Discussion Paper Series – CRC TR 224

Discussion Paper No. 067
Project A 03

Taxing Families: The Impact of Child-related Transfers on Maternal Labor Supply

Anne Hannusch*

August 2019
(First version : January 2019)

* University of Mannheim, Department of Economics, 68131 Mannheim (email: hannusch@uni-mannheim.de)

Funding by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) through CRC TR 224 is gratefully acknowledged.

Taxing Families: The Impact of Child-related Transfers on Maternal Labor Supply

Anne Hannusch*

August 2019

Abstract

The employment rate of married women with and without preschool children varies substantially across countries. To what extent can child-related transfers account for this variation? I develop a life-cycle model in which married couples jointly decide their labor supply, female human capital evolves endogenously, and some couples have access to grandparental childcare. I show that child-related transfers can explain most of the variation in the employment rates of married women, even after taking the labor income tax treatment and cross-country variation in childcare fees into account.

JEL Codes: E62, H24, H31, J12, J22

Keywords: Maternal Labor Supply, Nonlinear Transfers, Taxation, Two-earner Households

*University of Mannheim, Department of Economics, 68131 Mannheim (email: hannusch@uni-mannheim.de). I am grateful to Karen Kopecky and Tao Zha for their continuous encouragement and invaluable guidance throughout this project. In addition, I thank Toni Braun, Kaiji Chen, Hashem Dezhbakhsh, Lei Fang, Nicola Fuchs-Schündeln, Nezih Guner, Jeremy Greenwood, Chris Herrington, Julie Hotchkiss, David Jacho-Chávez, Fabian Kindermann, Dirk Krüger, Roozbeh Hosseini, Kim Huynh, Alex Ludwig, Federico Mandelmann, Sara Markowitz, Ian McCarthy, Melinda Pitts, Richard Rogerson, Juan Rubio-Ramírez, Victor Ríos-Rull, Pedro Silos, Michèle Tertilt, Vivian Yue, Zoe Xie and participants at numerous seminars and conferences for valuable feedback. Part of this research was conducted at the University of Pennsylvania. I thank the Department of Economics for its hospitality. I acknowledge financial support by the German Research Foundation (DFG) through CRC TR 224 (project A03).

The employment rate of married mothers with young children is on average 15% lower than the employment rate of married women without children (OECD; 2012).[1] I refer to this difference as the *maternal employment gap*. The size of this gap varies significantly across countries. For example, the employment rate of women with pre-school children is 13.2% lower in the US relative to women without children. In Denmark, on the other hand, the employment rate of mothers with small children is even slightly higher relative to women without children. How can we reconcile the varying size of the maternal employment gap across countries?

Countries differ substantially in the way their tax and transfer systems are designed. Take Denmark and the US as an interesting comparison. The tax and transfer system in both countries differs along three dimensions that are of first-order importance for the labor supply decision of families with children. The US taxes labor income of spouses jointly, while Danish labor income is taxed at the individual level. Childcare fees for a full-time daycare spot are about 25% lower in Denmark. Finally, the generosity and design of child-related transfers, defined as all government transfers to families with children, varies substantially: Denmark spends 3.1% of its GDP on child-related transfers, while the US spends 1.5% of its GDP on these policies. A large fraction of Danish subsidies are distributed in a lump-sum fashion. All programs that support families with children in the US are means-tested and taper off as family income increases.

This paper argues that the key difference to reconcile the variation in the maternal employment gap across countries is the design of child-related transfers. For example, introducing child-related transfers into the US model economy decreases the maternal employment by 15.8%, while the gap in the Danish economy is reduced by 5.10%.

This result is driven by the fact that a large fraction of Danish child-related transfers are distributed lump-sum, yet all US transfers for families with children are means-tested. While lump-sum transfers do not affect the decision of the second earner at the margin, means-tested transfers introduce important nonlinearities in the effective tax rates that families face. If family income falls into the phase-in range of such a transfer program, the size of the transfer is increasing with family income and provides strong incentives for the second income earner to enter the labor force. The opposite is true in the phase-out range: transfers are a decreasing function of family income. Hence, if the additional income of the second earner pushes the couples' income into the phase-out range of a large scale transfer program, parents might be better of specializing. In doing so, they forgo paying the costs for formal childcare and remain eligible for the transfer. As a result, the aggregate effect of child-related transfer programs

[1] At the same time, employment rates of men with and without children in the household are comparable.

is a function of the specific policy design as well as the distribution of family incomes in the economy.

To analyze the trade-offs stemming from taxes and transfers for families with children, I propose a life-cycle model in which spouses jointly decide their labor supply. The economy is populated by married couples and singles. Some households have children, which arrive early or late in the lifecycle. Having children consumes additional resources as working parents have to purchase childcare services, unless they have access to grandparents that can provide childcare at no cost. Male and female individuals are ex-ante heterogeneous in their education. While male age-earning profiles are taken as exogenous, female labor productivity evolves endogenously over the lifecycle.

I calibrate the model to the US economy. Holding preferences fixed, I use the model economy to predict the labor supply of married women with and without children for a set of twelve European countries. Four features of the model economy are adjusted and informed by country-specific data targets: Income taxes and transfers independent of the presence of children, out-of-pocket childcare costs, the fraction of couples relying on grandparents as the primary caretaker, and child-related transfers. Decomposing the total effect on maternal labor supply into the contribution of each component reveals that the latter component is most important to quantitatively match the data.

This paper is part of a growing macroeconomic literature that departs from the standard single earner decision problem and models the joint decision making of spouses in a unitary framework.[2] A number of these studies have emphasized the importance of income taxes and the social security benefits in determining the labor supply decision of the second earner in the household.[3] This paper extends the analysis and emphasizes differences in the decision problem for families with and without children. In doing so, it is closely related to a strand of macroeconomic research that explores the effects of childcare costs and childcare subsidies on family labor supply.[4] The analysis presented here contributes to these studies by providing a tractable framework that allows to systematically study the impact of nonlinear taxes and transfers on family labor supply for the entire income distribution and across countries.

The framework builds on the joint labor supply problem proposed by

[2] See Greenwood et al. (2003), Hong and Ríos-Rull (2007), and Heathcote et al. (2010), among others.

[3] Important contributions to this literature are Chade and Ventura (2002), Bar and Leukhina (2009), Kaygusuz (2010), Erosa et al. (2012), Guner et al. (2012), Chakraborty et al. (2015), Duval-Hernández et al. (2018) and Holter et al. (2019).

[4] Rogerson (2007), Attanasio et al. (2008) and Domeij and Klein (2013) study the effect of childcare costs and family transfers for stand-in households. Erosa et al. (2010) and Bick (2015) have extended the analysis to heterogeneous households.

Guner et al. (2018). Their analysis focuses on the US economy with the goal of studying the effect of childcare policy reforms on family labor supply and welfare. To account for the rich heterogeneity in taxes and transfers across countries in a parsimonious way, I rely on the method outlined in Bick and Fuchs-Schündeln (2018). They use the statutory non-linear income tax code for married couples provided by the OECD to infer effective tax rates of single and dual earner households in their model. I extend their method by accounting for the statutory size and eligibility criteria of family transfers. Ultimately, the framework developed this paper is the first to allow the systematic study of family transfers at the macroeconomic level across countries.

Finally, the paper is also related to an extensive empirical literature going back to Heckman (1974) that estimates the effects of childcare costs on maternal labor supply.[5] Estimates of maternal labor supply elasticity vary tremendously with most authors arguing that labor supply estimates should be carefully interpreted within the country-specific context of their study.[6] Another way of interpreting the large variation in estimates of the parameter estimates has been recently put forth by Attanasio et al. (2018): They document tremendous heterogeneity in female labor supply elasticities at the micro level due to observables such as age and education. The structural framework presented in this paper extends this notion. It shows that maternal labor supply elasticities crucially depends on the size and the design of the child-related transfers, the demographic structure of the economy as well as the distribution of family income and household composition.

The remainder of the paper is organized as follows. Section 1 presents a stylized version of the couple's decision problem. Section 2 summarizes important data facts used to discipline the quantitative model presented in section 3. Section 4 describes the calibration in detail. Section 5 presents the benchmark economy, while Section 6 performs policy experiments to assess the contribution of country-specific institutional factors to the maternal employment gap. Finally, section 8 concludes.

1 Maternal Employment Gap

Figure 1 summarizes the cross-country variation in the maternal employment gap in the data. The gap is defined as the difference in the average

[5] Hotz and Miller (1988), Schøne (2004), Baker et al. (2008) and Havnes and Mogstad (2011) and Blau and Currie (2006) for a summary.

[6] Examples include Sánchez-Mangas and Sánchez-Marcos (2008), Azmat and Gonazález (2010), Bettendorf et al. (2015), Cascio et al. (2015), Geyer et al. (2015), Givord and Marbot (2015), Nollenberger and Rodríguez-Planas (2015) and Raute (2019).

employment rate between two groups of married women. The first group includes married women with a child less than six years of age, while the second group is composed of married women without children or children older than the age of six. For simplicity, I refer to the latter group as married women without children. Looking at the data, it is striking that the employment rate for married women without pre-school children is very homogeneous within regions. The employment rates of married women with pre-school children varies significantly both within and across regions, resulting in large variations in the size of the maternal employment gap.

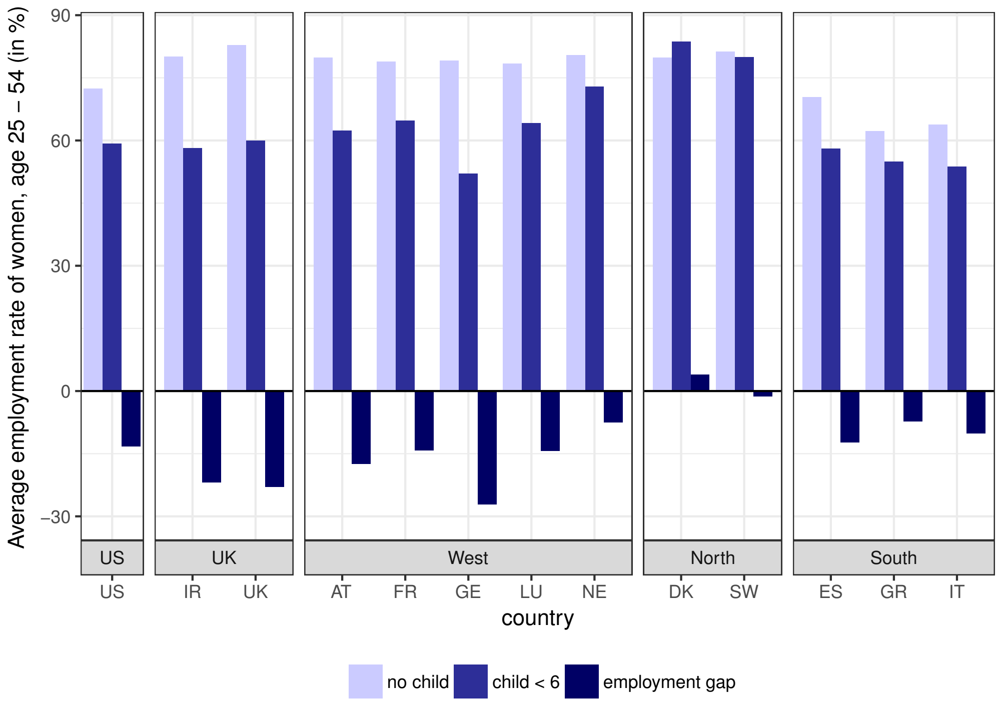

Figure 1: Employment Rates of Married Women, 2005-2007

Notes: Data for the US comes from the Current Population Survey (CPS), while employment rates for European countries are based on the European Labor Force Survey (ELFS). Due to the limited sample size in the ELFS, data between 2005 and 2007 are pooled. The sample is restricted to married women between the age of 25 and 54. Married women without pre-school children include married women without children as well as married women with children older than six.

One simple takeaway from the data is that there are factors that uniquely affect the labor supply decision of married couples with children. I introduce a stylized version of the couple's labor supply problem to formalize this notion. The goal is to derive an expression that summarizes the main components of the decision problem that impact married couples with and without children differently.[7]

For simplicity, take male labor supply, $\bar{l}_m$, as fixed. This fairly strong assumption will be relaxed in the quantitative model. Let us also abstract from savings for the time being. Couples derive utility from consumption c and incur disutility from work l_i, where $i \in \{f, m\}$. They face an additional utility cost from joint work, q. This utility cost can be interpreted as the loss in utility from two working spouses that are unable to spend time together. Alternatively, one could interpret q as capturing prevalent social norms towards working women.[8] Note, however, that q will not affect labor supply choices of women with and without children differently. Having children consumes resources and parents do not any utility from raising children. This implies that having children affects the household budget constraint only. Finally, consumption is a public good in the household and total household utility is defined as the sum of individual utilities.[9] The decision problem is given by:

$$\max_{\{c,l_f\}} \quad 2\log c - \phi \bar{l}_m^{\chi} - \phi l_f^{\chi} - q\mathbb{I}(l_f > 0)$$
$$\text{s.t. } (1+\tau_c)c = (1 + s_k(l_f))y_{hh}^{\nu} - \bar{w}k\psi\mathbb{I}(l_f > 0)\mathbb{I}(g = 0)$$

where y_{hh} is the after tax household income and ν specifies whether labor income is taxed jointly or separately.[10] k is an indicator that takes the value of 1 if a child is present in the household and 0 if not. If $k = 0$, all highlighted variables drop out of the budget constraint and it collapses to a standard version of the joint household labor supply problem. If children

[7] Mothers currently on maternity leave are counted as employed in the CPS and ELFS data. They will only show up as unemployed if their parental leave us up and they have not yet returned to work. Given this coding of the data, it is not possible to distinguish whether a mother is on parental leave or actually working if the child is one year of age. The employment gaps are of similar magnitude if mothers with children ages one and below are excluded. Lalive and Zweimüller (2009) show that parental leave duration affects labor supply in the short-run, but not in the long-run.

