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Child-Related Transfers, Household Labor Supply and Welfare

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Abstract

What are the macroeconomic and welfare effects of expanding transfers to households with children in the United States? How do childcare subsidies compare to alternative policies? We answer these questions in a life-cycle equilibrium model with household labor-supply decisions, skill losses of females associated to non participation, and heterogeneity in terms of fertility, childcare expenditures and access to informal care. We consider the expansion of transfers that are contingent on market work - childcare subsidies and Child and Dependent Care Tax Credits (CDCTC) - versus those that are not - Child Tax Credits (CTC). We find that expansions of transfers of the first group have substantial positive effects on female labor supply, that are largest at the bottom of the skill distribution. Universal childcare subsidies at a 75% rate lead to long-run increases in the participation of married females of 8.8%, while an equivalent expansion of the CTC program leads to the opposite - a reduction of about 2.4%. We find that welfare gains of newborn households are substantial and up to 2.3% under the CDCTC expansion. The expansion of none of the existing programs, however, receives majority support at the time of its implementation. Our findings show substantial heterogeneity in welfare effects, with a small fraction of households - young and poorer households with children - who gain significantly while many others lose.

JEL Codes: E62, H24, H31.

Keywords: Household labor supply, child-related transfers, childcare.

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1 Introduction

This paper is about the macroeconomic and welfare implications of transfers to households with children. We focus in detail on the evaluation of hypothetical large-scale expansions of existing programs in the United States. We ask: quantitatively, what are the effects of a large expansion of current arrangements on household labor supply? What are the consequences on female skill accumulation? What are the resulting welfare effects, i.e. who gains and who loses and by how much?

Three major reasons motivate our work. First, the findings from the literature on the determinants of labor supply suggest that the cost of childcare is a central determinant of female labor supply. From this perspective and given the underlying large elasticities of female labor supply, transfers that are tied to market work (e.g. childcare subsidies) would lead to significant increases in female labor force participation and hours. Moreover, these transfers are expected to have their largest effects on less-skilled females (i.e. those who participate less). Hence, they constitute a-priori an appealing form of transfers without the typical perverse consequences on work incentives. There are, however, natural trade-offs. Expansions of current programs can be concomitant with reductions in the labor supply of males and have to be financed with distortionary taxes. There can be welfare losses as a result.

Second, transfers to households with children are a topic of first-order policy relevance in the United States and other countries. Policies of this sort are routinely discussed in policy circles. In the United States, President Obama has discussed these policies in major speeches and events.[1] Candidates from both major parties have advanced proposals in this regard in the 2016 Presidential race.

Third, several high-income countries subsidize childcare provision in substantial ways. Sweden for instance, devotes nearly 0.9% of aggregate output to this form of public assistance, while annual public expenditures per child in formal childcare amount to about US$ 6,000 (PPP) in 2008. Several authors, e.g. Rogerson (2007), have attributed the high levels

[1] For instance, regarding childcare subsidies, Barack Obama stated in the 2015 State of the Union Address: *"In today's economy, when having both parents in the workforce is an economic necessity for many families, we need affordable, high-quality childcare more than ever. It's not a nice-to-have – it's a must-have. So it's time we stop treating childcare as a side issue, or as a women's issue, and treat it like the national economic priority that it is for all of us."*

of female labor supply in Scandinavia to the scope and magnitude of childcare subsidies there. In contrast, childcare subsidies in the United States are much smaller. The main childcare subsidy program in the United States, the Child Care Development Fund (CCDF), is minuscule in comparison.[2] Overall, the United States spends less than 0.1% of output in childcare subsidies, and subsidies per child in formal childcare amount to less than US$ 900 in 2011.[3] Indirect childcare subsidies via the Child and Dependent Care Tax Credit (CDCTC) program are also very small, with implicit expenditures of only about 0.02% of GDP.[4] On the other hand, the size of the Child Tax Credit (CTC) program that provides tax credits to households – independently of childcare expenses – is relatively larger and about 0.3% of GDP.[5] Overall, despite these policy differences between the U.S. and other rich countries, the consequences for the U.S. economy of an expansion of current transfers to households with children to levels elsewhere are largely unexplored. We fill this void in this paper in a systematic way, by focusing on the tradeoffs implied by different programs for their aggregate and distributional effects.

We build an equilibrium life-cycle model with heterogeneous single and married individuals suitable for policy analysis. Individuals differ in terms of their labor endowments, which differ both initially and how they evolve over the life cycle. In particular, the labor market productivities of females are endogenous and depend on their labor market histories: not working is costly for females since if they do not work their skills depreciate. If a female with children works, married or single, the household has to purchase childcare services. Married households decide if both or only one member should work, and if so how much, in the presence or absence of (costly) children and available child-related transfers.

Three key features, which we model together in a unified framework, distinguish our work from related papers. First, as in Guner, Kaygusuz and Ventura (2012-a, 2012-b), we allow for jointly determined labor-supply decisions of spouses at the extensive and intensive margins. This matters as a large expansion of current policy arrangements will affect married households, and changes in both margins within married households are possibly substantial

[2] See section 2 for a detailed description.

[3] Source: OECD Family Database, http://www.oecd.org/social/family/database.htm. Table PF3.1: Public spending on childcare and early education. Public expenditure on childcare is all public financial support (in cash, in-kind or through the tax system) for families with children participating in formal day-care services (e.g. crèches, day-care centres and family day-care for children under 3).

[4] Source: Maag (2013). The total spending on the CDCTC was 3.51 Billion dollars in 2013.

[5] Source: Maag (2013). The total spending on the CTC was 54.15 Billion dollars in 2013.

for generous expansions. Second, in line with data, we jointly account for the presence of children across married and single households, the timing of their arrival and the associated childcare costs. In particular, we account jointly for the observed heterogeneity in terms of the number of children, childcare costs and the availability of informal childcare. Finally, we model the dynamic costs and benefits of participation decisions by allowing the labor market skills of females to depreciate due to childbearing disruptions. Hence, the expansions of transfer schemes that we consider capture potential increases in female skills, and corresponding effects on gender wage gaps.

We parameterize our model in line with U.S. data, taking into account the three main programs of transfers to households with children: the direct U.S. childcare subsidy program (CCDF), the program of tax credits to households with realized childcare expenditures (CDCTC), and the program of tax credits to households with children (CTC). We use a host of aggregate and cross-sectional facts to discipline our benchmark economy. In line with data, our framework is consistent with the rise in female labor-force participation by skill, and the life-cycle patterns of participation rates by skill and by the presence of children.

Economy-wide Effects We evaluate and compare large-scale expansions of the three programs of transfers to households with children in our policy exercises. To achieve revenue neutrality, expansions beyond current levels are financed via an additional, proportional income tax on all households. We take universal subsidies at the current benchmark subsidy rate (75%) as a departing point, which is financed by an additional 1.3% income tax on households. We then evaluate expansions of the CTC and CDCTC programs that require the *same* additional tax rate on households. This ensures clean comparisons across the exercises that we conduct.

We first compare universal subsidies with an equivalent expansion of the CTC program at the same tax rate. These are sharply different exercises: one provides childcare subsidies for all at a flat rate, while the other one provides transfers to all households with children that decline with income. We then engineer an equivalent expansion of the CDCTC program – at the same tax rate – that provides a mixture of childcare subsidies and transfers that decline with income. In a nutshell, in order to receive tax credits from the CDCTC program, a household must have positive labor earnings – for both husband and wife if married – and positive childcare expenditures. In contrast to a 75% universal subsidy, the subsidy rate declines by household income, and can be initially higher than 100% in which case a household receives a transfer beyond what they spend on childcare expenditure.

We find that universal subsidies lead to substantial effects on participation rates and labor supply. At the benchmark subsidy rate, participation rates increase by 8.8% and aggregate hours by about 1.4% across steady states. The effects on participation are much higher for less educated females. A universal 75% subsidy on childcare increases the participation rate of married females with less than high school education by 21.5 %, while for those with more than college education it amounts to 4.7%. Similar, but more moderate effects emerge under an expansion of transfers to households under the CDCTC. The overall participation rates increases by 5.2%, and its change is also declining in educational attainment. Total hours of work remain essentially constant across steady states.

In contrast, the equivalent expansion of the CTC leads to reductions in labor supply across the board. Across steady states, the participation rate of married females drops by 2.4%, and hours worked of all drop by 1.6%. As a result of all changes, output falls by 1.2%. Behind these effects is the nature of this program, which is effectively a transfer to households with children without any work requirement. Thus, it produces an income effect on labor supply decisions that reduces hours of work.

Overall, our results show that the endogeneity of female skills in our setup is key in assessing the quantitative effects of child-related transfers. We find that the effects of expanding childcare subsidies or the CDCTC on participation rates and hours are sharply reduced when female skills are assumed to be exogenous. We find, for instance, that under exogenous skills, an expansion of the CDCTC program leads to an increase of participation rates of just one-third of the corresponding expansion in our benchmark economy. In contrast, with exogenous skills, the expansion of the CTC program has larger negative effects on female labor supply.

Welfare Three central findings emerge in terms of welfare. First, the welfare gains for newborn households are substantial. This occurs under the expansion of all programs. Taking into account transitions between steady states, welfare gains (consumption compensation) amount to 2.3%, 1.9% and 0.7%, under the expansions of the CDCTC and the CTC programs, and the universalization of childcare subsidies, respectively. Since the expansions are revenue neutral and designed to be comparable at a common tax rate, it is clear that the expansion of the CDCTC program maximizes welfare gains per dollar spent in transfers to households with children. These results underscore the sharp differences between the policy options. Transfers from CDCTC and the CTC decline with household income, and as a result, their expansion implies a larger level of redistribution to poorer households. Given diminishing marginal utility of consumption, these expansions result in larger welfare gains at the start of the life cycle.

Second, expansions of these programs generate a diversity of welfare effects. Taking into account transitions between steady states, the welfare gains for single mothers who have children early in life cycle are large: 15.3%, 10.3% and 4.0% under the expansions of CDCTC, CTC and the universalization of subsidies, respectively. Welfare gains are much larger for less educated households. For newborn married households with less than high school education, gains amount to 4.4% (12.5%) under the CDCTC (CTC) expansion, while those with more than college education experience losses under the CDCTC (CTC) expansion: -1.1% (-1.3%). Underlying these findings is the redistributive nature of the exercises we conduct. In other words, the CTC or CDCTC expansions disproportionately benefit poorer households, and/or childcare expenditures constitute a large burden for them.

Finally, a central finding is the absence of majority support for the expansion of any program at the date of their introduction. Indeed, for all the cases we analyze, we find that there is no majority support even among newborn households in the new steady state. Key for these findings is the simple fact that these transfers benefit relatively few households – young households with children who are not at the top of the skill distribution – and that their costs – additional taxes – have to be paid by all.

Related Literature This paper is related to several strands of literature. First, it is naturally related to the empirical literature, going back to Heckman (1974), that studies the effects on female labor supply of childcare costs in general, e.g. Hotz and Miller (1988), and childcare subsidies in particular. Blau and Hagy (1998), Tekin (2007) and Baker, Gruber and Milligan (2008) are examples of papers in this group; all find positive and large effects of childcare subsidies on female employment. It is also naturally related to the growing literature that studies macroeconomic models with heterogeneity in two-earner households. Examples of these papers are Chade and Ventura (2002), Greenwood, Guner and Knowles (2003), Olivetti (2006), Kaygusuz (2010, 2015), Hong and Rios-Rull (2007), Heathcote, Violante, Storesletten (2010), Erosa, Fuster and Restuccia (2010), Guner, Kaygusuz and Ventura (2012-a, 2012-b), Bick and Fuchs-Schündeln (2016), among others.

Finally, our paper is closely related to recent work in macroeconomics that studies the aggregate and cross-sectional effects of childcare costs and subsidies. Attanasio, Low and Sanchez-Marcos (2008) model female labor supply decisions in a life-cycle model with endogenous human capital accumulation for females and show that the observed declining cost of childcare had a large, positive effect on married female labor supply during recent decades in the United States. We differ from these authors in light of our policy-analysis focus; we evaluate the aggregate and welfare effects of transfers to households with children, including those that lower the childcare costs. Bick (2016) builds a life-cycle model of female labor supply and fertility and shows that an expansion of subsidized childcare in Germany would lead to a positive effect on female labor supply. In his model, universally available childcare increases the labor force participation of mothers with young (0-2 years old) children by about 14%. By emphasizing the emphasizes the heterogenous reactions of different households and the dynamic incentives to participate, we find smaller increases in participation in the aggregate (8.8%) that are largest for young and less skilled mothers.[6] Lastly, Domeij and Klein (2013) evaluate the desirability of childcare subsidies. Differently from our model, a household needs to purchase one hour of childcare for each hour that a female with children works. This feature allows them to approach childcare subsidies from a Ramsey optimal-taxation perspective. They argue that in economy with distortionary taxes on labor supply, tax deductibility of childcare costs can be optimal. In an application of their model to Germany, they find childcare subsidy rates that are welfare improving. However, welfare-maximizing subsidy rates are not supported by a majority of households. In the current paper, we study expansions of the existing programs targeted to households with children in the US, including childcare subsidies. We also find that such expansions are not supported by a majority of households.

Our paper is organized as follows. Section 2 outlines the main features of the transfer programs to households with children. Section 3 presents the model environment we study. In section 4, we discuss the parameterization of our model and choice of parameter values. In

[6] Attanasio, Low and Sanchez-Marcos (2008) do not study implications for welfare while Bick (2016) does. We study welfare effects in this paper, taking into account transitions between steady states. Bick (2016) finds that universal childcare subsidies in Germany lead to welfare losses, while we find ex-ante welfare gains for newborn households and welfare losses for all households alive.

section 5, we discuss the performance of our model in light of data. Section 6 and 7 present the main findings of the paper for aggregates and welfare. Section 6.3 discusses key aspects of our results. Finally, section 8 concludes.

2 Childcare Subsidies and Child-Related Tax Benefits

Government assistance to households with children in the U.S. takes three different forms: childcare subsidies, child-related tax credits, Earned Income Tax Credits (EITC) and means-tested transfers (welfare). In this section, we briefly describe aspects of programs of the first two groups, with a focus on how they affect expanses related to childcare. Further details are provided in the Online Appendix, where we also describe aspects of the EITC and means-tested transfers that we take into account in our analysis.

