spacing of births, and savings decisions over the life cycle, we estimate a structure that is defined by a total of 73 parameters.[27] We now discuss subsets of these parameters.

B. Atrophy Rates, Wages, and Amenity Values by Occupation

We display in panel A of table 3 the atrophy rates, measured as the value of skill loss resulting from a 1-year work interruption, which we allow to

[26] The J-statistic for the overall fit of the model is equal to 123,352, which implies the rejection of the equality of predicted and observed moments at any confidence level. The chi-square critical value at the 5 percent level and 670 degrees of freedom is equal to 731. The equality of the predicted and observed moments would not be rejected were the sample size 1 percent of the current sample size, which would still be larger than the sample sizes typically used in structural models.

[27] In addition, the initial choice of occupation, allowing for a fully interacted model with regional and time effects in the cost function (see eq. [7]), is defined by 88 parameters.

TABLE 3
Occupation-Specific Parameters

Parameter	Routine	Abstract	Manual
	A. Atrophy Rates Parameters (Annual Depreciation Rates)		
At 3 years of uninterrupted work experience	−.06%	−.11%	−.03%
	(1e−5%)	(2e−5%)	(2e−5%)
At 6 years of uninterrupted work experience	−.50%	−6.90%	−3.45%
	(.11%)	(.17%)	(.24%)
At 10 years of uninterrupted work experience	−.61%	−2.65%	−3.08%
	(14.2%)	(.01%)	(.18%)
	B. Wage Equation Parameters		
Log wage constant	3.39	3.6	3.32
	(.0038)	(.0054)	(.0059)
Years of uninterrupted work experience	.1	.09	.123
	(3.3e−05)	(3.6e−05)	(.0001)
Years of uninterrupted work experience, squared	−.00382	−.0021	−.00463
	(3e−06)	(4.1e−06)	(6.4e−06)
	C. Amenity Value of Occupations		
Utility of work if children	0	−.056	−.014
		(.001)	(.0005)
Utility of part-time work if children	0	−.42	−.08
		(.003)	(.007)

Note.—The wage equation is defined as a function of skills—which corresponds to uninterrupted work experience—and not work experience. The former is allowed to depreciate when out of the labor force. Asymptotic standard errors are in parentheses.

vary by level of skills and by occupation (see eq. [2]). As skills accumulate in the same way as work experience but depreciate when out of work, a skill level of x is equivalent to x years of uninterrupted work experience, and we report the atrophy rates at 3, 5, and 10 years.

In routine occupations, atrophy rates are low and vary between 0.06 percent and 0.6 percent. In contrast, in abstract occupations, atrophy rates are far higher and vary substantially over the career cycle (between 0.1 percent and 6.9 percent per year), while manual jobs take an intermediate position. In both types of occupations, atrophy rates are highest at about 6 years of uninterrupted work experience, suggesting that intermittency is far more costly at intermediate career stages, possibly because of differing learning intensity over the career cycle, and important career steps being decided at those career points.[28] An uninterrupted work experience of 6 years corresponds, on average, to an age of 26 years,

[28] Kim and Polachek (1994) estimate atrophy rates of about 2–5 percent, depending on the sample and the estimation techniques. Albrecht et al. (1999) find atrophy rates of about 2 percent per year. Both papers do not allow for differences by occupation or level of skills.

which is when many women find it desirable to have children. Fertility decisions are therefore likely to be affected far more by career concerns in abstract (and to some extent in manual) jobs than in routine occupations. This is in line with the evidence in table 1 on the age at first birth across occupational groups. In addition, the nonlinear evolution of atrophy rates in these occupations, being highest at midcareer stages, adds a further important (and so far largely ignored) consideration when considering occupational choices of women and how these interact with desired fertility.[29]

In panel B of table 3, we display the parameters of the (log) wage as a function of uninterrupted work experience (defined as in eq. [3]), which represent average treatment effects of working full-time in a given occupation.[30] The estimates suggest that wage returns to human capital (the constant terms) are highest in abstract occupations. Furthermore, while wage increases are similar across occupational groups in the early years, wage profiles are less concave in abstract occupations and continue to grow at a faster pace at higher total work experience.[31] Thus, interruptions at midcareer in abstract jobs are more costly not only because of higher atrophy rates but also because of considerably higher opportunity costs as individuals forgo earnings while not in work.

An additional dimension when balancing occupational choice with labor supply and fertility decisions, besides atrophy rates and opportunity costs, is the amenity value of an occupation with regard to children (which can be interpreted as the ease with which women in these occupations can combine work with child raising).[32] We present estimates of these amenity values, normalized to be zero for routine occupations, in panel C of table 3. The figures show that—in comparison to routine jobs—abstract jobs are least desirable when children are present. Our estimates imply that if abstract and manual occupations had the same amenity value as routine ones, the proportion of women opting for abstract or manual occupations

[29] Contrasting these estimates with those from simple (fixed-effects) regressions as in Polachek (1981) and Kim and Polachek (1994), obtained by first simulating life cycle careers using our model and then regressing changes in log wages following interruptions on the time out of work by occupation, and allowing for nonlinearities, leads to estimates that understate the role of atrophy but reproduce the ranking across occupations. This is mainly due to such regressions ignoring that those who return to work are positively selected, as they are more likely to have drawn a positive wage shock, something that is built into our model and estimation.

[30] Compared to the ordinary least squares (OLS) coefficients shown in table A8 in the online appendix, these structural parameters are "causal," taking account of selection; further, they refer to a measure of skills that, unlike real experience, depreciates when the individual is out of work.

[31] For instance, after 10 years of uninterrupted work experience, wages in abstract jobs increase by about 2 percent more per additional year than in the other two occupations.

[32] These parameters are identified through variations in labor supply of women with and without children in various occupations, which cannot be explained by differences in atrophy rates, opportunity costs, or selection.

would increase by 5 percent. The amenity of part-time work—an option chosen by many mothers in our data—is likewise lower in abstract jobs, as the second row of this panel shows. Our estimates imply that if women in abstract jobs had the same amenity value for part-time jobs as in routine ones, the proportion of part-time work in abstract jobs would be 7 percent higher by the age of 30. These estimates point at a complex interaction between career and fertility decisions. Women in abstract occupations face higher atrophy rates, have higher opportunity costs of leaving the labor market, and have a higher utility cost of handling children and work. This will induce women with a higher desired fertility to choose more often careers in routine occupations and to have children earlier. On the other hand, as children are costly, higher wages in abstract jobs—and the prospect of marrying a better husband—make this career also desirable, as assets can be built up faster to smooth consumption when children arrive. We illustrate these trade-offs below.

C. *Utility of Consumption*

Table 4 presents estimated parameters that characterize consumption decisions. The estimate of the discount factor (first row) is 0.96 annually, similar to values in the previous literature (e.g., Cooley and Prescott 1995). Our estimate for the curvature of the utility function (or the relative risk aversion, row 2) is close to two, again a common value in the literature. Row 3 displays the estimated weights children have in the consumption equivalence scale. This parameter is important as it drives not only fertility choices but also savings choices to smooth consumption over the life cycle. Our estimate is close to 0.4, slightly higher than the one in the "modified OECD scale," which is equal to 0.3. The last two rows present the estimates of the cost of child care, distinguishing between the age of the youngest child. These are estimated to be €31 per day for infants and €12 per day for older children.[33]

The consumption costs of children and the cost of child care suggest that households may gain from smoothing consumption by anticipating births. We illustrate this in figure 2, which shows that savings rates start to increase at least 4 years prior to birth and decline afterward. Hence, savings are likely an important factor to understand fertility decisions and how these are affected by policy interventions, something that we investigate in Section IV.G.

[33] The average cost of day care in Germany is estimated by the OECD to represent about 11 percent of net family income (http://www.oecd.org/els/soc/PF3.4%20Childcare%20support%20-%20290713.pdf), which amounts to about €15 per day. Our estimated parameter also takes into account other expenses linked to work and children such as transportation.