[8] Fernández (2007), Fogli and Veldkamp (2011) and Fernández (2013) emphasize the importance of changing social norms on female labor supply.

[9] An alternative view of the household are collective models in which partners can disagree about decisions. See Browning et al. (2014) and Doepke and Kindermann (2019) for a discussion on non-unitary household models.

[10] Following Bénabou (2002), the after tax household income can be expressed as

$$y_{hh}^{\nu} = \begin{cases} 2(1-\delta)\left(\dfrac{w_m l_m + w_f l_f}{2}\right)^{1-\xi} & \text{if } \nu = \text{joint taxation} \\ (1-\delta)(w_m l_m)^{1-\xi} + (1-\delta)(w_f l_f)^{1-\xi} & \text{if } \nu = \text{separate taxation} \end{cases}$$

where ξ is the degree of progressivity embedded in the tax code. In the case of full progressivity, i.e. $\xi = 1$, the after-tax income for every household is identical. If $\xi = 0$, δ represents the average tax rate.

are present, there are two additional factors that affect the household labor supply decision through the budget constraint: (1) Households have to pay for childcare if both partners are working $\psi\mathbb{I}(l_f > 0)$. If parents have access to informal care provided by grandparents, $g > 0$, the indicator function $\mathbb{I}(g > 0)$ takes the value of zero, implying that the household does not face formal childcare costs. (2) Families with children receive child-related transfers $s_k(l_f)$ that effectively increase the after-tax household income. Note that these transfers are a non-linear function of household income.

In this simple set up, married women without children ($k = 0$) enter the labor force if

$$u(c, l_f|k)\Big|_{l_f>0} - u(c, l_f|k)\Big|_{l_f=0} \geq 0.$$

Define the pre-tax labor income of a 2-earner household as $Y_{hh,2} = w_m l_m + w_f l_f$ and let $Y_{hh,1} = w_m l_m$ be the pre-tax income of a single earner household. Then, a married woman without children enters the labor force if

$$\underbrace{\left(\frac{Y_{hh,2}}{Y_{hh,1}}\right)^{1-\xi}}_{\text{Financial Gain}} \geq \underbrace{\exp\{\phi l_f^{\chi} + q\}}_{\text{Utility Cost}}$$

where the gain from entering the labor force is the additional after-tax labor income earned by the wife, which depends on ξ, the progressivity of the tax code. The cost of entering the labor force is the disutility of labor and the cost of joint work. As long as the additional after-tax household income exceeds the utility costs, a married woman chooses to work. A married woman with children faces the following trade-off:

$$\underbrace{\left(\frac{Y_{hh,2}}{Y_{hh,1}}\right)^{1-\xi} - \overbrace{\left(\frac{1}{1+s_k(l_f)}\right)\frac{\bar{\omega}\psi\mathbb{I}(g)}{y_{hh,1}^{\nu}}}^{\text{Effective Childcare Costs}}}_{\text{Financial Gain}} \geq \underbrace{\exp\{\phi l_f^{\chi} + q\}}_{\text{Utility Cost}}$$

We can see right away that the financial gain from working is smaller for mothers if the effective childcare costs are positive. Notice that the presence of grandparents , $\mathbb{I}(g) = 0$, reduces the decision problem to the case of a married women without children. In the absence of grandparents, the effective cost of childcare is given by

$$\left(\frac{1}{1+s_k(l_f)}\right)\frac{\bar{\omega}\psi}{y_{hh,1}^{\nu}}.$$

While out-of-pocket childcare ψ decreases the financial gain from working, child-related transfers $s_k(l_f)$ can compensate the increase in employment costs. Instead, means-tested transfers introduce strong nonlinearities in the effective tax rates that households with children face.

2 Stylized Facts

In general, two types of transfer programs for families with children can be distinguished: child benefits and childcare subsidies. Child benefits that are lump-sum or means-tested and paid out to every family conditional on having a child. The benefit amount usually varies with child age. The second type of benefit are childcare subsidies that compensating families for the cost of childcare. Often times, these programs often take the form of a tax credit and allow families to deduct the childcare fees from their taxable income.

Table A1 summarizes the different types of transfer programs, including eligibility criteria, for Denmark and the US. Based on these information, we can construct a benefit function that summarizes the amount of benefits a single or dual earner family is eligible for.

Figure 2 plots family benefits in Denmark and the US as a function of household labor income normalized by mean labor earnings in 2004. Child-related transfers introduce important non-linearities, especially at the low end of the income distribution. In the US, these programs have a pronounced phase-in range during which benefits are increasing in income. Hence, they provide strong labor supply incentives. Once household income approaches mean labor earnings, these benefits taper off rather quickly, effectively introducing an additional wage tax on labor income (Guldi and Schmidt; 2017). In the US, the phase-out range for single earner households is mainly driven by the design of the Earned Income Tax Credit. Denmark, on the other hand, subsidizes single earner families more heavily throughout the income distribution. In addition, the benefit is designed as a simple lump-sum transfer and leaves labor supply decisions at the margin unchanged.

For dual earner households in the US, the phase-out range is even steeper once household income exceeds 80% of mean labor earnings. Prior to this threshold, childcare costs are heavily subsidized. Once household income exceeds 80%, the childcare subsidy through the federal Child Care and Development (CCDF) drops to zero. This pronounced decrease in the benefit function implies that many households are better off specializing to avoid this sizeable wage tax. While Denmark also subsidizes childcare costs for low income families in addition to a lump-sum transfer, the subsidy phases out more slowly, resulting in a smaller wage tax at the margin compared to the US benefit design.

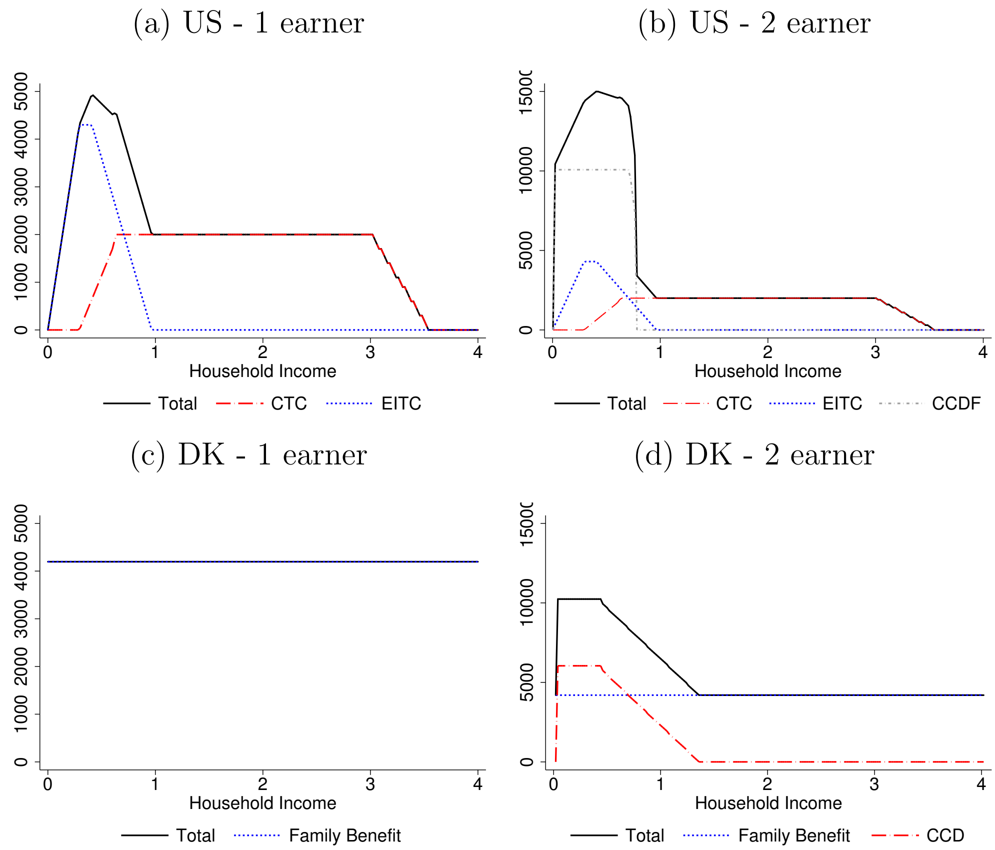

Figure 2: Child-related Transfers to Families with 2 Children

Notes: All benefits are shown in 2004 USD for married households with 2 children aged 2 and 4 years. Benefits are calculated using the OECD Taxes and Wages Module. In case of a 1-earner household, it is assumed that children are cared for by the non-working spouse and hence no childcare subsidies are paid out.

Empirical work studying the effects of benefit programs on maternal labor supply has mainly focused on the case of single mothers.[11] The overall conclusion is that EITC benefit expansions have increased the labor supply of single mothers. In contrast, few studies consider the effect on labor supply of married women. Notable exceptions are Eissa and Hoynes (2004) and Eissa and Hoynes (2006) who show that EITC expansions led to reductions in the labor supply for married women. This paper provides a framework to reconcile these results. While most single mothers are better off working and receiving childcare subsidies, a large fraction of middle-income families chooses to specialize and avoids the effective wage tax imposed by the phasing out of subsidy programs. Ho and Pavoni (2019) argue that the optimal design of child-related transfers for single mothers

[11]See Eissa and Liebman (1996), Grogger (2003) and Meyer and Rosenbaum (2003).

in the US is qualitatively in line with existing features of the current US benefit scheme. It is not clear that this notion extends to dual earner households given the varying labor supply effects of these programs for single versus married mothers.

A simple way of characterizing the trade-offs that couples with children face is to compute the participation tax of the second earner (Brewer et al. (2010)). Participation tax rates measure the financial gain for the household if the second spouse works. They are defined as 1 minus the financial gain from being a two earner household relative to the gross income of the two earner household:

$$\tau^{PTR} = 1 - \frac{y^{cc}_{hh,2} - y_{hh,1}}{Y_{hh,2}}$$

Notice that the after tax income $y^{cc}_{hh,2}$ assumes that dual-earner families with children pay for childcare and, if the statutory income tax code allows, are able to deduct these expenses from their taxable income. The higher the participation tax rate, the more reduced is the gain from being a two earner couple. Hence, a participation tax rate of one implies that there is no financial gain for the spouse to start working.

Figure 3 plots participation tax rates for couples at different points in the income distribution. The income of the first earner is fixed. If the first earner's labor income is 0.25 or 0.5 of mean labor income, the couple is referred to as low income. If the labor income of the first earner is 0.75 or equal to mean labor income, the couple is classified as medium income. The participation tax rate is calculated for a range between zero and mean labor income of the second earner. While the participation tax rate for US families with children is less than one in almost low income households, the medium income panel shows that the participation tax rate is higher than one for a large fraction of households with a combined income between 0.75 and 1.6 times mean labor income. Couples in this income range are better off specializing. In Denmark, participation tax rates are never above one for low income households and barely above one for a small range of households in the medium income range.

(a) US - low income (b) DK - low income (c) US - medium income (d) DK - medium income

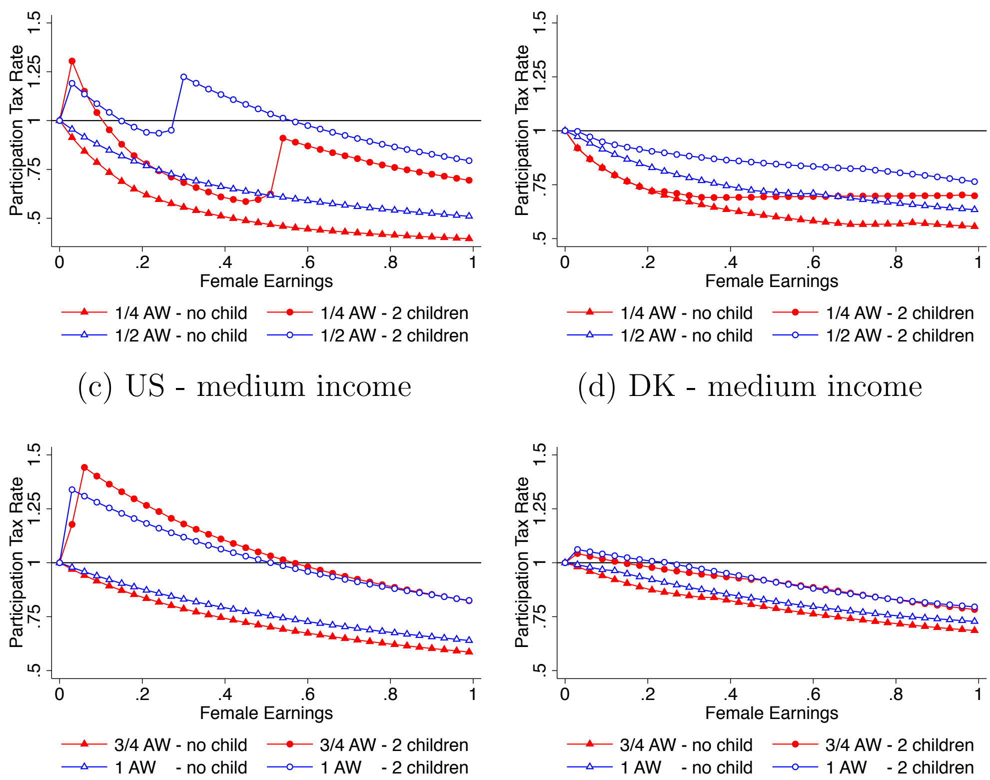

Figure 3: Participation Tax Rates for Married Couples

Notes: Effective tax rates are calculated for married households with 2 children, 2 and 4 years of age. Rates are calculated using the OECD Taxes and Wages Module. In case of a 1-earner household, it is assumed that children are cared for by the non-working spouse and the household is ineligible for childcare subsidies.

