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

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December 2018

Abstract

Childbirth causes persistent gender differences in labor force participation and the difference in employment rates of married women with and without pre-school children varies substantially across countries. To what extent can child-related transfers account for this differential? To answer this question, I develop a life-cycle model of joint labor supply, in which female human capital evolves endogenously and a fraction of households has access to informal childcare. I calibrate the model to the US and Denmark, two countries in which the gap in employment rates of women with and without pre-school children differs in sign and magnitude: the gap is 13.2% in the US and -3.7% in Denmark. After taking the labor income tax treatment of married couples and variation in childcare fees into account, I find that child-related transfers are key to explaining the positive gap in the US and the negative gap in Denmark. I show that this mechanism is quantitatively important to account for variation in the maternal participation gap across other European countries as well.

Keywords: Maternal Labor Supply, Two-earner Households, Family Transfers, Taxation
JEL Codes: E62, H31, J12, J22

*Affiliation: University of Mannheim, contact: hannusch@uni-mannheim.de. I am grateful to Karen Kopecky for her continuous encouragement and invaluable guidance throughout this project. I am also indebted to Kaiji Chen and Tao Zha for their indispensable support. In addition, I thank Toni Braun, Hashem Dezhbakhsh, Lei Fang, Nicola Fuchs-Schündeln, Nezih Guner, Jeremy Greenwood, Chris Herrington, Julie Hotchkiss, David Jacho-Chávez, 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 seminar participants at the Federal Reserve Bank of Atlanta, the 2018 EMMMC conference, the 2018 REDg workshop and the 2018 USC Marshall Macro Day for helpful comments and suggestions. Part of this research was conducted at the University of Pennsylvania. I thank the Department of Economics for its hospitality. I gratefully acknowledge financial support by the German Research Foundation (DFG) through CRC TR 224.

1 Introduction

Despite increasing female educational attainment, the convergence in gender differences in earnings and labor force participation has stagnated in recent years. Recent literature attributes these remaining gender differences to the effect of childbirth on the labor market trajectories of women relative to men (Goldin et al. (2017), Kleven et al. (2018)). Across OECD countries, 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 participation gap*. The size of the maternal participation gap varies significantly across countries. For example, the participation 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 participation rate of mothers is 3.7% higher relative to childless women, resulting in a negative maternal participation gap. This paper explores the following two questions quantitatively: 1. What are the key factors that account for the size of the maternal participation gap in a given country? 2. Can these factors explain the variation in the size of the maternal gap across countries? To answer both questions, this paper focuses on the US and Denmark. The maternal participation gap in the US is representative of the gap observed in many Western European countries, such as Austria, France, Ireland, and Luxembourg. Denmark, in contrast, displays the lowest maternal participation gap across all OECD countries.

Important differences in the tax system and the design of child-related transfers in the US and Denmark motivate the analysis. The tax and transfer systems in both countries differ along three dimensions that are of first-order importance for the labor supply decision of households with children.[2] First, the US taxes the labor income of both spouses jointly, while Danish labor income is taxed at the individual level. Next, child-related transfers are much more generous in Denmark relative to the US. I define child-related transfers as all government transfers to households with young children, including child tax credits, childcare subsidies, subsidies for lone parents and supplementary transfers to low income families with children. Denmark spends 3.1% of its GDP on child-related transfers, while the US spends 1.5% of its GDP on these policies. Finally, childcare fees are about 25% lower in Denmark.

This paper argues, first, that child-related transfers are key to explaining the maternal participation gap in the US and in Denmark. Child-related transfers increase the maternal participation gap in the US, while they reduce the gap in Denmark. The country-specific design of child-related transfers introduces important differences in the effective tax rates that households with and without children face and these differences are driving the result. Holter et al. (2018) show that families with children, on average, face lower levels of labor income taxes and a higher tax progressivity. However, the cross-sectional differences in the

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

[2] Another strand of literature emphasizes cultural values as a key factor to explain variations in maternal participation rates across countries and across time. Examples of these papers are Fogli and Veldkamp (2011), Fernández (2013), and Giavazzi et al. (2013).

effective tax rates for households with and without children are even more pronounced, in particular for low income families. The setup presented in this paper fully accounts for these nonlinearities. Second, the differential impact of child-related transfers in both countries cannot be attributed to the fact that the US is a joint taxation country in which the secondary earner faces higher marginal tax rates compared to a single taxation country, such as Denmark.

I develop a life-cycle model of joint household labor supply, in which a fraction of households has access to informal childcare. The model economy is populated by married and single households. Households either have two children or no children. If households have children, they arrive early or late in the lifecycle. Parents do not derive utility from children, but having children consumes additional households resources. During child rearing periods, single and married females have to purchase childcare services if they choose to work. A fraction of households in the economy has access to informal childcare provided by grandparents. As a result, these households do not pay for childcare, even if both parents work. Male and female individuals start their life at working-age and differ in terms of their initial education. Female labor productivity evolves endogenously over the lifecycle. In the model, both spouses choose consumption, labor supply and savings.

I choose the US economy as my benchmark and calibrate it to the Danish data by adjusting the model economy along specific dimensions. The calibration uses US macroeconomic and microeconomic data, as well as country-specific data on labor income taxes and child-related transfers from the OECD. Holding preferences fixed, I predict the labor supply behavior of married women with and without children in Denmark by re-calibrating the following four features of the economy: First, taxes and transfers that impact all households are modified. This includes consumption, capital, and labor income taxes, social security transfers, and old-age benefits. In addition, child-related transfers and out-of-pocket childcare costs are adjusted to match Danish data. Third, female human capital growth rates conditional on education are estimated from the data and passed into the model to account for differences in the evolution of female labor productivity over the lifecycle in Denmark. Finally, I adjust the size of the informal care market to match the fraction of households that use informal care in the data. Using this set up, I analyze the two questions posed at the beginning of this paper.

This paper contributes to several distinct strands of literature. First, this study is motivated by an extensive empirical literature going back to Heckman (1974) that studies the effects of childcare costs on maternal labor supply (Hotz and Miller (1988), Schøne (2004), Baker et al. (2008)).[3] Blau and Currie (2006) provide an overview of these studies and report a wide range of maternal labor supply elasticities across countries: The reported estimates vary between 0.06 and -3.60. This paper attempts to reconcile these findings by providing a structural framework that allows to decompose the effect of country-specific and institutional factors on maternal labor supply. The elasticity of maternal labor supply is likely to be affected by current wage levels, female participation rates, the tax code, and the generosity of the social

[3]The strong correlation between childcare costs and maternal labor supply has led to the general conclusion that affordable childcare is the main driving force for the cross-country differences in maternal employment (Havnes and Mogstad; 2011).

security system. These cross-country differences pose a challenge to many empirical studies as they introduce identification problems. The majority of empirical studies thus shifted the focus to quasi-experimental methods that exploit exogenous variations in childcare prices as a result of policy reforms.[4] Even in the presence of a clean identification strategy, most authors carefully interpret their estimates in the country-specific context (Cascio et al. (2015)). A structural framework like the one presented in this paper can be used to reconcile the variation in empirical labor supply elasticity estimates across countries.

A second contribution is that this paper uses the actual nonlinear tax and subsidy systems rather than average marginal tax rates as model inputs to predict maternal labor force participation. Bick and Fuchs-Schündeln (2018) show that linear tax functions introduce a correlation between male and female hours worked that is much larger than in the data and that differences in hours worked between the US and Europe are overstated by 57% using a model with linear tax functions. Nonlinearities in the tax code, that is, the difference in effective tax rates between households with and without children, are even more pronounced when analyzing the household labor supply problem of families with small children. Child-related transfers are typically conditional on household income and/or parental labor force status and thus lead to heterogeneous maternal labor supply incentives in the cross-section of households. The model presented in this paper can account for these differences as it takes into account the full nonlinearity of the tax and transfer schemes in the US and Denmark.

This paper builds on a model of joint household labor supply developed by Guner et al. (2018). They calibrate the model to the US economy and analyze the effect of policy reforms, such as an expansion in childcare subsidies and child tax credits, on labor supply and family welfare. The key difference is, this paper uses actual tax data from the OECD to identify effective tax rates for different household types, thus taking the full non-linearity of the tax code into account. In addition, the model set up can be easily extended to other OECD countries and lends itself for further cross-country studies. The way taxes are introduced into the model is based on Bick and Fuchs-Schündeln (2018), who systematically implement country-specific non-linear income tax codes for married household types. In contrast to Bick and Fuchs-Schündeln (2018), who abstract from the presence of children, this paper explicitly models the decision problem for households with and without children.

This work is part of a growing body of literature on the joint labor supply decision problem of married couples from a macroeconomic perspective. In this strand of literature, the decision to be a single or dual-earner household is endogenous (Greenwood et al. (2003), Hong and Ríos-Rull (2007), and Heathcote et al. (2010) among others). Chade and Ventura (2002), Kaygusuz (2010), Guner et al. (2012), Chakraborty et al. (2015), Bick and Fuchs-Schündeln (2018), Duval-Hernández et al. (2018) and Holter et al. (2018) explore to what extent the labor supply decision of the second earner depends on the income tax code and the social security system. A related strand of macroeconomic research has explored the effects of childcare costs and childcare subsidies, both in the aggregate (Rogerson (2007),

[4] See for example, 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), for recent empirical evidence.