TABLE 4
ESTIMATED PARAMETERS: CONSUMPTION DECISION AND COST OF CHILDREN

Parameter	Estimate
Annual discount factor	.959 (.00028)
Constant relative risk aversion utility	1.98 (.0021)
Weight of children in consumption equivalence scale	.392 (.00167)
Cost of working, if children, age ≤ 6 (€ per day)	31.1 (.36)
Cost of working, if children, age > 6 (€ per day)	12.6 (.24)

NOTE.—Asymptotic standard errors are in parentheses.

D. Unobserved Heterogeneity

Panel A in table 5 lists the parameters that characterize individual types. As explained above, we allow for unobserved heterogeneity, with two different levels of ability/taste for leisure and two types of preferences toward fertility. Columns LA/HC, LA/LC, HA/LC, and HA/HC refer to combinations of low ability (LA)—high ability (HA) and low taste for children (LC)—high taste for children (HC) types. Note that as we explain in Section III, we allow groups with different ability to have different tastes

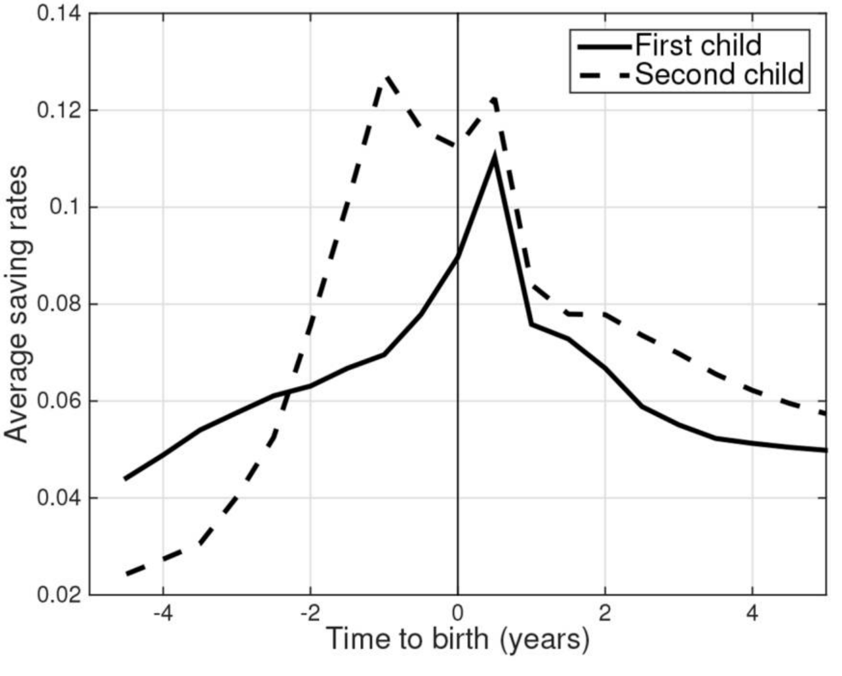

FIG. 2.—Savings rates around first and second births, model prediction. Computed through simulations of the model, involving 12,000 draws.

TABLE 5
Estimated Parameters: Unobserved Ability and Utility of Children

Parameter	LA/HC	LA/LC	HA/HC	HA/LC
	A. Individual Type (Ability/Fertility)			
Proportion in sample	.125	.174	.309	.393
	(8.05e–05)	(.0621)	(.00775)	(.0621)
Log wage intercept	0	0	.145	.145
	. . .	. . .	(.0026)	(.0026)
Utility of leisure	0	0	.257	.257
	. . .	. . .	(.0032)	(.0032)
Utility of one child	.484	.158	.484	.158
	(.0056)	(.014)	(.0056)	(.014)
Utility of two children	1.28	−2.04	1.28	−2.04
	(.00026)	(1.3)	(.00026)	(1.3)
Corr(ability, desired fertility)	.02			
	B. Outcome by Type			
Total fertility	1.88	.953	1.88	.951
Proporton in routine occupation	.3	.231	.301	.232
Proportion in abstract occupation	.404	.509	.407	.508
Proportion in manual occupation	.296	.26	.292	.26

Note.—LA: low ability; HA: high ability; LC: low taste for children; HC: high taste for children. Note that we allow ability groups to have different tastes for leisure. Asymptotic standard errors are in parentheses. Proportions in given occupation are calculated at the start of the career.

for leisure. The first row reports the proportions for the four type combinations in our data. The next two rows show the differences in log wages across ability types and the utility of leisure, where we have normalized LA-type women to zero. High-ability women earn wages that are 0.14 log points higher than those of low-ability women and have a lower utility of leisure (by about 26 percent). Rows 4 and 5 display the utility of children for the different categories, showing that women with a high taste for children (HC) obtain positive utility for both the first and second child, while LC types derive a positive utility only for the first child.[34] The correlation between taste for children and ability is close to zero, suggesting that it is not the combination of high ability and low taste for children that leads women in better-paid careers to have fewer children; rather, the choice of steeper career paths for these women induces considerable costs through the sacrifice of fertility.

Panel B, which reports estimated type-specific fertility rates and proportions in the different occupations, shows that women with a low taste for children have, on average, about one child, while women with a high taste have 1.9 children. Interestingly, we do not find much difference in

[34] As the model also allows for idiosyncratic preference shocks toward conception, women with low permanent taste for children (f_i^C) may nonetheless have more than one child.

terms of total fertility with respect to ability. The last three rows in the table show the proportion of each type in the three different occupational groups, providing evidence of sorting on ability and desired fertility: close to 50 percent of women with a low taste for children opt for an abstract occupation, while routine occupations are relatively more frequent for women with a high taste for fertility.[35]

E. *Career Costs of Fertility*

We now use our model to assess the career costs of children, which is how much a woman would gain in monetary terms if she decided not to have children. We evaluate these costs by simulating life cycle outcomes under two scenarios. First, we simply match the model to the fertility pattern in our data, which serves as our baseline scenario. Second, we set the conception probability to zero, so that a woman knows ex ante that no children will be conceived and will therefore base all her decisions on that knowledge. This includes the initial choice of occupation, as well as labor market decisions and savings over the entire life cycle.[36] We first present the differences in career paths for the two scenarios along various dimensions. We then compute the cost of children as the net present value of the difference in life cycle earnings at age 15 between the two scenarios.[37]

Occupational choice and labor supply.—Figure 3*a* displays the differences in occupational choices at age 15 between the two scenarios. It shows that the expectation about future fertility affects the choice of occupation even before fertility decisions are made: a woman who knows that she will remain childless is less likely to work in routine and manual occupations (by about 3 percent and 2 percent, respectively) and more likely to work in occupations involving mainly abstract tasks (by about 5 percent). This is an important insight, suggesting that key career decisions are affected by the expectation about future fertility, possibly long before fertility decisions are made, and implies that some of the career costs of children are determined even before a child is born. Below we will assess the magnitude of these costs.

Figure 3*b* plots the difference in labor supply over the life cycle between the two scenarios. In the no-fertility scenario, a woman is more likely to work at any age: the difference increases from about 10 percent in her early

[35] We report other parameter estimates as well as the arrival rates of offers in different states in the online appendix.

[36] Note that, as the probability of marriage and the type of husband depend on endogenous choices such as occupation and skills, a change in fertility will also affect women along this margin. We find, however, that these indirect effects are small.

[37] As we are interested in the career costs for a single individual, we compute partial equilibrium results. The results might differ if all women chose not to have children.