3 Model

This section develops a life-cycle economy of joint household labor supply, in which female human capital evolves endogenously and a fraction of households in the economy have access to informal care. The model is used to study to what extent labor income taxes, child-related transfers, and out-of-pocket childcare costs contribute to the cross-country variation in the maternal employment gap. While the general equilibrium framework is not of first-order importance for the within-country decomposition exercise, it allows for interesting cross-country experiments that shed light on the importance of the design child-related transfers for maternal labor supply.

3.1 Firms

Firms hire capital K and labor L_y on perfectly competitive factor markets to transform it into a single output good according to the Cobb-Douglas production technology given by

$$Y \equiv F(K, L) = AK^{\alpha} L_y^{1-\alpha} \tag{1}$$

Capital depreciates at rate δ_a. Total labor services, L, are divided into labor available for the production of consumption goods, L_y, and labor used to provide childcare services, L_c, such that $L = L_y + L_c$. Households can purchase a risk-free asset that pays a competitive rate of return given by $r = R - \delta_a$.

3.2 Households

The economy is populated by a continuum of males m and females f and $j \in \{1, 2, ..., J\}$ denotes the age of individuals. The population grows at a constant rate n. Hence, the fraction of agents of the population at age j is given by $\mu_{j+1} = \frac{\mu_j}{1+n}$. Individuals begin their life at working-age in period 1, retire after period J_R, and die at the end of period J. Individuals are either born single or married and marital status is constant throughout the lifetime. In addition, both individuals in a married household are assumed to have the same age.

Labor Productivity Individuals are endowed with a certain level of education at the start of their life. These exogenous education types are given by $z \in Z$ for males and $x \in X$ for females and both sets X and Z are finite. Male productivity evolves exogeneously over the lifetime, conditional on the initial level of education, such that the age-specific labor productivity of a male with education level z in period j is given by $\omega_m(z, j)$. Female education types map into an initial human capital level, $h_1 = \eta(x)$ at the start of period 1. Female human capital evolves endogenously thereafter. Female productivity in the next period is described by Λ and depends on her initial education type x, current period human capital h and current period labor supply l_f, as well as age j. Λ is increasing in the female education x and current period human capital h and non-decreasing in labor supply l_f:

$$h' = H(x, h, l_f, j) \qquad \forall\, h \in H. \tag{2}$$

The distributions of agents by household type, by education and by spouse education for married couples are stationary. First, let $M_j(z)$ be the distribution of all males in the economy of education type z at age j. Further, $F_j(x)$ define the distribution of all females by education type and age j. Since marital status is invariant over the lifecycle, the following identities have to be satisfied:

$$M_j(z) = \sum_{z \in Z} \Omega_j(z, x) + \Pi_j(z) \tag{3}$$

$$F_j(x) = \sum_{x \in X} \Omega_j(z, x) + \Lambda_j(x) \tag{4}$$

$\Omega_j(z, x)$ is the distribution of females of education type x married to a male of education type z. The distribution of singles by education type is given by $\Pi_j(z)$ for males and $\Lambda_j(x)$ for females. Since marital status does not change over the lifecycle, it has to be that the distribution of married couples, $\Omega_j(z, x) = \Omega(z, x)$, and single males, $\Pi_j(z) = \Pi(z)$, is constant across all ages j, which implies that the distribution of all males is stationary: $M_j(z) = M(z)$. In addition, for single females, $\Lambda_j(x) = \Lambda(x)$ $\forall j$, which implies that $F_j(x) = F(x)$ for all periods j.

Children Household either have no children or 2 children attached to them. If a household is born with children, these children arrive either early (period 1) or late (period 2) in the life cycle. This gives rise to three childbearing types: households *without children*, *early childbearers* and *late childbearers*. The childbearing type for each household is indexed by $b = \{0, 1, 2\}$, respectively. Children stay in the household for three model periods, that is, *early childbearers* raise children in period 1,2 and 3, while *late childbeares* nuture in period 2, 3 and 4. The age of children is indicated by $s = \{1, 2, 3\}$.

Cost of Childcare A fraction of households has access to informal care

$$\mathbb{I}(g) = \begin{cases} 0 & \text{if } g = 1 \\ 1 & \text{otherwise} \end{cases} \tag{5}$$

This function takes the value of zero if $g = 1$, that is, if households have access to informal care provided by grandparents, they do not incur any childcare costs. In the absence of informal care, a working mother, single or married, has to purchase formal childcare. The cost of care, ϕ_s, varies with child age s and is modeled as a fraction of the average earnings in the economy. Notice that the fraction of income spent on childcare is independent of maternal education or household income. Empirically, we observe that mother with higher education spend a larger fraction of household income on childcare for every child. At the same time, lower educated households spend less on childcare per child, but tend to have more children. These to effects counteract each other in the model, such that the childcare expenses are modeled as a constant fraction of the average earnings.

Utility Cost from Joint Work Married couples face an additional utility cost from joint work, $q \in Q$ where Q is a finite set. Couples draw this cost at the beginning of their lives and it remains constant throughout the lifetime. The initial draw of q is conditional on the education type of the husband, z. Let $p(q|z)$ be the probability that the cost of joint work amounts to q, with $\sum_{q \in Q} p(q|z) = 1$.

Preferences Individuals derive utility from consumption c and dislike market work l_n, $n = \{m, f\}$. Utility is additively separable and the momentary utility function for a single male or single female household reads

$$u_n^S(c, l_n) = \log c - \phi l_n^\chi \qquad n = \{f, m\} \tag{6}$$

Married couples maximize the summed utility of individual household members. Consump-tion is a public good within the household. The weight and curvature of the disutility of labor is identical for all individuals, independent of gender and marital status.

$$u^M(c, l_m, l_f, q) = 2 \log c - \phi l_m^\chi - \phi l_f^\chi - q \mathbb{I}(l_f > 0) \tag{7}$$

The utility cost q captures a utility loss due to joint work of both spouses, which could originate from inconvenience for scheduling joint work, forgone home production or spending less family time with children (as in Cho and Rogerson (1988)).

3.3 Government

The government taxes labor income and levies a flat tax on capital income and collects tax receipts from payroll taxes. It uses these tax receipts to subsidize families with small children through transfers and childcare subsidies, to pay old-age benefits to retirees and to finance government consumption.

Income Taxation and Child-related Transfers The taxable income is defined as the sum of labor income and capital income. For a working-age single male household, taxable income equals $I_m^S = w\omega(z, j)l_m + ra$ and $I_f^S = wh_x l_f + ra$ for working-age single females. Taxable income for working-age couples is given by $I^M = w\omega(z, j)l_m + wh_x l_f + ra$. All workers, in addition, pay payroll taxes on their individual labor income.

The total tax liability for the different households types is also contingent on the presence of children. The government subsidizes households through tax credits and childcare subsidies, conditional on household income and labor force status. There are two types of tax credits in the economy. The first type is only contingent on the presence of a child in the household, i.e. $k = 1$. The second type of tax credit is additionally contingent on total household income. This type of tax credit fully reduces the household's tax liability of total income I is below a threshold $\bar{I}$ and phases out at a constant rate if $I > \bar{I}$. This tax credit fully phases out if $I > \hat{I}$.

The tax functions $t^S(I^S_m, k)$, $t^S(I^S_f, k)$, and $t^M(I^M, k)$ summarize the income tax code in the economy, as well as the child-related tax credits and childcare subsidies. They can be interpreted as the *effective income tax rate* households face. This general representation of the labor income tax code encompasses both individual and joint taxation regimes.

Old-age Benefits Old-age benefits are not taxed by the government, and thus taxable income for retirees is simply capital income defined as $I^R = (1+r)a$. Old-age benefits depend on the innate education type of the individuals, which helps to capture the positive correlation between lifetime earnings and the size of old-age benefits. $p^S_f(x)$, $p^S_m(z)$ and $p^M(x, z)$ define the level of old-age benefits for single females, single males and married couples, respectively, conditional on initial education levels.

3.4 Household Problem in Recursive Form

This section lays out the decision problem for married and single households in recursive form. The state space for single males is given by $\{a, z, j\}$ and for single females by $\{a, x, h, b, g, j\}$. For married couples, the state space is given by $\{a, z, x, h, b, q, g, j\}$. Notice that $b = 0$ for all households without children. Single male households never have children attached to them.

Single Males The decision problem of a single male household essentially can be decomposed in the two periods only: working age, $j < J_R$, and retirement, $j \geq J_R$. Single males choose consumption and savings in every period according to

$$V^S_m(a, z, j) = \max_{a', l_m} \left\{ u^S_m(c, l_m) + \beta V^S_m(a', z', j+1) \right\} \tag{8}$$

subject to

$$(1+\tau_c)c + a' = \begin{cases} (w\omega_m(z, j)l_m + ra)(1 - t^S(I^S_m, 0)) + a(1 + r(1 - \tau_a)) & \text{if } j < J_R \\ \\ a(1 + r(1 - \tau_k)) + p^S(z) & \text{if } j \geq J_R \end{cases}$$

and

$$l \geq 0, \quad a' \geq 0 \qquad \text{and} \quad I_m^S = w\omega_m(z,j)l_m + ra.$$

Single Females In contrast to single males, single females can be born with children attached to their household. $k = 1$ indicates the presence of a child in a given period. Moreover, if females have children they can be early ($b = 1$) or late childbearers ($b = 2$). If they are early childbearers $k = 1$ during ages $j = \{1, 2, 3\}$, while $k = 1$ during ages $j = \{2, 3, 4\}$ for late childbearers. $\mathbb{I}(g)$ indicates whether mothers have access to informal care. If mothers do not have access to informal care from grandparents, $\mathbb{I}(g = 1) = 0$ and no childcare costs are incurred. The cost for formal care varies with child age $i = \{1, 2, 3\}$. Female human capital evolves endogeneously. Hence, the state space for females is characterized not only by their innate education level x, but also current period human capital h.

To simplify notation, let $\mathbf{s}_f^S \equiv (x, b, g)$ be the vector of exogenous state variables for single females. If $g = 1$, females have access to informal care provided by grandparents and do not pay for formal care. They choose consumption and savings as given by

$$V_f^S(a, h, \mathbf{s}_f^S, j) = \max_{a', l_f} \left\{ u_f^S(c, l_f) + \beta V_f^S(a', h', \mathbf{s}_f^S, j+1) \right\} \tag{9}$$

subject to

$$(1+\tau_c)c + a' = \begin{cases} (wh_x l_f + ra)(1 - t^S(I_f^S, k)) + a(1 + r(1-\tau_a)) & \\ -\omega\psi_i \mathbb{I}(l_f > 0)\mathbb{I}(g = 0) & \text{if } j < J_R \text{ and } k = 1 \\ & \\ (wh_x l_f + ra)(1 - t^S(I_f^S, k)) + a(1 + r(1-\tau_a)) & \text{if } j < J_R \text{ and } k = 0 \\ & \\ a(1 + r(1-\tau_k)) + p^S(x) & \text{if } j \geq J_R \end{cases}$$

and

$$l \geq 0, \quad a' \geq 0 \qquad \text{and} \quad I_f^S = wh_x l_f + ra.$$

Married Couples Both spouses maximize the sum of the individual utilities of both spouses. Consumption is a public good. Similar to female singles, married couples can be of all childbearing types, i.e. $b = \{0, 1, 2\}$. Let $\mathbf{s}^M$ be the state space of exogenous state variables for married couples: $\mathbf{s}^M \equiv (z, x, q, b, g)$. Couples maximize household utility by choosing consumption, labor supply and savings according to

$$V^M(a, h, \mathbf{s}^M, j) = \max_{a', l_f, l_m} \{ u^M(c, l_m, l_f, q) + \beta V^M(a', h', \mathbf{s}^M, j+1) \} \tag{10}$$

subject to

$$(1+\tau_c)c + a' = \begin{cases} (w\omega(z,j)l_m + wh_x l_f + ra)(1 - t^M(I^M, k)) & \\ +a(1 + r(1-\tau_k)) - \omega\psi_i \mathbb{I}(l_f > 0)\mathbb{I}(g = 0) & \text{if } j < J_R \text{ and } k = 1 \\ & \\ (w\omega(z,j)l_m + wh_x l_f + ra)(1 - t^M(I^M, k)) & \\ +a(1 + r(1-\tau_k)) & \text{if } j < J_R \text{ and } k = 0 \\ & \\ a(1 + r(1-\tau_k)) + p^M(x,z) & \text{if } j \geq J_R \end{cases}$$

$$l \geq 0, \quad a' \geq 0 \qquad \text{and} \qquad I^M = w\omega(z,j)l_m + wh_x l_f + ra.$$

4 Calibration

The model is used assess what accounts for the variation in the maternal employment gap across countries. Thus the calibration proceeds in 2 steps. First, the model is calibrated to match data moments from 2004 U.S. data. More specifically, parameter values are assigned to endowments, preferences, technology, childcare costs, and policy parameters related to tax and transfer functions. Next, the parameters related to childcare costs, government policies, and female human capital are adjusted to match data moments for Denmark.