Attanasio et al. (2008) and Domeij and Klein (2013)) and across household types (Erosa et al. (2010), Bick (2015) and Guner et al. (2018)).

The remainder of the paper proceeds as follows. Section 2 presents a stylized household decision problem that summarizes the model components that generate variation in the maternal participation gap across countries. Section 3 gives an overview of important data facts that are used to discipline the quantitative model presented in section 4. Section 5 describes the calibration in detail. Section 6 presents the benchmark economy, while Section 7 performs policy experiments to assess the contribution of country-specific institutional factors to the participation gap. Section 8 provides cross-country evidence, while section 9 concludes.

2 Maternal Participation Gap

Figure 1 summarizes the cross-country variation in the maternal participation gap in the data. The gap is defined as the difference in the average employment rate of married females with children less than 6 years of age and married females without children. The participation gap varies significantly across European countries and the US. It is virtually non-existent in Denmark and Sweden and largest in Germany, the UK and Ireland. While the gap is relatively small in Southern European countries, it is worth noting that the employment rates for females without children are particularly low in this region as well. In fact, the maternal participation rates in Greece and Italy are among the lowest in the sample.

A stylized version of the household labor supply problem can rationalize the cross-country variation in the maternal participation gap observed in the data. The goal is to derive an expression that helps to summarize how the main components that generate differences in employment rates for married women with and without children enter the theoretical model. In addition, the exercise highlights how these model components vary across countries, which will be important for the quantitative exercise.

For simplicity, assume that male labor supply is fixed, $\bar{l}_m$. This fairly strong assumption will be relaxed in the quantitative model. In addition, the problem also abstracts from savings and households simply choose consumption and female labor supply for the time being. Households derive utility from consumption c and incur disutility from labor l_i, where $i \in \{f, m\}$. Married couples 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 or forgone home production. Having children is costly and households do not derive any utility from raising children. This implies that in this model setup having children only affects the household budget constraint. Finally, consumption is a public good within the household and total household utility is defined as the sum of individual utilities. The household decision problem is given by:

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

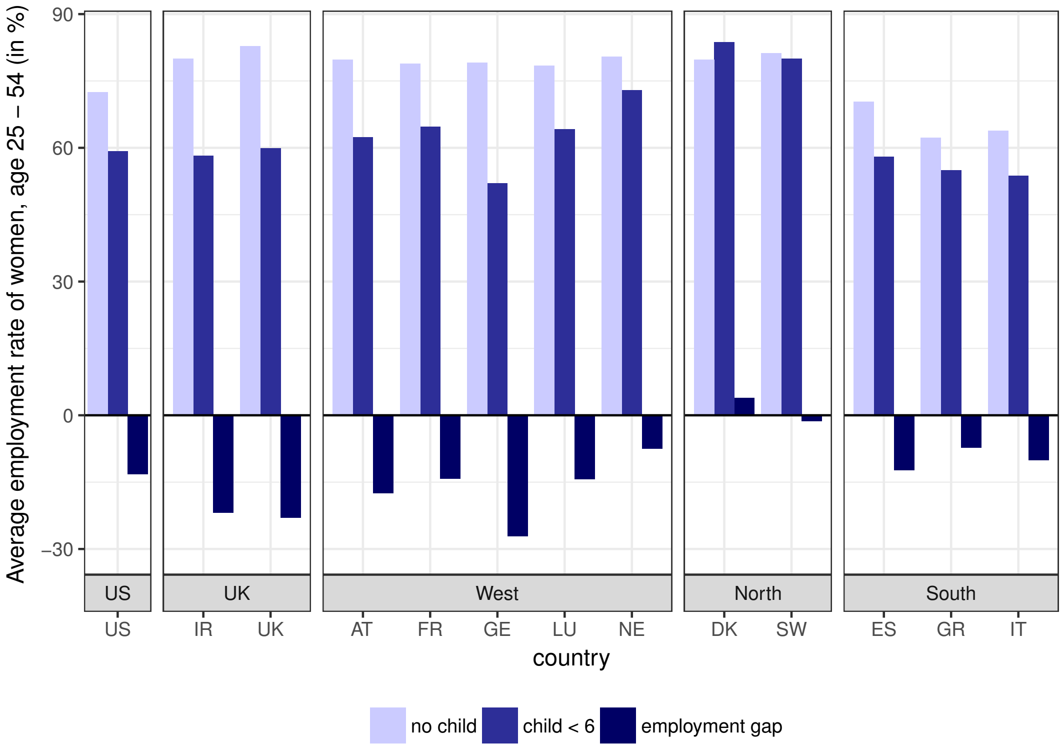


Figure 1: Female employment rates, 2005-2007

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 from 2005 to 2007 are pooled. The sample is restricted to married females between the age of 25 to 54.

where y_{hh}^{ν} is the after tax household income. Following Bénabou (2002), the after tax household income can be expressed as

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

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. 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 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 the female is working $\psi\mathbb{I}(l_f > 0)$, which is modeled as a fraction of the average income in the economy. 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) Second, families with children receive child-related transfers s_k that effectively increase the after-tax household income. If couples have access to informal care, child-related transfers are the only variation between the decision problem between a married couple with and without children.

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

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

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. The gain from entering the labor force for a married woman with children is the additional after-tax household income, and therefore identical to the participation gain for a woman without children.

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

The out-of-pocket cost of childcare relative to the after-tax income of a single earner household reflects the degree to which the budget constraint of a household is tightened due to the presence of children. The maternal participation gap arises if the costs of participating for mothers is different from the cost of participating for married women without children. This is the case if

$$\begin{aligned} u(c, l_f|k=0)\big|_{l_f>0} - u(c, l_f|k=1)\big|_{l_f>0} &\neq 0 \\ \Leftrightarrow \underbrace{\left(\frac{1}{1+s_k}\right)\frac{\bar{\omega}\psi\mathbb{I}(g)}{y_{hh,1}^{\nu}}}_{\text{Effective Relative Childcare Cost}} &\neq 0 \end{aligned}$$

Hence, the maternal participation gap arises due to (1) out-of-pocket childcare costs ψ, (2) access to informal care provided by grandparents $\mathbb{I}(g)$, and (3) child-related transfers s_k. All these costs effectively tighten the budget constraint of households with small children relative to households without children and make participation for mothers more costly.

It is easy to see that these factors also contribute to the cross-country variation in the participation gap. In addition, net household income of a single earner household, $y^{\nu}_{hh,1}$, which is a function of the country-specific labor income tax code, contributes to the variation in the effective relative childcare costs (ERCC):

$$ERCC^{\text{joint}} = \left(\frac{1}{1+s_k}\right) \frac{\bar{\omega}\psi\mathbb{I}(g)}{2(1-\delta)(\frac{w_m l_m}{2})^{1-\xi}}$$
$$ERCC^{\text{separate}} = \left(\frac{1}{1+s_k}\right) \frac{\bar{\omega}\psi\mathbb{I}(g)}{(1-\delta)(w_m l_m)^{1-\xi}}$$

Notice, that in a world where labor income is taxed at a flat rate, i.e. $\xi = 0$, the effective relative childcare costs do not differ across the two taxation systems, all else equal. In this case, the participation gain $\left(\frac{Y_{hh,2}}{Y_{hh,1}}\right)^{1-\xi}$ is also identical.

3 Stylized Facts

This section summarizes corresponding data moments for each of the key factors that drive a wedge between the decision problem of households with and without children in the theoretical model. It focuses on the US and Denmark. Empirical evidence for other countries is summarized in figure 11 in the Appendix D. The data moments are later used to discipline the quantitative model in section 5.

3.1 Maternal Employment by Age of Mother

The average employment rate for prime-age married women presented in figure 1 masks important patterns in the employment rates for married women of different age groups. Figure 2 compares the employment rates for married women with pre-school children and without children across different age bins and for the US and Denmark.