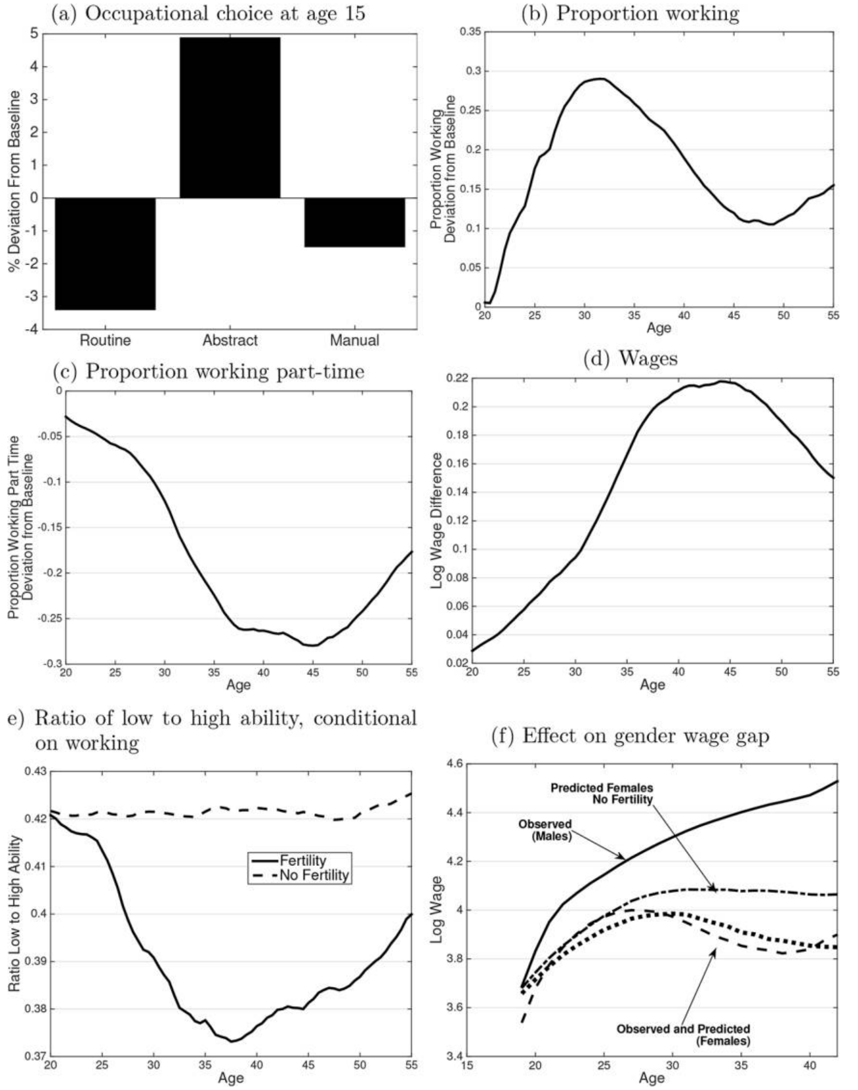

FIG. 3.—Effect of no fertility. The different panels display the difference in outcomes between a baseline scenario and one in which a woman knows that she is infertile.

20s to 30 percent in her mid-30s. It then declines to about 10 percent, as women who had children gradually return to the labor market. Hence, the difference in labor supply over the life cycle is an important component of the overall costs of children, as we demonstrate below. Fertility affects labor supply also at the intensive margin: Figure 3*c* shows that children increase the probability of working part-time (conditional on working), and the difference increases with age to reach about 25 percentage points between ages 35 and 45. Interestingly, and comparing figures 3*b* and 3*c*, women who return to the labor market in their late 30s and early 40s tend to remain in part-time jobs, compared to the nonfertility scenario. This feature comes from the fact that women derive a higher utility of leisure when children are present but need to work to finance higher consumption needs. The effect of fertility on women's labor supply over the life cycle also has a stark impact on work experience: our simulations show that by the time they retire at age 60, mothers have, on average, 22 percent less work experience per child.

Wages and selection over the life cycle.—Figure 3*d* plots the deviation of wages in the no-fertility scenario from the baseline scenario. Here, and in the simulations below, we report average daily (rather than hourly) wages conditional on working. Hence, differences across scenarios result from differences in skills, the number of hours worked per day, occupational choices, and differences in the ability composition of women who choose to work. The figure shows that, while at age 20, the daily wage in the no-fertility scenario is only about 0.03 log points higher than in the baseline scenario, this difference rises to 0.22 log points by age 40 and then slightly declines when women return to the labor market. Hours of work contribute only partly to these differences in daily wages. We find that by age 40, the full-time wage in the no-fertility scenario is, on average, 10 percent higher than in the baseline scenario.

One reason for this difference in wages is composition. There is a long tradition in economics—dating back to the seminal work of Heckman (1974) and including work by Blau and Kahn (1996), Blundell et al. (2007), Mulligan and Rubinstein (2008), and Olivetti and Petrongolo (2008)—of evaluating the selection of women into the labor market. Our model allows us to assess the role of fertility decisions in shaping the ability composition of women in the work force over the life cycle. In figure 3*e*, we present the ratios of working women of low versus high ability over the life cycle under the two scenarios. In the no-fertility scenario, this ratio is close to 0.43 and relatively stable, while in the fertility scenario, the composition of working women changes substantially over the career cycle. While at age 20 the ratio is equal to 0.42, it decreases to 0.37 by age 35, when low-ability women are less likely to work than high-ability women, and rises again toward the end of the working life as mothers return to the labor market.[38] Hence, selection into the labor market due to fertility is time varying and depends on both fertility choices and the timing of births. Part of the rise in the wage differential in figure 3*d* is therefore due to this dynamic selection, with the difference

[38] As shown above, this is not because low-ability women have more children, but rather because they are less likely to come back to work once their children are older.

in wages due to differential ability (f_i^P) at age 35 being equal to about 0.01 log points out of a total difference of 0.22 log points.

Decomposing the net present value of fertility choices.—The graphs presented above show various aspects of the career costs of fertility in terms of occupational choice, labor supply, and wages. We summarize these costs by calculating their net present value (NPV) at the start of the career (at age 15) taking account of all earnings, unemployment, and maternity benefits (w_{it}^s, $b_{U,it}^s$, and $b_{M,it}^s$), where the index $s = F, NF$ stands for the baseline (F) and the no-fertility scenario (NF). Defining an indicator variable $I_{j_{it}^s}$, which is equal to one if j is true under scenario s, the net present value for individual i is given by

$$\mathrm{NPV}_i^s = \sum_{t=0}^{T} \beta^t \left(w_{it}^s I_{\mathrm{work}_{it}^s} + b_{U,it}^s I_{\mathrm{Unempl}_{it}^s} + b_{M,it}^s I_{\mathrm{Mat.Leave}_{it}^s} \right). \tag{8}$$

We evaluate the relative costs of children by computing $1 - \mathrm{NPV}^{NF}/\mathrm{NPV}^{F}$, using an annual discount factor of $\beta = 0.95$. These costs reflect the difference in earnings, labor supply, and occupational choice induced by the presence of children. On the basis of this calculation, and comparing the baseline scenario with the no-fertility scenario, the overall costs of children are close to 35 percent of the net present value of income at age 15 (see table 6).

To better understand the sources of these costs, we isolate two components: the contribution of labor supply and the contribution of wages (see panel A in table 6). The first component is obtained by fixing wages at the scenario with children, while computing the difference in terms of labor supply for women with and without children. The second component fixes labor supply for the no-children scenario and computes the difference in wages for women with and without children.[39] According to this decomposition, about three-quarters of the costs (i.e., 27 percent of the total 35.3 percent overall reduction in lifetime income) result from differences in the labor supply over the life cycle, while about one-quarter result from differences in wages. Thus, although wages are an important component of the cost of children, more important are unearned wages of women who drop out of the labor force for considerable periods over their career.

In panel B of table 6, we provide two decompositions that break down the contribution of wages into occupational choice and atrophy when out of work and a respective residual term ("other factors"). The figures in the table show that the overall contribution of atrophy to the lower wage in the fertility scenario is about 20 percent, or 5 percent of the total life cycle earnings difference in the fertility versus the no-fertility scenario.