Endowments Individuals start their life at age 25, work for 40 years, retire at age 65, and die with certainty at age 80. One model period corresponds to five years, which implies that every individuals lives for 11 periods. The first model period corresponds to ages 25-29 ($j = 1$) and the begin of retirement corresponds to ages 65-69 ($j = J_R$). Population growth is set to 1.1% per annum, which is the average population growth rate for the U.S. economy between 1960-2000.

Males and females can be one of four education types: high school (hs), some college (sc), college (col), more than college ($col+$). Age-efficiency profiles are constructed by computing average weekly wages using annual wages and salary income divided by the number of weeks worked. The data to compute age-efficiency profiles comes from the March Supplement of the 2000 Current Population Survey (CPS) for the US and the Survey of Income and Living Conditions (SILC) for Denmark. Wages are normalized by the average wages for all males and females of age between 25 and 64. The sample is restrictions follow Katz and Murphy (1992). First, the sample is restricted to the civilian population who work full-time. Excluded are self-employed and unpaid workers. In the US data, workers who make less than half the minimum wage are excluded. Figure x shows the labor productivity profiles for males and females, fitted to the data using second degree polynominals. The fitted values are used to calibrate the labor-efficiency units for males $\omega(z, j)$.

Initial labor-efficiency levels for females in period 1 are pinned down following the same procedures as for males. Table D3 in the Appendix shows the initial efficiency levels for males and females and the corresponding gender wage gap. The initial gender differences are about 10% smaller for both low and high educated females in Denmark. The evolution of female human capital after period 1 follows Attanasio et al. (2008) and is determined by

$$h' = H(x, h, l_f, j) = \exp\left[\ln h + \alpha_j^x \mathbb{I}(l_f > 0) - \delta_x(1 - \mathbb{I}(l_f > 0))\right] \qquad (11)$$

Human capital depreciation is estimated conditional on female education using the Panel Study of Income Dynamics (PSID) data following Mincer and Ofek (1982). Due to the small sample size, female education types are collapsed into two skill groups. δ_1 is set to 2.2% for skilled females with *col* and *col+* education and δ_2 is set to 0.9% for less skilled females with *hs* and *sc* education. The data suggest that the human capital of skilled females depreciates more than twice as fast in a given year if females interrupt their employment. α_j^x is selected in such a way that the wage profile of females who participate in every period has the same shape as the one for males of the same education type x. This implies that α_j^x are effectively set to the values of growth rates for males wages at age j. The same procedure is applied using data from the SILC for Denmark. Table D4 shows the values for all α_j^x. Due to the small sample size of the SILC, I pool data between 2004 and 2010 for Denmark to estimate α_j^x and only distinguish two education types: low educated women (*hs* and *sc*) and high educated women (*col* and *col+*).

Demographics $F(x)$ and $M(x)$ are the stationary distributions of females and males by innate education type. The distributions are estimated using U.S. data from the 2004 Census and are based off of all household heads and spouses belonging to age group 30-39. This age group is selected to capture the distributions of individuals across productivity types during their prime-age working years. In addtition, the fraction of females and males for each education cell is computed using the same sample. 26% of households are single and 74% of households are married. Using the data for married households, the distribution of married households by male and female education, $\Omega(z, x)$, is constructed. Table D5 summarizes the distributions.

The ELFS data for Denmark reveals that the fraction of married couples in the age group 30-30 is only 53.01%. However, the cohabitation rate is in

Denmark is significant. When accounting for cohabitation, the number of couples increases to 73.5%, which is surprisingly close to the distribution of married and singles in the US. I hence keep the distributions of singles and married couples constant across both countries.

Children There are three childbearing types in the model: *childless*, *early childbearer* and *late childbearer*. Every single female and every married couple can be one of the three childbearing types, while single males are always childless. Early childbearers have two children at ages 25-29, 30-34, and 35-39, which corresponds to model periods 1, 2 and 3. In contrast, late childbearers have children during model periods 2, 3 and 4, corresponding to ages 30-34, 35-39, and 40-44. In the U.S. data from the 2004 June Supplement, conditional on having a child married couples have on average two children and these births occur within a relatively short time period, between ages 25-29 for low educated households and 30-34 for high educated households. For single households the fraction of 40-44 year old women who were never married or divorced and never had children determine the measure of women who never have children in the model ($b = 0$). Next, the fraction of females 25 and older with their last birth between the ages of 25 and 29 gives the fraction of early childbearers ($b = 1$). Finally, females 25 and older with their last birth between the ages of 30 and 34 determine the fraction of old childbearers ($b = 2$). The distribution of females by childbearing type is given in Appendix D7 for singles. U.S. Census data is used to calculate the fraction of childless married couples with childless wives aged 40-44.[12] The Census only provides information on the total number of children in the household, not the total number of birth. Thus, the fraction of married couples aged 35-39 with no children in the household are used as a measure for childless married couples. The CPS June Supplement is used to calculate the fraction of couples above 25 who have a child early (age 25-29) or late (30-34) in the lifecycle. Appendix D8 shows the distributions. For Denmark, the measure of childless couples is computed using the EU-SILC.

Out-of-pocket Childcare Costs In the US, out-of-pocket childcare costs paid by parents for full-time formal center-based care vary substantially. While some families may pay 100% of costs, others may have fully subsidized care, while others may have partially subsidized care. Eligibility for child care subsidies is based on state-determined criteria for family income and work requirements and these requirements vary widely by state. The OECD Tax Benefit Model assumes cost and eligibility criteria as observed in Michigan. In 2004, a full-time center-based daycare spot was $7,916 for a child less than three years of age and $6,616 for children in the age group 3-

[12]The fraction of childless married females is too small in the CPS June Supplement.

5 years. Using data from the Survey of Income and Program Participation (SIPP), families spend on average 10% of their income on childcare for children below the age of 6 and around 7.7% for school-age children.

In Denmark, the maximum payable price for public day care is calculated as a proportion of the average expenses for all day care facilities of a given type in the municipality. The proportion that parents pay can be at a maximum of 30%. The OECD Tax Benefit Model assumes public day care center fees before subsidies of DKK 26,700 ($4,463) for children 0-2 years of age and DKK 19,000 ($3,176.21) for children 3-5. This corresponds to 8.4% of the average Danish income in 2004 for children below the age of 3 and to 6% for children age 3-6.

Informal Care Data on the fraction of households that use informal care as their primary care arrangement for children comes from the Survey of Income Program Participation (SIPP) for the US and from the SILC for Denmark. In the US data, more educated mothers spend more on childcare than less educated mothers, which potentially reflects differences in childcare quality. At the same time, more educated mothers have fewer children. These two effects counteract each other in the model and almost cancel out perfectly.[13] I thus abstract from modeling variation of childcare cost by maternal education and variation in the number of children by maternal education type. In 2004, about 24% of US families use informal care (i.e. care provided by grandparents) as their primary care arrangement for children under the age of 6, while the fraction in Denmark is significantly lower with 9.5%.

Capital and Consumption Taxes Consumption tax rates and capital tax rates are provided by McDaniel (2012), who calculates consumption and capital tax rates from NIPA data. The advantage over these tax rates over simple value added tax rates is that they capture excise taxes, and exemptions from value added taxes, among others. The difference between consumption and capital taxes between the US and Denmark are large. While the consumption tax in the US is about 7.5%, the same tax is more than four times as large with 31% in Denmark.

Non-linear Labor Income Taxes The tax functions for singles and married couples without children, $t^S(I, 0)$ and $t^M(I, 0)$, are approximated using the OECD Tax Benefit model, which is comparable to the NBER TaxSim module for the US. The OECD Tax Benefit model calculates labor income taxes according to the statutory labor income tax code, and includes employees' social security contributions and benefits, conditional

[13] Guner et al. (2018) introduce both channels into the model and do not find that it significantly affects their conclusions, even in the cross-section.

on the number of children, child age, and marital status. The OECD model calculates the household net income for any combination of male and female earnings for married couples. It takes standard deductions, such as basic allowances, allowances for children, deduction of social security contributions into account. In addition, since 2004 the tax deductibility of childcare expenses is included. The model abstracts from individual non-standard deductions, such as mortgage payment deductions and deductions for expenses on household helpers.

Using the module, I compute the effective tax rate for a single household with earnings between 0 and 6 times the average wage in the economy using an equally spaced grid of 251 grid points. For married couples, I construct a 2 dimensional grid. One dimension captures the labor income of married women, the other dimensions captures earnings of a married man. The combination of both incomes gives the effective tax rate that the couples faces. Female labor income varies between 0 to 6 times the average wage in the economy and is approximated on 251 grid points. Male earnings vary between 0 and 9 times the average wage in the economy and 151 grid points are used to capture earnings for males. This gives a total of 37,901 combinations of husbands' and wives' labor income. I then use two-dimensional interpolation to find the effective tax rate that a model household faces given the individual earnings faces.

Child-related Transfers The presence of children in the household is indicated by $k = 1$. The functions $t^S(I, 1)$ and $t^M(I, 1)$ approximate the effective tax rates for families with children. The tax grids are computed under the assumption that every household has two children of ages 2 and 4 attached to it. To compute the effective tax rates for households with young children, I take advantage of the special 2004 OECD Taxing Wages module, that implements the tax deductibility of childcare expenses in addition to benefits, such as child tax credits and lone-parent benefits, across countries.

The OECD Tax Benefit model computes the relevant transfers and tax credits conditional on statutory eligibility criteria. For example, childcare expenses in the US are only tax deductible if the mother is working and programs such as the Childcare Development Fund (CCDF) or the Child and Dependent Care Credit (CDCC) are means-tested. Child benefits in Denmark, on the other hand, are universal.

Across both countries, two patterns emerge: First, at all income levels, families with young children face lower effective tax rates. This is mainly due to policies, such as child tax credits that vary with income level, but are only conditional on the presence of a child within the family. Second, non-linearities in the tax code are more pronounced among low-income families, and in particular with young children. This is due to the fact low-income families are usually subject to means-tested programs that include special benefits or tax credits for families with young children.

Childcare cost in Denmark are subsidized. For low-income families fees are subsidized up to 100%. The extent of the subsidy diminishes as income increases. There are also special discount rates for single-parents and for siblings. Childcare fees are not tax deductible and subsidized day-care is available to all households with young children. Local authorities finance nurseries, kindergartens, other day-care institutions and pre-school classes from block grants allocated to them by the State. A so called care guarantee has been introduced by many authorities guaranteeing a subsidized day-care place for the child from when the child is 26 weeks until school age. Parents pay a maximum of 25% of the budgeted gross operating expenditure for day-care services. There is no charge for day-care if the personal income (i.e. gross income net of general social security contributions) is below DKK 156 301. From DKK 156 301 to DKK 159 765 the payment is 5% of the full rate. From that income level, the payment is linearly increased until the full price is paid at a personal income of DKK 485 499.

Childcare services are primarily provided through a market-based system at rates deter-mined by market forces. Rates vary substantially based on region, state, age of child, and type of child care setting. The Child Care and Development Fund (CCDF) is the government child care subsidy program, which provides subsidies to low-income working families to offset the cost of purchasing child care, while maintaining the parental choice afforded by the market system. CCDF is a federal block grant program, providing funds directly to states, territories and tribes to operate a child care subsidy program designed to meet local needs. States have broad flexibility in determining eligibility guidelines (up to a maximum of 85% of state median income, set to 37% in Michigan in 2010), reimbursement rates, and co-payment amounts, as well as the scope and quality of services. In Michigan, subsidies provided through the CCDF vary with family income, size of the family and age of the child in care. The (non-refundable) Child and Dependent Care Credit (CDCC) provides assistance to working taxpayers. A maximum of 35% of childcare costs (after CCDF and subject to a ceiling) can be claimed. Child care fees are tax deductible through the CDCC. The tax credit is non-refundable, so families that do not pay taxes do not benefit from the credit.