Childcare Subsidies The main program that provides childcare subsidies for low-income families in the US is the Child Care Development Fund (CCDF). The program was created as part of the welfare reform (the Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA) of 1996), and consolidated an array of programs into one.[7] The program assists families, usually by providing them with vouchers, to obtain childcare so they can work, or participate in training or education. It explicitly targets low-income households. In order to qualify for a subsidy, parents must be employed, in training, or in school. States use the CCDF funds to assist families with incomes up to 85 percent of state median income (SMI), but can set a lower income eligibility criterion. As of 2011, state income eligibility limits varied from 37% to 83% of SMI; see Lynch (2001). In 1999, the population-weighted average of the income threshold was $25,637 (calculations based on Blau 2000, Table 3, and population estimates from the Census Bureau), which represents about 60-61% of U.S. median household income in 1999. However, only a small fraction of families who qualify actually get the subsidy. According to Administration for Children and Families, for the years 1999 and 2000, the CCDF served only 12-15% of eligible children

[7] An excellent overview of the history of childcare subsidy programs in the U.S. as well as the current system can be found in Blau (2003). CCDF currently is administered at the Federal level by the Child Care Bureau (CCB), Office of Family Assistance in the Administration for Children and Families (ACF). States, Territories, and Tribes receive grants from the program, and they are responsible for ensuring that these are administered in compliance with Federal statutory and regulatory requirements. As a block grant, States have significant discretion in implementing the program and in determining how funds are used to achieve the overall goals of CCDF.

(Blau and Tekin, 2007). In 2010, about 1.7 million children (ages 0-13) were served by the CCDF, which is about 5.5% of all children (ages 0-13) in the US.[8]

Families receiving childcare subsidy from the CCDF must make a co-payment. These co-payments increase with parental income. Both the level of co-payments and the benefit reduction rate differ greatly across states. On average co-payments were about 6% of total family income.[9] Given an average income of $19,000 for recipients, this amounts to a co-payment of about $1,140 dollars per year. In 2010, the CCDF paid a monthly amount of about $400 per family, or $4,800 per year, to care providers (including the co-payment).[10] Hence about 24% of childcare costs ($1,120 out of $4,800) were paid by the families, while the remaining 76% constituted the subsidy.

In general, families that receive the program subsidies are poor, single mothers. In 2010, about half of families had a household income that was less than about $18,000, and only 13% of them had incomes above $27,000. Average income of those receiving subsidy were about $19,000 (about 27% of mean household income in 2010).[11] About 80% of children who receive a childcare subsidy live in a single-mother family. In about 73% of households receiving a subsidy the parents worked, while in about 20% of households, they were in training or education.[12]

Childcare Tax Credits A program that aims to help families with childcare expenditure is the Child and Dependent Care Tax Credit (CDCTC). The CDCTC is a non-refundable tax credit that allows parents to deduct a fraction of their childcare expenses from their tax liabilities. While the childcare subsidies within the CCDF program mainly serves poor households, the CDCTC provides to all, not just poor, households a credit on their out-of-pocket childcare expenses for children below age 12. The maximum qualified childcare expenditure is $3,000 per child, with an overall maximum of $6,000. Parents receive a fraction of qualifying expenses as a tax credit. This fraction starts at 35%, remains at this level up to a household income of $15,000, and then declines with household income. The lowest rate,

[8] Source: http://www.acf.hhs.gov/programs/occ/resource/fy-2010-data-tables-final

[9] Source: http://archive.acf.hhs.gov/programs/occ/data/ccdf_data/data_fact_sheet.pdf

[10] Source: http://www.acf.hhs.gov/programs/occ/resource/fy-2010-data-tables-final

[11] About 49% of families had incomes that were less than $18,310, about 27% has incomes between $18,310 and $27,465, and 13% had incomes that were greater than $27,465. Source: http://archive.acf.hhs.gov/programs/occ/data/ccdf_data/data_fact_sheet.pdf

[12] Source: http://archive.acf.hhs.gov/programs/occ/data/ccdf_data/data_fact_sheet.pdf

which applies for families with a total household income above $43,000, is 20%.[13] As a result of these provisions, a household with income above this limit and two or more children below age 12 can deduct up to $1,200 – 20% of $6,000 – from their tax liabilities. To be able to qualify for the tax credit, both parents must work. Since the CDCTC is not refundable, only households with positive tax liabilities benefit from it. As a result, while the Child Care Development Fund subsidizes expenditures of poorer households, those at the bottom of income distribution do not receive anything from the CDCTC program. More than 50% of benefits were received by households in the top two income quantiles in 2013, with an average benefit of $500 per receiving household (Maag, 2013).

Child Tax Credits The Child Tax Credit (CTC) is a program that provides households a non-refundable tax credit for each child, independently of their childcare expenditures and the labor market status of parents. Thus, it can be viewed as a transfer to households with children subject to income qualifications.

The CTC starts at $1,000 per qualified children under age 17, and stays at this level up to a household income level of $75,000 for single and $110,000 for married couples. Beyond this income limit, the credit declines at a 5% rate until it is completely phased out when the household income is more than $40,000 the income limit ($115,000 for single and $150,000 for married couples). It is worth noting that the CTC is also a non-refundable tax credit: it does not provide benefits for poor households with zero or low tax liabilities. This is partly compensated by the Additional Child Tax Credit (ACTC) that gives part or full of the unused portion of the CTC back to families. The ACTC, however, does not make the CTC fully refundable since only households with some minimum earnings start getting the ACTC. If a household's earnings exceed this minimum earnings threshold, it receives 15% of the difference between its earnings and the threshold or the unused portion of the CTC, whichever is smaller.[14]

[13] See http://www.taxpolicycenter.org/briefing-book and https://www.irs.gov/uac/Ten-Things-to-Know-About-the-Child-and-Dependent-Care-Credit.

[14] See http://www.taxpolicycenter.org/briefing-book and https://www.irs.gov/uac/Ten-Facts-about-the-Child-Tax-Credit. The minimum earnings to qualify for the ACTC was $11,000 in 2005. The 2009 American Recovery and Reinvestment Act lowered this minimum income to $3,000 and this was extended through 2017 as part of the 2012 American Taxpayer Relief Act. This increased the number of poor families getting transfers from the CTC significantly. In 2013, close to 50% of benefits under the CTC and the ACTC were received by households in the bottom two income quantiles, but given the way the ACTC works, the largest share of benefits were still collected by households who are in the second income quantile (Maag, 2013). The

Current Policy Debate Expansion of child-related transfers to working families with children is at the center of the policy debate in the US today. The current proposals to reform the existing programs take three forms:

1. *Expansion of Childcare Subsidies:* The CCDF currently serves only a small fraction of families that it is intended to serve (families with incomes up to 85 percent of state median income). States either use direct rationing or put less effort reaching out to potential users, and the application procedures tend to be complicated (Adam and Rohacek 2002 and Adams and Heller 2015). Not surprisingly, there has been several calls for providing further funding for the program and making it more accessible to poor families. As part of his 2015 State of the Union initiative, for example, President Obama proposed to expand the CCDF so that it covers about 1 million additional children, an almost 60% increase in the number of children covered (White House, 2015). We consider the expansion (universalization) of childcare subsidies in our main exercises.

2. *Making the CTC and the CDCTC refundable:* Since the CTC and CDCTC are not fully refundable, they do not serve poor families with very low tax liabilities. As a result of the temporary legislations mentioned above, the CTC is currently refundable for a much large number of poor families. This temporary legislation, however, will end in 2018 and there have been proposal to make the $3,000 minimum earnings threshold to qualify for the ACTC permanent, or to reduce it to zero and make the CTC fully refundable (Maag, 2015). Along similar lines, there has also been calls for making the CDCTC fully refundable (Burman, Maag, and Rohaly, 2005). We evaluate the effects of making these programs fully refundable.

3. *Increasing the CTC and the CDCTC payments:* Finally, there has been calls for increasing directly the CTC and CDCTC payments. A recent proposal suggests to increase the maximum per-chid CTC from $1,000 to $2,500 (Maag, 2015). President Obama suggested to increase the CDCTC such that any family with young (0 to 5 years old) children whose income is below $120,000 qualifies for a $3,000 per child tax credit (White House, 2015). Such a family would get $1,200 credit under the current

average amount of benefits per receiving household was about $1,500.

system. We evaluate fully-refundable expansions of the CTC and CDCTC in our main exercises.

3 The Economic Environment

We study a stationary overlapping generations economy populated by a continuum of males (m) and a continuum of females (f). Let $j \in \{1, 2, ..., J\}$ denote the age of each individual. Population grows at rate n. Individuals differ in terms of their marital status. For tractability, we assume that they are born as either single or married and their marital status does not change over time. Each individual is also born with a given type (education level). The life-cycle of agents is split into two parts. Each agent starts life as a worker and at age J_R, individuals retire and collect pension benefits until they die at age J. We assume that married households are comprised by individuals who are of the same age. As a result, members of a married household experience identical life-cycle dynamics.

Married households and single females also differ in terms of the number of children attached to them. They can be childless or endowed with children. The number of children that a household has depends on its marital status, as well as on education levels of its members. These children appear either early or late in the life-cycle exogenously. Children affect the resources available to households for three periods, and this is mitigated partially or fully by government policies targeted to children. Children do not provide any utility.

Each period, working households (married or single) make labor supply, consumption and savings decisions. Children imply a fixed time cost for females. If a female with children, married or single, works, then the household also has to pay childcare costs. Households differ whether they have access to informal childcare (care provided, for example, by grandparents and other relatives), and the childcare costs depends on the availability of informal care, the marital status of the household, and the education levels of household members. The heterogeneity in childcare costs captures differences in childcare demand by households, both in quantity and quality. Not working for a female is costly; if she does not work, she experiences losses of labor efficiency units for next period. Furthermore, if the female member of a married household supplies positive amounts of market work, then the household incurs a utility cost.

A government taxes households and provides transfers. Some of the transfers, such as childcare subsidies, child tax credits, and childcare tax credits aim to lower the burden of childcare costs for families, while others, such as Earned Income Tax Credits and welfare payments, work mainly as income transfers for low income households.

Production and Markets There is an aggregate firm that operates a constant returns to scale technology. The firm rents capital and labor services from households at the rate R and w, respectively. Using K units of capital and L_g units of labor, firms produce $F(K, L_g) = K^\alpha L_g^{1-\alpha}$ units of consumption (investment) goods. We assume that capital depreciates at rate δ_k. Childcare services are provided using labor services only. Thus, the price of childcare services is the wage rate, w. As a result, total labor services available are split between childcare services and in the production of consumption and investment goods, L_g. Households save in the form of a risk-free asset that pays the competitive rate of return $r = R - \delta_k$.

Heterogeneity and Demographics Individuals differ in terms of their labor efficiency units in two respects. First, at the start of life, each *male* is endowed with an exogenous type z that remains constant over his life cycle. Let $z \in Z$ and $Z \subset R_{++}$ be a finite set. We refer to this type of heterogeneity as the education type. Second, within each education type, there is further heterogeneity; some agents with the same education are more productive than others. This additional level of heterogeneity is denoted by ε_z. Let $\varepsilon_z \in E_z$ and $E_z \subset R$ be a finite set. Like z, ε_z is drawn at the start of an agent's life and remains constant over his life cycle.

Average productivity of age-j, type-z agents are denoted by the function $\varpi_m(z, j)$, while the productivity of a age-j, type-z agent with ε_z is given by $\varpi_m(z, j)\varepsilon_z$. Let $\Omega_j(z)$ denote the fraction of age-j, type-z males in male population, with $\sum_{z \in Z} \Omega_j(z) = 1$. We assume that ε_z is distributed symmetrically around 1, and let $\Xi_z(\varepsilon_z)$ be the fraction of type ε_z agents such that $\sum_{\varepsilon_z \in E_z} \Xi(\varepsilon_z)\varepsilon_z = 1$. Hence, while some type-z agents have productivity levels above the mean along their life-cycle, others have productivity levels below the mean.

As males, each female starts her working life with a particular education type, which is denoted by $x \in X$, where $X \subset R_{++}$ is a finite set. Let $\Phi_j(x)$ denote the fractions of age-j, type-x females in female population, with $\sum_{x \in X} \Phi_j(x) = 1$. Again as males, each female is also assigned a particular ε_x value at the start her life. Let $\varepsilon_x \in E_x$ and $E_x \subset R$ be a finite set with $\sum_{\varepsilon_x \in E_x} \Xi(\varepsilon_x)\varepsilon_x = 1$.

As women enter and leave the labor market, their labor market productivity levels evolve endogenously. Each female starts life with an initial productivity level that depends on her education level, denoted by $h_1 = \varpi_f(x, 1) \in H$. After age-1, the next period's productivity level (h') depends on the female's education x, her age, the current level of h and current labor supply (l). We assume that for $j \geq 1$,

$$h' = \mathcal{H}(x, h, l, j).$$

The function $\mathcal{H}$ is increasing in h and x, and non-decreasing in l. It captures the combined effects of a female's education, age and labor supply decisions on her labor market productivity growth. We specify this function in detail in Section (4). The labor market productivity for a female with human capital level h, and a productivity realization ε_x, is given by $h\varepsilon_x$.

Let $M_j(x, z)$ denote the fraction of marriages between an age-j, type-x female and an age-j type-z male, and let $\omega_j(z)$ and $\phi_j(x)$ be the fraction of single type-z males and the fraction of single type-x females, respectively. We assume that given their education types, agents are matched randomly according to their ε values. Hence, among $M_j(x, z)$ couples, a fraction $\Xi_z(\varepsilon_z)\Xi_x(\varepsilon_x)$ is formed by $(\varepsilon_x, \varepsilon_z)$-couples.

Then, the following accounting identity must hold

$$\Omega_j(z) = \sum_{x \in X} M_j(x, z) + \omega_j(z). \tag{1}$$

Furthermore, since the marital status does not change, $M_j(x, z) = M(x, z)$ and $\omega_j(z) = \omega(z)$ for all j, which implies $\Omega_j(z) = \Omega(z)$. Similarly, for age-j females, we have

$$\Phi_j(x) = \sum_{z \in Z} M_j(x, z) + \phi_j(x). \tag{2}$$

Since marital status does not change $\phi_j(x) = \phi(x)$ and $\Phi_j(x) = \Phi(x)$ for all j

We assume that each cohort is $1 + n$ bigger than the previous one. These demographic patterns are stationary so that age j agents are a fraction μ_j of the population at any point in time. The weights are normalized to add up to one, and obey the recursion, $\mu_{j+1} = \mu_j/(1+n)$.