[39] As in the standard Oaxaca-type decompositions, there are two alternative reference groups. In the table, we present estimates based on the average of the two.

TABLE 6
CAREER COST OF CHILDREN: PERCENTAGE LOSS IN NET PRESENT VALUE OF INCOME AT AGE 15, WITH AND WITHOUT FERTILITY

	Percentage Loss Compared to Baseline
Total cost	−35.3%
	A. Oaxaca Decomposition of Total Cost
Labor supply contribution	−27%
Wage contribution	−8.5%
	B. Oaxaca Decomposition of Wage Contributions
Contribution of atrophy	−1.8%
Contribution of other factors	−6.7%
Contribution of occupation	−1.6%
Contribution of other factors	−7%

NOTE.—The career costs are evaluated using simulations and comparing the estimated model with a scenario in which the woman knows ex ante that she cannot have children. The costs are computed as the net present value of female incomes, including all wages, unemployment benefits, and maternity benefits in the calculations. The discount factor is set to 0.95 annually. Initial occupation is the one in the no-fertility scenario.

Occupational choices at the beginning of the career, and before any fertility decision is made, represent 19 percent of the overall costs induced through wages, indicating that a substantial portion of the wage-induced career costs of children is already determined before fertility decisions are made, through occupational choices conditioned on expected fertility pattern.

Table 7 displays the costs of fertility of having one or two children (in terms of net present value at age 15), where we allow the spacing of births to differ. The figures in the table show that the cost of a second child is lower than the cost of the first child. For instance, a first child at age 20 induces total career costs of 31 percent compared to a scenario without children. A second child conceived at age 22 increases these costs to 36 percent. The results are qualitatively similar to those in Bertrand, Goldin, and Katz (2010), who also find that the cost of a second child is much lower than that of the first. The cost of a second child is increasing in the spacing of births, as it prolongs the time the mother spends out of the labor market. The costs of children are also decreasing in the age at birth, for two reasons. First, as we measure the discounted costs, more distant costs are valued less. Second, older mothers have time to establish themselves in the labor market and accumulate sufficient human capital, which lowers the depreciation rate (see table 3, panel A). The fact that children impose a lower cost for older mothers does not imply that it is optimal to have children late, however, as women also derive utility from their children. The optimal timing of births is therefore a trade-off between the various costs of children and their utility.

TABLE 7
Career Cost of Children: Timing and Spacing of Births

Age at First Birth	Only One Child (%)	Age at Second Birth (%)				
		22	24	26	28	30
20	−31.4	−36.4	−36.6	−36.6	−37	−36.9
22	−30.2	. . .	−34.6	−34.8	−34.8	−35.2
24	−28.1	. . .	. . .	−32.2	−32.3	−32.3
26	−26.0	. . .	. . .	. . .	−29.8	−29.8
28	−24.0	. . .	. . .	. . .	. . .	−27

Note.—The career costs are evaluated using simulations and comparing the scenario with no children with one in which either one or two children are born at a given age. The costs are computed as the net present value at age 15. The discount factor is set to 0.95 annually.

F. *Fertility and the Gender Gap*

Having shown that fertility leads to a sizable reduction in life cycle earnings and affects women's wage profiles throughout their careers, we now examine the extent to which the gender gap in earnings can be explained by fertility. To do so, we compare the women studied here to men of similar qualifications.[40] Again, we compute this difference for the average daily (rather than hourly) wage, which we believe is the most appropriate measure because it includes the change from full-time to part-time work as an important margin of fertility adjustment (see fig. 3*c*).

In figure 3*f*, we show the observed daily wages for working males (solid line) and females (dashed line) by age, as well as the predicted profile for females from our model (dotted line). The observed and predicted wages for females are very similar, illustrating that the model fits the data well. Whereas men's daily wages increase monotonically with age, women's wages in the baseline scenario increase up to age 27 but then decrease and begin increasing again only after age 38. The overall gap increases as women reduce the number of hours worked between ages 25 and 45 and then return to the labor market with lower labor market experience and depreciated skills once their children are older.

To assess the contribution of fertility to the gender wage gap, we compute, as above, the counterfactual wage profile (conditional on working) of a woman who remains childless and conditions on that knowledge from the start of her career, which in figure 3*f* is labeled "Predicted Females, No Fertility." The gender gap closes by about 0.2 log points when

[40] These are men belonging to the same birth cohorts, having the same education (lower or intermediate secondary school), who enrolled in apprenticeship training schemes before labor market entry, and whom we observe from labor market entry onward.

women are in their 30s, which corresponds to about a third of the overall gap.[41]

G. *The Effect of Pro-Fertility Policies on Fertility and Women's Careers*

In many countries, fertility is encouraged in the form of tax relief or transfers. A stream of literature has evolved on the effects of such policies on fertility and sometimes on labor supply.[42] Some of this research, which typically identifies these effects based on policy changes, nonlinearities in the tax and transfer system, regional variation, and/or changes or differences in entitlements across family characteristics, reports considerable effects on total fertility. The focus of this literature, however, tends to be limited to short-run responses of fertility because of two important problems: first, it is difficult in many data sets to track women affected by such policies over an extended period, and until the completion of their fertility cycle. Second, and more importantly, because data become contaminated over time by other factors that affect the fertility and careers of particular birth cohorts, making a causal statement about the effect of a policy some years after its implementation requires restrictive assumptions. Hence, extant studies pay little attention to long-term consequences and how fertility behavior is affected at the extensive and intensive margins.[43] Yet, long-run effects of policy changes and the way they affect behavior of different cohorts are very important for the evaluation of such policies. Any policy change affects different cohorts differently, depending on where women are in their career and fertility cy-

[41] These findings are in line with those of Bertrand et al. (2010), who, using different techniques, show that fertility-induced differences in the labor supply of MBAs explain a large part of the male-female annual earnings differential, although our population of women is, on average, less skilled. See also Rosenzweig and Schultz (1985) and Goldin and Katz (2002), who illustrate the impact of fertility shocks on labor market participation and wages.

[42] See, e.g., Cohen et al. (2013), who investigate the effect of Israel's child subsidy program on fertility; Laroque and Salanie (2014), who study the impact of child subsidies in France on total fertility and labor supply; Milligan (2005), who investigates the impact of a new lump-sum transfer to families that have a child in Quebec; Sinclair, Boymal, and De Silva (2012), who analyze the effect of a similar policy on fertility in Australia; Haan and Wrohlich (2011), who estimate the effect of child care subsidies on fertility and employment in Germany; Lalive and Zweimüller (2009), who investigate the effects of parental leave policy on fertility in Austria; and Kearney (2004), who studies the impact on fertility of caps on child benefits paid for an additional child.

[43] Two notable exceptions are Parent and Wang (2007) and Kim (2014). Parent and Wang follow a cohort of Canadian women over their fertility cycle and find that the long-run response is low compared to the short-run response. Kim studies the long-run impact of changes in the child allowance policy in Quebec (see also Milligan 2005). He finds a small or no permanent impact on fertility.

cle when the policy is implemented. While young women about to enter the labor market can adjust not only their fertility behavior but also their occupational choices and entire career paths to the policy change, older women, having already made most career and savings decisions, have fewer possibilities of adjustment. The effects of the policy will thus change over time as more women condition on it when making their fertility and career choices. At the same time, transfer policies may affect decisions other than fertility, such as labor supply, occupational choices, savings decisions, and human capital investments. These "secondary" effects, despite being important for assessing the full impact of these policies, are hardly investigated.

To help fill this void, we use our life cycle model to evaluate the effect of a policy that provides a cash transfer at birth of €6,000. Policies of this type have been implemented in different countries, as illustrated in the above-mentioned literature. We show the effect of the policy on the probability of giving birth, by age, in figure 4*a*, comparing the behavior of women under the baseline and the policy. The difference in the probability is positive at first and then negative, showing that the policy induces women to have their children earlier, but it has little effect on the overall number of children per woman.