Preferences Following Kaygusuz (2010), Guner et al. (2012) and Guner et al. (2018), χ, the elasticity of labor supply, is set to 0.4. This is consistent with survey estimates (see Blundell and MaCurdy (1999), Domeij and Flodén (2006), and Keane (2011) for a discussion of these estimates). Given χ, I select the weight on the disutility of labor, $\phi = 5.71$, to match average hours worked per worker in the data, which is 44%. Average hours worked are calculated using a sample of all employed and unemployed individuals between the age of 25 to 64 in the CPS data. I assume that individuals work at most 80 hours per week. The discount factor β is set to 0.973 annually, such that the capital-to-output ratio is 2.93, which is consistent with US data.

The utility cost from joint work for married couples is calibrated using the method de-veloped in Kaygusuz (2010), which was later applied in Guner et al. (2012), Guner et al. (2018) and Bick and Fuchs-Schündeln (2018). At the beginning of their life-cycle, married couples draw a utility cost parameter conditional on the husband's initial education type z. The utility cost parameter q_z is drawn from a flexible gamma distribution with shape parameter k_z and scale parameter θ_z and $\Gamma(\cdot)$ is the Gamma function :

$$q \sim p(q|z) \equiv q^{k_z - 1} \frac{\exp(-q/\theta_z)}{\Gamma(k_z)\theta_z^{k_z}}.$$

z, k_z and θ_z are selected in such a way that the employment rates of a married female with education type x married to a male of education type z is matched as closely as possible in the US data. This implies that for each couple of type (z, x), there is a q_z^* that makes the a married women indifferent between working and not working. This optimal q_z^* will be higher for women with higher education who can earn higher returns to market work. Hence, married women with higher education will have a higher employment rate conditional on husband's education, a pattern that is consistent with the data. Appendix D11 summarizes the parameters governing the distributions of utility costs.

Table 1: Employment rates of married females, age 25-54

	USA			
m/f	hs	sc	col	col+
hs	48.7	66.5	71.2	78.8
sc	52.6	72.8	77.4	85.1
col	54.4	70.8	75.7	84.2
col+	52.6	67.9	70.8	75.6
Total	50.4	70.7	74.2	78.3

Using 2004 CPS data, I calculate the employment-to-population ratio based on individuals in the civilian labor force (i.e. excluding armed forces). Table 1 displays the resulting distribu-tions. The employment rate for married females aged 25-54 is 72.3%, ranging from 50.4% for the lowest education type to 78.3% for the highest education type.

Technology The capital share α of the Cobb -Douglas production function and the capital depreciation rate δ_a are calibrated using a notion of capital that includes fixed private capital, land, inventories, and consumer durables. The capital-to-output ratio for the period 1960-2000 is on average 2.93 annually. The capital share is set to 0.343 and the annual depreciation rate to 0.055.

Summary Table 2 summarizes the parameter choices for the benchmark economy. While the previous sections laid out as detailed as possible which parameters where chosen from exogenous estimates, the following parameters were chosen to match specific targets. First, the discount factor β is chosen to match the capital-to-ouput ratio in the model. Next disutility of market work, γ, is chosen to match average hours worked in the model. Finally, the utility cost from joint work for married couples is $p(q|z)$ is chosen such that the employment rates for married females conditional on their own education type and their husbands' education type is matched.

Table 2: Calibration of Benchmark Economy

Parameter		Value US	Adj. for DK	Target
		A. Preferences		
Discount factor	β	0.973	–	Capital-to-output ratio
Intertemporal elasticity	γ	0.400	–	Literature estimates $[0.2, 0.4]$
Disutility of work	ϕ	5.710	–	Average hours worked
Joint utility cost	$p(q\|z)$		–	Female LFP by education
		B. Technology		
Capital share	α	0.342	–	Guner et al. (2012)
Depreciation rate	δ_k	0.055	–	Guner et al. (2012)
		C. Female Human Capital		
Depreciation fem COL+	δ_1	0.020	–	PSID data
Depreciation fem <COL	δ_2	0.009	–	PSID data
Growth female HC	α_j^x			Guner et al. (2012)
		D. Childcare Costs		
Childcare cost young	ψ_1	0.100	0.084	Childcare exp. for 0-5 yr olds
Childcare cost old	ψ_2	0.077	0.060	Childcare exp. for 6-15 yr olds
		E. Government		
Capital income tax	τ_k	0.236	0.408	McDaniel (2012)
Consumption tax	τ_c	0.075	0.310	McDaniel (2012)
Income tax schedule	$t^M(I,k)$			OECD Tax Benefit Model
	$t^S(I,k)$			OECD Tax Benefit Model
Old-Age-Benefits	$b^M(x,z)$			CPS and SILC data (see App.)
	$b^S(x)$			CPS and SILC data (see App.)
	$b^S(x)$			CPS and SILC data (see App.)

5 Benchmark Economy

This section compares the results of the benchmark economy to the data. BThe model is calibrated to the US economy. As shown in panel A and B in table 2, preference and technology parameters are set to the same values for the Danish economy. In addition, the parameters governing human capital depreciation for low and high skilled females, δ_1 and δ_2, are estimated from the PSID data. These depreciation parameters are not adjusted in the Danish economy due to a lack of panel data for Denmark in the SILC.

The following key parameters of the model are adjusted for the Danish economy. First, the growth rate of female human capital, α_j^x, is adjusted. Due to data limitations in the SILC, only two education groups can be distinguished for Denmark: high skilled (*col* and *col+*) and low skilled (*hs* and *sc*) women. Next, the out-of-pocket childcare costs (Panel D) are adjusted to levels that are observed in the data and correspond to the assumptions made by the OECD in the Tax Benefit simulation model. Finally, all functions and parameters that govern taxes households pay to the government and the benefits they receive from the government are modified to match the Danish tax system: capital taxes, consumption taxes, labor income tax functions and old-age benefits. Labor income taxes functions differ for married and single household and whether they have children and not. Old-age benefits are conditional on marital status and education.

	USA		Denmark	
	Data	Model	Data	Model
K/Y	2.93	2.94	3.20	3.06
Avg. hours	0.44	0.43	0.35	0.30
LFP married	72.30	73.10	79.80	74.20
LFP mothers	59.10	59.00	83.70	78.90
LFP_{gap}	13.20	14.10	−3.90	−4.70

Table 3: Results for the Benchmark Economy

At the aggregate level, the model matches the capital-to-output ratio and the average hours worked in the US economy quite well, which are moments targeted by the calibration. Employment rates of all married women aged 25-54 is 73.1% in the model and 72.3% in the data, a moment targeted by calibrating the joint utility cost for married couples. The model almost perfectly matches the maternal employment rate, which is 59% in the model and 59.1% in the data. The resulting maternal employment gap for the US is 14.1% in the model compared to 13.2% in the data.

It is worth noting that maternal employment rate and the resulting participationg gap is not a targeted moment. In Guner et al. (2012) and Guner et al. (2018), the time cost for rearing children is chosen such that the model matches the maternal employment gap in the data. In contrast, the model economy presented here abstracts from time costs for females with children. Thus, the difference between employment rates of women with and without children is only driven by differences in the household budget constraint.

The key feature to generate the employment gap endogenously is to introduce the actual tax and transfer system, including child-related transfers and all social benefits. This notion is supported by the fact that the time cost in Guner et al. (2018) is 85% lower than in the simpler model version in Guner et al. (2012). The key difference between both studies is that the later model version specifically models means-tested programs in the US (such as TANF, CCDF and CCDC) that give additional child tax credits to low income families or allow low-income families to deduct childcare expenses from their taxable income. These policies are absent from Guner et al. (2012), and the model has a hard time matching the maternal employment gap without exogeneously imposing a fixed time cost. As pointed out by Bick and Fuchs-Schündeln (2018), capturing the full non-linearities introduced by these policies is crucial in matching the employment rate of married women. The benchmark results demonstrate that this point can be extended to married women with and without pre-school children.

For Denmark, the model matches the capital-to-output ratio and average hours worked quite closely, even though these moments are not targeted. Average hours are about 14% lower in the model that in the data. Similarly, the employment rates of married women in general and married women with small children are both about 5% lower than in the data. This finding is consistent with Bick and Fuchs-Schündeln (2018). They note that Denmark is an outlier in their sample of OECD countries. They attribute the fact that the model does not perform as well for Denmark to the fact that it features the highest average tax rate in Scandinavia, thereby providing a huge disincentive to work. The model matches the maternal employment gap quite closely, it is -3.9% in the data and -4.7% in the model. The negative gap is mainly due to the underlying age composition of both groups. The statistics for married women with young children is comprised of younger women who have children either between the ages 25-29 or ages 30-34. Those periods are also periods during which the growth in human capital is the largest. Hence, in countries with very generous policies that alleviate the cost of child-rearing for women, the labor force employment of mothers tends to be very high.

6 Decomposition

To identify the model component driving a wedge between the employment costs for married women with and without children, I pursue the following strategy: First, all model features that affect households, and in particular women, with and without children differently, are removed. The three components are the cost of childcare $\psi = 0$, access to informal care $g = 0$, and child-related transfers, $s_k = 0$. In the quantitative model, this implies that the tax functions $t^M(I, 0)$ and $t^S(I, 0)$ are applied to families with young children. As a next step, the same three model features are turned on successively to understand their impact on maternal employment rates. This strategy gives rise to four economies:

(1) No child-related differences: $\{\psi, g, s_k\} = 0$
There are no model differences between households with and without children, which implies that the budget constraint for married couples with and without children is identical. The same holds for the budget constraint of single households with and without children.

(2) Childcare-cost-economy: $\{\psi > 0, g = 0, s_k = 0\}$
Mothers who work have to purchase formal childcare. No working mother has access to informal care and no child-related transfers are paid.

(3) Informal-care-economy: $\{\psi > 0, g > 0, s_k = 0\}$
In this economy, working mothers have to pay out-of-pocket childcare costs, but a fraction of them has access to informal care.

(4) Benchmark economy: $\{\psi > 0, g > 0, s_k > 0\}$
This calibration is identical to the benchmark economy, in which households receive child-related transfers, a fraction of families has access to informal childcare, and working mothers without access to informal care face out-of-pocket childcare expenses.

Table 4 summarizes the results from the decomposition exercise and reports the maternal employment gap and the change in the employment gap across model economies. Relative to the no child-related differences economy, in which households face no costs of having children, introducing out-of-pocket childcare costs for working mothers, $\psi > 0$, increases the employment gap. The effect of out-of-pocket childcare costs is significantly larger in the US where childcare fees are about 25% higher relative to Denmark.

The increase in the maternal employment gap due to out-of-pocket childcare costs in (2) is largely alleviated by allowing a fraction of households in the economy to have access to informal care, $g > 0$, as in model economy

Table 4: Decomposition

	Data	(2) $\psi > 0$	(3) $g > 0$	(4) $s_k > 0$
USA				
LFP_{gap}	13.20	4.30	−1.70	14.10
$\%\Delta\ \text{LFP}_{\text{gap}}$		10.90	−6.00	15.80
Denmark				
LFP_{gap}	−3.70	2.30	0.50	−4.60
$\%\ \Delta\ \text{LFP}_{\text{gap}}$		2.90	−1.80	−5.10

(3). Informal care mutes the effect of out-of-pocket childcare costs for households with access to it. The effect of informal care on maternal employment is larger in the US since a greater fraction of households in the US rely on informal care as their primary care arrangement. It is crucial to note, however, that the maternal employment gap cannot be matched, even qualitatively, if only out-of-pocket childcare costs and informal care arrangements are considered. The economy predicts a negative maternal employment gap for the US and a positive gap for Denmark.

Model version (4), the benchmark economy, taxes households with young children according to the statutory labor income tax code, i.e. it accounts for child tax credits and the tax deductibility of childcare costs: $s_k > 0$. The model now generates a maternal employment gap that is positive in the US and negative in Denmark. The aggregate change masks even larger impacts of the differential tax treatments for different household types. Table 5 decomposes the changes in employment rates between economy (3) and (4) by for married couples of different educational composition. It shows that the impact of child-related transfers, s_k, is particularly strong on married women with less than college education. In addition, the impact is even stronger when the spouse is less than college educated as well. These households are likely to earn less than the average income in the economy, which implies that they are mostly affected by the means-tested US policy programs designed to subsidize families with children. These programs introduce large reductions in the effective tax rates for households with children that earn up to the average wage in the economy.

In Denmark, on the other hand, the impact on employment rates of females with less than college education is the opposite: removing child-related transfers substantially increases the employment gap for less than college educated females. Here, the removal of childcare subsidies that reduce out-of-pocket childcare fees for low-income families make it optimal for low earning couples to specialize. For higher income households, the removal of child-related transfers slightly reduces the employment gap. However, the effect is much smaller than on low income households.

In sum, the decomposition by household types shows that increase in the in the maternal employment gap in the US and the decrease of the gap in Denmark due to child-related transfers are driven by less than college educated households, which are more likely to be affected by family transfers and childcare subsidies.