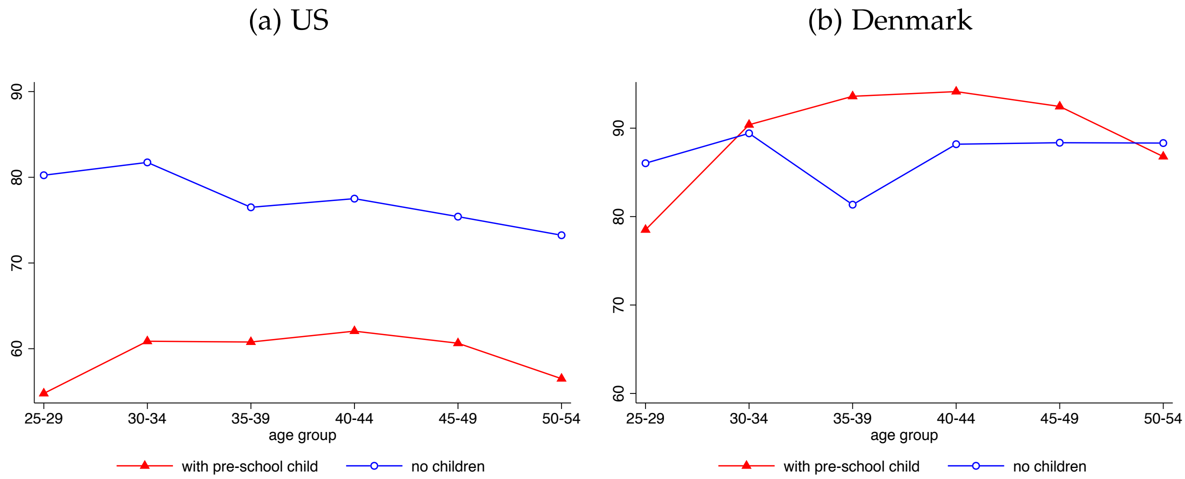


Figure 2: Employment rates for married women, 25-54.

Notes: Data for the US comes from the 2005 Current Population Survey (CPS). Danish data comes from the ELFS and due to the limited sample size, data between 2005 to 2010 are pooled. The sample is restricted to married females of prime age, i.e. 25 to 54.

While the level of employment rates varies significantly across countries, two patterns seem to be consistent across countries. The employment rate for married women with pre-school children is hump-shaped and slightly lower for age group 25-29 and 50-54. The employment rate for married women without children, in contrast, tends to decline with age.

3.2 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 and the Danish government caps the maximum payable price for parents at 30% of operating costs[5]. 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 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 1: 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.

3.3 Child-related Transfers

The US and Denmark differ widely in the types of family policies that are used to support families with children. In general, two types of policies can be distinguished: child benefits

[5]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

and childcare subsidies. Child benefits that are lump-sum or means-tested and paid out to every family that has a child. The benefit amount usually declines with child age. The second type of benefit are childcare subsidies that are used to lower the cost of childcare for families with children.

Table 2: Child-related Transfers

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

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.

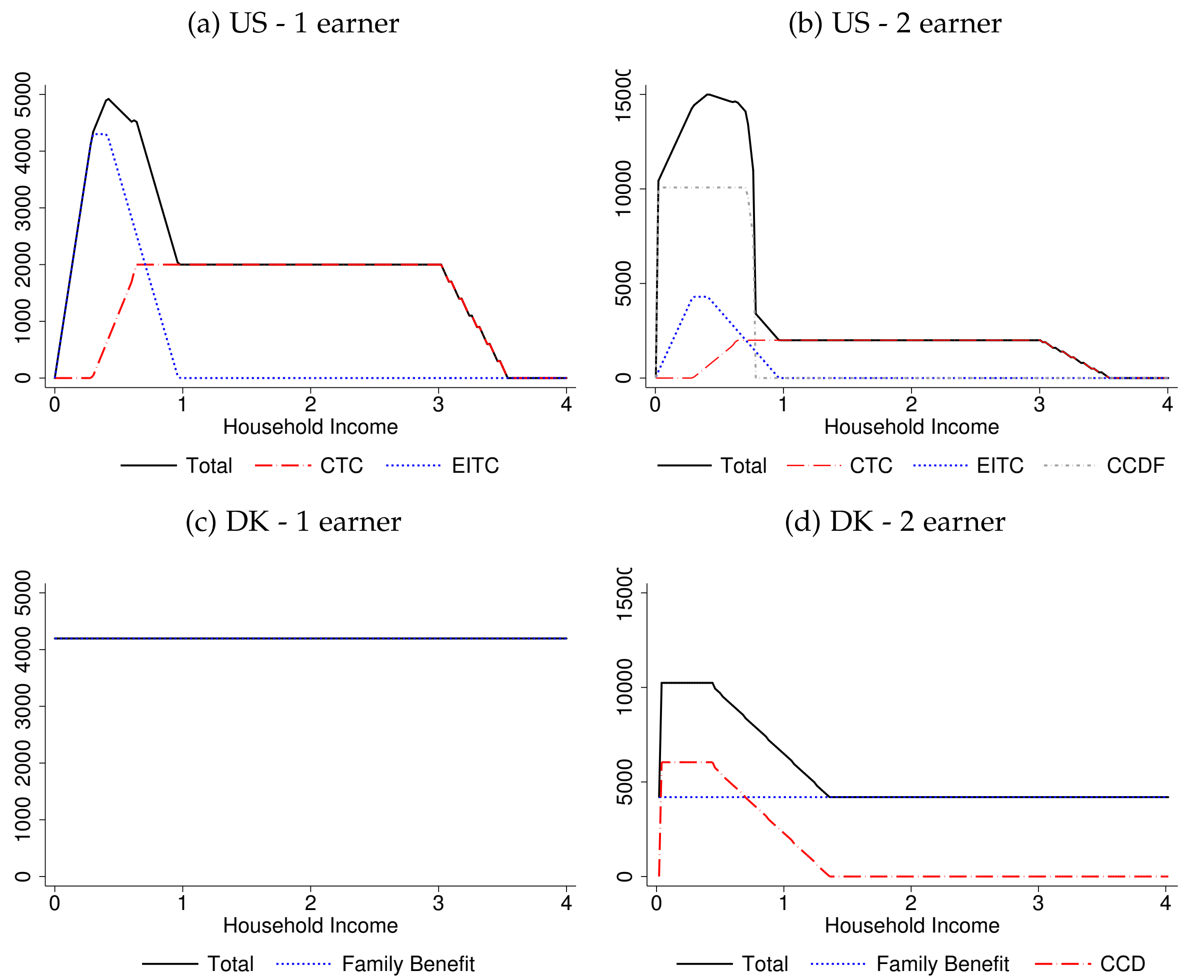


Figure 3: Child-related Transfers to Families with 2 Children

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 thus do not incur childcare expenses. Hence, 1-earner households are not eligible for programs that reduce the cost of formal childcare.

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.

Figure 3 summarizes the benefits paid to 1-earner and 2-earner families in Denmark and the US as a function of household labor income normalized by mean labor earnings in each country in 2004. It is easy to see that the country-specific design of child-related transfers introduces important non-linearities, especially at the low end of the income distribution. In addition, these programs have specific phase-in, and phase-out ranges, which correspond to a wage subsidy and a wage tax, respectively (Guldi and Schmidt; 2017). The predicted effects on the intensive and extensive margin of household labor supply are quite different for each range. In other words, the income and substitution effect dominate at different ranges of the total benefit function.

Another way of looking at the problem is to compare the effective tax rates that households with and without children face. Figure 4 summarizes the effective tax rates for households at different points in the income distribution. The effective tax rate is defined as the percentage between gross and net household income. Here, childcare benefits and costs are counted in household net income. In countries with very high childcare costs and no childcare benefits, it can thus be the case that households with children face a higher effective tax rates than households without children conditional on income, such as in Ireland and the UK (see Figure 5).

The graphs below show effective tax rates for various household types that are defined according to male labor earnings. Low income households are defined as households in which men earn 1/4 or 1/2 of mean labor income. Medium income households are households in which the men earns 3/4 of mean labor income or mean labor income. Finally, high income households are defined as households with 3/2 or twice the mean labor income for men. Keeping male labor income fixed, the figure displays the evolution of the effective tax rates as the female increases her labor income from zero to twice the mean labor income in 2004. Tax rates are displayed separately for households with 2 children and without children to demonstrate the effect of child-related transfers on the effective tax rates that households with the same total labor income face.