Next we investigate the aggregate effect of the policy by computing the number of children born every year, before and after the policy is implemented. In doing this, we leave aside general effects. We use our model to simulate many overlapping birth cohorts of women, between the ages of 15 and 60. Each year, a new cohort enters and the oldest cohort exits. Hence, when the policy is implemented, women are at different stages of their life cycle. The older ones have already made their fertility choices, while the youngest ones are still far from their first child. However, the latter can alter their occupation, their labor supply, or their savings in response to the policy. Figure 4*b* plots the increase in the number of children born every year, compared to a baseline without a cash transfer. The policy starts in year 4 and is not anticipated. We observe a spike in the number of children born, with a 4.5 percent increase in total fertility in the first year of the policy. This spike is what a reduced-form analysis would identify as the short-run effect of the policy. However, the effect of the policy lasts more than a few years. The effect reduces to half that size after 8 years and is very close to zero after 20 years. Simulating policies with various levels of benefit, we find a short-run elasticity with respect to benefits of about 0.04.[44]

While figure 4*b* displays the composite response to the policy for women in different age groups, we illustrate in table 8 the effect of the policy on

[44] This elasticity is similar to the one reported by Zhang, Quan, and van Meerbergen (1994) (0.05) and lower than that reported by Milligan (2005) (0.10).

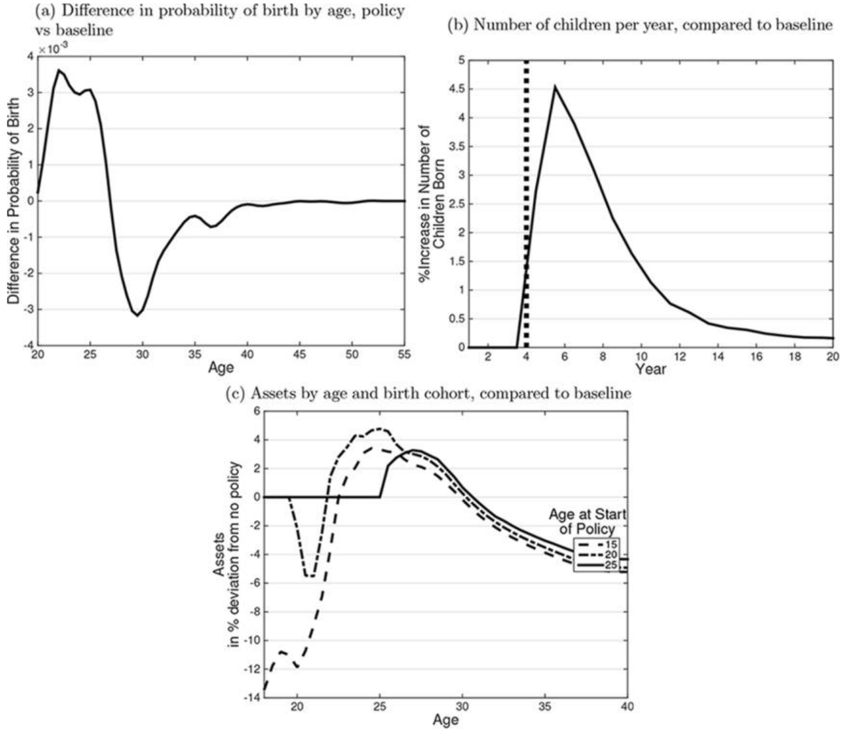

Fig. 4.—Effect of child premium. Panel a shows the effect of the policy (cash transfer of €6,000 at birth) by age on the probability of giving birth, comparing the policy to the baseline. In the policy scenario, women learn at age 15 about the policy. Panel b depicts the aggregate effect of the policy, by year, in an overlapping generation economy. The graph aggregates each year the behavior of women aged 15–60. Each year a new cohort of 15-year-olds enters the economy and the cohort who is 60 exits. The policy starts in year 4. Panel c displays the percentage change in assets as a function of age, compared to a baseline without transfer. The birth cohort who is 15 at the start of the policy can adjust right away their behavior. The cohorts who are 20 or 25 when the policy starts do not anticipate the policy.

women in three different age groups at the start of the policy (15, 25, and 35). For the group of women who are 15 when the policy is implemented and who can adjust not only fertility but also their labor supply, consumption, and occupation choices, the proportion of those with no children decreases by 0.8 percent, while the proportion with two children (or more) increases by 0.2 percent. The policy induces women to have their first child earlier (by 0.4 year) and leads mothers to spend about 0.1 year longer out of work, which translates into lower levels of skills (by about 0.3 percent). Similar effects of cash transfers have been found by Card, Chetty, and Weber (2007) in the context of a lump-sum severance payment. We also find a moderate increase in part-time work for the youngest cohort.

TABLE 8
Effect of Increased Child Benefits

	Age at Start of Policy			
	15	25	35	45
Change, no child (%)	−.8%	−.7%	0%	0%
Change, one child (%)	−.08%	−.05%	−.05%	0%
Change, two children (%)	.2%	.2%	.07%	0%
Change, age at first birth (years)	−.4	−.1	−.0005	0
Change, age at second birth (years)	−.04	−.007	.002	0
Change, skills (%)	−.29%	−.11%	−.049%	−.0019%
Change, number of years working	−.08	−.03	−.01	−.0004
Change, number of years working part-time	.04	.01	−.007	−.0003
Change, proportion routine	.3%	0%	0%	0%
Change, proportion manual	.07%	0%	0%	0%

Note.—The table compares two scenarios, a baseline one and one that introduces a cash transfer at birth of €6,000. Changes in fertility, skills, and work experience are computed at age 60. Changes in occupations are computed at age 15. Simulations are performed over 12,000 individuals.

Finally, the proportion of women opting for a routine or manual job increases, respectively, by 0.3 and 0.07 percent. Cash transfers therefore allow women to opt for less lucrative careers while maintaining a similar level of consumption. For older cohorts, the responses are muted as many decisions have already been made, and women have less scope to respond to the policy. For instance, as occupational choices are made predominantly at a young age before training in vocational schools, there is no discernible effect on occupational choices.

An important channel through which cash transfers affect behavior is assets. One reason for fertility to be brought forward is that fewer assets need to be accumulated before a child is born. To investigate this further, we plot in figure 4*c* the change in assets due to the policy for women who have been 15, 20, and 25 when the policy was implemented, in percent deviation from the no-policy scenario. The youngest cohort anticipates the policy and saves less in their early 20s. When children are born, around age 27 on average, the conditional cash transfer is saved and spread over a period lasting about 10 years. Assets then decrease below the baseline by about 2 percent as the household has lower resources because of lower skill levels and more children. The patterns for the older cohorts are similar, but these have less scope to adjust their savings.

These results not only highlight the important difference in the short- and longer-run effect of these policies on choices other than fertility but also stress that the impact of these policies may be largest for cohorts that do not show immediate fertility responses, because of their younger age. For these cohorts, such policies may have important consequences for career decisions as well as savings decisions—aspects that are usually not investigated in the literature.

V. Conclusion

In this paper, we develop and estimate a model of fertility and career choice that sheds light on the complex decisions determining fertility choices, how these interact with career decisions, and how they determine the career costs of children. Following early work by Polachek (1981), we consider occupational choice as an essential part of a woman's career plan. We show that different occupations not only imply different opportunity costs for intermittency and different wage growth but diverge in the amenity "child raising value." Moreover, the loss of skills when interrupting work careers varies across occupations, is nonlinear over the career cycle, and is highest at around midcareer, which has potentially important implications for the interplay between career choice and fertility.