Table 5: Change in employment Rates by Education Group

	USA				Denmark			
	LFP(Bench) - LFP($s_k = 0$)				LFP(Bench) - LFP($s_k = 0$)			
m/f	HS	SC	COL	COL+	HS	SC	COL	COL+
HS	−18.0	−15.7	−3.9	0.1	3.9	16.1	−10.5	−1.4
SC	−5.3	−7.3	−2.3	−1.4	0.8	20.7	−2.0	−0.5
COL	−8.7	−1.5	0.7	0.7	1.5	−4.1	−1.3	−1.9
COL+	−0.6	0.9	−0.3	−7.6	−6.8	−0.3	−0.9	−0.1

6.1 The Impact of Individual Policy Programs

This section decomposes the impact of child-related transfers, s_k, into individual government programs designed to support families with children. We can broadly distinguish two types of program: (a) family benefits and (b) childcare subsidies.

Table 6 recomputes the benchmark economy while shutting down three of the largest programs that subsidize families with children: (1) higher tax breaks and the extended income brackets that determine eligibility for the Earned Income Tax Credit (EITC), (2) the Child Tax Credit (CTC), and (3) childcare subsidies through the Child Care and Development Fund (CCDF) and the Child Care and Dependent Care Credit (CCDC). When breaking down the aggregate effect on maternal employment into different policies, we can see that the removal of EITC is the only program that reduces the employment gap between married women with and without children. Note that this experiment does not correspond to a removal of the EITC program, but simply the extended tax credits for families with children relative to childless households. The phase-out range is thus moved to the left of the income distribution and removes the strong disincentive of labor supply from the phase-out range for some families (Meyer; 2002). A large fraction of households with children are now ineligible for EITC payments conditional on the husband's earnings and the incentives for females to drop out of the labor force to qualify for EITC benefits are reduced.

Table 6: Child-related Transfers in the US by Policy Program

	USA				
	Data	Benchmark	(1) no addEITC	(2) no CTC	(3) no CC subsidies
$LFP_{married}$	72.3	73.10	78.7	71.4	72.6
$LFP_{mothers}$	59.1	59.0	69.9	56.0	57.8
LFP_{gap}	13.2	14.1	9.0	15.4	14.8
Δ			−5.1	1.3	0.7

Notes: (1) no addEITC removes the extended tax credits for families with children of the EITC program. All families face the tax credits that families without children face in a given income bracket. (2) removes the Child Tax Credit. (3) removes all childcare subsidies coming through either the CCDF or CCDC.

Removing either the Child Tax Credit or childcare subsidies coming through the CCDC or CCDF increases the employment gap. However, the individual effect of these programs is rather small compared to the EITC. Table E12 shows that removing the childcare subsidies impacts less educated mothers more and that the aggregate effect masks large heterogeneity in the cross-section. Notice that the aggregate effect of these programs is larger than when considering each program in isolation. The combined effect of these programs introduces much steeper phase-in and phase-out ranges than each program considered by itself. Hence, studies that only consider one of these programs might understate the effect of these policies.

In Denmark, removing the family benefit program (FB) and the childcare subsidy program CCD both increase the maternal employment gap. The family benefit program is a lump-sum transfer and the small variations in the employment rates are driven by general equilibrium effects. It is worth noting that the removal of this lump-sum transfer program increases the government tax revenue by 16%, due to the reduction in transfer payments and the slight increase in average hours worked for married men and women. This is driven by the negative income effect for families with children in the absence of the program. Table E13 summarizes the effect for spouses of different education types.

6.2 Policy Experiment

Is the finding that child-related transfers decrease the employment gap in Denmark, but increase the gap in the US driven by differences in the unit of taxation? To explore this angle further, consider a very simple policy

Table 7: Child-related Transfers in Denmark by Policy Program

	Denmark			
			(1)	(2)
	Data	Benchmark	no FB	no CCD
$LFP_{married}$	79.8	73.6	74.2	73.6
$LFP_{mothers}$	83.7	77.8	78.9	77.8
LFP_{gap}	−3.9	−4.7	−4.2	0.5
Δ			0.5	3.2

Notes: (1) FB stands for Family Benefits, a lump-sum transfer that every family with children receives. (2) CCD is a means-tested childcare subsidy program for low-income families.

experiment: Keep the US tax rates for families without children fixed as in the benchmark economy. Simulate the effective tax rates for families with children by capturing the difference between the effective tax rates for households with and without children in Denmark face. For each income combination, this tax rate difference captures the amount of child-related transfers that Danish households with children receive.

Table 8 summarizes the effect of an introduction of Danish child-related transfers into the US economy. The design of Danish transfers closes the employment gap by 2/3 from 14.1% to 4.9%. This suggests that most the specialization of US households with children is mainly driven by the shape of the benefit function and not the fact households are taxed jointly instead of separately. Notice, however, that the reduction of the employment gap is a costly policy experiment in the sense that it significantly reduces government tax revenue. The reduction in the employment gap in this experiment is mainly driven by low income households that do not generate enough additional tax revenue from labor income to finance the more generous transfers.

Table 8: US economy with Danish child-related transfers

	USA		
	Data	Benchmark	DK transfers
$LFP_{married}$	72.30	73.10	77.30
$LFP_{mothers}$	59.10	59.00	72.40
LFP_{gap}	13.20	14.10	4.90

7 Cross-country Evidence

To provide more systematic evidence for the fact that child-related transfers are key to explain-ing cross-country variation, the decomposition exercise from section 6 is repeated for a sample of 13 European countries. The exercise is similar in spirit to macroeconomic cross-country studies by Prescott (2004) and, more recently, Bick and Fuchs-Schündeln (2018). It is worth noting that in contrast to these previous studies, this paper does not only consider a static decision problem, but considers the joint household labor supply decision problem in a dynamic life-cycle model, in which female human capital evolves endogenously. Second, while Bick and Fuchs-Schündeln (2018) re-calibrate the distribution of joint employment costs q for each country, all the preference parameters, including q, are left unchanged in this exercise.

Table 9 and table 10 summarize the results. For the majority of countries in Britain, Western and Northern Europe, the key result holds: the model cannot generate the partici-pation gap as observed in the data without accounting for child-related transfers $s_k > 0$. The introduction of child-related transfers seems to be crucial for explaining the employment gaps in Western European countries. The model for Germany, however, can only explain one third of the gap observed in the data. The model significantly overpredicts the employment gap for Ireland, while the employment gap in the UK is very similar across panel B and C. This implies that introducing child-related transfers does not improve the explanatory power of the model for the UK significantly. The same is true for the Finish model economy.

Finally, the model cannot explain the maternal employment gap in Southern European countries, such as Greece, Italy, Portugal and Spain. This is not surprising, given that child-related transfers in these countries do not introduce significant differences in the participation tax rates for families with and without children. Nollenberger and Rodríguez-Planas (2015) point out that countries like Spain show low level of social assistance for families with children relative to other European economies. In addition, these economies are characterized by institutional characteristics, such as the absence of part-time schemes, a large fraction of service sector jobs with a split work schedule and other labor market rigidities that make it harder for mothers to enter the labor market (Adsera; 2004).

	Western Europe					Britain	
	AT	FR	GE	LX	NL	IR	UK
A. Data							
$LFP_{married}$	79.9	78.9	79.1	78.4	80.4	80.0	82.8
$LFP_{mothers}$	62.3	64.7	52.0	64.1	72.9	58.2	59.9
LFP_{gap}	17.5	14.2	27.1	14.3	7.5	21.9	22.9
B. Without Child-related Transfers: $s_k^i = 0$							
LFP_{gap}	−8.8	1.6	−4.3	−5.7	−7.3	−1.2	18.7
C. With Child-related Transfers: $s_k^i > 0$							
LFP_{gap}	10.7	18.9	8.0	8.2	7.4	42.1	19.2

Table 9: Cross-country Evidence 1/2

	Northern Europe		Southern Europe			
	FI	SW	GR	IT	PT	SP
A. Data						
$LFP_{married}$	81.8	81.3	62.2	63.8	73.5	70.3
$LFP_{mothers}$	62.7	80.0	54.9	53.7	75.3	58.0
LFP_{gap}	19.1	1.3	7.3	10.1	−1.8	12.3
B. Without Child-related Transfers: $s_k^i = 0$						
LFP_{gap}	16.7	−3.7	−6.5	1.3	−2.7	1.7
C. With Child-related Transfers: $s_k^i > 0$						
LFP_{gap}	17.6	4.5	−5.0	−0.3	−0.7	0.9

Table 10: Cross-country Evidence 2/2

8 Conclusion

Child-related transfers programs that are characterized by phase-in and phase-out ranges introduce strong incentives and disincentives for families with children to move from being a one-earner to a two-earner couple. In contrast, lump-sum programs do not affect labor supply decisions at the margin. This paper uses a lifecycle model in which spouses with children make joint labor supply decisions to show that the varying design of child-related transfer programs can account for a large fraction of maternal employment rate differences across countries.

Two interesting questions emerge from the exercises in this paper. While previous research has documented that the optimal design of child-related transfer programs for single headed households should include a phase-out range, it is not clear that this notion can easily be extended to married couples. In addition, given data limitations, the paper abstracts from parental leave policies. Given that leave policies have implications for fertility and short-term labor supply effects have been document, future studies should analyze family labor supply in the context of both child-related transfers and parental leave policies.

References

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

Attanasio, O., Levell, P., Low, H. and Sánchez-Marcos, V. (2018). Aggregating Elasticities: Intensive and Extensive Margins of Women's Labour Supply, *Econometrica* (forthcoming).

Attanasio, O., Low, H. and Sánchez-Marcos, V. (2008). Explaining Changes in Female Labor Supply in a Life-Cycle Model, *American Economic Review* **98**(4): 1517–1552.

Azmat, G. and Gonazález, L. (2010). Targeting Fertility and Female Participation Through the Income Tax, *Labour Economics* **17**(3): 487–502.

Baker, M., Gruber, J. and Milligan, K. (2008). Universal Child Care, Maternal Labor Supply, and Family Well-Being, *Journal of Political Economy* **116**(4): 709–745.

Bar, M. and Leukhina, O. (2009). To Work or Not to Work: Did Tax Reforms Affect Labor Force Participation of Married Couples?, *The B. E. Journal of Macroeconomics* **9**(1).

Bénabou, R. (2002). Tax and Education Policy in a Heterogeneous-Agent Economy: What Levels of Redistribution Maximize Growth and Efficiency?, *Econometrica* **70**(2): 481–517.

Bettendorf, L., Jongen, E. and Muller, P. (2015). Childcare Subsidies and Labour Supply - Evidence from a large Dutch Reform, *Labour Economics* **36**(C): 112–123.

Bick, A. (2015). The Quantitative Role of Child Care for Female Labor Force Participation and Fertility, *Journal of the European Economic Association* **14**(3): 1–30.

Bick, A. and Fuchs-Schündeln, N. (2018). Taxation and Labor Supply of Married Couples across Countries: A Macroeconomic Analysis, *Review of Economic Studies* **85**(3): 1543–1576.

Blau, D. and Currie, J. (2006). Pre-School, Day Care, and After-School Care: Who's Minding the Kids?, *Handbook of the Economics of Education* .

Blundell, R. and MaCurdy, T. (1999). Labor Supply: A Review of Alternative Approaches, *Handbook of Labor Economics* **3A**: 1559–1695.

Brewer, M., Saez, E. and Shephard, A. (2010). *Means-testing and Tax Rates on Earnings*, Oxford University Press.

Browning, M., Chiappori, P.-A. and Weiss, Y. (2014). *Economics of the Family*, Cambridge University Press.

Cascio, E. U., Haider, S. J. and Nielsen, H. S. (2015). The Effectiveness of Policies that Promote Labor Force Participation of Women With Children: A Collection of National Studies, *Labour Economics* **36**: 64–71.

Chade, H. and Ventura, G. (2002). Taxes and Marriage: A Two-Sided Search Analysis, *International Economic Review* **43**(3): 955–986.

Chakraborty, I., Holter, H. A. and Stepanchuk, S. (2015). Marriage Stability, Taxation and Aggregate Labor Supply in the U.S. vs. Europe, *Journal of Monetary Economics* **72**(C): 1–20.

Doepke, M. and Kindermann, F. (2019). Bargaining Over Babies: Theory, Evidence, and Policy Implications. forthcoming in *American Economic Review*.

Domeij, D. and Flodén, M. (2006). The Labor-Supply Elasticity and Borrowing Constraints: Why Estimates are Biased, *Review of Economic Dynamics* **9**(2): 242–262.

Domeij, D. and Klein, P. (2013). Should Day Care be Subsidized?, *Review of Economic Studies* **80**(1): 568–595.

Duval-Hernández, R., Fang, L. and Ngai, R. (2018). Taxes and Market Hours - the Role of Gender and Skill. mimeo.

Eissa, N. and Hoynes, H. (2006). The Hours of Work Response of Married Couples: Taxes and the Earned Income Tax Credit, *in* J. Agell and P. B. Sorensen (eds), *Tax Policy and Labor Market Performance*, Cambridge and London: MIT Press.

Eissa, N. and Hoynes, H. W. (2004). Taxes and the Labor Market Participation of Married Couples: The Earned Income Tax Credit, *Journal of Public Economics* **88**: 1931–1958.

Eissa, N. and Liebman, J. B. (1996). Labor Supply Response to the Earned Income Tax Credit, **111**(2): 605–37.

Erosa, A., Fuester, L. and Kambourov, G. (2012). Labor Supply and Government Programs: A Cross-Country Analysis, *Journal of Monetary Economics* **59**: 84–107.