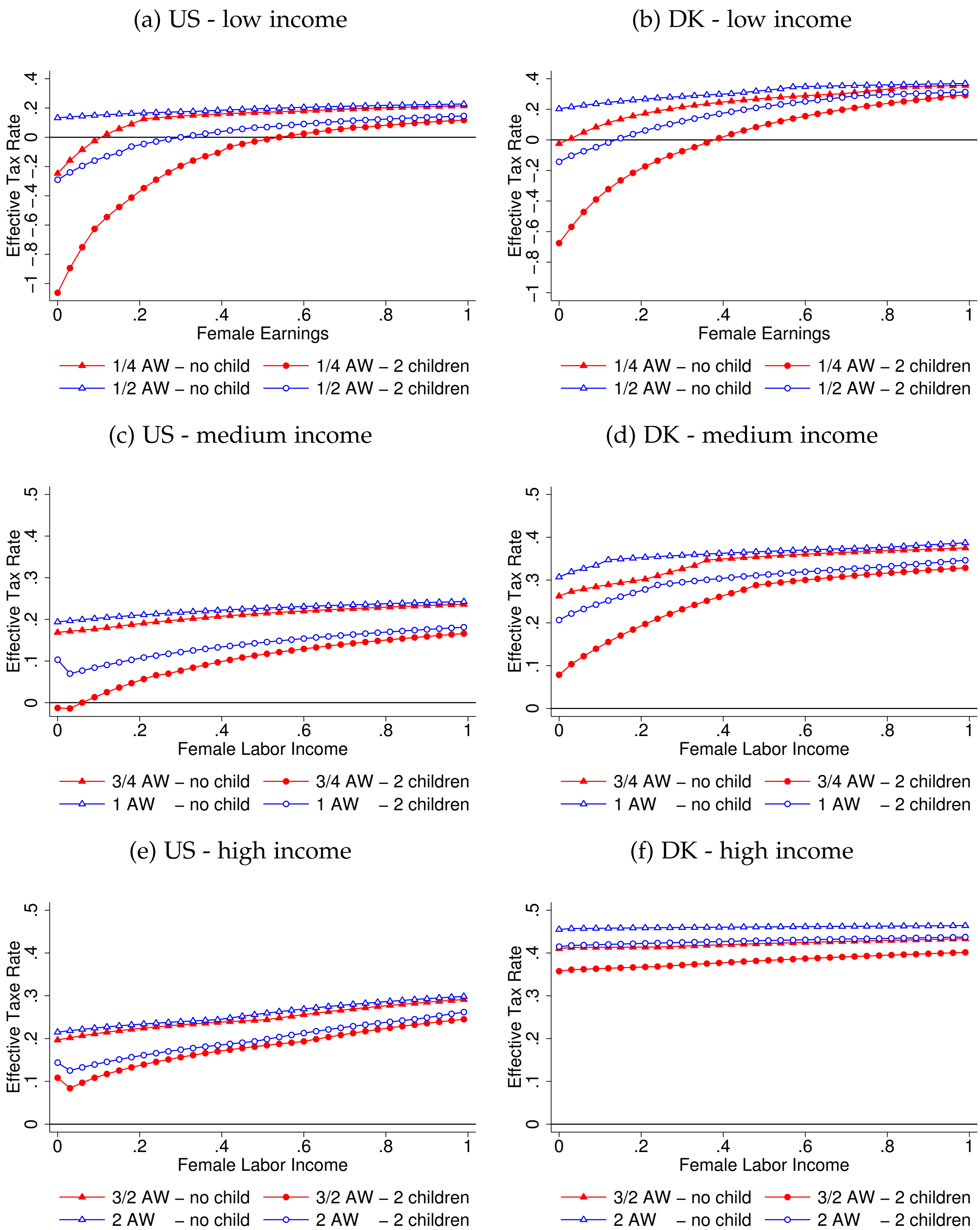


Figure 4: Differences in effective tax rates for married couples with and without children

Notes: Effective tax rates are calculated for married households with 2 children, 2 and 4 years of age. The effective tax rate is defined as the percentage difference between gross labor income and net labor income after taxes and subsidies. Rates are calculated using the OECD Taxes and Wages Module. In case of a 1-earner household (female labor income is zero), it is assumed that children are cared for by the non-working spouse. Since 1-earner households do not incur childcare expenses, they are not eligible for childcare subsidies.

4 Model

This section develops an overlapping generations 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 differences in labor income taxes, child-related transfers, out-of-pocket childcare costs and access to informal care contribute to the cross-country variation in the maternal participation gap. The model is similar to Guner et al. (2018). The key difference from their paper is the way in which non-linear labor income tax functions and the non-linear transfer functions are implemented.

4.1 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 $r = R - \delta_a$.

4.2 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. Consumption 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)).

4.3 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.

4.4 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

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

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

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

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

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

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

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

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

5 Calibration

This section describes the calibration of model parameters. The model is used assess what accounts for the variation in the maternal participation 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 B1 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

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

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 labor force participation. 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 B2 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. Approximately 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 B3 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

B5 for singles. U.S. Census data is used to calculate the fraction of childless married couples with childless wives aged 40-44.[6] 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 B6 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 3-5 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.[7] 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

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

[7]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.

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 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 determined 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 developed 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 labor force participation 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 participation rate conditional on husband's education, a pattern that is consistent with the data. Appendix B9 summarizes the parameters governing the distributions of utility costs.

	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

Table 3: Labor force participation of married females, age 25-54

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 3 displays the resulting distributions. The aggregate participation 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 4 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 participation rates for married females conditional on their own education type and their husbands' education type is matched.

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 market 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 female COL+	δ_1	0.020	–	PSID data
Depreciation female less COL	δ_2	0.009	–	PSID data
Growth female HC	α_j^x			CPS and SILC data (see App.)
		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.)

Table 4: Calibration of Benchmark Economy

6 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 4, 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 5: 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. In addition, the labor force participation 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 participation rate, which is 59% in the model and 59.1% in the data. The resulting maternal participation gap for the US is 14.1% in the model compared to 13.2% in the data.

It is worth noting that maternal participation 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 participation gap in the data. In contrast, the model economy presented here abstracts from time costs for females with children. Thus, the difference between participation rates of women with and without children is only driven by differences in the household budget constraint.

The key feature to generate the participation 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 participation 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 labor force participation 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 participation 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 participation 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 participation of mothers tends to be very high.

7 Decomposing the Maternal Participation Gap

I employ the following strategy to identify the key model component that drives a wedge in the participation costs between married women with and without children from the perspective of the structural model: 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 participation 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.

	Data	(1) $\{\psi, g, s_k\} = 0$	(2) $\psi > 0$	(3) $g > 0$	(4) $s_k > 0$
	USA				
LFP_{gap}	13.20	−6.60	4.30	−1.70	14.10
	Denmark				
LFP_{gap}	−3.70	−0.60	2.30	0.50	−4.60

Table 6: Decomposition

Table 6 summarizes the results from the decomposition exercise and reports the maternal participation gap that arises endogenously in each of the model versions, both for the model calibrated to the US and to Denmark.

In the no child-related differences economy (1), households with children do not face any additional costs due to the presence of young children. The negative participation gap arises in both economies due to differences in the age composition of married women with and without children. In the model, mothers have young children during model period 1 and 2. These are the periods where the returns from working are particularly high since female human capital evolves endogenously. The labor force participation rate of all married women with and without children is computed as the average rate between ages 25-54, corresponding to model period 1-6. Thus, the higher participation rates of married women with children is driven by the age effect.

Model economy (2) introduces out-of-pocket childcare costs for working mothers, $\psi > 0$. The effect of the participation gap is homogeneous across both countries. The participation gap increases substantially with the effect of out-of-pocket childcare costs being significantly larger in the US where childcare fees are about 25% higher relative to Denmark.

The strong increase in the maternal participation gap due to the introduction of 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 economy (3). Informal care relaxes the household budget constraint as working mothers do not face out-of-pocket childcare cost. The effect of informal care on maternal participation 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 participation 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 participation 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 participation 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 7 decomposes the changes in participation 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. Hence, the reductions increase tax progressivity at the bottom of the income distribution, thereby reinforcing the incentive for females to drop out of the labor force. Once these tax credits are removed, low income households face higher average taxes, but less tax progressivity. In addition, dropping out of the labor force is very costly at the beginning of the life-cycle. Females are only willing to incur this cost if households are compensated by large tax credits. Once these credits are removed, it becomes optimal for females from low-income households to enter the labor force. In Denmark, on the other hand, the impact on participation rates of females with less than college education is the opposite: removing child-related transfers substantially increases the participation 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 participation 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 participation 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.

	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

Table 7: Adjustment in participation rates between Benchmark and $s_k = 0$

This finding deserves further discussion. The next section breaks down child-related transfers by individual policy programs in both countries.

7.1 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 8 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). We have previously seen that the introduction of government programs to support families with children increases the maternal participation gap in the aggregate. When breaking this effect down into different policies, we can see that the removal of EITC is the only program that reduces the participation gap between married women with and without children. This is not surprising given that most households in the economy are at the plateau or phase-out range of the EITC. For these recipients, the after-tax income is reduced through the negative income effect stemming from the reductions in the EITC (Meyer; 2002). The policy experiment reduces this negative income effect as it shifts the extended phase-out range for families with children to the left of the income distribution. 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. The left panel of Table 11 summarizes the effect of removing the EITC expansion for families in the cross-section. The effect is largest for less than college educated mothers.

	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

Table 8: Child-related Transfers in the US by Policy Program

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.

	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 9: Adjustment in participation rates between Benchmark and (1) and (3)

Removing either the Child Tax Credit or childcare subsidies coming through the CCDC or CCDF increases the participation gap. However, the individual effect of these programs is rather small compared to the EITC. Table 11 shows that removing the childcare subsidies impacts less educated mothers more and that the aggregate effect masks large heterogeneity in the cross-section.

Finally, while each program itself impacts the aggregate maternal participation gap, it is evident that the cumulative impact of these programs on the participation rate of married mothers is larger than when considering each program in isolation. This suggests that the detailed modeling of the labor income tax codes in conjunction with the non-linear design of family transfer programs are key for understanding the labor supply behavior of married women with and without children.