Children Children are assigned exogenously to married couples and single females at the start of life, depending on the education of parents. Each married couple and single female can be of three types: *early* child bearers, *late* child bearers, and those *without* any children. Let $k(x)$ and $k(x, z)$ denote the number of children that a single female of type-x and a married couple of type (x, z) have, if they are early or late childbearers. Early child bearers have these children in ages $j = 1, 2, 3$ while late child bearers have children attached to them in ages $j = 2, 3, 4$. We assume that childbearing status of married couples and singles females differs only with respect to their education types.

Childcare Costs We assume that if a female with children works, married or single, then the household has to pay for childcare costs. These costs are associated with labor force participation decisions of females and are independent of how many hours she decides to work. We also assume that single-female and married-couple households differ whether they have access to informal childcare, denoted by $g \in \{0, 1\}$. The childcare costs depends on the age of the child (s), the type (education) level of parents as well as whether they have access to informal childcare. Let $d(s, x, g)$ and $d(s, x, z, g)$ be the per-child childcare costs for a single female of type-x and a married couple of type-(x, z), respectively. The dependence of childcare costs on parental education intended to capture differences in the quality of childcare that different households might choose, while its dependence on the availability of informal care captures the fact that households who have access to informal care (e.g. grandparents) on average spend less on childcare that households who do not have access to informal care. Since the competitive price of childcare services is the wage rate w, the total cost of childcare for a single female and married couple household with age-s children is given by $wk(x)d(s, x, g)$ and $wk(x, z)d(s, x, z, g)$, respectively.

Utility Cost of Joint Work We assume that at the start of their lives married households draw a $q \in Q$, where $Q \subset R_{++}$ is a finite set. These values of q represent the utility costs of joint market work for married couples. For a given household, the initial draw of utility cost depends on the education of the husband. Let $\zeta(q|z)$ denote the probability that the cost of joint work is q, with $\sum_{q \in Q} \zeta(q|z) = 1$.

Preferences The momentary utility function for a single female is given by

$$U_f^S(c, l, k_y) = \log(c) - \varphi(l + k_y \eta)^{1+\frac{1}{\gamma}},$$

where c is consumption, l is time devoted to market work, φ is the parameter for the disutility of work, η is fixed time cost having age-1 (young) children for a female, and γ is the intertemporal elasticity of labor supply. Here $k_y = 0$ stands for the absence of age-1 (young) children in the household, whereas $k_y = 1$ stands for young children being present. Since a single male does not have any children, his utility function is simply given by

$$U_m^S(c, l) = \log(c) - \varphi(l)^{1+\frac{1}{\gamma}}.$$

Married households maximize the sum of their members utilities. We assume that when the female member of a married household works, the household incurs a utility cost q. Then, the utility function for a married female is given by

$$U_f^M(c, l_f, q, k_y) = \log(c) - \varphi(l_f + k_y\eta)^{1+\frac{1}{\gamma}} - \frac{1}{2}\chi\{l_f\}q,$$

while the one for a married male reads as

$$U_m^M(c, l_m, l_f, q) = \log(c) - \varphi l_m^{1+\frac{1}{\gamma}} - \frac{1}{2}\chi\{l_f\}q,$$

where $\chi\{.\}$ denote the indicator function. Note that consumption is a public good within the household. Note also that the parameter $\gamma > 0$, the intertemporal elasticity of labor supply, and φ, the weight on disutility of work, are independent of gender and marital status.

Following the tradition in macroeconomics literature, we restrict the preferences to be consistent with a balanced-growth path. An alternative specification would allow the marginal utility of consumption to be affected by demographics (e.g. household size) and the female labor force participation decision.[15] In the current specification, the female labor force participation to affect the level of utility through the cost of joint work, q.

3.1 Government

The government taxes labor and capital income, and uses these tax collections to pay for government consumption, tax credits, transfers and childcare subsidies. It also collects payroll taxes and pays for social security transfers.

[15] See, for example, Attanasio, Banks, Meghir and Weber (1999) and Attanasio, Low and Sanchez-Marcos (2008). If the level of childcare expenditure were a choice variable, such a flexible specification would help us to generate the right level of childcare expenditure along the life-cycle for different types of household, and provide us with more flexibility in matching the life-cycle patterns of married females labor supply. Our model, however, performs relatively well in matching different aspects of married female labor supply well (see Table 2 and Figures 2 and 3 below).

Incomes, Taxation and Social Security Income for tax purposes, I, is defined as total labor and capital income. Let a stand for household's assets. Then, for a single male worker, taxable income equals $I = ra + w\varpi_m(z,j)\varepsilon_z l_m$, while for a single female worker, it reads as $I = ra + wh\varepsilon_x l_f$. For a married working household, taxable income equals $I = ra + w(\varpi_m(z,j)\varepsilon_z l_m + h\varepsilon_x l_f)$. We assume that social security benefits are not taxed, so income for tax purposes is simply given by ra for retired households. The total income tax liabilities of married and single households, before any tax credits, are affected by the presence of children in the household, and are represented by tax functions $T^M(I,k)$ and $T^S(I,k)$, respectively, where k stands for the number of children at the household. These functions are continuous in I, increasing and convex. This representation captures the actual variation in tax liabilities associated to the presence of children in households.

There is a (flat) payroll tax that taxes individual labor incomes, represented by τ_p, to fund social-security transfers. Moreover, each household pays an additional flat capital income tax for the returns from his/her asset holdings, denoted by τ_k. We assume that the social security system has to balance its budget every period.

Retired households have access to social security benefits. We assume that social security benefits depend on agents' education types, i.e. initially more productive agents receive larger social security benefits. This allows us to capture in a parsimonious way the positive relation between lifetime earnings and social security transfers, as well as the intra-cohort redistribution built into the system. Let $p_f^S(x)$, $p_m^S(z)$, and $p^M(x,z)$ indicate the level of social security benefits for a single female of type x, a single male of type z and a married retired household of type (x,z), respectively. Hence, retired households pre-tax resources are simply $a + ra + p_f^S(x)$ and $a + ra + p_m^S(z)$ for singles, and $a + ra + p^M(x,z)$ for married ones.

Childcare Subsidies Each household, married or single, with total income level below $\widehat{I}$ and with a working mother receives a subsidy of θ percent for childcare payments. As a result, effective childcare expenditures for a single-female household of type-(x,g) with $k(x)$ children of age s is given by $wk(x)d(s,x,g)(1-\theta)$, if the household qualifies, and $wk(x)d(s,x,g)$ otherwise. For a married couple household, the effective expenditures for a household that do and do not qualify for childcare subsidies are given by $wk(x,z)d(s,x,z,g)(1-\theta)$ and $wk(x,z)d(s,x,z,g)$, respectively.

Tax Credits and Transfers Each household can receive three different tax credits: Earned Income Tax Credits (EITC), Child Tax Credits (CTC), and Child and Dependent Care Tax Credit (CDCTC). Details of these programs are provided in Sections 2, 4 and in the Online Appendix. In a nutshell, the EITC works as a wage subsidy for households below a certain income level, while the CTC is payment for households with children below a certain income level (independent of their childcare expenses). The EITC is fully refundable, i.e. if a household's qualified credits exceed its tax liabilities, then the household gets a refund. The CTC is not refundable but, as it was explained in Section2, it becomes partly refundable due to the Additional Child Tax Credit. The CDCTC, on the other hand, provides a portion of childcare expenses as a non-refundable tax credit and is not means-tested. Finally, each household below a certain income level receives a transfer from the government as a function of its marital status and income. While our quantitative exercises focus on child-related transfers, the presence EITC and the welfare system in the benchmark economy allows us to capture the effects of two important exiting redistribution programs in the U.S. affecting labor supply choices.

For a household with income level I, number of children k and total childcare expenditure D, the total tax credits and transfers for single-male, single-female and married-couple households are represented by functions $TR_f^S(I, D, k)$, $TR_m^S(I, D, k)$ and $TR^M(I, D, k)$, respectively.

3.2 Decision Problem

We now present the decision problem for different types of agents in the recursive language. For single males, the individual state is (a, z, ε_z, j). For single females, the individual state is given by $(a, h, x, \varepsilon_x, b, g, j)$. For married couples, the state is given by $(a, h, x, z, \varepsilon_x, \varepsilon_z, q, b, g, j)$. Note that the dependency of taxes on the presence of children in the household is summarized by age (j) and childbearing status (b): (i) if $b = \{1, 2\}$ and $j = \{b, b+1, b+2\}$, then a household has children, and (ii) there is no child in the house, if $b = 2$ and $j = 1$, or $b = \{1, 2\}$ for all $j > b + 2$, or $b = 0$ for all j. Similarly, the presence of age-1 (young) children (k_y) depends on b and j.

For expositional purposes, we collapse the permanent/exogenous characteristics in the household problems in single vector of state variables. Let $\mathbf{s}^M \equiv (x, z, \varepsilon_x, \varepsilon_z, q, b, g)$ be the vector of exogenous states for married households. Similarly, let $\mathbf{s}_f^S \equiv (x, \varepsilon_x, b, g)$ and $\mathbf{s}_m^S \equiv (z, \varepsilon_z)$ be the vector of exogenous variables for single females and single males, respectively.

The Problem of a Single Male Household Consider now the problem of a single male of type $(a, \mathbf{s}_m^S, j)$. He decides how much to work and how much to save. His problem is given by

$$V_m^S(a, \mathbf{s}_m^S, j) = \max_{a',l} \{U_m^S(c, l) + \beta V_m^S(a', \mathbf{s}_m^S, j+1)\}, \tag{3}$$

subject to

$$c + a' = \begin{cases} a(1 + r(1 - \tau_k)) + w\varpi_m(z, j)\varepsilon_z l(1 - \tau_p) \\ -T^S(I, 0) + TR_m^S(I, 0, 0) \quad \text{if } j < J_R \\ \\ a(1 + r(1 - \tau_k)) + p_m^S(z) - T^S(I, 0) + TR_m^S(I, 0, 0), \text{ otherwise} \end{cases},$$

and

$$l \geq 0,\ a' \geq 0 \text{ (with strict equality if } j = J),$$

where income I is given by

$$I = w\varpi_m(z, j)\varepsilon_z l + ra.$$

Given our assumptions, note that income is $I = w\varpi_m(z, j)\varepsilon_z l$ when he works ($j < J_R$), and by $I = ra$ when he is retired ($j \geq J_R$).

The Problem of a Single Female Household In contrast to a single male, a single female's decisions also depends on her current human capital h and her child bearing status b. Hence, given her current state, $(a, h, \mathbf{s}_f^S, j)$, the problem of a single female is

$$V_f^S(a, h, \mathbf{s}_f^S, j) = \max_{a',l} \{U_f^S(c, l, k_y) + \beta V_f^S(a', h', \mathbf{s}_f^S, j+1)\},$$

subject to

(i) With kids: if $b = \{1, 2\}$, $j \in \{b, b+1, b+2\}$, then there are $k(x)$ children in the household and

$$c+a' = \begin{cases} a(1+r(1-\tau_k))+wh\varepsilon_x l(1-\tau_p)-T^S(I,k(x)) \\ +TR_f^S(I,D(1-\theta),k(x)) \\ -wd(j+1-b,x,g)k(x)(1-\theta)\chi(l) \text{ if } I \leq \widehat{I} \\ \\ a(1+r(1-\tau_k))+wh\varepsilon_x l(1-\tau_p)-T^S(I,k(x)) \\ +TR_f^S(I,D,k(x)) \\ -wd(j+1-b,x,g)k(x)\chi(l), \text{ otherwise} \end{cases},$$

where $I = wh\varepsilon_x l + ra$ and D, childcare expenditures, are $D = wd(j+1-b,x,g)k(x)$. Furthermore, if $b = j$, then $k_y = 1$.

(ii) Without kids but not retired: if $b = 0$, or $b = \{1,2\}$ and $b+2 < j < J_R$, or $b = 2$ and $j = 1$, then there are no children at home and

$$\begin{aligned} c+a' &= a(1+r(1-\tau_k))+wh\varepsilon_x l(1-\tau_p)-T^S(wh\varepsilon_x l+ra,0) \\ &\quad +TR_f^S(wh\varepsilon_x l+ra,0,0). \end{aligned}$$

(iii) Retired: if $j \geq J_R$, then $k(x) = 0$, and

$$c+a' = a(1+r(1-\tau_k))+p_f^S(x)-T^S(ra,0)+TR_f^S(ra,0,0).$$

In addition,

$$h' = \mathcal{H}(x,h,l,j),$$

and

$$l \geq 0,\ a' \geq 0 \text{ (with strict equality if } j = J).$$

Note how the cost of children depends on the age of children, availability of grandparents and the education of the mother. Consider a single female of type-x with available informal care, $g = 1$, whose income is low enough to qualify for the subsidy. If $b = 1$, the household has $k(x)$ children at ages 1, 2 and 3, then $wd(j+1-b,x,g)k(x)(1-\theta)$ denote childcare costs for ages 1, 2 and 3 with $j = \{1,2,3\}$. If $b = 2$, the household has children at ages 2, 3 and 4, then $wd(j+1-b,x,g)k(x)(1-\theta)$ denotes the cost for children of ages 1, 2 and 3 with $j = \{2,3,4\}$ again assuming that she receives the subsidy θ. A female only incurs the time cost of children, i.e. $k_y = 1$, if her kids are 1 model-period old, and this happens if $b = j = 1$ or $b = j = 2$.