Erosa, A., Fuster, L. and Restuccia, D. (2010). A General Equilibrium Analysis of Parental Leave Policies, *Review of Economic Dynamics* **13**(4): 742–758.

Fernández, R. (2007). Women, Work, and Culture, *Journal of European Economic Association* **5**(2-3): 305–332.

Fernández, R. (2013). Cultural Change as Learning: The Evolution of Female Labor Force Participation over a Century, *American Economic Review* **103**(1): 472–500.

Fogli, A. and Veldkamp, L. (2011). Nature or Nuture? Learning and the Geography of Female Labor Force Participation, *Econometrica* **79**(4): 1103–1138.

Geyer, J., Haan, P. and Wrohlich, K. (2015). The Effects of Family Policy on Maternal Labor Supply: Combining Evidence from a Structural Model and a Quasi-experimental Approach, *Labour Economics* **36**(C): 84–98.

Givord, P. and Marbot, C. (2015). Does the Cost of Child Care affect Female Labor Market Participation? An Evaluation of a French Reform of Childcare Subsidies, *Labour Economics* **36**(C): 99–111.

Greenwood, J., Guner, N. and Knowles, J. (2003). More on Marriage, Fertility, and the Distribution of Income, *International Economic Review* **44**(3): 827–862.

Grogger, J. (2003). The Effects of Time Limits, the EITC, and Other Policy Changes on Welfare Use, Work, and Income among Female-Headed Families, **85**(2): 394–408.

Guldi, M. and Schmidt, L. (2017). Taxes, Transfers, and Women's Labor Supply in the United States, *in* S. L. Averett, L. M. Argys and S. D. Hoffman (eds), *The Oxford Handbook of Women and the Economy*, Oxford University Press.

Guner, N., Kaygusuz, R. and Ventura, G. (2012). Taxation and Household Labor Supply, *Review of Economic Studies* **79**(3): 1113–1149.

Guner, N., Kaygusuz, R. and Ventura, G. (2018). Child-Related Transfers, Household Labor Supply and Welfare. Conditionally accepted at *Review of Economic Studies*.

Havnes, T. and Mogstad, M. (2011). Money for Nothing? Universal Child Care and Maternal Employment, *Journal of Public Economics* **95**(11): 1455–1465.

Heathcote, J., Storesletten, K. and Violante, G. L. (2010). The Macroeconomic Implications of Rising Wage Inequality in the United States, *Journal of Political Economy* **118**(4): 681–722.

Heckman, J. (1974). Effects of Child-Care Programs on Women's Work Effort, *Journal of Political Economy* **82**(2): 153–161.

Ho, C. and Pavoni, N. (2019). Efficient Child Care Subsidies. forthcoming in *American Economic Review*.

Holter, H. A., Krüger, D. and Stepanchuk, S. (2019). How Do Tax Progressivity and Household Heterogeneity Affect Laffer Curves? Forthcoming in *Quantitative Economics*.

Hong, J. and Ríos-Rull, J. V. (2007). Social Security, Life Insurance and Annuities for Families, *Journal of Monetary Economics* **54**(1): 118–140.

Hotz, V. J. and Miller, R. A. (1988). An Empirical Analysis of Life Cuycle Fertility and Female Labor Supply, *Econometrica* **56**(1): 91–118.

Katz, L. F. and Murphy, K. M. (1992). Changes in Relative Wages, 1963-1987: Supply and Demand Factors, *Quarterly Journal of Economics* **107**(1): 35–78.

Kaygusuz, R. (2010). Taxes and Female Labor Supply, *Review of Economic Dynamics* **13**(4): 725–741.

Keane, M. P. (2011). Labor Supply and Taxes: A Survey, *Journal of Economic Literature* **49**(4): 961–1075.

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

McDaniel, C. (2012). Average Tax Rates on Consumption, Investment, Labor and Capital in the OECD 1950- 2003. working paper.

Meyer, B. D. (2002). Labor Supply at the Extensive and Intensive Margins: The EITC, Welfare, and Hours Worked, *American Economic Review* **92**(2): 373–379.

Meyer, B. D. and Rosenbaum, D. T. (2003). Welfare, the Earned Income Tax Credit, and the Labor Supply of Single Mothers, *Quarterly Journal of Economics* **116**(3): 1063–1114.

Mincer, J. and Ofek, H. (1982). Interrupted Work Careers: Depreciation and Restoration of Human Capital, *Journal of Human Resources* **17**(1): 3–24.

Nollenberger, N. and Rodríguez-Planas, N. (2015). Full-time Universal Childcare in a Context of Low Maternal Employment: Quasi-experimental Evidence from Spain, *Labour Economics* **36**(C): 124–136.

OECD (2012). Closing the Gender Wage Gap: Act Now.
URL: *http://dx.doi.org/10.1787/9789264179370-en*

Prescott, E. C. (2004). Why Do Americans Work So Much More Than Europeans?, *Federal Reserve Bank of Minneapolis Quarterly Review* **28**(1): 2–13.

Raute, A. (2019). Can Financial Incentives Reduce the Baby Gap? Evidence from a Reform in Maternity Leave Benefits, *Journal of Public Economics* **169**: 203–222.

Rogerson, R. (2007). Taxation and Market Work: Is Scandinavia an Outlier?, *Economic Theory* **32**(1): 59–85.

Sánchez-Mangas, R. and Sánchez-Marcos, V. (2008). Balancing Family and Work: The Effect of Cash Benefits for Working Mothers, *Labour Economics* **15**(6): 1127–1142.

Schøne, P. (2004). Labour Supply Effects of a Cash-for-care Subsidy, *Journal of Population Economics* **17**(4): 703–727.

Appendix (not for publication)

A Child-related Transfers in Denmark and the US

Denmark subsidizes families with children lump-sum transfers for every child below the age of 17. Lump-sum transfers are higher for younger children. In 2004, the Danish government paid USD 2,204 (DKK 13,204 or 4.2% of mean labor income) to every child between the age of 0-2, USD 1,992 (DKK 11,932 or 3.8% of mean labor income) for children aged 3-6 and USD 1,567 (DKK 9,388 or 3.0% of mean labor income) for children 7-17 years of age. Childcare expenses for households that earned below USD 20,852 (DKK 124,901 or 39.5% of mean labor income) received a 100% subsidy. The subsidy linearly declines with income and households earning USD 64,675 or more (DKK 387,401 or 122% of mean labor income) are not eligible for childcare subsidies. However, out-of-pocket expenses are capped at 30% of the average operating expenses for daycare by law.

The tax and transfer system in the US used to subsidize families with children is far more complex compared to the Danish system. The key differences between the two systems are that the US does not pay any lump-sum transfers and all US programs are means-tested. Family benefits are paid through the Child Tax Credit (CTC). The tax credit is non-refundable, meaning that poor households that do not pay sufficient taxes do not benefit from this policy. In addition, families are subsidized through the Earned Income Tax Credit (EITC). Both tax credits are initially increasing in income (phase-in range), pay the maximum benefit for a certain income bracket (flat range) and eventually decline with income (phase-out range). The Child Tax Credit pays a maximum benefit of USD 1,000 per child. In 2004, the CTC phases in for household incomes of USD 10,750 and above (0.29% of mean labor income). For married couples in 2004, the maximum benefit is paid up to an income of USD 110,000 (300% of mean labor income). In 2004, the EITC phase-in range was between USD 0 and USD 10,750 for married couples with 2 children, which corresponds to 0.29% of mean labor income. The maximum benefit of USD 4,300 was paid out until family income reaches the maximum threshold of USD 15,040 (or 40.3% of mean labor income), and phases out thereafter.

B Out-of-pocket Childcare Costs

Childcare fees are defined as the unsubsidized rates for purchasing childcare conditional on child age. The concept of out-of-pocket childcare costs that parents incur fundamentally differ between the US and Denmark. In Denmark, daycare rates are based on the actual operating costs per child

Table A1: Child-related Transfers: USA and Denmark

A. Child Benefits	
USA	Denmark
1. *Child Tax Credit (CTC)* - non-refundable - means-tested 2. *Earned Income Tax Credit* (EITC) - refundable - means-tested - conditional on employment status	*Family Benefit* - lump-sum - non-taxable
B. Childcare Subsidies	
USA	Denmark
1. *Child and Dependent Care Credit* (CDCC) - conditional on employment status - means-tested 2. *Childcare Development Fund* (CCDF) - conditional on employment status - means-tested	*Childcare Subsidies* (CCD) - means-tested

Notes: Both countries additionally subsidize poor families through social assistance and housing benefits. These subsidies are means-tested and conditional on the number of children in the household. They pay higher subsidies to households with children relative to households without children conditional on household income. The US

and the Danish government caps the maximum payable price for parents at 30% of operating costs[14]. The OECD reports the average cost for providing full-time daycare to a child between the age of 0 to 5 was DKK 40,049 (USD 6,686). This corresponds to 12.7% of the average Danish labor income in 2004. In contrast, childcare in the US is not provided by the public sector, but primarily through a private market in which rates are determined by supply and demand. In the US, full-time center-based childcare was USD 7,916 for 0-2 year-olds and USD 6,616 for 3-5 year-olds, which corresponds to 21.5% and 18.0% of the average US labor income in 2004.

While the rates for full-time center based childcare are striking between both countries, it is worth noting that differences in the average expenses per household for childcare are less extreme. This could be due to the fact

[14]The government pays the difference in operating costs and fees paid by parents directly to childcare providers. Thus, the costs presented below are based on the average fees that parents pay

that more children in the US spent fewer hours in center-based care (less than full-time) and more households use informal care. The table below summarizes the average expenditure for childcare in 2004 for the US and Denmark for different age groups of children.

Table B2: Childcare Fees

	US		Denmark	
	US$	% of AW	US$	% of AW
0-2 years	3,674	0.100	4,457	0.084
3-5 years	2,829	0.077	3,173	0.060

Notes: Data for the US average expenditures for childcare per household comes from the 2004 Survey of Income and Program Participation (SIPP) and the average childcare expenditures for Denmark are documented by the OECD Wages and Benefits module.

C Stationary Equilibrium

In the stationary equilibrium of this economy, all factor markets clear. The aggregate state of the economy consists of the stationary distributions of households across different household types, over assets and human capital levels. $\chi^S_{m,j}(a, \mathbf{s}^S_m)$ is the distribution of single males across assets and exogenous states in period j. Similarly, $\chi^S_{f,j}(a, h, \mathbf{s}^S_f)$ is the distribution of single females and $\chi^M_j(a, h, \mathbf{s}^M)$ for married couples, both across assets, female human capital levels and exogenous states. The state space is defined as $\mathbf{s}^M \equiv (z, x, q, b, g)$. While assets, a, and female human capital levels, h, are continuous, that is $a \in A = [0, \bar{a}]$ and $h \in H = \left[0, \bar{h}\right]$. In contrast, education types z and x, as well as childbearing types b, access to informal care g and utility cost q are finite.

The distribution of married couples of type (x, z) satisfies at all ages

$$\Omega(z, x) = \sum_q \sum_b \sum_g \int_{A \times H} \chi^M_j(a, h, \mathbf{s}^M)\, dh\, da$$

The faction of single males and females is given by

$$\Lambda(x) = \sum_b \sum_g \int_{A\times H} \chi^S_{f,j}(a,h,\mathbf{s}^S_f)\,dh\,da$$
$$\Pi(z) = \int_A \chi^S_{m,j}(a,h,\mathbf{s}^S_m)\,da$$

The distribution of married couples and single females across childbearing types $b = \{0,1,2\}$ and the fraction of households that have access to informal care $g \in \{0,1\}$ have to obey the following: $\sum_b \sum_g \phi^M_{b,g}(x,z) = 1$ and $\sum_b \sum_g \phi^S_{b,g}(x) = 1$.