In Denmark, removing the family benefit program (FB) and the childcare subsidy program CCD both increase the maternal participation gap. The family benefit program is a lump-sum transfer and the small variations in the participation 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 response is due to the negative income effect that households with children face in the absence of family transfers. Setting childcare subsidies to zero gas a larger effect on the maternal participation gap and low educated mothers respond more due to the absence of this policy. In general, the changes in maternal participation rates due to removing individual family policies in Denmark are much smaller than in the US. This is for two reasons. First, the transfers to low income households in the US are much larger than in Denmark as evident from Figure 3. Second, changes in the marginal tax rates due to policy changes impact both the first and the second income earner in the US. The impact of joint versus single taxation on the results is further explored in the next section.

	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

Table 10: Child-related Transfers in Denmark by Policy Program

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.

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

Table 11: Adjustment in participation rates between Benchmark and (1) and (3)

7.2 Policy Experiment

To what extent is the finding that child-related transfers decrease the participation gap in Denmark, but increase the gap in the US driven by joint vs. separate taxation? To explore this angle further, think of the following 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 as evident in the Danish tax code. For each income combination, this tax rate difference captures the amount of child-related transfers that Danish households with children receive (see Figure 4b).

Table 12 summarizes the effect of an introduction of Danish child-related transfers into the US economy. The design of Danish-transfers closes the participation gap by 2/3 from 14.1% to 4.9%. This suggests that the larger participation gap in the US economy is mainly due to the specific design of US family policies and cannot merely be attributed to the fact that the US is a joint taxation country in which the 2-earner faces a higher marginal tax rate than in Denmark. Notice, however, that the reduction of the participation gap is a costly policy experiment in the sense that it significantly reduces government tax revenue. Danish child-related transfers are on average a lot more generous than US transfers, in particular due to the family benefit program that provides a lump-sum transfer to all families with children. In addition, the reduction in the participation gap is mainly driven by low income earners that generate too little additional labor income tax revenue to finance the increase in 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

Table 12: US economy with Danish child-related transfers

8 Cross-country Evidence

To provide more systematic evidence for the fact that child-related transfers are key to explaining cross-country variation, the decomposition exercise from section 6 is repeated for all European countries in the sample. 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 participation costs q for each country, all the preference parameters, including q, are left unchanged in this exercise.

Table 13 and table 14 summarize the results. For the majority of countries in Britain, Western and Northern Europe, the key result holds: the model cannot generate the participation 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 participation 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 participation gap for Ireland, while the participation 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 participation 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 effective tax rates that households with and without children face (see Appendix C, Figure 9 and 10).

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). These types of frictions are completely absent in the model developed in this paper.

	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 13: 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 14: Cross-country Evidence 2/2

9 Conclusion

In this paper, I develop a lifecycle model of joint household labor supply, in which female human capital evolves endogenously and a fraction of households with young children has access to informal care. I use the model to explore key determinants of the maternal participation gap, i.e. the difference in the participation rates of married females with and without children in two countries: the US and Denmark. I find that child-related transfers are key to accounting for the maternal participation gap quantitatively. These transfers introduce important differences in the effective tax rates for households with and without children.

Two interesting questions emerge from the policy exercises in this paper. First, government programs that are characterized by phase-in and phase-out ranges as well as varying benefit levels have important implications for the incentive of households to move from a one-earner to a two-earner household. It is not clear how these ranges should be optimally designed to maximize family welfare. This would be an interesting extension of the current framework. Second, labor market frictions as those discussed for Southern European economies are currently outside of this model. Incorporating labor market frictions in the current setup could be an important extension to shed more light on the incentives for mothers to participate in the labor force in these economies.

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., 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.

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.

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.

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.

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. (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.

Giavazzi, F., Schiantarelli, F. and Serafinelli, M. (2013). Attitudes, Policies, and Work, *Journal of the European Economic Association* **11**(6): 1256–1289.

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.

Goldin, C., Kerr, S. P., Olivetti, C. and Barth, E. (2017). The Expanding Gender Earnings Gap: Evidence from the LEHD-2000 Census, *American Economic Review: Papers and Proceedings* **107**(5): 110–114.

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

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. mimeo.

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.

Holter, H. A., Krüger, D. and Stepanchuk, S. (2018). How Do Tax Progressivity and Household Heterogeneity Affect Laffer Curves? mimeo.

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.

Kleven, H. J., Landais, C. and Søgaard, J. E. (2018). Children and Gender Inequality: Evidence from Denmark, *American Economic Journal: Applied Economics* . forthcoming.

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.

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.

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

Sánchez-Mangas, R. and Sánchez-Marcos (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 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 $h \in H = [0, \bar{h}]$. 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:

$$\chi_j^M(a', h', \mathbf{s}^M) = \int_{A\times H} \chi_{j-1}^M(a, h, \mathbf{s}^M)\mathbb{I}\{a^M(a, h, \mathbf{s}^M, j-1) = a', h^M(a, h, \mathbf{s}^M, j-1) = h'\}\, da\, dh \tag{12}$$

$$\chi_{f,j}^S(a', h', \mathbf{s}_f^S) = \int_{A\times H} \chi_{f,j-1}^S(a, h, \mathbf{s}_f^S)\mathbb{I}\{a^S(a, h, \mathbf{s}_f^S, j-1) = a', h^S(a, h, \mathbf{s}_f^S, j-1) = h'\}\, da\, dh \tag{13}$$

$$\chi_{m,j}^S(a', \mathbf{s}_m^S) = \int_A \chi_{m,j-1}^S(a, \mathbf{s}_m^S)\mathbb{I}\{a^S(a, \mathbf{s}_f^S, j-1) = a'\}\, da \tag{14}$$

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

$$\chi_1^M(a', h', \mathbf{s}^M) = \begin{cases} \Omega(z, x)\phi_{b,g}^M(x, z)p(q|z) & \text{if } a = 0,\ h = \eta(x) \\ 0, \text{ otherwise} \end{cases} \tag{15}$$

$$\chi_{f,1}^S(a', h', \mathbf{s}_f^S) = \begin{cases} F(x)\phi_{b,g}^S(x) & \text{if } a = 0,\ h = \eta(x) \\ 0, \text{ otherwise} \end{cases} \tag{16}$$

$$\chi_{m,1}^S(a', \mathbf{s}_m^S) = \begin{cases} M(z) & \text{if } a = 0 \\ 0, \text{ otherwise} \end{cases} \tag{17}$$

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:

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

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

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

and means-tested transfers as

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

6. The social security balances

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

B Calibration

Table B1: 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.

Table B2: 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 B3: 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 B4: 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 B5: 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 B6: 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 B7: 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 B8: 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 B9: 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 participation rates of all married women by education type.