The Problem of Married Households Like singles, married couples decide how much to consume, how much to save, and how much to work. They also decide whether the female member of the household should work. Their problem is given by

$$V^M(a,h,\mathbf{s}^M,j)=\max_{a',\,l_f,\,l_m}\{[U_f^M(c,l_f,q,k_y)+U_m^M(c,l_m,l_f,q)]+\beta V^M(a',h',\mathbf{s}^M,j+1)\},$$

subject to

(i) <u>With kids:</u> if $b=\{1,2\}$, $j\in\{b,b+1,b+2\}$, then the household has $k(x,z)$ children and

$$c+a'=\begin{cases} a(1+r(1-\tau_k))+w(\varpi_m(z,j)\varepsilon_z l_m+h\varepsilon_x l_f)(1-\tau_p) \\ -T^M(I,k(x,z))+TR^M(I,D(1-\theta),k(x,z)) \\ -wd(j+1-b,x,z,g)k(x,z)(1-\theta)\chi(l_f) \text{ if } I\leq\widehat{I} \\ \\ a(1+r(1-\tau_k))+w(\varpi_m(z,j)\varepsilon_z l_m+h\varepsilon_x l_f)(1-\tau_p) \\ -T^M(I,k(x,z))+TR^M(I,D,k(x,z)) \\ -wd(j+1-b,x,z,g)k(x,z)\chi(l_f),\ \text{otherwise}\end{cases},$$

where $I=w\varpi_m(z,j)\varepsilon_z l_m+wh\varepsilon_x l_f+ra$ and $D=wd(j+1-b,x,z,g)k(x,z)$. Furthermore, if $b=j$, then $k_y=1$.

(ii) <u>Without kids but not retired:</u> if $b=0$, or $b=\{1,2\}$ and $b+2<j<J_R$, or $b=2$, $j=1$, then $k(x,z)=0$ and

$$\begin{aligned} c+a' &= a(1+r(1-\tau_k))+w(\varpi_m(z,j)\varepsilon_z l_m+h\varepsilon_x l_f)(1-\tau_p) \\ &- T^M(I,0)+TR^M(I,0,0), \end{aligned}$$

where $I=w\varpi_m(z,j)\varepsilon_z l_m+wh\varepsilon_x l_f+ra$.

(ii) <u>Retired:</u> if $j\geq J_R$, then $k(x,z)=0$ and

$$c+a'=a(1+r(1-\tau_k))+p^M(x,z)-T^M(ra,0)+TR^M(ra,0,0).$$

In addition,

$$h'=\mathcal{H}(x,h,l_f,j),$$

and

$$l_m\geq 0,\ \ l_f\geq 0, a'\geq 0 \text{ (with strict equality if } j=J).$$

3.3 Stationary Equilibrium

The aggregate state of this economy consists of distribution of households over their types, asset and human capital levels. Let the function $\psi_j^M(a, h, \mathbf{s}^M)$ denote the number of married individuals of age j with assets a, female human capital level h, and exogenous states $\mathbf{s}^M$. The function $\psi_{f,j}^S(a, h, \mathbf{s}_f^S)$, for single females, and the the function $\psi_{m,j}^S(a, \mathbf{s}_m^S)$, for single males, are defined similarly. Note that household assets, a, and female human capital levels, h, are continuous decisions. We denote by $A = [0, \overline{a}]$ and $H = [0, \overline{h}]$ the sets of possible assets and female human capital levels.

We present a formal notion of a stationary equilibrium for our economy in the Online Appendix. We describe here the government budget constraint in detail as it is a central part of our subsequent quantitative exercises. In equilibrium, total taxes must cover government expenditures, G, total government spending on childcare subsidies, C, and total transfers, TR. That is,

$$\begin{aligned} G + C + TR &= \sum_j \mu_j [\sum_{\mathbf{s}^M} \int_{A\times H} T^M(I, k(x,z)) \psi_j^M(a, h, \mathbf{s}^M)\ dh\ da \\ &+ \sum_{\mathbf{s}_m^S} \int_A T^S(I, 0) \psi_{m,j}^S(a, \mathbf{s}_m^S)\ da \\ &+ \sum_{\mathbf{s}_m^S} \int_{A\times H} T^S(I, k(x)) \psi_{f,j}^S(a, h, \mathbf{s}_f^S)\ dh\ da] + \tau_k r K, \end{aligned} \quad (4)$$

where I represents a household's total income as defined earlier in the description of the individual and household problems. The total government expenditure on childcare subsidies is given by

$$\begin{aligned} C &= \theta \sum_{\{\mathbf{s}^M|b\}} \sum_{b=1,2} \sum_{j=b,b+2} \mu_j \int_{A\times H} \chi(I, \widehat{I}, l_f^M) k(x,z) w d(j+1-b, x, z, g) \psi_j^M(a, h, \mathbf{s}^M)\ dh\ da \\ &+ \theta \sum_{\{\mathbf{s}_f^S|b\}} \sum_{b=1,2} \sum_{j=b,b+2} \mu_j \int_{A\times H} \chi(I, \widehat{I}, l_f^S) w k(x) d(j+1-b, x, g) \psi_{f,j}^S(a, h, \mathbf{s}_f^S)\ dh\ da], \end{aligned} \quad (5)$$

where the indicator function $\chi(I, \widehat{I}, l)$ indicates whether a household qualifies for a subsidy. It equals 1 if $I \leq \widehat{I}$ and $l > 0$, and 0 otherwise.

In turn, aggregate transfers are given by

$$
\begin{aligned}
TR &= \sum_j \mu_j [\sum_{\mathbf{s}^M} \int_{A\times H} TR^M(I, D, k(x,z)) \psi_j^M(a, h, \mathbf{s}^M)\ dh\ da \\
&+ \sum_{\mathbf{s}_m^S} \int_A TR_m^S(I, 0, 0) \psi_{m,j}^S(a, \mathbf{s}_m^S)\ da \\
&+ \sum_{\mathbf{s}_f^S} \int_{A\times H} TR_f^S(I, D, k(x)) \psi_{f,j}^S(a, h, \mathbf{s}_f^S)\ dh\ da],
\end{aligned} \tag{6}
$$

where D stands for childcare expenditures, as defined earlier in the description of the household problems.

4 Parameter Values

We now proceed to assign parameter values to the endowment, preference, and technology parameters of our benchmark economy. To this end, we use aggregate as well as cross-sectional and demographic data from multiple sources. As a first step in this process, we start by defining the length of a period to be 5 years.[16]

Endowments Agents start their life at age 25 as workers and work for forty years, corresponding to ages 25 to 64. The first model period ($j = 1$) corresponds to ages 25-29, while the first model period of retirement ($j = J_R$) corresponds to ages 65-69. After working 8 periods, agents retire at age 65 and live until age 80 ($J = 11$). The population grows at the annual rate of 1.1%, the average values for the U.S. economy between 1960-2000.

There are 5 education types of males. Each type corresponds to an educational attainment level: *less than high school* (hs-), *high school* (hs), *some college* (sc), *college* (col) and *post-college* (col+) education. We use data from the 2008 CPS March Supplement to calculate age-efficiency profiles for each male type. Within an education group, efficiency levels correspond to mean weekly wage rates, which we construct using annual wage and salary income and weeks worked. We normalize wages by the mean weekly wages for all males and females between ages 25 and 64.[17] Figure A1 in the Online Appendix shows the

[16] Details of the mapping of model to data for taxes, Earned Income Tax Credit, welfare payments and social security are relegated to the Online Appendix.

[17] We include in the sample the civilian adult population who worked as full time workers last year, and exclude those who are self-employed or unpaid workers or make less than half of the minimum wage. Our sample restrictions are standard in the literature and follow Katz and Murphy (1992).

second degree polynomials that we fit to the raw wage data. In our quantitative exercises, we calibrate the male efficiency units, $\varpi_m(z,j)$, using these fitted values.

There are also 5 education types for females. Table A1 in the Online Appendix reports the initial (ages 25-29) efficiency levels for females together with the initial male efficiency levels and the corresponding gender wage gap. We use the initial efficiency levels for females to calibrate their initial human capital levels, $h_1 = \varpi_f(x,1)$. After ages 25-29, the human capital level of females evolves endogenously according to

$$h' = \mathcal{H}(x,h,l,j) = \exp\left[\ln h + \alpha_j^x \chi(l) - \delta_x(1-\chi(l))\right]. \tag{7}$$

We calibrate the values for δ_x and α_j^x as follows. First, we calculate from the Panel Study of Income Dynamics (PSID), the median annual wage loss associated to non-participation for females conditional on their education. Given the small sample size, we restrict our attention to two education groups: unskilled (hs-, hs and sc), and skilled (col and col+). We find that the skills of more educated females depreciate faster. From our estimates, we set $\delta_x = 0.009$ for the unskilled group and $\delta_x = 0.022$ for the skilled group.[18] We select α_j^x so that if a female of a particular type works in every period, her wage profile has exactly the same shape as a male of the same type. This procedure takes the initial gender differences as given, and assumes that the wage growth rate for a female who works full time will be the same as for a male worker; hence, it sets α_j^x values equal to the growth rates of male wages at each age. Table A2 in the Online Appendix shows the calibrated values for α_j^x.

We assume that the variables capturing residual heterogeneity within educational types, ε_x and ε_z, take two values: $\varepsilon_z \in E_z = \{\varepsilon, -\varepsilon\}$ and $\varepsilon_x \in E_x = \{\varepsilon, -\varepsilon\}$. Furthermore, we set $\Xi_z(\varepsilon) = \Xi_x(-\varepsilon) = \Xi_z(\varepsilon) = \Xi_x(-\varepsilon) = 0.5$. This leaves us with one parameter (ε) to calibrate. We set this parameter so that, in conjunction with heterogeneity in education types, the model reproduces the variance of log-wages for males in our first age group. Using estimates in Heathcote, Storesletten and Violante (2004), we calculate a value of about 0.227 for this statistic. Matching this value requires $\varepsilon = 0.395$ (39.5%).

Demographics We determine the distribution of individuals by productivity types for each gender, i.e. $\Omega(z)$ and $\Phi(x)$, using data from the 2008 U.S. Census. For this purpose,

[18] The details are provided in the Online Appendix.

we consider all household heads or spouses who are between ages 30 and 39 and for each gender calculate the fraction of population in each education cell. For the same age group, we also construct $M(x,z)$, the distribution of married working couples, as shown in Table A3 the Online Appendix. Given the fractions of individuals in each education group, $\Phi(x)$ and $\Omega(z)$, and the fractions of married households, $M(x,z)$, in the data, we calculate the implied fractions of single households, $\omega(z)$ and $\phi(x)$, from accounting identities (5) and (6) in the article. The resulting values are reported in Table A4 in the Online Appendix. About 74% of households in the benchmark economy consists of married households, while the rest (about 26%) are single. Since we assume that the distribution of individuals by marital status is independent of age, we use the 30-39 age group for our calibration purposes. This age group captures the marital status of recent cohorts during their prime-working years, while being at the same time representative of older age groups.

Children In the model each single female and each married couple belong to one of three groups: *without* children, *early* child bearer and *late* child bearer. The early child bearers have children at ages 1, 2 and 3, corresponding to ages 25-29, 30-34 and 35-39, while late child bearers have their children at ages 2, 3, and 4, corresponding to ages 30-34, 35-39, 40-44. This particular structure captures the fact that births occur within a short time interval, mainly between ages 25 and 29 for households with low education and between ages 30 and 34 for households with high education in 2008 CPS June supplement.[19]

For singles, we use data from the 2008 CPS June supplement and calculate the fraction of 40 to 44 years old single (never married or divorced) females with zero live births. This provides us with a measure of lifetime childlessness. Then we calculate the fraction of all single women above age 25 with a total number of two live births who were below age 30 at their last birth. This fraction gives us those who are early child bearers, and the remaining fraction are assigned as late child bearers. The resulting distribution is shown in Table A5 the Online Appendix.

We follow a similar procedure for married couples, combining data from the CPS June Supplement and the U.S. Census. For childlessness, we use the larger sample from the U.S. Census.[20] The Census does not provide data on total number of live births but the total

[19]The CPS June Supplement provides data on the total number of live births and the age at last birth for females, which are not available in the U.S. Census.

[20]The CPS June Supplement is not particularly useful for the calculation of childlessness in married

number of children in the household is available. Therefore, as a measure of childlessness we use the fraction of married couples between ages 35-39 who have no children at home.[21] Then, using the CPS June supplement we look at all couples above age 25 in which the female had a total of two live births and was below age 30 at her last birth. This gives us the fraction of couples who are early child bearers, with the remaining married couples labeled as the late ones. Table A6 shows the resulting distributions.

Table A7 shows how lifetime fertility, conditional on having a child, differs by the education for single and married households.[22] The differences in fertility are non trivial. For instance, Table A7 shows that single females with more than college education have about 1.6 children on average, while their counterparts with less than high school education have 2.7 children. Equivalent fertility differences are present for married couples, albeit they tend to be smaller in magnitude.

Childcare Costs We use the U.S. Bureau of Census data from the Survey of Income and Program Participation (SIPP) to calibrate childcare costs we use.[23] The total yearly cost for employed mothers, who have children between 0 and 5 and who make childcare payments, was about \$6,414.5 in 2005. This is about 10% of average household income in 2005. The Census estimate of total childcare costs for children between 5 and 14 is about \$4,851, which amounts to about 7.7% of average household income in 2005.

We assume that childcare costs depend on whether a household has access to informal care, as households with access to informal childcare are likely to spend less on childcare. We also assume that the childcare costs depend on the education level of household members, as more educated households spend more on childcare than less educated households in the data, possibly reflecting differences in childcare quality. Table A8 shows the fraction of households who use informal care by marital status and the education level of the mother.

couples. The sample size is too small for some married household types for the calculation of the fraction of married females, aged 40-44, with no live births.

[21] Since we use children at home as a proxy for childlessness, we use age 35-39 rather than 40-44. Using ages 40-44 generates more childlessness among less educated people. This is counterfactual, and simply results from the fact that less educated people are more likely to have kids younger, and hence these kids are less likely to be at home when their parents are between ages 40-44.

[22] The table shows children ever born for single and married females of different types. We use the 2008 CPS June Supplement that provides detailed fertility statistics. As a measure of completed fertility, the children ever born by ages 40-44 are reported.

[23] See Table 6 in http://www.census.gov/population/www/socdemo/child/tables-2006.html

Table A9 shows how childcare expenditures differ by education of females in single female and married couple households, conditional availability of informal childcare. Given data limitations, we condition married couples' childcare expenditure only on wives' education.[24] Since the use of informal childcare is very limited for older (above age 5) children we do not condition childcare expenditure on the availability of informal childcare for these children. The table shows non-trivial heterogeneity in expenditures. We note that for children under age 5, a single female with more than college education spends almost twice as much as a single female with less than high school education. Similar figures hold for couples in which both members have more than college education.