Thus, the costs of fertility consist of a combination of occupational choice, lost earnings due to intermittency, lost investment into skills, and atrophy of skills while out of work and a reduction in work hours when in work. In addition, fertility plans affect career decisions already before the first child is born, through the choice of the occupation for which training is acquired—an aspect that is important not only for policies aimed at influencing fertility behavior but also for understanding behavior of women before children are born. An important additional aspect for the lifetime choices of fertility and career is savings that help women to smooth consumption. Furthermore, fertility leads to sorting of women into work, with the composition of the female workforce changing over the life course of a cohort of women, because of different career and fertility choices made by women of different ability.

These complex interdependencies between fertility and career choices imply that pro-natalist policies have effects over and above their primary intention, something that we illustrate in the simulations of our model. Moreover, the impact of any such policy is likely to be particularly pronounced for cohorts of women that are at the beginning of their careers, as they are able to adjust all future decisions in response, such as occupational choices and the timing of the first birth. These women, however, are usually not the subject of analysis in empirical work that evaluates these policies, the reason being that because of their young age, their fertility behavior does not respond around the policy implementation. Furthermore, it is not just fertility that may be affected, but other career decisions associated with fertility as well. Our analysis suggests that responses of this sort may be important, leading to possibly undesired consequences of any such policies. As DiD designs require restrictive assumptions to interpret longer-term effects to policy interventions as causal, they typically focus on short-term effects around the policy intervention. Combinations of clean 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.

Appendix

Model Description

A. Probability of Marriage and Divorce

The probability of marriage is a function of age, skills, and taste for children:

$$P(h_{it} = 1 | h_{it-1} = 0; \mathrm{age}_{it}^{M}, x_{it}, f_i^C) = \lambda_0^M + \lambda_1^M(\mathrm{age}_{it}^M) + \lambda_2^M x_{it} + \lambda_3^M f_i^C, \tag{A1}$$

where $\lambda_1^M(\cdot)$ is a nonlinear function of the age of the woman. We define the probability of divorce as a function of age and the number of children in the household:

$$P(h_{it} = 0 | h_{it-1} = 1; \mathrm{age}_{it}^{M}, n_{it}) = \lambda_0^D + \lambda_1^D(\mathrm{age}_{it}^M) + \lambda_2^D n_{it}, \tag{A2}$$

where again $\lambda_1^D(\cdot)$ is a nonlinear function of the age of the woman.

B. Job Offer Probability

Offers consist of an occupation $\tilde{o}$ and of hours of work $\tilde{l}$ (either part-time or full-time work). New offers arrive randomly and depend on the current occupation and hours of work. The probability of receiving a job offer is denoted $\phi_0(o_{it}, l_{it})$. Conditional on having received an offer, the probability of that offer being in occupation $\tilde{o}$ with hours of work $\tilde{l}$ is $\phi_1(\tilde{o}, \tilde{l} | o_{it}, l_{it})$ and depends again on current occupation and hours of work. We impose some structure on that probability as it contains potentially many terms to be estimated. We assume that the offer concerning hours of work depends only on prior hours of work, whereas occupation offers depend on prior occupation and prior working status (i.e., working or out of the labor force, but not whether the individual is in part-time or full-time work). Variations in the rate of part-time work across occupations in the model come from differential fertility choices across women and the amenity value of occupations with regard to children.

C. Utility Function

Women derive utility from their own consumption, the number of children, and leisure. We define I_j an indicator variable taking the value of one if j is true and zero otherwise. The utility function takes the following form for individual i in period t:

$$
\begin{aligned}
u_{it} = {} & \frac{(c_{it}/\bar{c})^{(1-\gamma c)}-1}{1-\gamma c}\exp\Big[\gamma_{PT}^{1} I_{l_{it}=PT} + \left(\gamma_U^1 + f_i^L\right) I_{l_{it}=U} \\
& + \left(\gamma_{\mathrm{OLF}}^1 + f_i^L\right) I_{l_{it}=\mathrm{OLF}}\Big] \exp\left(\gamma_{NC} I_{n_{it}>0}\right) \\
& + \left[\gamma_N^1 (f_i^C) I_{n_{it}=1} + \gamma_N^2 (f_i^C) I_{n_{it}=2}\right] \cdot \exp\left(\gamma_{NH} I_{n_{it}>0\&h_{it}=1}\right) \\
& \cdot \exp(\gamma_U)^{I_{l_{it}=U}} \cdot \exp\Big(\gamma_{\mathrm{OLF}} + \gamma_{A,\mathrm{OLF}}^1 I_{\mathrm{age}_{it}^K \in [0,3]} \\
& + \gamma_{A,\mathrm{OLF}}^2 I_{\mathrm{age}_{it}^K \in [4,6]} + \gamma_{A,\mathrm{OLF}}^3 I_{\mathrm{age}_{it}^K \in [7,9]}\Big)^{I_{l_{it}=\mathrm{OLF}}} \\
& \cdot \exp\Bigg(\sum_{i_o=1}^{3} \gamma_{i_o,PT} I_{o_{it}=i_o} + \gamma_{A,PT}^1 I_{\mathrm{age}_{it}^K \in [0,3]} \\
& + \gamma_{A,PT}^2 I_{\mathrm{age}_{it}^K \in [4,6]} + \gamma_{A,PT}^3 I_{\mathrm{age}_{it}^K \in [7,9]}\Bigg)^{I_{l_{it}=PT}} \\
& \cdot \exp\left(\sum_{i_o=1}^{3} \gamma_{i_o,W} I_{o_{it}=i_o}\right)^{I_{l_{it}=PT,FT}} + \eta_{it}^C b_{it} + \eta_{it}^{NC}(1 - b_{it}).
\end{aligned}
\tag{A3}
$$

The first term is the utility obtained from consumption (c_{it}). The parameter γ_C is the relative risk aversion and $\bar{c}$ is a consumption scale. As in Attanasio et al. (2008) and Blundell et al. (2013), we allow for an interaction between consumption and labor supply. We distinguish between part-time work, unemployment, and being out of the labor force. We introduce heterogeneity in the utility of leisure through the variable f_i^L. We also allow the marginal utility of consumption to differ when children are present (through the parameter γ_{NC}). The individual also derives utility from the number of children, which is displayed in the third line. The parameters $\gamma_N^1(f_i^C)$ and $\gamma_N^2(f_i^C)$ vary with the taste for children, f_i^C. Finally, we allow the utility from children to differ when a husband is present ($h_{it} = 1$).

The fourth to eighth lines allow for the utility of children to vary with labor supply and occupation choices. In a demanding occupation, the individual derives a lower utility from children, as it is more difficult to spend time with them. For instance, even if part-time work is available, the woman may not be able to stay at home when the child is sick or reschedule hours of work to attend a school performance. We also distinguish between different statuses of nonwork, as women who are unemployed may require time to search for a job. It should be noted that, because full-time work is the baseline, we do not specify a utility level associated with that outcome. In lines 6 and 7, we allow mothers who work part-time to obtain utility from leisure (relative to full-time work) dependent on the age of their youngest child. Here, we distinguish between infancy (0–3 years), preschool (4–6 years), and primary school (7–9 years). The final part of the utility function introduces iid preferences toward conception or nonconception, denoted η_{it}^C and η_{it}^{NC}. The shock that affects the woman depends on whether she decides to conceive or not (indicated by the indicator variable b_{it}). These shocks are assumed iid and extreme value distributed.

D. *Dynamic Choice*

We now describe in more detail the dynamic choices individuals make. Table A1 in the online appendix lists the notation used in the model. The main text describes it with the generic Bellman equation:

$$V_t(\Omega_{it}) = \max_{\{b_{it}, c_{it}, o_{it}, l_{it}\}} u(c_{it}, o_{it}, l_{it}; n_{it}, h_{it}, \text{age}^K_{it}, \Upsilon_{it}, f_i) + \beta E_t V_{t+1}(\Omega_{it+1}), \tag{A4}$$

with the state space defined as

$$\Omega_{it} = \{l_{it-1}, o_{it-1}, A_{it-1}, h_{it-1}, \text{age}^M_{it}, x_{it}, n_{it}, \text{age}^K_{it}, \Upsilon_{it}, f_i\}. \tag{A5}$$

The Bellman equation can be decomposed into a sequence of choices, involving conditional value functions, where the conditioning is on labor supply status and the decision to conceive or not. We make the distinction between being in work, being unemployed, and being out of work because individuals face different choice sets. For instance, individuals out of the labor force are not eligible for unemployment benefits and cannot choose to become unemployed in the next period. Individuals who choose to conceive have a probability of becoming pregnant and cannot be fired. Hence, these conditional value functions model institutional features explicitly, which are implicit only in (A4).