C Effective Tax Rates Across European Countries

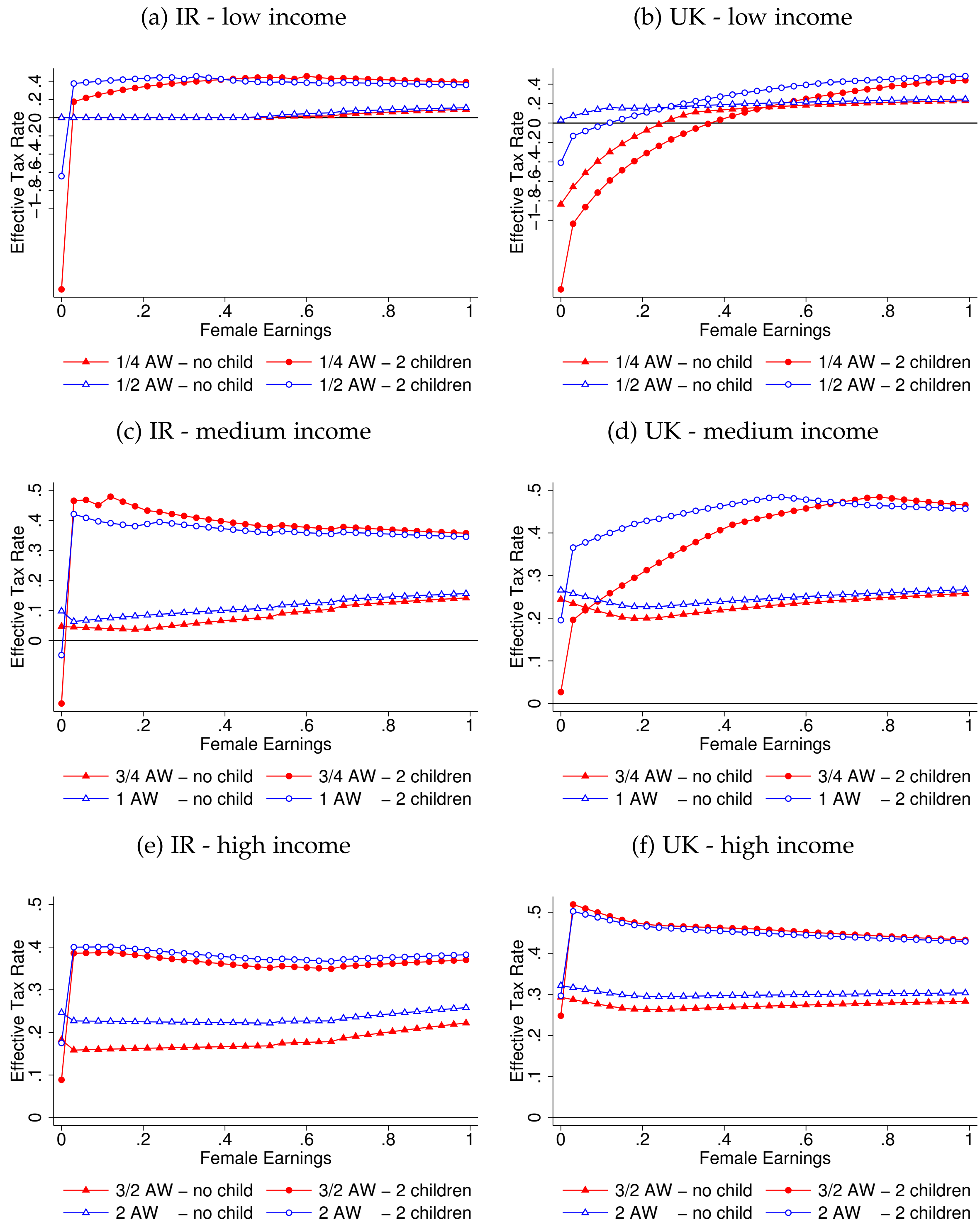


Figure 5: Effective Tax Rates: Ireland and United Kingdom

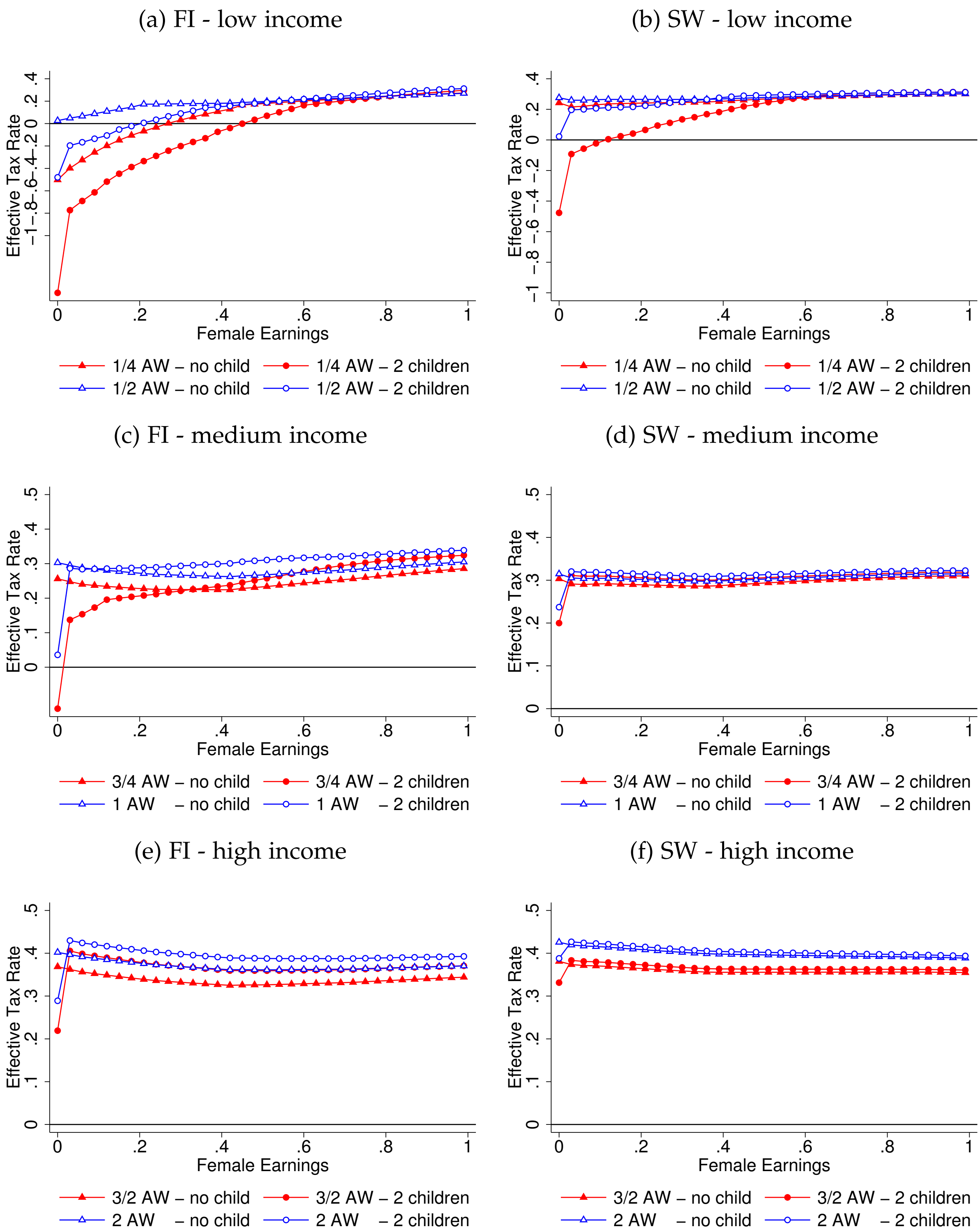
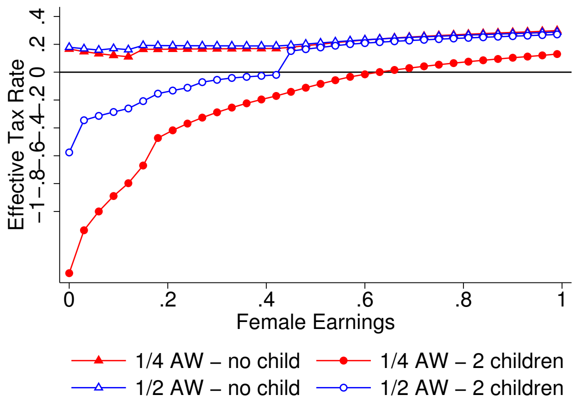
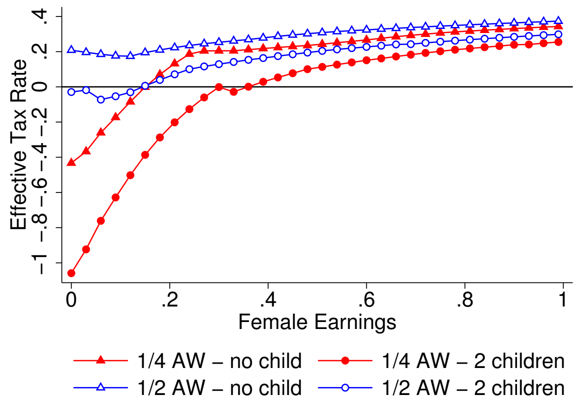