Recall that $d(s, x, g)$ and $d(s, x, z, g)$ are the efficiency units of labor required for childcare for a single female of type-(x, g), and for a married couple of type-(x, z, g), respectively. Then, the total cost of childcare for a single female and married couple household with age-s children is given by $wk(x)d(s, x, g)$ and $wk(x, z)d(s, x, z, g)$, respectively. Our strategy is to choose $d(s, hs-, g = 0)$ – i.e. for a single female with less than high school education without access to informal care– and set all other childcare costs according to Table A9 to ensure that on average, households spend about 10% and 7.7% of average household income on young and old children. In the benchmark economy, this choice of parameter values results in 1.2% of the total labor input is used to produce childcare services. This is broadly in line with the share of employment in the childcare sector in the U.S, which was about 1.1% in 2012.[25]

Childcare Subsidies We assume that the childcare subsidies in the model economy reflect the childcare subsidies provided by the Children Child Care and Development Fund (CCDF) in the US. In 2010, abut 1.7 million children (ages 0-13) were served by CCDF. This is about 5.5% of all children (ages 0-13) in the US. In 2010, the average household income of households that received childcare subsidy was about $19,000. About 74% of families who

[24] Table A9 reports average weekly childcare expenditures for households between ages 25-44. The data comes from the 2004 SIPP Panel, Wave 4, 4th reference month (January 2005 to April 2005). All the income and demographics were extracted from the core files, while the data related to childcare expenditure comes from the Childcare Topical Module. We restrict the sample to households in which mothers are employed in all months.

[25] Total employment in childcare services (NAICS 6244) was about 1.6 million in 2012. This number is the sum of total paid employment and the number of establishments without paid employees. See http://thedataweb.rm.census.gov/TheDataWeb_HotReport2/econsnapshot/2012/snapshot.hrml?NAICS=6244.

receive childcare subsidies from CCDF made co-payments were about 6% of family income. If we take \$19,000 as average income of subsidy receivers, this amounts to a co-payment of 1,140 dollars per year. In 2010, the average monthly payment for childcare providers (including the co-payment by the families) was about \$400 per month or \$4,800 a year. Hence about 24% of total payments $(1,140/4,800)$ came from households, while the remaining 76% are subsidies. In our calibration we simply set $\theta = 0.75$ and set $\widehat{I}$ such that the poorest 5.5% of families with children receive a subsidy from the government. This procedure sets $\widehat{I}$ at about 21% of mean household income in the benchmark economy. In the main policy experiments that we consider, we make the childcare subsides universal by setting $\widehat{I}$ to an arbitrarily large number.

Child Tax Credits We model child tax credits and childcare tax credits as closely as possible to how they are present in the U.S. tax code. Child tax credits operate as a means-tested transfers to households with children. If a household's income is below a certain limit, $\widehat{I}_{CTC}$, then the potential credit is \$1,000 per child. If the household income is above the income limit, then the credit amount declines by 5% for each additional dollar of income. In the current tax code, $\widehat{I}_{CTC}$ is \$110,000 for a married couple and \$75,000 for singles. As a result, a married couple with two children whose total household income is below \$110,000 has a potential child tax credit of \$2,000, a household with two children whose total household income is \$120,000 can only get \$1,500. The child tax credits become zero for married couples (singles) whose total household income is above \$150,000 (\$115,000). As the CTC is not fully refundable, the actual CTC that a household gets depends on the total tax liabilities of the household and other child-related credits that the household might qualify.

Child Care Tax Credits Unlike child tax credits, all households with positive income can qualify for childcare tax credits. Potential childcare tax credits is calculated in two steps, using the total childcare expenditures of the household, a cap, and rates that depend on household income. First, for each household, a childcare expenditure is calculated that can be claimed against credits. This expenditure is simply the minimum of the earnings of each parent in the household, the cap and actual childcare expenditures. The cap is set \$3,000 and \$6,000 for households with one child and with more than one children. Second, each household can claim a certain fraction of this qualified expenditure as a tax credit.

This fraction starts at 35%, and declines by household income by 1% for each $2,000 above $15,000 until it reaches 20%, and then remains constant at this level.

All income thresholds are translated into multiples of mean household income for proper model calculations. Figure 1 shows the potential CTC and CDCTC credits for a married household with two children. The actual credits that a household receive depend on the total tax liabilities of the household. Further details are presented in the Online Appendix. For Figure 1, we assume that at each income level the husband and the wife earn 60% and 40% of the household income, respectively, and that all households spend 10% of their income on childcare. As Figure 1 shows, the CTC has a very clear structure: all households up to an income threshold are potentially qualified for about $2,000 (about 3.3% of mean household income in the US in 2004) and above this threshold the credit starts declining until it hits zero. The potential CDCTC credit is small for households with very low incomes as the earnings of the wife might be less than the maximum credit. It first peaks and then declines as the earnings of the wife increases, and all households above an income threshold get $1,200 (2% of mean household income). In the policy experiments below, these schedules are multiplied by a constant and shifted up.

Preferences and Technology There are three utility functions parameters to be determined: the intertemporal elasticity of labor supply (γ), the parameter governing the disutility of market work (φ), and fixed time cost of young children (η). We set γ to 0.4. This value is contained in the range of recent estimates by Domeij and Floden (2006, Table 5). Given γ, we select the parameter φ to reproduce average market hours per worker observed in the data, about 40.1% of available time in 2008.[26] We set η to match the labor force participation of married females with young, 0 to 5 years old, children. From the 2008 U.S. Census, we calculate the labor force participation of females between ages 25 to 39 who have two children and whose oldest child is less than 5 as 62.2%. We select the fixed cost such that the labor force participation of married females with children less than 5 years (i.e. early child bearers between ages 25 and 29 and late child bearers between ages 30 and 34), has the same value. Finally, we choose the discount factor β, so that the steady-state capital

[26] The numbers are for people between ages 25 and 54 and are based on data from the Census. We find mean yearly hours worked by all males and females by multiplying usual hours worked in a week and number of weeks worked. We assume that each person has an available time of $5,000$ hours per year. Our target for hours corresponds to 2005 hours in the year 2003.

to output ratio matches the value in the data consistent with our choice of the technology parameters (2.93 in annual terms).

Utility costs associated to joint work allows to capture the residual heterogeneity among couples, beyond heterogeneity in endowments and childbearing status, that is needed to account for the observed heterogeneity in participation choices. We assume that the utility cost parameter of joint participation is distributed according to a (flexible) gamma distribution, with parameters k_z and θ_z. Thus, conditional on the husband's type z,

This procedure allows us to exploit the information contained in the differences in the labor force participation of married females as their own wage rate differ with education (for a given husband type). In this way we control the slope of the distribution of utility costs, which is potentially key in assessing the effects of changing incentives for labor force participation.

Using Census data, we calculate that the employment-population ratio of married females between ages 25 and 54, for each of the educational categories defined earlier.[27] Table A10 in the Online Appendix shows the resulting distribution of the labor force participation of married females by the productivities of husbands and wives for married households. The aggregate labor force participation for this group is 72.2%, and it increases from 61.8% for the lowest education group to 81.9% for the highest. Our strategy is then to select the two parameters governing the gamma distribution, for every husband type, so as to reproduce each of the rows (five entries) in Table A10 as closely as possible. This process requires estimating 10 parameters (i.e. a pair (θ, k) for each husband educational category).

Finally, we specify the production function as Cobb-Douglas, and calibrate the capital share and the depreciation rate using a notion of capital that includes fixed private capital, land, inventories and consumer durables. For the period 1960-2000, the resulting capital to output ratio averages 2.93 at the annual level. The capital share equals 0.343 and the (annual) depreciation rate amounts to 0.055.[28]

Summary Table 1 summarizes our parameter choices. As we detailed above, given a choice of multiple parameters from exogenous estimates, we select others to match jointly

[27] We consider all individuals who are *not* in armed forces.

[28] We estimate the capital share and the capital to output ratio following the standard methodology; see Cooley and Prescott (1995). The data for capital and land are from Bureau of Economic Analysis (Fixed Asset Account Tables) and Bureau of Labor Statistics (Multifactor Productivity Program Data).

several targets. First, we choose the additional proportional tax on capital so that the model matches corporate tax collections from data. Similarly, we select the social security benefit of the least skilled male to balance the budget. Second, the level of efficiency unit requirements for childcare is calibrated so that households spend the right amount of resources on childcare. Third, the discount factor is selected to match capital-to-output ratio. Fourth, the disutility from market work is chosen to match hours per worker, and the time cost of children is selected so as to match labor force participation of married females with young children. Finally, gamma-function parameters – ten in total – are chosen so as to generate the observed female force participation by husbands and wives types.

5 The Benchmark Economy

Table 1 summarizes our parameter choices. Table 2 illustrates the performance of the model in relation to data. We comment below on how the model performs in terms of variables that are pertinent for the main questions of this paper.

Participation Rates As Table 2 shows, the model reproduces quite well the aggregate facts for labor-force participation rates. The table shows that in the model, participation rates for married females by skill rise from about 48.0% for less than high school females, to about 79.3% for those with more than college education. In the data, participation rates rise from 46.4% to 81.9%, respectively.

We now discuss the model's performance for participation rates by focusing on how this variable changes with age. These patterns were not explicitly targeted in the calibration and serve as an external validity check on our model economy. Moreover, the conformity of model with data in terms of participation rates is important as policies towards households with children are expected to have substantial effects on this variable. We start by considering married females by their skill level, and divide them in two groups, skilled and unskilled.[29] Figure 2 shows the data and the model-implied participation rates. For skilled married women, participation rates are roughly constant over the life cycle while for the unskilled ones, participation rates slightly increase with age. As the figure shows, the model is in conformity with the data.

[29] As before, the 'skilled' group comprises those with college and more than college education, while the 'unskilled' group comprises those with less than college education.

Figure 3 considers the patterns of participation rates by childbearing status. We divide married females in two different groups in this case; those with children and those without. The figure shows that participation rates for women with children increase during childbearing age, while the opposite occurs for childless married women. Once again, the figures demonstrate that the model reproduces the empirical patterns in both cases.

Wage-gender Gap Our model has implications for the gender wage gap, defined as the ratio of female hourly wages to male hourly wages. By construction, our calibration matches the gender gap in the first model period, for ages 25-30. Afterwards, the gender wage gap evolves endogenously as married females decide whether to work or not and their wages change accordingly. In particular, if a female does not to participate in the labor market, her human capital depreciates and the gender wage gap grows with age. While the gender wage gap is about 84% for ages 25-30 in the data, it increases gradually to 70% by ages 50-55. As we document in Figure 4, our model generates the same pattern, but the increase in the gap is not as steep as in the data. By ages 50-55, the wage-gender gap implied by the model amounts to about 75%, suggesting that other factors we do not entertain are at play.

6 Aggregate Implications of Child-Related Transfers

We report in this section the steady-state effects of our quantitative experiments. Our experiments are conducted under the assumption of a small-open economy, where the rate of return on capital, and thus the wage rate, are unchanged across steady states.[30] All policies considered are revenue neutral, and are financed via a proportional flat-rate income tax applied to all households. The regular income tax system, the payroll tax, and the additional capital income tax do not change with respect to the benchmark economy.

We conduct two sets of different but related experiments. In the first set, we expand the current childcare subsidy scheme in the US. In the second set, we entertain the expansion of tax-credit policies targeted to households with children. We also consider the effects of making the current tax-credit programs in the US fully refundable. These experiments broadly encompass proposals discussed in policy circles, and are designed to quantify the

[30] We analyze the effects when factor prices change in section 6.3.

tradeoffs at play when evaluating these policies.

6.1 Expanding Childcare Subsidies

We conduct exercises that change the eligibility into the current subsidy scheme and make it available to all households. We refer to this scenario as the *universal subsidies* case. We consider three subsidy rates; 50%, 75% (the benchmark value) and 100%. The key results are contained in Table 3.[31]

Fully eliminating eligibility constraints has substantial consequences on aggregate variables. Under the benchmark subsidy rate (75%), making the subsidies universal leads to a the long-run increase in participation amounts of about 8.8%. Concomitant with the effects on participation rates, hours per worker among females drop, and the labor supply of males reacts negatively to the expansion of the subsidies. Under the benchmark subsidy rate of 75% hours worked by men drop by 1.2%. Overall, making subsidies universal lead to increases in total hours worked, with changes that amount to about 1.4% at the benchmark subsidy rate. Aggregate output also increases, although changes are small.[32]

The effects driven by changes in the subsidy rate are also substantial. When subsidies are universal, increasing the subsidy rate from 50% to 100% implies an increase in participation rates of about 6.2% and 11.0%, respectively, relative to the benchmark case. In this case, it is worth noting that the changes in participation as subsidies increase are large, but of a lower magnitude than the effects associated to eliminating eligibility requirements into the subsidy program. Put differently, the elimination of eligibility requirements into the subsidy program has first-order consequences on household labor supply.

Expanding the scope of the subsidy program leads to rather large changes in its size. In the benchmark economy, only about 5.5% of all children are covered by childcare subsidies, and the program is minuscule, totalling about 0.07% of GDP – in line with its actual size. But as the eligibility changes – or the subsidy rate increases – the size of the subsidy program increases sharply and becomes of macroeconomic significance. About 83% of all children receive subsidies under a universal program. The program at a 75% rate accounts for 1.25% of aggregate output and requires a tax rate on all incomes of about 1.3% to support it.

[31] In the Online Appendix we show results for intermediate values of eligibility into the subsidy scheme.
[32] The measure of output that we report pertains to output for consumption and investment, and does *not* include the value of childcare services.

Overall, in understanding these findings, the reader should bear in mind that upon an expansion in the scope of childcare subsidies, (i) the long-run tax rate increases to pay for them, (ii) married households reallocate hours of work between spouses, and (iii) females with children working prior to the expansion of subsidies choose to reduce their hours.[33] In addition, in some households, labor supply and intertemporal asset choices adjust in order to have access to tax credits (i.e. not to lose them). Given the relatively small magnitude of additional tax rates, which amount to about 1.3% when all households are eligible, the second and third effects appear of quantitative importance. Childcare subsidies have an income effect in the determination of labor supply, both for males and females in the case of married households, and lead to lower hours per worker. This naturally explains why, despite the large changes in participation rates and hours of married females, total hours worked and output react much less, and can even decline.