The individual maximizes these conditional value functions in sequence, which simplifies the overall model as one can rely on closed-form solutions for some of the choices, given particular distributional assumptions on the taste shocks in Υ_{it} (extreme value distribution). We denote these conditional value functions by indexing them with C for conception or NC if the individual decides not to conceive. We also index them with W for work (either part-time or full-time; the distinction hours of work is contained in the state variable l_{it} in Ω_{it}), U for unemployment, and O for out of the labor force. Finally, we introduce two value functions describing individuals after birth, who enter that state from work or nonemployment, and index these, respectively, by L_W and L_{NW}. At the beginning of a period, women take as given their age, skills, occupation, labor supply in the previous period, the number of children, the age of the youngest child, whether the spouse is present, and family assets. Women first observe the income shock to their wage and to the earnings of the husband, if present, and then decide whether to conceive a child or not. If conception is successful, the child is born at the beginning of the next period. Women next decide how much to consume and save.

Once fertility and consumption choices have been made, individuals observe shocks to labor supply, which consist of layoffs (if in work) and job offers. These shocks determine the labor status at the beginning of the next period. New offers arrive randomly and have two features: occupation and part-time or full-time work. The probability of receiving a job offer is denoted $\phi_0(o_{it}, l_{it})$ and depends on the current occupation and hours of work. Conditional on having received an offer, the probability of that offer being in occupation $\tilde{o}$ with hours of work $\tilde{l}$ in period $t+1$ is $\phi_1(\tilde{o}, \tilde{l} | o_{it}, l_{it})$ and depends again on current occupation and hours of work.

Value of working.—We start with the value of working and conceiving a child. In writing the values, we distinguish their deterministic part from the stochastic part due to the preference shocks, which we introduce below and which enter in a linear and additive way. As the decision to conceive has already been made, the woman has to decide how much to consume. Choices over occupations and hours of work are made at the end of the period. The value is written as

$$\begin{aligned} V^{W,C}(\Omega_{it}) = & \max_{c_{it}} u(c_{it}, o_{it}, l_{it}; n_{it}, h_{it}, \text{age}^K_{it}, Y_{it}, f_i) \\ & + \pi(\text{age}^M_{it}, f^F_i)\, \beta E_t V^{L_w}(\Omega^P_{it+1}) \\ & + \delta [1 - \pi(\text{age}^M_{it}, f^F_i)]\, \beta E_t V^U(\Omega_{it+1}) \\ & + (1-\delta)[1 - \pi(\text{age}^M_{it}, f^F_i)][1 - \phi_0(o_{it}, l_{it})]\beta E \max \\ & + (1-\delta)[1 - \pi(\text{age}^M_{it}, f^F_i)]\, \beta\phi_0(o_{it}, l_{it}) E\widetilde{\max}, \end{aligned} \tag{A6}$$

where E_t is the expectation operator. The first line consists of the current utility of consumption, leisure, and children. The second line is the future flow of utility if conception is successful, which occurs with a probability $\pi(\text{age}^M_{it})$. As the woman is working in the current period, she is entitled to paid maternity leave, with a flow of utility $V^{L_w}(\cdot)$, defined below. This value depends on the next state space Ω^P_{it+1}, where the superscript P indicates that the women is pregnant, so that the number of children is increased by one and the age of the youngest child is set to zero. Assets and skills evolve as described in equations (1) and (2).

The last three lines describe the case in which conception is unsuccessful. With a probability δ the individual is laid off and starts next period in unemployment, with a value $V^U(\cdot)$. If she is not laid off, she does not get an alternative job offer with a probability $1 - \phi_0(o_{it}, l_{it})$ and has to choose between staying in work, leaving for unemployment, and leaving the labor force. We define the term Emax as

$$E\max = E_t \max[V^W(\Omega_{it+1}) + \eta^W_{it+1}, V^U(\Omega_{it+1}) + \eta^U_{it+1}, V^O(\Omega_{it+1}) + \eta^O_{it+1}]. \tag{A7}$$

The η^k_{it+1}, $k = W, U, O$, are utility shocks, and we assume that they are iid and follow an extreme value distribution, which leads to a closed-form solution for the Emax operator. The final row of equation (A6) describes the case in which the individual receives an alternative job offer $\{\tilde{o}, \tilde{l}\}$. This happens with a probability $\phi_1(\tilde{o}, \tilde{l} | o_{it}, l_{it})$. In this case, the individual has to also decide whether to choose this new job. We define the continuation value as

$$\begin{aligned} E\widetilde{\max} = E_t \sum_{\tilde{o} \neq o_{it}, \tilde{l} \neq l_{it}} \phi_1(\tilde{o}, \tilde{l} | o_{it}, l_{it}) \max\big[& V^W(\Omega_{it+1}) + \eta^W_{it+1}, V^W(\tilde{\Omega}_{it+1}) \\ & + \tilde{\eta}^W_{it+1}, V^U(\Omega_{it+1}) + \eta^U_{it+1}, V^O(\Omega_{it+1}) + \eta^O_{it+1}], \end{aligned} \tag{A8}$$

where $\tilde{\Omega}_{it+1}$ is the future state space when the individual accepts the alternative job $\{\tilde{o}, \tilde{l}\}$ and where $\tilde{\eta}^W_{it}$ is the shock associated with the alternative offer. The value of working without conceiving is defined as

$$\begin{aligned} V^{W,NC}(\Omega_{it}) = \max_{c_{it}} u\,(c_{it}, o_{it}, l_{it}; n_{it}, h_{it}, \text{age}_{it}^{K}, \Upsilon_{it}, f_i) & \\ + \beta\delta E_t V^{U}(\Omega_{it+1}) & \\ + \beta\,(1-\delta)[1-\phi_0(o_{it}, l_{it})]E \max & \\ + \beta\,(1-\delta)\phi_0(o_{it}, l_{it})E\widetilde{\max}. & \end{aligned} \tag{A9}$$

At the beginning of next period, the individual starts with an updated state space Ω_{it+1}, where all the state variables have been updated but the number of children. Here again, the individual can be laid off and starts as unemployed or has to choose next period's labor market status.

Value of unemployment.—When unemployed, the individual can choose whether to stay unemployed for another period or exit the labor market altogether. If a job offer is received, the individual then decides whether to take up the offer or to remain nonemployed. The value of being in unemployment and not conceiving is

$$\begin{aligned} V^{U,NC}(\Omega_i) = \max_{c_{it}} u(c_{it}, o_{it}, l_{it}; n_{it}, h_{it}, \text{age}_{it}^{K}, \Upsilon_{it}, f_i) & \\ + \beta[1-\phi_0(o_{it}, l_{it})]E_t \max[V^{U}(\Omega_{it+1}) + \eta_{it+1}^{U}, V^{O}(\Omega_{it+1}) + \eta_{it+1}^{O}] & \\ + \beta\phi_0(o_{it}, l_{it})E_t \sum_{\tilde{o}\neq o_{it}, \tilde{l}\neq l_{it}} \phi_1(\tilde{o}, \tilde{l}\,|\,o_{it}, l_{it}) & \\ \max\left[V^{U}(\Omega_{it+1}) + \eta_{it+1}^{U}, V^{O}(\Omega_{it+1}) + \eta_{it+1}^{O}, V^{W}\left(\tilde{\Omega}_{it+1}\right) + \tilde{\eta}_{it+1}^{W}\right], & \end{aligned} \tag{A10}$$