The decision rules for savings and labor supply are given by $a^S_m(a,\mathbf{s}^S_m,j)$ and $l^S_m(a,\mathbf{s}^S_m,j)$ for single males and $a^S_f(a,h,\mathbf{s}^S_f,j)$ and $l^S_f(a,h,\mathbf{s}^S_f,j)$ for single females. Married couples choose savings, husband labor supply and wife labor supply according to $a^M(a,h,\mathbf{s}^M,j)$, $l^M_m(a,h,\mathbf{s}^M,j)$ and $l^M_f(a,h,\mathbf{s}^M,j)$. The level of human capital is defined by $\mathbf{h}^S$ and $\mathbf{h}^M$ for single and married females:

$$\mathbf{h}^S(a,h,\mathbf{s}^S_f,j) = H(a,h,l^S_f(a,h,\mathbf{s}^S_f,j-1),j-1)$$
$$\mathbf{h}^M(a,h,\mathbf{s}^M,j) = H(a,h,l^M_f(a,h,\mathbf{s}^M,j-1),j-1)$$

Finally, the law of motion for the distributions of household types in period $j > 1$ are determined as follows for married, single female and single male households, respectively:

$$\chi^M_j(a',h',\mathbf{s}^M) =$$
$$\int_{A\times H} \chi^M_{j-1}(a,h,\mathbf{s}^M)\mathbb{I}\{a^M(a,h,\mathbf{s}^M,j-1) = a', h^M(a,h,\mathbf{s}^M,j-1) = h'\}\,da\,dh$$
$$\chi^S_{f,j}(a',h',\mathbf{s}^S_f) =$$
$$\int_{A\times H} \chi^S_{f,j-1}(a,h,\mathbf{s}^S_f)\mathbb{I}\{a^S(a,h,\mathbf{s}^S_f,j-1) = a', h^S(a,h,\mathbf{s}^S_f,j-1) = h'\}\,da\,dh$$
$$\chi^S_{m,j}(a',\mathbf{s}^S_m) =$$
$$\int_A \chi^S_{m,j-1}(a,\mathbf{s}^S_m)\mathbb{I}\{a^S(a,\mathbf{s}^S_f,j-1) = a'\}\,da$$

Initial distributions for married couples, single females and single males at $(j = 0)$ are given by

$$\chi_1^M(a', h', \mathbf{s}^M) = \begin{cases} \Omega(z,x)\phi_{b,g}^M(x,z)p(q|z) & \text{if } a = 0,\ h = \eta(x) \\ 0, \ \text{otherwise} \end{cases}$$

$$\chi_{f,1}^S(a', h', \mathbf{s}_f^S) = \begin{cases} F(x)\phi_{b,g}^S(x) & \text{if } a = 0,\ h = \eta(x) \\ 0, \ \text{otherwise} \end{cases}$$

$$\chi_{m,1}^S(a', \mathbf{s}_m^S) = \begin{cases} M(z) & \text{if } a = 0 \\ 0, \ \text{otherwise} \end{cases}$$

Given these recursions, the stationary competitive equilibrium for the economy is given by:

1. The value function $V^M(\chi^M)$, and the policy functions $c(\chi^M)$, $a(\chi^M)$, $l_f(\chi^M)$ and $l_m(\chi^M)$ solve the household optimization problem for married couples given tax functions, factor prices and initial conditions. Similarly, the value function $V_f^S(\chi_f^S)$ and the policy functions $c(\chi_f^S)$, $a(\chi_f^S)$, $l_f(\chi_f^S)$ and solve the optimization problem for single females, and value function $V_m^S(\chi_m^S)$ with policy functions $c(\chi_m^S)$, $a(\chi_m^S)$, and $l_m(\chi_m^S)$ for single males given tax functions, factor prices and initial conditions.

2. Markets for aggregate capital K and labor L clear:

$$\begin{aligned} K = \sum_j \mu_j \Big\{ & \sum_z \sum_x \sum_b \sum_g \sum_q \int_{A\times H} a\chi_j^M(a,h,\mathbf{s}^M)\,dh\,da \\ & + \sum_x \sum_b \sum_g \int_{A\times H} a\chi_{f,j}^S(a,h,\mathbf{s}_f^S)\,dh\,da \\ & + \sum_z \int_A \chi_{m,j}^S(a,\mathbf{s}_m^S)\,da \Big\} \end{aligned}$$

and

$$L = \sum_j \mu_j \Big\{ \sum_z \sum_x \sum_b \sum_g \sum_q \int_{A\times H} [hl_f^M(a,h,\mathbf{s}^M,j) + \omega(z,j) l_m^M(a,h,\mathbf{s}^M,j)] \chi_j^M(a,h,\mathbf{s}^M)\, dh\, da + \sum_x \sum_b \sum_g \int_{A\times H} a\chi_{f,j}^S(a,h,\mathbf{s}_f^S)\, dh\, da + \sum_z \int_A \chi_{m,j}^S(a,\mathbf{s}_m^S)\, da \Big\}$$

3. The factor prices are determined competitively and satisfy

$$w = (1-\alpha)\left(\frac{K}{L_y}\right)^{\alpha} \qquad \text{and} \qquad r = \alpha \left(\frac{K}{L_y}\right)^{\alpha-1} - \delta_a$$

4. The distributions $\chi_j^M(a,h,\mathbf{s}^M)$, $\chi_{f,j}^S(a,h,\mathbf{s}_f^S)$ and $\chi_{m,j}^S(a,\mathbf{s}_m^S)$ are consistent with individual decisions.

5. The government budget balances, i.e. the tax revenue finances government consumption G, childcare transfers TR_c and mean-tested transfers TR_m

$$G + TR_c + TR_m = \Big\{ \sum_z \sum_x \sum_b \sum_g \sum_q \int_{A\times H} T^M(I,k)\, \chi_j^M(a,h,\mathbf{s}^M)\, dh\, da + \sum_x \sum_b \sum_g \int_{A\times H} T^S(I,k)\, \chi_j^S(a,h,\mathbf{s}_f^S)\, dh\, da + \sum_z \int_A T^S(I,0)\, \chi_{m,j}^S(a,\mathbf{s}_m^S)\, da \Big\} + \tau_a r K$$

and government spending on childcare services is defined as

$$TR_c = \theta \sum_{\{\mathbf{s}^M|b\}} \sum_{b=1,2} \sum_{j=b,b+2} \mu_j \int_{A\times H} \mathbb{I}(I \leq \bar{I}) \omega \psi_i \mathbb{I}(l_f > 0) \chi_j^M(a,h,\mathbf{s}^M)\, dh\, da + \theta \sum_{\{\mathbf{s}_f^S|b\}} \sum_{b=1,2} \sum_{j=b,b+2} \mu_j \int_{A\times H} \mathbb{I}(I leq \bar{I}) \omega \psi_i \mathbb{I}(l_f > 0) \chi_{f,j}^S(a,h,\mathbf{s}_f^S)\, dh\, da$$

and means-tested transfers as

$$TR_m = \sum_j \mu_j [\sum_{\mathbf{s}^M} \int_{A\times H} TR^M(I,k)\chi_j^M(a,h,\mathbf{s}^M)\, dh\, da$$
$$+ \sum_{\mathbf{s}_f^S} \int_{A\times H} TR_f^S(I,k)\chi_{f,j}^S(a,h,\mathbf{s}_f^S)\, dh\, da$$
$$+ \sum_{\mathbf{s}_m^S} \int_A TR^S(I,0)\chi_{m,j}^S(a,\mathbf{s}_m^S)\, da]$$

6. The social security balances

$$\tau_p wL = \sum_{j\geq J} [\sum_{\mathbf{s}^M} \int_{A\times H} b^M(z,x)\chi_j^M(a,h,\mathbf{s}^M)\, dh\, da$$
$$+ \sum_{\mathbf{s}_f^S} \int_{A\times H} b_f^S(x)\chi_{f,j}^S(a,h,\mathbf{s}_f^S)\, dh\, da$$
$$+ \sum_{\mathbf{s}_m^S} \int_A b_m^S(z)\chi_{m,j}^S(a,\mathbf{s}_m^S)\, da]$$

D Calibration

Table D3: Initial Labor Productivity Differences, by Education and Gender

	USA			Denmark		
	males (z)	females (x)	x/z	males (z)	females (x)	x/z
hs	0.640	0.511	0.799	0.837	0.727	0.869
sc	0.802	0.619	0.771			
col	1.055	0.861	0.816	1.212	1.079	0.890
col+	1.395	1.139	0.817			

Notes: The table displays initial productivity levels for males and females, ages 25-29, based on weekly wages. Data for the US comes from the 2004 March Supplement and data for Denmark comes from the SILC. For Denmark, data between 2004 and 2013 is pooled due to the small sample size of the SILC.

E Policy Experiments

Table D4: Evolution of Female Labor Market Productivity (%)

	USA				Denmark	
	hs	sc	col	col+	hs-sc	col-col+
25-29	0.129	0.153	0.207	0.145	0.057	0.204
30-34	0.091	0.109	0.134	0.111	0.139	0.142
35-39	0.061	0.076	0.083	0.085	0.064	0.039
40-44	0.036	0.050	0.043	0.064	0.096	0.046
45-49	0.014	0.027	0.009	0.047	0.013	0.006
50-54	−0.008	0.006	−0.025	0.032	0.010	0.004
55-60	−0.029	−0.014	−0.062	0.019	0.024	0.005

Notes: The table displays values for the human capital appreciation parameter α_j^x, which governs the evolution of female labor efficiency over the lifecycle. Notice that the education groups for Denmark are collapsed into high skilled and low skilled females due to the small sample size of the data. Data for the US comes from the 2004 CPS and estimates for Denmark are based on the SILC, pooled for years 2004-2013 to ensure a sample size of 33,478. The regression for Denmark thus includes year dummy variables.

Table D5: Distribution of Married Couples By Education

	Females			
Males	hs	sc	col	col+
hs	28.44	9.19	3.55	0.81
sc	7.54	12.50	5.13	1.50
col	2.14	4.52	10.65	3.63
col+	0.44	1.24	4.39	4.33

Notes: The table shows the fraction of married couples broken down by wife and husband education. The data comes from the 2004 CPS March Supplement. The statistics are based on age group 30-39. All entries add up to 100.

Table D6: Distribution of Individuals by Gender, Education, and Marital Status

	Males			Females		
	All	Married	Singles	All	Married	Singles
hs	40.42	31.12	9.30	38.39	29.56	8.83
sc	26.58	20.47	6.11	29.33	22.58	6.75
col	21.72	16.72	5.00	23.01	17.72	5.29
col+	11.02	8.49	2.53	9.28	7.15	2.13

Notes: The table shows the fraction of individuals by gender, education and marital status. The data comes from the 2004 CPS March Supplement. The statistics are based on age group 30-39. The breakdown between married and singles is derived under the stationary population assumption that is described in the text.

Table D7: Childbearing Status of Single Females

	Childless	Early	Late
hs	29.44	59.27	11.29
sc	34.80	48.40	16.80
col	53.07	31.45	15.31
col+	70.56	8.33	21.11

Notes: The table shows the fraction of single females by education and childbearing status. The data comes from the 2002 CPS June Supplement due to the small sample size of the 2004 CPS June Supplement.

Table D8: Childbearing Status of Married Couples

	Childless				Early			
	Female				Females			
Male	hs	sc	col	col+	hs	sc	col	col+
hs	9.29	10.63	14.63	18.47	68.03	59.90	42.14	42.39
sc	10.44	10.29	12.95	15.30	60.72	59.91	38.72	29.38
col	8.05	10.64	11.48	13.85	59.78	54.13	32.46	19.62
col+	7.79	9.89	8.99	13.13	56.73	39.50	31.30	23.98

Notes: The table shows the distribution of married couples by education type of husband and wife and by childbearing status. The data comes from the 2002 CPS June Supplement due to the small size of the 2004 CPS June Supplement.

Table D9: Social Security Benefits for Singles

	USA		Denmark	
	Males	Females	Males	Females
hs	1	0.914	1	1.019
sc	1.173	1.059	1.128	1.243
col	1.213	1.067	1.962	1.732
col+	1.291	1.066	1.962	1.732

Notes: The table shows the distribution of social security income for single males and females. The US data comes from the 2000 Census and includes all individuals 70 years and older.

Table D10: Social Security Benefits for Married Couples

	USA				Denmark			
	Female				Females			
Male	hs	sc	col	col+	hs	sc	col	col+
hs	1.755	1.874	1.969	1.879	1.667	2.044	2.291	2.291
sc	1.888	1.996	1.978	2.141	1.833	2.108	2.709	2.709
col	2.012	2.057	2.096	2.200	2.672	2.887	3.649	3.649
col+	2.033	2.110	2.175	2.254	2.672	2.887	3.649	3.649

Notes: The table shows the distribution of social security income for married couples by education type of husband and wife. The data comes from the 2000 CPS Basic monthly data.

Table D11: Parameters governing the distribution for q

Male	k_z	θ_z
hs	1.220	0.345
sc	0.225	2.050
col	0.125	7.780
col+	0.310	1.480

Notes: The flexible gamma distribution is characterized by shape parameter k_z and scale parameter θ_z. Conditional on the husband's type both parameters are chosen to match the average employment rates of all married women by education type.

Table E12: Changes in Employment Rates: Individual Policies

USA								
	LFP(Bench) - LFP(no addEITC)				LFP(Bench) - LFP(no CC subsidies)			
m/f	HS	SC	COL	COL+	HS	SC	COL	COL+
HS	11.9	11.6	7.1	3.2	3.5	−5.9	−3.8	−2.7
SC	8.8	9.2	1.8	1.2	2.5	−1.7	−2.0	0.0
COL	14.7	4.3	0.6	0.2	−3.3	−5.0	−0.5	−0.7
COL+	11.1	7.2	1.8	−0.5	−2.3	−0.1	−0.2	−0.1

Table E13: Adjustment in employment rates between Benchmark and (1) and (3)

Denmark								
	LFP(Bench) - LFP(no FB)				LFP(Bench) - LFP(no CC subsidies)			
m/f	HS	SC	COL	COL+	HS	SC	COL	COL+
HS	0.4	0.4	−0.8	0.8	1.7	−5.9	−3.8	−2.7
SC	0.3	0.1	1.1	0.0	2.5	−1.7	−2.0	0.0
COL	0.0	0.3	−0.2	0.1	−3.3	−5.0	−0.5	−0.7
COL+	−0.3	0.3	−0.1	−0.1	−2.3	−0.1	−0.2	−0.1