Who Increases Participation? Since overall changes in participation rates are substantial, it becomes important to identify which households react more to changes in the scope of subsidies. Table 3 shows changes in labor force participation of married females relative to the benchmark economy, for women with different education levels and by child-bearing status. The table also shows that the effects of more generous subsidies on women with different education levels is far from uniform. Changes are greater for women with less education, with percentage changes that monotonically decline as the level of education increases. With universal subsidies at the benchmark level of 75%, women with less than high school education increase their participation rate by about 21.5%, whereas the increase for those with more than college education is of about 4.7%. These sharp differences are not surprising. Childcare costs constitute a more significant fraction of household income for households with less skilled women and as a result, these households benefit the most from subsidies. Furthermore, their labor force participation is lower to start with and therefore, there is ample room for them to increase their participation.

Similar findings hold for married women according to child-bearing status. Women with children arriving earlier in their life cycle increase their participation rates more than those

[33] As we document in Figure A10 in the Online Appendix, these findings are broadly consistent with cross-country evidence. For a group of high income countries, public spending on childcare has a positive relation with labor force participation and a negative one with hours worked for married females.

with children late. This result is in line with the discussion above. Women in households with early childbearing are disproportionately less skilled and have more children, whereas the opposite is true for women in households with late childbearing.[34]

6.2 Expanding Tax Credits

We now consider the case of expanding existing programs that explicitly provide tax credits for households with children; the Child Tax Credit (CTC) and the Child and Dependent Care Tax Credit (CDCTC). As explained in section 2, these programs differ in key ways. While the CTC provides a tax credit independently of labor market status of parents, the CDCTC partly compensates for childcare expenses at rates that decline with household income. Our experiments focus on three distinct cases. In the first case, we evaluate a hypothetical expansion of the CTC under full refundability of this program only. In the second case, we evaluate a fully-refundable expansion of the CDCTC that combines implicit childcare subsidies and transfers. Finally, we also examine the implications of the current eligibility rules into these programs by evaluating the implications of simply removing current refundability restrictions for both, while keeping all other features of the programs intact.

For ease of exposition and to facilitate a proper comparison with the analysis of childcare subsidies, we conduct the expansions of CTC and CDCTC when these expansions are associated to a tax rate and resources available for redistribution that are equal to the case of universal subsidies under the benchmark subsidy rate of 75%.[35] Results are in Table 4, where for reference we repeat the results associated to the expansion of childcare subsidies.

CTC Expansion Our expansion of this program consists in increasing the basic transfer per child built into the program.[36] It is clear from the results in Table 4 that a CTC

[34] As we show in Table A16 in the Online Appendix, even conditional on education, the effects on participation are larger for early childbearers. Early childbearers have a longer working life after their childbearing years and hence, more to benefit from increasing their participation.

[35] Specifically, revenue neutrality is achieved as follows. First, we impose the additional tax rate emerging under universal subsidies (1.30%) to a given expansion of either CTC or CDCTC. Second, we ensure that the expansion of either program is consistent with the level of government consumption and transfers under universal subsidies with the subsidy rate of 75%.

[36] This is an increase in the parameter d_{CTC} by a factor of 2.9. See Online Appendix for details. In terms of Figure 1, the experiment shifts up the credit schedule. Since the CTC credits now starts declining at a higher income level, a large number of households with children receive a tax credit of about 10% of the mean household income ($6,000).

expansion depresses labor supply across the board. The participation rates of married females drops by 2.4%, while total hours worked by married females drop by more (3.1%), as households reduce hours on the intensive margin as well. As a result of all these changes, aggregate output falls by 1.2% across steady states. These results are unsurprising. The CTC program involves a transfer to all households with children, regardless of labor market participation. Hence, it implies a negative income effect in labor supply, that is relatively more important for households at the bottom of the skill distribution. Participation changes are expected to be larger for less skilled households, as Table 4 confirms.

CDCTC Expansion Motivated by the sharp differences between the previous exercises – flat rate subsidies versus transfers to all households with children that decline with income – we entertain an expansion of the CDCTC that captures elements of both programs. We construct a fully refundable, equivalent expansion of the CDCTC program that provides a mixture of childcare subsidies and transfers that decline with household income. While there can be many ways to combine childcare subsidies and direct transfers to households with children, the expansion of the CDCTC provides a natural way to do this. In particular, we shift up the CDCTC schedule by increasing the rates used in the calculation of the credit by a common factor. Given the CDCTC formula, for households to qualify they must have positive labor earnings, for both partners if married, and positive childcare expenditures. Hence, the credit is conditional on market work. Furthermore, we allow the total credit to exceed childcare expenditures, in which case a household receives a transfer beyond what it spends on childcare.[37] The expansion generates an increase in the number of children covered by the program of thirteen points; from 74% in the benchmark to 87%.

The results in Table 4 indicate that the CDCTC expansion leads to effects that are qualitatively similar to childcare subsidies, but quantitatively more moderate. The expansion is associated to substantial increases in female labor supply. The aggregate participation rate increases by 5.2%, with increases that are much larger at the bottom of the skill distribution than at the top. Like in the case of childcare subsidies, these effects are accompanied by a reduction in hours worked per worker for both males and females. Total hours are nearly

[37] In terms of Figure 1, this experiment implies multiplying the potential CDCTC credit schedule by a factor of 5.75. A married-couple household with very low incomes and two children is now able get a credit of about 15% of the mean household income in the economy (about $10,000). The credit for richer households, on the other hand, is now about 10% of the mean household income (about $6,000).

unchanged.

Full Refundability of Credits Full refundability of credits implies that, relatively to the benchmark case, poorer households (those whose tax liabilities were below the levels of credits) have now access to a partial refund of childcare expenses via the CDCTC while others receive credits via the CTC. Thus, there are two forces in operation. One the one hand, the full refundability of the CDCTC leads to expansions in participation and labor supply, whereas the income effects of the CTC have the opposite effects. The results in Table 4 demonstrate that the negative income effects stemming from the CTC dominate, leading to relatively small reductions in participation rates. Since the changes in participation and hours are small – in particular at the top of the skill distribution– and the required tax rates are small, the concomitant effects on output are nearly zero.

6.3 Discussion

Quantitatively, the changes on female labor supply induced by a large-scale expansion of either childcare subsidies, or the CDCTC program, are large. Placing our findings in some perspective, in related work and using a version of this framework (Guner et al, 2012-a), we found that fully replacing the income tax schedule by a proportional income tax leads to steady-state changes in participation rates of about 5.1% in an open economy. As Tables 3 and 4 demonstrate, this is less than 60% of the effect that we find when subsidies are universal under the benchmark subsidy rate of 75%, and close to, but smaller than, the consequences of a CDCTC expansion. Unlike the case of a tax reform, however, these effects are mitigated by the reallocation of hours from males to females in married households and by the overall reduction in hours worked by females along the intensive margin. As a result, the overall effects on aggregate hours and output are relatively minor.

The effects on labor supply of an equivalent expansion of the CTC program – a child-related transfer scheme that is not conditioned on market work – are negative across the board and are accompanied by a drop in output. This drop in output – 1.2% – is quantitatively significant, given the small required tax rate to balance the budget. Note that in the opposite extreme, the equivalent expansion of childcare subsidies – from the current scheme to the universal case – leads to an increase in output of nearly half a percentage point.

It is worth noting that the effects on participation rates associated to the expansion of subsidies are non-trivially larger than the effects from the expansion of the CDCTC program for the same tax rate. This is not surprising. The implicit childcare subsidies from the CDCTC program are quite substantial for households at the bottom of the skill distribution, but they strongly decline with household income. In contrast, universal childcare subsidies are available to all at the same rate. This leads to much larger effects for households at the top of the skill distribution, as Table 4 demonstrates.

Redistributive Effects In Table 5, we provide a quantification of the size of childcare subsidies and transfers at different deciles of the income distribution in each major expansion. For the case of childcare subsidies, subsidies are at 75% rate at all levels and transfers are zero. For the case of the CTC expansion, childcare subsidies are zero, but transfers are substantial and decline with household income. The transfers are reported as a fraction of the mean household income in the economy. Hence, under the CTC expansion, households in the lowest income decile receive 11% of the mean household income (about $6,000 in 2005). For the mixed case of the CDCTC expansion, subsidies are 100% for low income levels and subsequently decline to about 50%. Transfers in this case – or credits in excess of childcare expenditures – are substantial for low income levels (about 7% of mean household income for the lowest income decile) and strongly decline as income increases. These properties of the expanded CDCTC scheme are key for the welfare findings that we discuss below. Note that there is a non-monotonicity in subsidy rates under the CDCTC expansion, as households at the top of the income distribution, who have larger childcare expenditures, have higher benefits than the households who are in the second and third top deciles.

The expansions of programs also lowers the poverty rate among households. For instance, in the benchmark economy, about 1.1% of married-couple households have incomes below one-third of mean household income. The fraction of households below this threshold declines to 0.7%, 0.4% and 0.5% under the expansions of childcare subsidies, the CTC and the CDCTC, respectively. Similarly, while the fraction of single-mother households below one-third of mean household income is 17.6% in the benchmark economy, this fraction declines to 16.9%, 16.2% and 16.2% under the expansions of childcare subsidies, the CTC and the CDCTC programs, respectively.[38] Hence, the expansion of these programs reduce the

[38] In order to calculate the poverty rates for each experiment, we use the level of poverty threshold from the benchmark economy. The one-third mean household income approximately correspond

poverty rate substantially among married households. The reduction for single households is important but of a lower magnitude, as the bulk of these households benefited substantially from transfer programs in the first place.

The Role of Endogenous Skills A novel aspect of our analysis is the explicit consideration of the depreciation of female skills due to non participation. How important is this channel quantitatively? To answer this question, we shut down the endogenous skill channel, and study the expansion of childcare subsidies, the CTC and the CDCTC programs in an economy in which each married female type has exogenously the *same* skill profile that she had in the benchmark economy. Hence, her skills do not change if she chooses to change her participation decision in response to the policy changes.

We find that the endogeneity of female skills plays a crucial role for our results. Without it, the labor supply by married females increases much less under an expansion of childcare subsidies or the CDCTC program – and decreases much more under the CTC expansion. Table A16 in the Online Appendix documents our findings for the interested reader. With the universalization of subsidies, the participation rate of married females increases by 4.7% for the case of exogenous skills, whereas it increases by about 8.8% when the endogenous skill channel is operative. Similarly, under the CDCTC expansion, participation rates increase by only 1.7% when skills are exogenous versus 5.2% when skills are endogenous. That is, less than half of the total change in participation rates under the CDCTC expansion is accounted for by the model with exogenous skills.

6.4 Robustness

We next evaluate the importance of different features of our model for the aggregate implications of our child-related transfers. We ask: what is the role associated to the reallocation of hours worked (from males to females) within couples? What is the quantitative importance of the small open economy assumption in the benchmark case? What is the importance of imperfect substitutability of skills in production?

In order to answer these questions, we first compute stationary equilibria when we expand

to the poverty threshold in the US for a four-person household with two children, respectively. This threshold was about $22,000 in 2008 (see https://www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-thresholds.html) childcare subsidies, the CTC and the CDCTC while keeping the labor supply decisions of married males at their benchmark values. With labor supply decisions of married males fixed, households find optimal not to increase married female labor supply as much as they do in the benchmark economy, but the difference is quantitatively very small. On the other hand, since males are on average more skilled than females, when the labor supply of males is fixed, total output increases more with the expansion of subsidies or the CDCTC program. With the universal subsidies, for example, the increase in output amounts to about 1.5%, in contrast to 0.4% in the baseline experiments.

Next, we replicate our experiments under a closed economy assumption, where the factor prices adjust to changes in factor supplies. Overall, we find that the differences with the benchmark experiments are very small, since the capital-labor ratio and, as a result, factor prices, barely change with the policy experiments.

Finally, we extend the model to account for imperfect substitution between labor types in the production of consumption and investment goods. We consider a version of the model with two 'types' of labor; *skilled* labor and *unskilled* labor. Production of childcare services requires only unskilled labor. We empirically identify the skilled group with college and more than college labor. The unskilled group is the rest: less than college, high school and less than high school. Consumption and investment goods are produced according to

$$Y = F(K, S, U) = K^{\alpha} \left[(\nu S^{\rho} + (1-\nu) U^{\rho})^{\frac{1}{\rho}} \right]^{1-\alpha}, \ \rho \in (-\infty, 1).$$

The assumption on the production technology implies that there are two rental prices for labor, w^S and w^U. As childcare services are produced with unskilled labor, the price one unit of childcare services is the wage rate of unskilled labor. Note that the model has to be calibrated again, which we detail in the Online Appendix. We find that the expansions of different programs have very similar effects in an economy with imperfect substitutability of skills. Under the expansion of childcare subsidies, for example, the participation rate of married females goes up by 8.8% in the benchmark economy. When skills are imperfect substitutes, the corresponding increase is 8.5%. The changes in the skill premium associated to the expansion of different programs are minimal. The largest change occurs with the case of the CTC expansion where the skill premium increases by 0.8%.

Overall, we conclude that our benchmark findings on female labor supply are largely robust to deviations from our benchmark. Further details and complete results are provided in the Online Appendix for the interested reader.

7 Welfare Implications of Child-Related Transfers

We now concentrate on the implied welfare effects associated to the expansion of child-related transfers. For these purposes, we compute the transitional dynamics between steady states implied by the policy change under consideration, when the policy change is unanticipated at, say, $t = t_0$. Our notion of welfare is standard; we calculate consumption compensations, or the common percentage change in consumption in all future dates that leaves a household indifferent between the status quo and the new transitional path. We balance the budget in each period via the additional flat-rate income tax applied to all households.

7.1 Young Households

We first focus on young (newborn) households at the date of the policy change, taking into account transitional dynamics between steady states. As earlier, we focus on three comparable cases: universal childcare subsidies at a 75% rate and the equivalent expansions of the CDCTC and CTC programs. We summarize key results in Table 6, where we present findings for single females and married households. For singles, we separate findings by childbearing status and educational type. For married households, we show welfare effects by childbearing status only, by aggregating across all types of spouses.[39] The table also shows the welfare effects for all newborn households at $t = t_0$.