Figure 6: Effective Tax Rates: Finland and Sweden

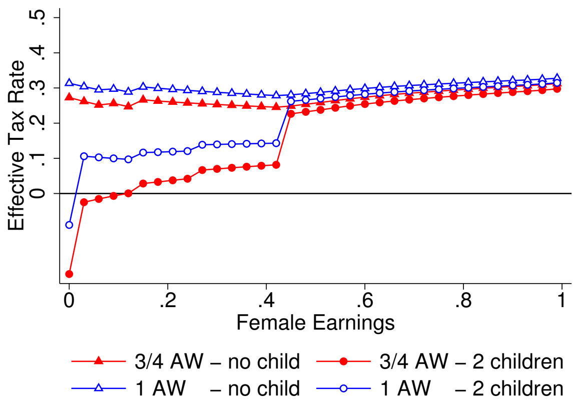
(a) AT - low income



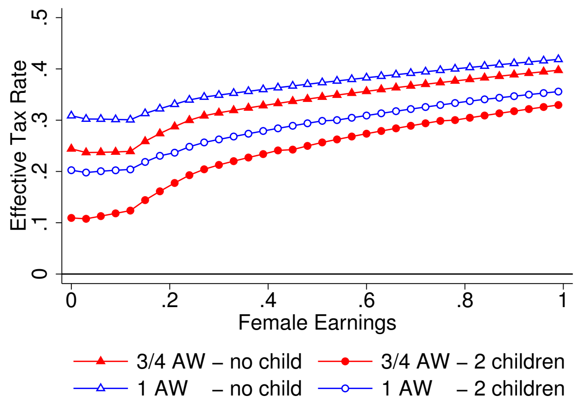
(b) GE - low income



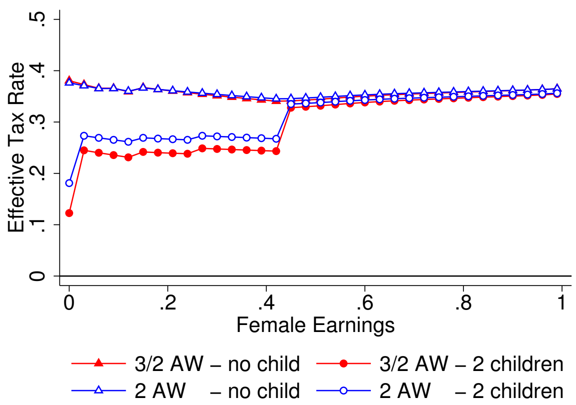
(c) AT - medium income



(d) GE - medium income



(e) AT - high income



(f) GE - high income

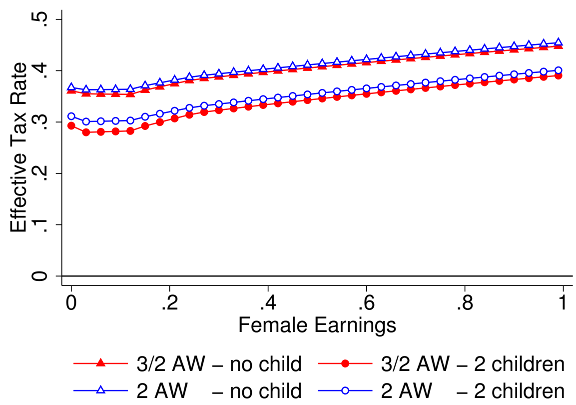


Figure 7: Effective Tax Rates: Austria and Germany

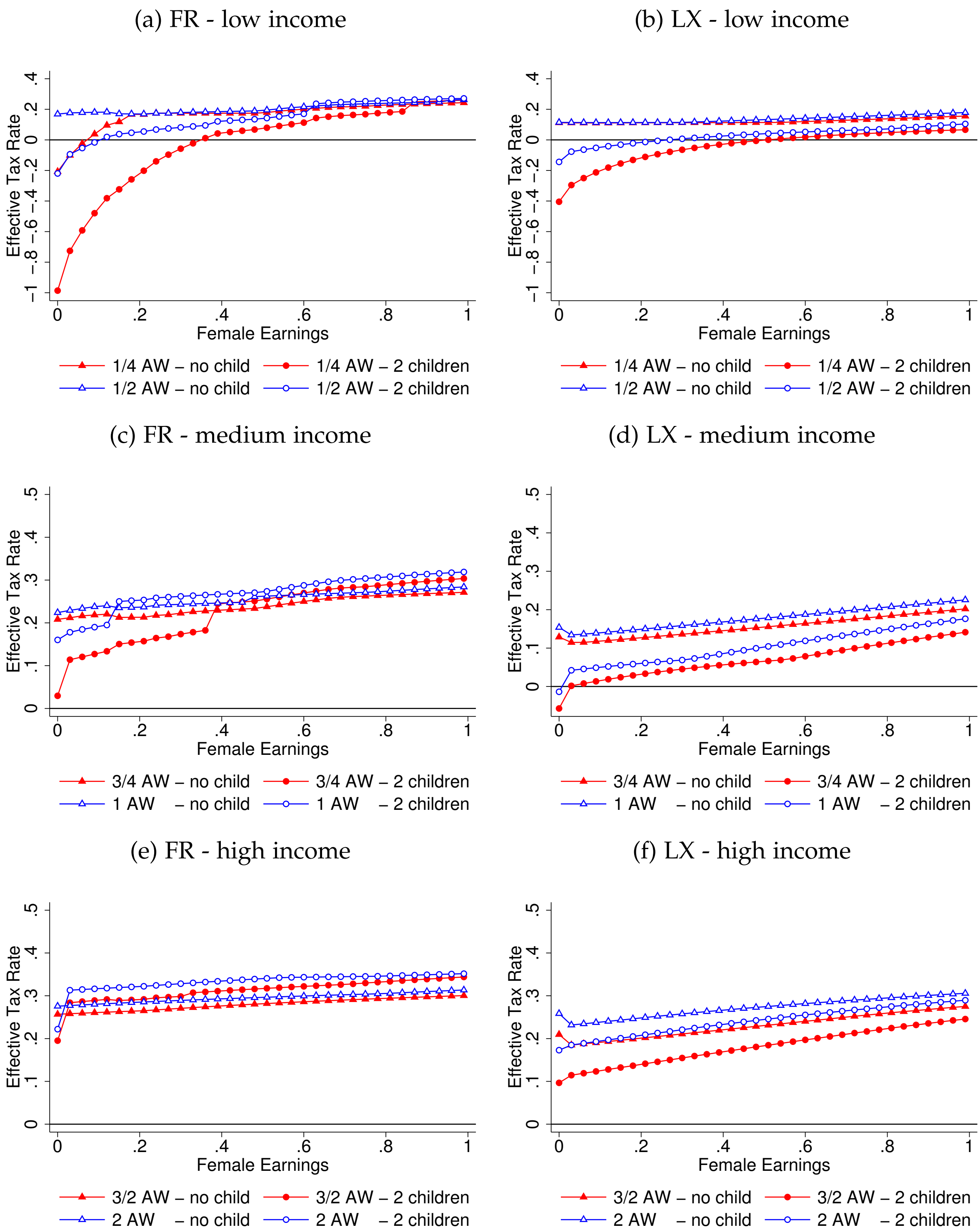


Figure 8: Effective Tax Rates: France and Luxembourg

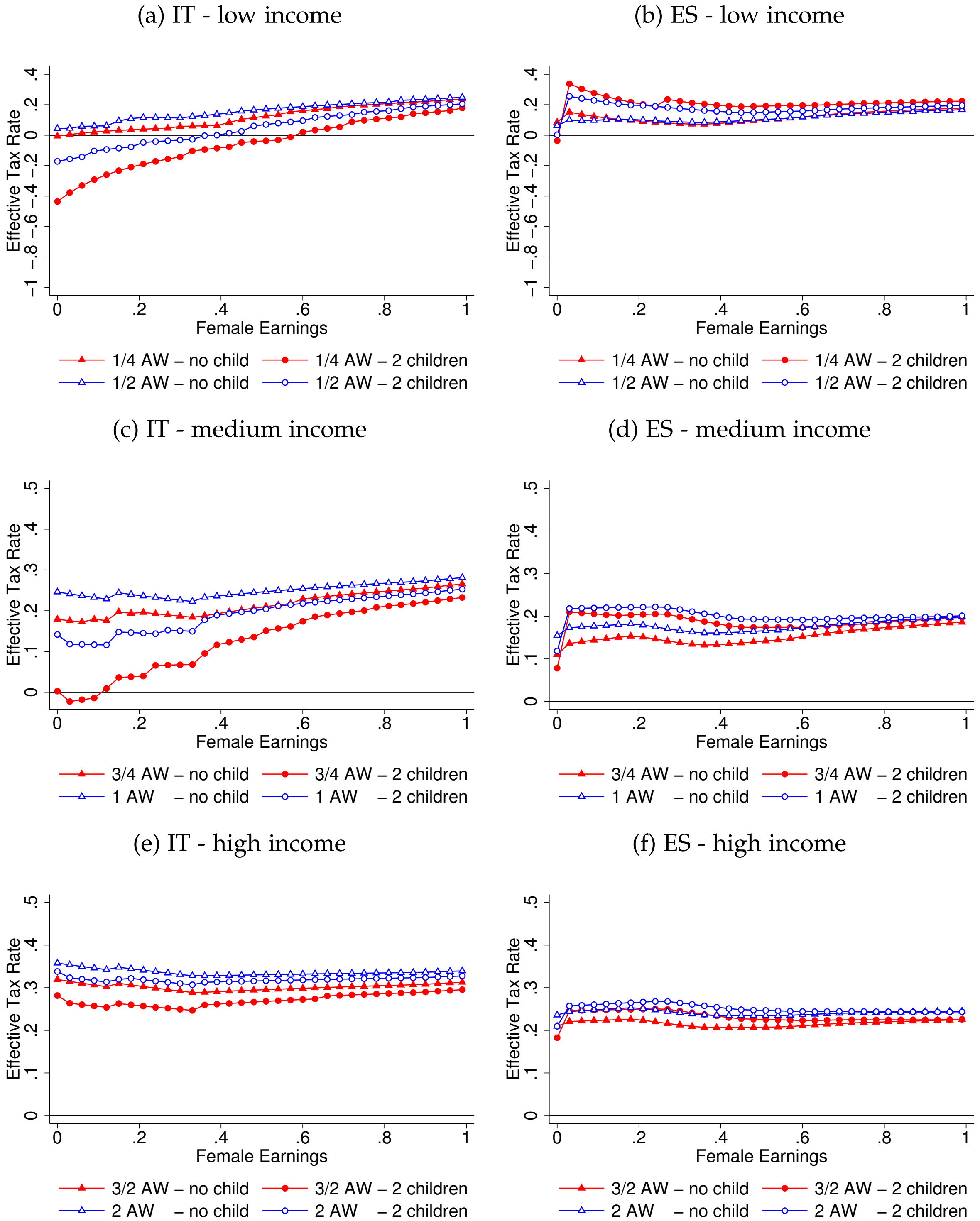
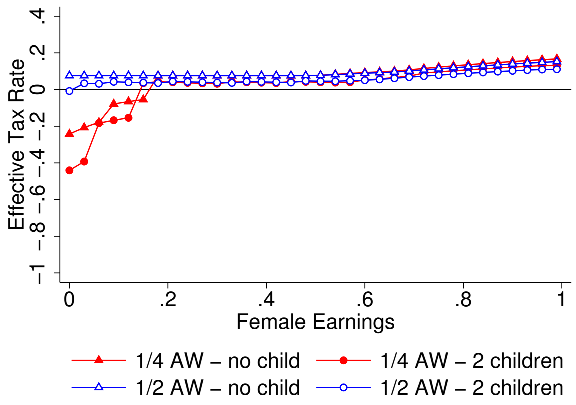
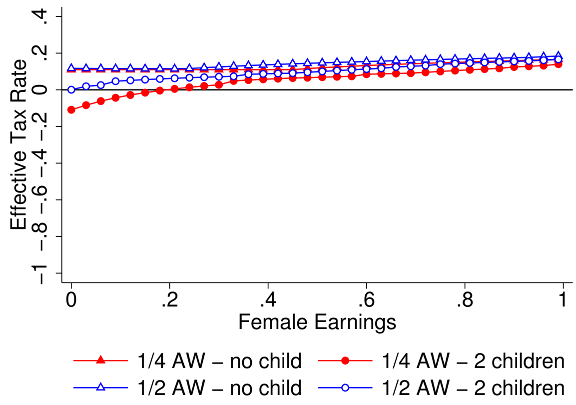