where we again denote with a tilde the variables involved with the alternative job; for example, $\tilde{\Omega}_{it+1}$ is the state space for women who accepted an alternative job. The value of conceiving while in unemployment is defined as

$$\begin{aligned} V^{U,C}(\Omega_{it}) = \max_{c_{it}} u(c_{it}, o_{it}, l_{it}; n_{it}, h_{it}, \text{age}_{it}^{K}, \Upsilon_{it}, f_i) & \\ + \pi(\text{age}_{it}^{M}, f_i^{F})\beta E_t V^{L_{NW}}(\Omega_{it+1}^{P}) + [1-\phi_0(o_{it}, l_{it})][1-\pi(\text{age}_{it}^{M}, f_i^{F})] & \\ \beta E_t \max[V^{U}(\Omega_{it+1}) + \eta_{it+1}^{U}, V^{O}(\Omega_{it+1}) + \eta_{it+1}^{O}] & \\ + \beta[1-\pi(\text{age}_{it}^{M}, f_i^{F})]\phi_0(o_{it}, l_{it})E_t \sum_{\tilde{o}, \tilde{l}} \phi_1(\tilde{o}, \tilde{l}\,|\,o_{it}, l_{it}) & \\ \max\left[V^{U}(\Omega_{it+1}) + \eta_{it+1}^{U}, V^{O}(\Omega_{it+1}) + \eta_{it+1}^{O}, V^{W}\left(\tilde{\Omega}_{it+1}\right) + \tilde{\eta}_{it+1}^{W}\right]. & \end{aligned} \tag{A11}$$

If conception is successful, the mother is entitled to maternity leave but will not be entitled to a job at the end of that spell, generating a flow of utility $V^{L_{NW}}(\cdot)$ as defined below.

Value of being out of the labor force.—The value of being out of work and trying to conceive a child is modeled as

$$
\begin{aligned}
V^{O,C}(\Omega_{it}) = {} & \max_{c_{it}} u\left(c_{it}, o_{it}, l_{it}; n_{it}, h_{it}, \text{age}_{it}^{K}, \Upsilon_{it}, f_i\right) \\
& + \pi(\text{age}_{it}^{M}, f_i^{F})\beta E_t V^{L_{NW}}(\Omega_{it+1}^{P}) \\
& + [1 - \phi_0(o_{it}, l_{it})][1 - \pi(\text{age}_{it}^{M}, f_i^{F})]\beta E_t V^{O}(\Omega_{it+1}) \\
& + \phi_0(o_{it}, l_{it})[1 - \pi(\text{age}_{it}^{M}, f_i^{F})]\beta E_t \sum_{\tilde{o} \neq o_{it}, \tilde{l} \neq l_{it}} \phi_1\left(\tilde{o}, \tilde{l} | o_{it}, l_{it}\right) \\
& \max\left[V^{O}(\Omega_{it+1}) + \eta_{it+1}^{O}, V^{W}\left(\tilde{\Omega}_{it+1}\right) + \tilde{\eta}_{it+1}^{W}\right],
\end{aligned}
\tag{A12}
$$

whereas the value of not conceiving is

$$
\begin{aligned}
V^{O,NC}(\Omega_{it}) = {} & \max_{c_{it}} u\left(c_{it}, o_{it}, l_{it}; n_{it}, h_{it}, \text{age}_{it}^{K}, \Upsilon_{it}, f_i\right) \\
& + [1 - \phi_0(o_{it}, l_{it})]\beta E_t V^{O}(\Omega_{it+1}) \\
& + \phi_0(o_{it}, l_{it})\beta E_t \sum_{\tilde{o} \neq o_{it}, \tilde{l} \neq l_{it}} \phi_1\left(\tilde{o}, \tilde{l} | o_{it}, l_{it}\right) \\
& \max\left[V^{O}(\Omega_{it+1}) + \eta_{it+1}^{O}, V^{W}\left(\tilde{\Omega}_{it+1}\right) + \tilde{\eta}_{it+1}^{W}\right].
\end{aligned}
\tag{A13}
$$

It should be noted that individuals who are out of the labor force cannot become unemployed and start claiming benefits.

Value of maternity leave.—Maternity leave lasts for two periods during which the mother is not working and receives maternity benefits. The amount she gets depends on her prior labor market status. The value of maternity for a woman who previously worked is defined as

$$
\begin{aligned}
V^{L_W}(\Omega_{it}) = {} & \max_{c_{it}, c_{it+1}} u\left(c_{it}, o_{it}, l_{it}; n_{it}, h_{it}, \text{age}_{it}^{K}, \Upsilon_{it}, f_i\right) \\
& + \beta u(c_{it+1}, o_{it}, l_{it}; n_{it}, h_{it}, \text{age}_{it+1}^{K}, f_i) \\
& + [1 - \phi_0(o_{it}, l_{it})]\beta^2 E_t \max[V^{W}(\Omega_{it+1}) \\
& + \eta_{it+1}^{W} + V^{U}(\Omega_{it+1}) + \eta_{it+1}^{U}, V^{O}(\Omega_{it+1}) + \eta_{it+1}^{O}] \\
& + \phi_0(o_{it}, l_{it})\beta^2 E_t \sum_{\tilde{o} \neq o_{it}, \tilde{l} \neq l_{it}} \phi_1\left(\tilde{o}, \tilde{l} | o_{it}, l_{it}\right) \max[V^{W}(\Omega_{it+1}) + \eta_{it+1}^{W}, \\
& V^{W}\left(\tilde{\Omega}_{it+1}\right) + \tilde{\eta}_{it+1}^{W}, V^{U}(\Omega_{it+1}) + \eta_{it+1}^{U}, V^{O}(\Omega_{it+1}) + \eta_{it+1}^{O}].
\end{aligned}
\tag{A14}
$$

In this state, the woman is entitled to maternity leave, which consists of a fixed transfer and a variable one, which is a function of prior earnings. If the individual did not work prior to giving birth, she is not guaranteed a job at the end of the maternity leave and receives only the fixed transfer:

$$V^{L_{NW}}(\Omega_{it}) = \max_{c_{it}, c_{it+1}} u\left(c_{it}, o_{it}, l_{it}; n_{it}, h_{it}, \text{age}_{it}^{K}, \Upsilon_{it}, f_i\right) + \beta u(c_{it+1}, o_{it}, l_{it}; n_{it}, h_{it}, \text{age}_{it+1}^{K}, f_i) + [1 - \phi_0(o_{it}, l_{it})]\beta^2 E_t \max[V^U(\Omega_{it+1}) + \eta_{it+1}^{U}, V^O(\Omega_{it+1}) + \eta_{it+1}^{O}] + \phi_0(o_{it}, l_{it})\beta^2 E_t \sum_{\tilde{o}, \tilde{l}} \phi_1\left(\tilde{o}, \tilde{l} | o_{it}, l_{it}\right) \max\left[V^W\left(\tilde{\Omega}_{it+1}\right) + \tilde{\eta}_{it+1}^{W}, V^U(\Omega_{it+1}) + \eta_{it+1}^{U}, V^O(\Omega_{it+1}) + \eta_{it+1}^{O}\right]. \tag{A15}$$

Conception decision.—The decision of whether to conceive or not is made as

$$V^k(\Omega_{it}) = \max[V^{k,C}(\Omega_{it}), V^{k,NC}(\Omega_{it})], \; k = \{W, U, O\}. \tag{A16}$$

As the preference shocks toward conception and nonconception η_{it}^{C} and η_{it}^{NC}, which are part of the state vector Ω_{it}, are drawn from an extreme value distribution, the probability of conception takes a logistic form, with the values of conception and nonconception as arguments. The decision to conceive, noted b_{it} in equation (5) in the main text, is the argmax of expression (A16).

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