Newborn households, as a group, experience welfare gains associated to the expansion of child-related transfers. As we elaborate below, these gains can be substantial but not across the board as some types experience welfare losses. In the aggregate, Table 6 shows that gains for all newborn households range from nearly 0.7% for the universalization of childcare subsidies, to 2.0% and 2.3% in the case of the CTC and CDCTC expansions, respectively. It is clear that these gains are large by the standards of applied general-equilibrium analysis.

Across households, the welfare effects differ sharply. Single females who have children early in the life cycle gain more than those who tend to have their children late. This naturally follows from the fact that the early childbearing group contains a disproportionate fraction of

[39] For simplicity of exposition, we do not show results for single men, who uniformly lose with the introduction of child-related transfers.

less skilled females. Hence, expansions of child-related transfers are highly valuable for these females and thus, their expansion leads to higher welfare gains. Conversely, the expansion of transfers leads to welfare losses for single females with no children. Likewise, those with children and access to informal care gain less those without access to informal care. This pattern is also repeated for married households according to childcare status.

Married Households Table 7 shows disaggregated effects for newborn married households. Universal subsidies lead to modest gains for poorer households of the same educational type (e.g. $<$ HS and $<$ HS). As the female type increases, welfare gains increase as well. As the type of both spouses increases, gains first increase, and then decline and become eventually negative. This reflects the fact that childcare subsidies provide uniform benefits to all in proportion of childcare expenditures. A married household in which both spouses have some college education gains about 1.8%, whereas those households in which both spouses have more than college education lose by about 0.2%. Hence, the benefits of universal childcare subsidies at the top are more than compensated by the concomitant higher taxes needed to finance the program.

In contrast, Table 7 shows that the welfare gains are concentrated at the bottom of the skill distribution for the CDCTC and CTC expansion, and are potentially large. A household in which both members have less than high school education gains about 4.5% and 12.6% under the CDCTC and CTC expansion, respectively. Gains decline sharply as the education of both members increase, and become significantly negative at the top of the skill distribution. This reflects the nature of these programs, which by design, reduce their benefits as household income increases.

Discussion A central message from results in Tables 6 and 7 is the asymmetry in welfare effects – both gains and losses and substantial in some cases – and that the gains associated to the expansion of the CTC and CDCTC programs are *larger* than for the universalization of childcare subsidies, and largest in the CDCTC case. Why does the expansion of the CTC and CDCTC programs dominate in welfare terms the universalization of subsidies? The upshot is that both the CTC and the CDCTC expansions concentrate their benefits among poorer households. There are childcare subsidies available in the benchmark economy, and their universalization is for all households at common rate (75%). Instead, the expansion of the CTC and the CDCTC programs leads to disproportionate benefits at the bottom of the skill distribution, as the findings in Table 5 show. This occurs as (i) benefits –either childcare subsidies, transfers or both – are high for poorer households with children and decline with household income, and (ii) the expansion of these programs removes obstacles to the refundability of credits for poorer households.

Put differently, the expansion of both the CDCTC and CTC programs redistributes much more in favor of poorer households than the universalization of childcare subsidies. Given diminishing marginal utility of consumption, it is not surprising that the welfare gains for newborn households are smallest when subsidies are made universal.

7.2 All Together Now

We now turn our attention to the welfare consequences on all households alive at date $t = t_0$. The top panel of Table 8 shows the welfare consequences for households of different age groups (across all educational types, childbearing and marital status), as well as for all households alive as a group. The results show sharp differences between groups in terms of the welfare impact of childcare subsidies. Younger households as a group win whereas older households lose. This occurs for the expansion of all transfer programs. For instance, in the case of the CDCTC expansion, the consumption compensation decreases monotonically from 2.3% for newborns (aged 25-29), to -2.1% for those aged 50-54.

These results are naturally driven by the fact that at the time of the policy change, younger households are net beneficiaries as child-related transfers are concentrated at young ages. For older age groups, these transfers become less important for those alive at the date of the introduction of the policy, while higher taxes affect all households. Hence, welfare gains become lower with the group age and eventually become negative.

No Majority Support Aggregate welfare gains in Table 8 are negative. This is not surprising given the fact that only few households at $t = t_0$ benefit from the policy change – at most 13.3% in the case of the universalization of subsidies. More importantly, the results show that there is no majority of households supporting the expansion of any transfer program. This occurs with when counting all households alive when transfers are expanded, and *also* among newborn households in the new steady states. This is a strong implication of our findings for policy design.

8 Concluding Remarks

We evaluate the macroeconomic implications of expanding child-related transfers in an equilibrium environment with multiple features that make it suitable for policy analysis. We find that an expansion of current arrangements – childcare subsidies, CTC and CDCTC – can have substantial effects on observables such as participation rates and hours worked across steady state equilibria. We find that the aggregate effects of these policies depend critically on whether they are tied to market work, or not. When childcare subsidies are universal at a 75% rate, the participation rate of married females increases by about 8.8%. An equivalent expansion of the CDCTC program, encompassing both childcare subsidies and transfers, increases participation by about 5.2%. In contrast, the equivalent expansion of the CTC program, a program available to all household with children regardless of parental work, reduces participation by about 2.4%.

We find large asymmetries in terms of welfare. On the one hand, child-related transfers lead to substantial gains for some households, and for newborn households as a group, at the date when the childcare subsidy scheme is expanded. Redistribution towards less skilled households is key for this finding. On the other hand, we find that childcare subsidies do *not* lead to welfare gains under an utilitarian welfare criterion, taking into account transitions between steady states. Key for these findings is the simple fact that childcare subsidies benefit relatively few households, and that costs (i.e. additional taxes) have to be paid by all. Indeed, when considering the expansion of child-related policies that are equivalent to universal subsidies at a 75% rate, we find that there is not even a majority of newborn young households who support their implementation.

Our analysis abstracts from parental choice in terms of childcare expenses and fertility. Rather, we treat childcare expenses per child and the number of children per household as exogenous. We doubt that the inclusion of endogenous parental choices in the analysis could change our quantitative findings in a significant way. Specifically on fertility, child-related policies that lead to higher participation rates are unlikely to change much parental decisions. There are countervailing effects that are expected to cancel each other out. Childcare costs are only a small fraction of the lifetime costs of raising children, and a reduction in these costs is balanced by increases in tax rates needed to finance the expansion of childcare subsidies. Along these lines, Bick (2016, Table 4) finds that childcare subsidy expansions in Germany lead to negligible changes in the overall fertility rate.

We close the paper by asking: how an expansion of child-related transfers can be justified on utilitarian grounds? First, we note that some transfer programs, like childcare subsidies, by altering how much time and resources children receive from their parents, are likely to affect the outcomes of children in the future. In this regard, the available evidence is mixed. Baker, Gruber and Milligan (2008) and Herbst and Tekin (2010) document that childcare subsidies can worsen outcomes for children, while Griffen (2012) and others estimate small but positive effects on children's cognitive skills. Given our findings so far, we conjecture that rather strong effects on children's future skills, combined with also strong altruistic motives, would be needed to justify an expansion of child-related transfers or to generate a majority support for their implementation.

Second, we note that we abstract from income risk that households face and as a result, do not capture possible gains that programs like childcare subsidies or the CDCTC can generate by making household labor supply more flexible. Blundell, Pistaferri and Saporta-Eksten (2016) show that female labor supply plays an important role in insuring households against labor market shocks. In ongoing work, Guner, Kaygusuz and Ventura (2016), we explore this issue by modeling household labor supply and the extensive margin in female labor supply, when households are heterogeneous, experience uninsurable shocks and government transfers are operative. An analysis incorporating these features may make an expansion of child-related transfers appealing for a majority of newborn young households.

Table 1: Parameter Values

Parameter	Value	Comments
Population Growth Rate (n)	1.1	U.S. Data
Discount Factor (β)	0.972	Calibrated - matches K/Y
Labor Supply Elasticity (γ)	0.4	Literature estimates.
Disutility of Market Work (φ)	7.63	Matches hours per worker
Time cost of Children (η)	0.021	Matches LFP of married females with young children
Dep. of skills, females (δ_x)	0.009, 0.021	See Online App. - PSID data
Growth of skills (α_j^x, α_j^z)	-	See text - CPS data
Distribution of utility costs $\zeta(.\|z)$ (Gamma Distribution)	-	See text - matches LFP by education conditional on husband's type
Within group heterogeneity (ε)	0.388	Calibrated
Capital Share (α)	0.343	Calibrated
Depreciation Rate (δ_k)	0.055	Calibrated
Childcare costs for single females, $d(s,x,g)$	-	See text - matches expenditure by age, skills and access to informal care.
Childcare costs for married females $d(s,x,z,g)$	-	See text - matches expenditure by age, skills and access to informal care.
Childcare subsidy (θ)	75%	U.S. Data
Income threshold ($\widehat{I}$) (as a % of mean household income)	16.5%	Calibrated
Tax functions $T^M(I,k)$ and $T^S(I,k)$		See Online App. - IRS Data
Transfer functions $TR^M(I,D,k)$, $TR_f^S(I,D,k)$ and $TR_m^S(I,D,k)$		See text and Online App.
Payroll Tax Rate (τ_p)	0.086	See Online App.
Social Security Incomes, $p_m^S(z)$, $p_f^S(x)$ and $p^M(x,z)$	-	See Online App. - U.S. Census
Capital Income Tax Rate (τ_k)	0.097	See Online App. - matches corporate tax collections

Note: Entries show parameter values together with a brief explanation on how they are selected – see text and Online Appendix for details.

Table 2: Model and Data

Statistic	Data	Model
Capital Output Ratio	2.93	2.97
Labor Hours Per-Worker	0.40	0.40
LFP of Married Females with Young Children (%)	62.6	62.4
Variance of Log Wages (ages 25-29)	0.227	0.227
Participation rate of Married Females (%), 25-54	72.2	71.5
Less than High School (<HS)	46.4	48.0
High School (HS)	68.8	66.5
Some College (SC)	74.0	73.3
College (COL)	74.9	74.0
More than College (COL+)	81.9	79.3
Total	72.2	71.5
With Children	68.3	65.0
Without Children	85.9	82.9

Note: Entries summarize the performance of the benchmark model in terms of empirical targets and key aspects of data. Total participation rates, with children and without children are not explicitly targeted.

Table 3: Expansion of Childcare Subsidies (%)

	Universal Subsidies (50%)	Universal Subsidies (75%)	Universal Subsidies (100%)
Participation Married Females	6.2	8.8	11.0
Total Hours	1.1	1.4	1.6
Total Hours (MF)	5.2	7.1	8.6
Hours per worker (f)	-0.5	-1.3	-1.8
Hours per worker (m)	-1.0	-1.2	-1.7
Output	0.2	0.4	0.2
Tax Rate	0.8	1.3	1.7
Effects on Participation:			
By Education			
< HS	13.6	21.5	28.0
HS	8.7	12.1	15.4
SC	5.6	8.0	9.9
COL	5.2	7.4	8.9
COL+	3.8	4.7	5.3
By Child Bearing Status			
Early	8.8	12.6	16.0
Late	5.2	7.2	8.6

Note: Entries in the top panel show effects (percentage changes) across steady states on selected variables driven by the expansion of the childcare subsidy system. The values for "Tax Rate" correspond the values that are necessary to achieve revenue neutrality. The bottom panel shows the effects on the participation rates of married females of different schooling levels. See text for details.

Table 4: Expansion of Tax Credits (%)

	Universal Subsidies (75%)	CTC Expansion	CDCTC Expansion	100% Refundability
Participation Married Females	8.8	-2.4	5.2	-0.8
Total Hours	1.4	-1.6	-0.1	-0.4
Total Hours (MF)	7.1	-3.1	3.5	-0.9
Hours per worker (f)	-1.3	-1.6	2.1	-0.3
Hours per worker (m)	-1.2	-0.7	-1.5	-0.2
Output	0.4	-1.2	-0.4	-0.1
Tax Rate (%)	1.3	1.3	1.3	0.2
Effects on Participation:				
By Education				
< HS	21.5	-3.8	21.6	-1.5
HS	12.1	-1.8	10.5	-2.3
SC	8.0	-2.1	5.2	-0.8
COL	7.4	-0.9	3.5	-0.1
COL+	4.7	-0.5	1.5	-0.1
By Child Bearing Status				
Early	12.6	-2.6	9.4	-1.4
Late	7.2	-1.0	4.1	-0.3

Note: Entries in the top panel show effects (percentage changes) across steady states on selected variables driven by the 100% refundability of the CTC and CDCTC programs, and the expansion of each program. The values for "Tax Rate" correspond the values that are necessary to achieve revenue neutrality. The bottom panel shows the effects on the participation rates of married females of different schooling levels. See text for details.

Table 5: Childcare Subsidies and Transfers in Policy Exercises (%)

	Universal Subsidies		CTC Expansion		CDCTC Expansion	
Income decile	Subsidy	Transfer	Subsidy	Transfer	Subsidy	Transfer
1st	75	0	0	10.6	100	7.2
2nd	75	0	0	10.2	100	6.2
3rd	75	0	0	8.9	90	3.7
4th	75	0	0	6.0	71	1.1
5th	75	0	0	5.9	52	0.5
6th	75	0	0	5.1	50	0.5
7th	75	0	0	4.2	42	0.4
8th	75	0	0	5.4	56	0.5
9th	75	0	0	4.9	49	0.5
10th	75	0	0	3.8	67	0.6

Note: Entries show for each policy exercise (i) the explicit and implicit childcare subsidy rates at different deciles of the distribution of income; (ii) the implicit transfers received at different deciles of the distribution of income as a percentage of the mean household income. See text for details.

Table 6: Welfare Effects (Newborns)

	Universal Subsidies (75%)	CTC Expansion	CDCTC Expansion
Single F			
No Children	-1.58	-1.51	-1.55
Early	3.99	10.41	15.32
Late	3.43	8.05	12.37
Informal Care	3.24	10.01	13.25
No Informal Care	3.64	10.07	14.50
< HS	1.47	16.32	11.91
HS	2.20	9.17	10.86
SC	2.20	5.44	10.00
COL	1.19	1.96	5.49
COL+	0.63	0.61	3.19
Married			
No Children	-3.51	-3.36	-3.45
Early	2.71	3.87	3.74
Late	0.71	2.29	1.52
Informal Care	1.12	3.52	2.33
No Informal Care	1.98	2.53	2.52
All Newborns	0.66	2.02	2.31
(%) Winners	42.7	39.6	32.0

Note: Entries show the welfare effects (consumption compensation) driven by the expansion of child-related transfers, for young households (newborns) of different marital status, by educational types, childbearing status and availability of informal care. Calculations take into account transitions between steady states.