Figure 9: Effective Tax Rates: Italy and Spain

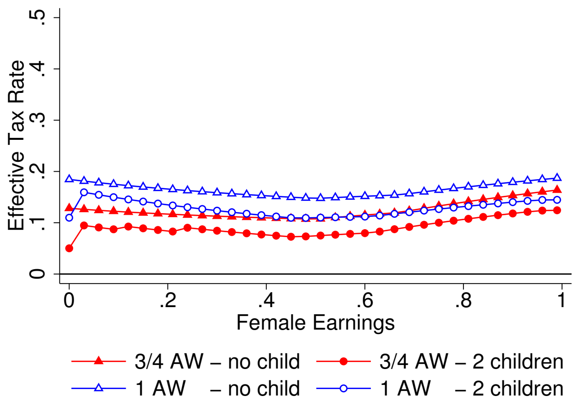
(a) GR - low income



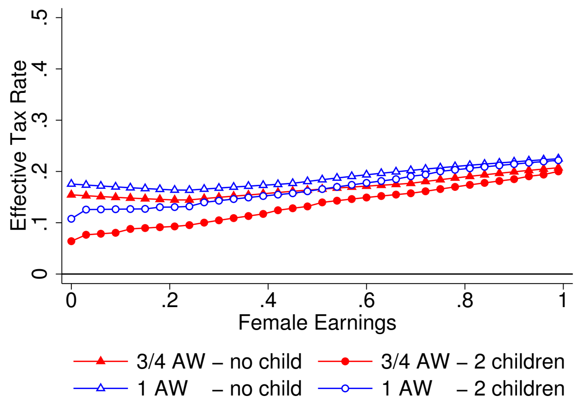
(b) PT - low income



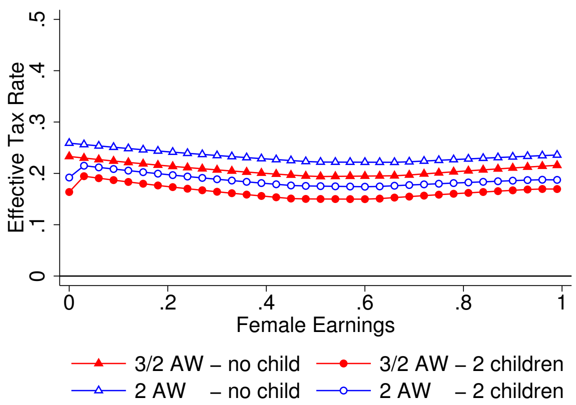
(c) GR - medium income



(d) PT - medium income



(e) GR - high income



(f) PT - high income

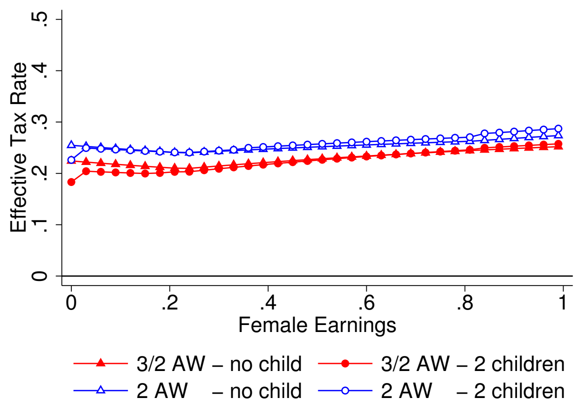


Figure 10: Effective Tax Rates: Greece and Portugal

D Employment rates of prime-age married women

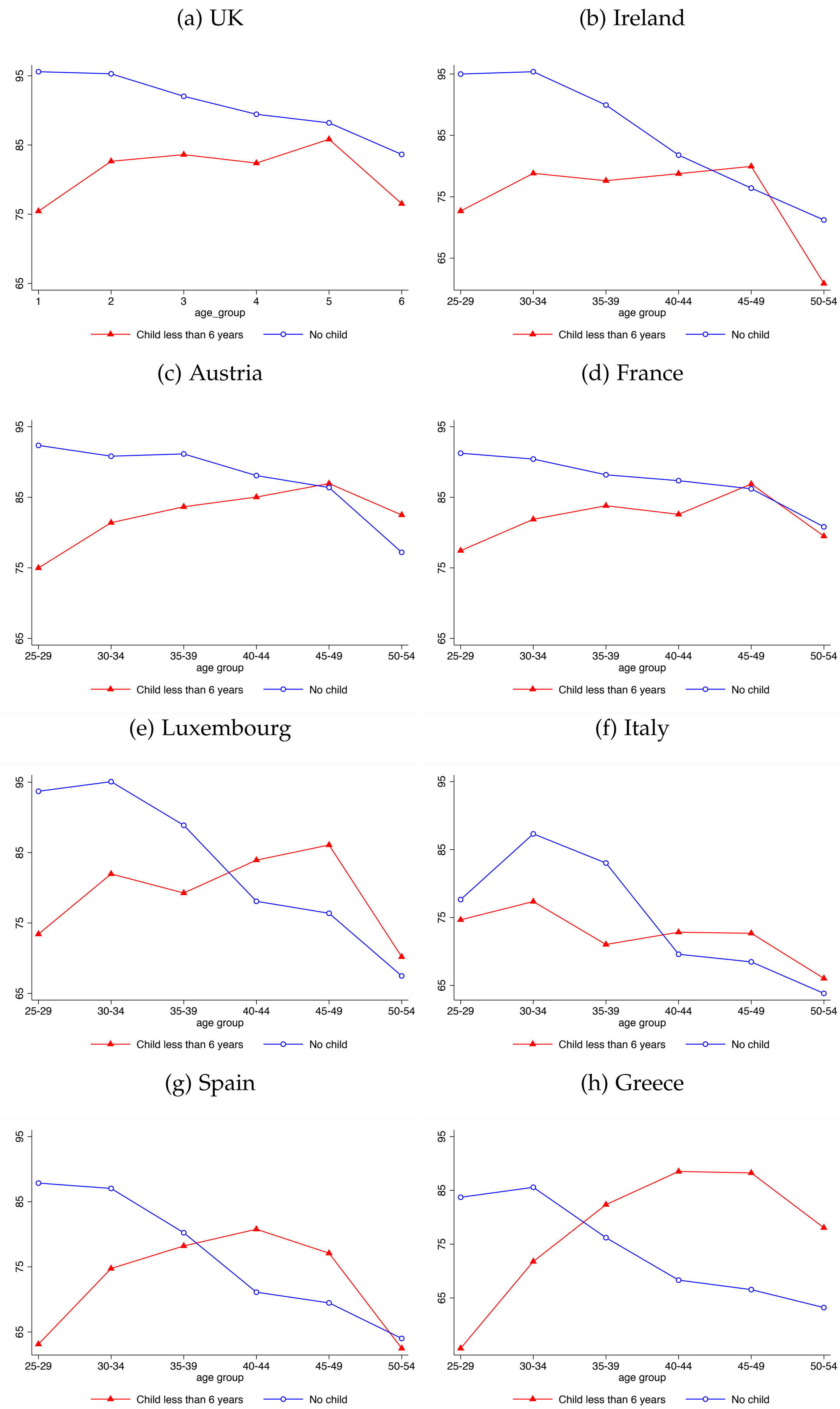


Figure 11: Employment Rates of prime-age married women