Table 7: Welfare Effects (Newborn Married Households)

	Universal Subsidies (75%)						CDCTC Expansion				
	Females						Females				
Males	<HS	HS	SC	COL	COL+	Males	<HS	HS	SC	COL	COL+
<HS	0.36	2.90	3.55	4.06	5.42	<HS	4.46	7.11	6.93	5.99	5.87
HS	0.10	1.54	2.13	3.04	5.41	HS	2.90	3.57	3.91	3.86	4.76
SC	0.28	1.06	1.80	2.36	3.34	SC	1.94	2.47	2.88	2.34	2.46
COL	-1.06	-0.34	0.09	0.30	1.32	COL	-0.47	0.34	0.43	0.16	0.18
COL+	-2.29	-1.68	-1.21	-0.62	-0.17	COL+	-2.09	-1.52	-1.13	-0.96	-1.10

	CTC Expansion				
	Females				
Males	<HS	HS	SC	COL	COL+
<HS	12.59	9.93	7.20	4.02	2.64
HS	6.97	4.04	3.27	2.04	1.10
SC	5.21	2.82	2.66	1.16	0.22
COL	2.88	1.20	0.99	-0.19	-0.44
COL+	0.21	0.09	0.22	-0.27	-1.22

Note: Entries show the welfare effects (consumption compensation) driven by the expansion of child-related transfers for young married households (newborns). Calculations take into account transitions between steady states.

Table 8: Welfare Effects

	Universal Subsidies (75%)	CTC Expansion	CDCTC Expansion
Age			
25-29	0.66	2.02	2.31
30-34	0.18	1.13	1.42
35-39	-1.04	-0.29	-0.16
40-44	-2.13	-1.90	-1.94
45-49	-2.44	-2.28	-2.38
50-54	-2.19	-2.03	-2.13
All	-1.01	-0.47	-0.40
(%) Winners	13.3	12.55	10.90
Steady States:			
Newborns	0.71	1.94	2.30
(%) Winners	45.9	38.01	32.88

Note: Entries show the welfare effects (consumption compensation) driven by the expansion of child-related transfers, for different age groups and in the aggregate, as well as the aggregate percentage of winners. The entries in the top panel show results taking into account the transition between steady states. The entries in the bottom panel show the corresponding results across steady states.

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[41] White House, "Fact Sheet: Helping All Working Families with Young Children Afford Child Care," Press Release, January 21, 2015. https://www.whitehouse.gov/the-press-office/2015/01/21/fact-sheet-helping-all-working-families-young-children-afford-child-care

Figure 1: Potential CTC and CDCTC (a household with 2 children)

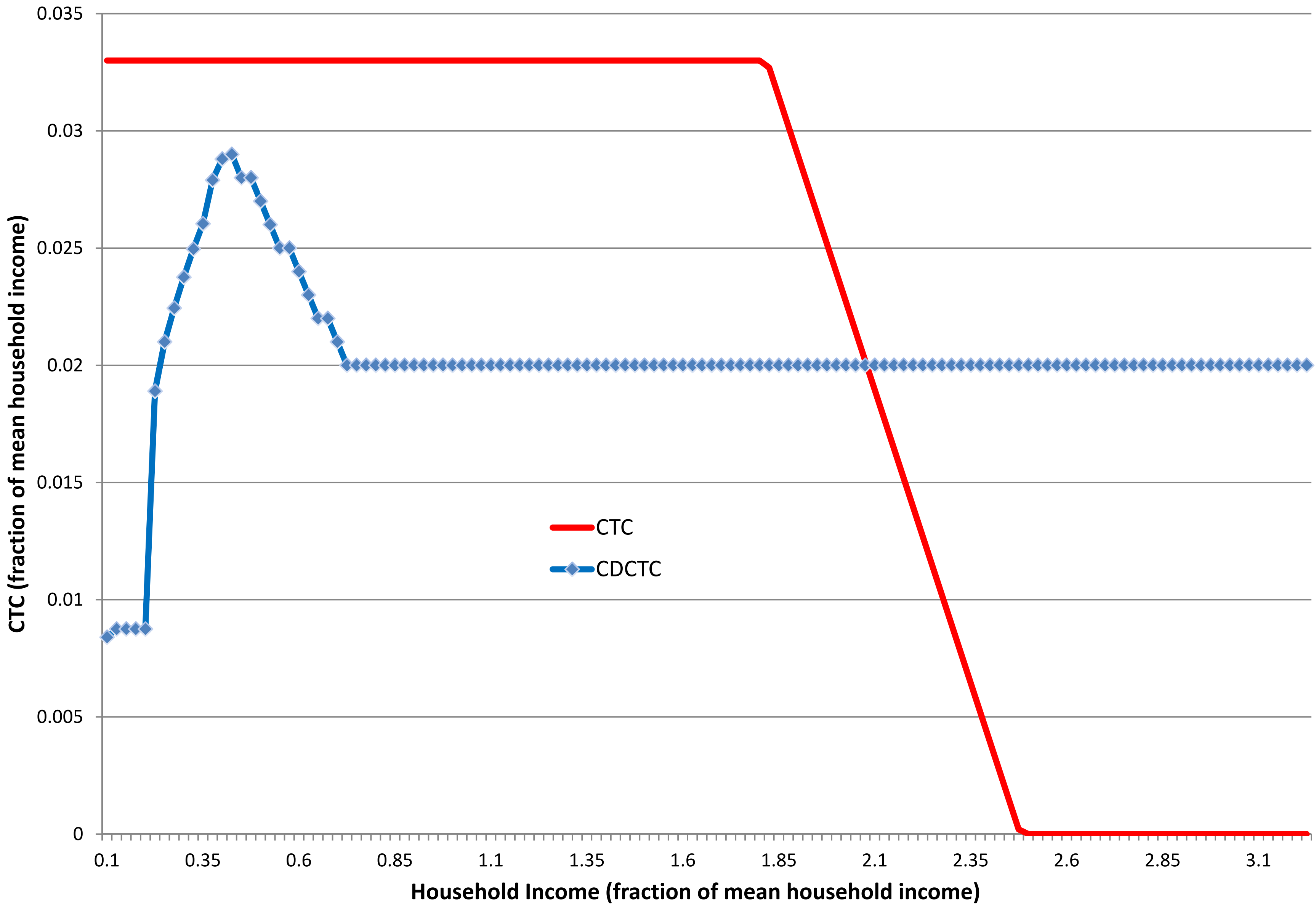


Figure 2: Married Female Labor Force Participation by Skill

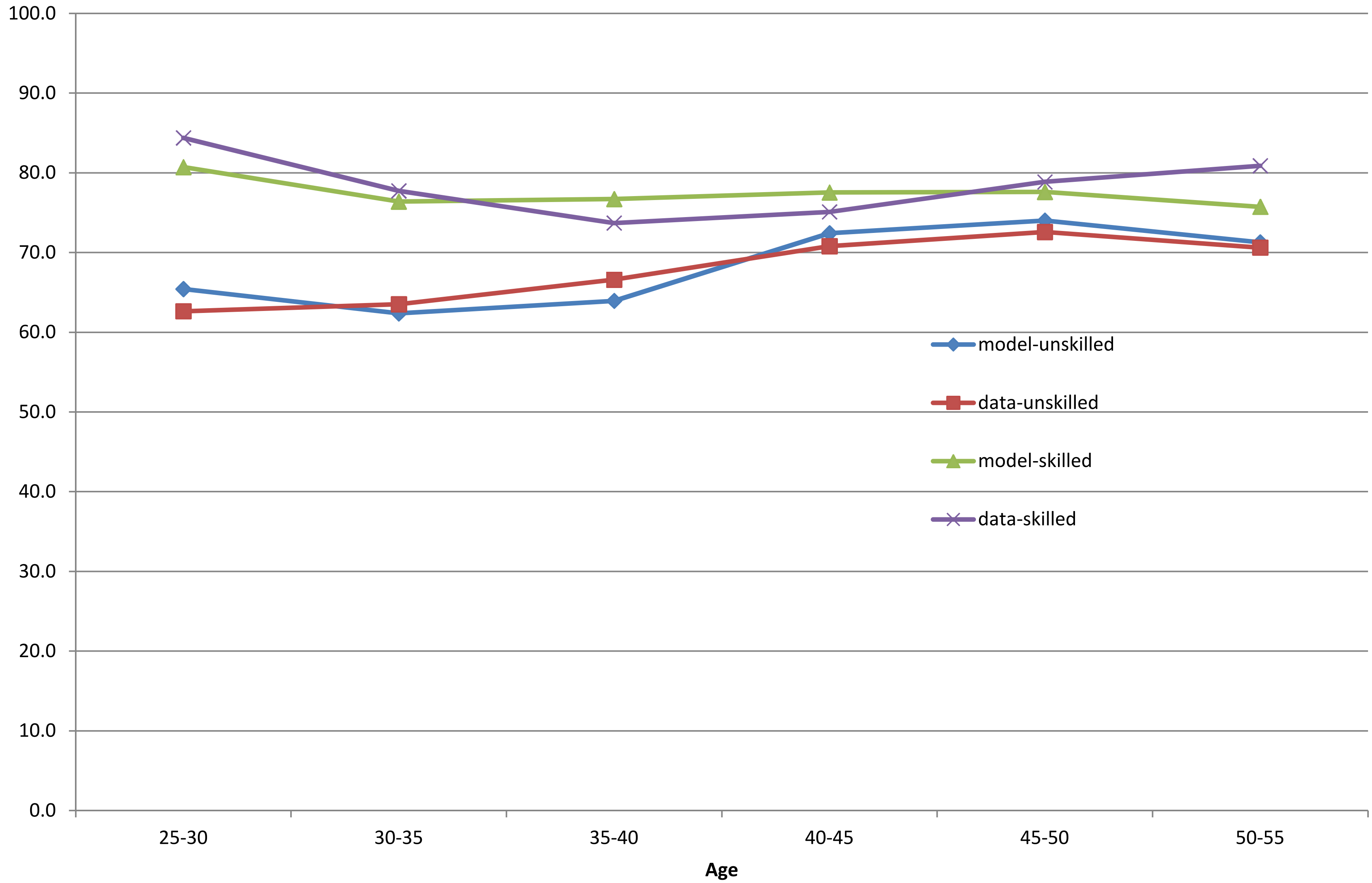
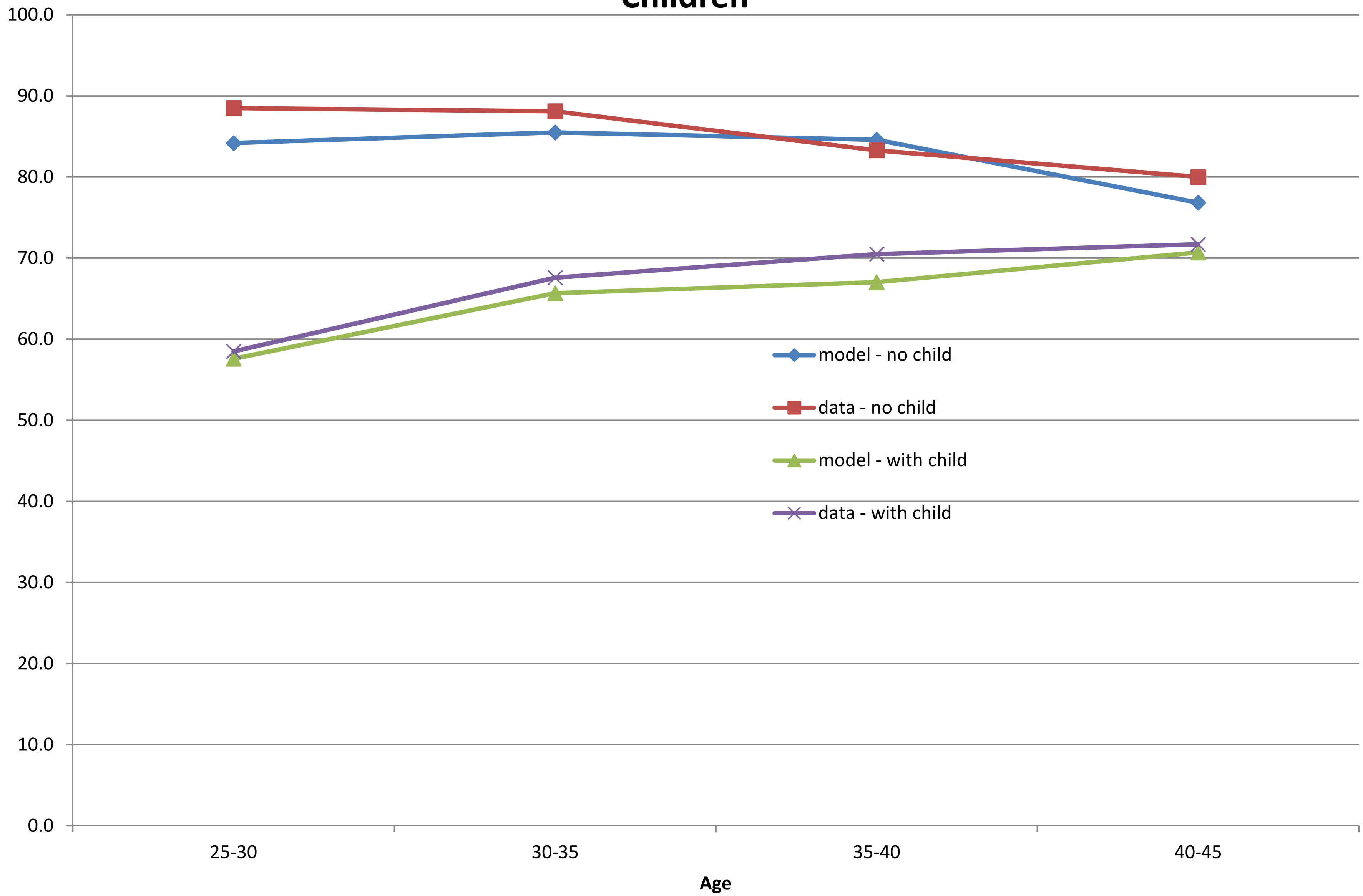


Figure 3: Married Female Labor Force Participation by the Presence of Children



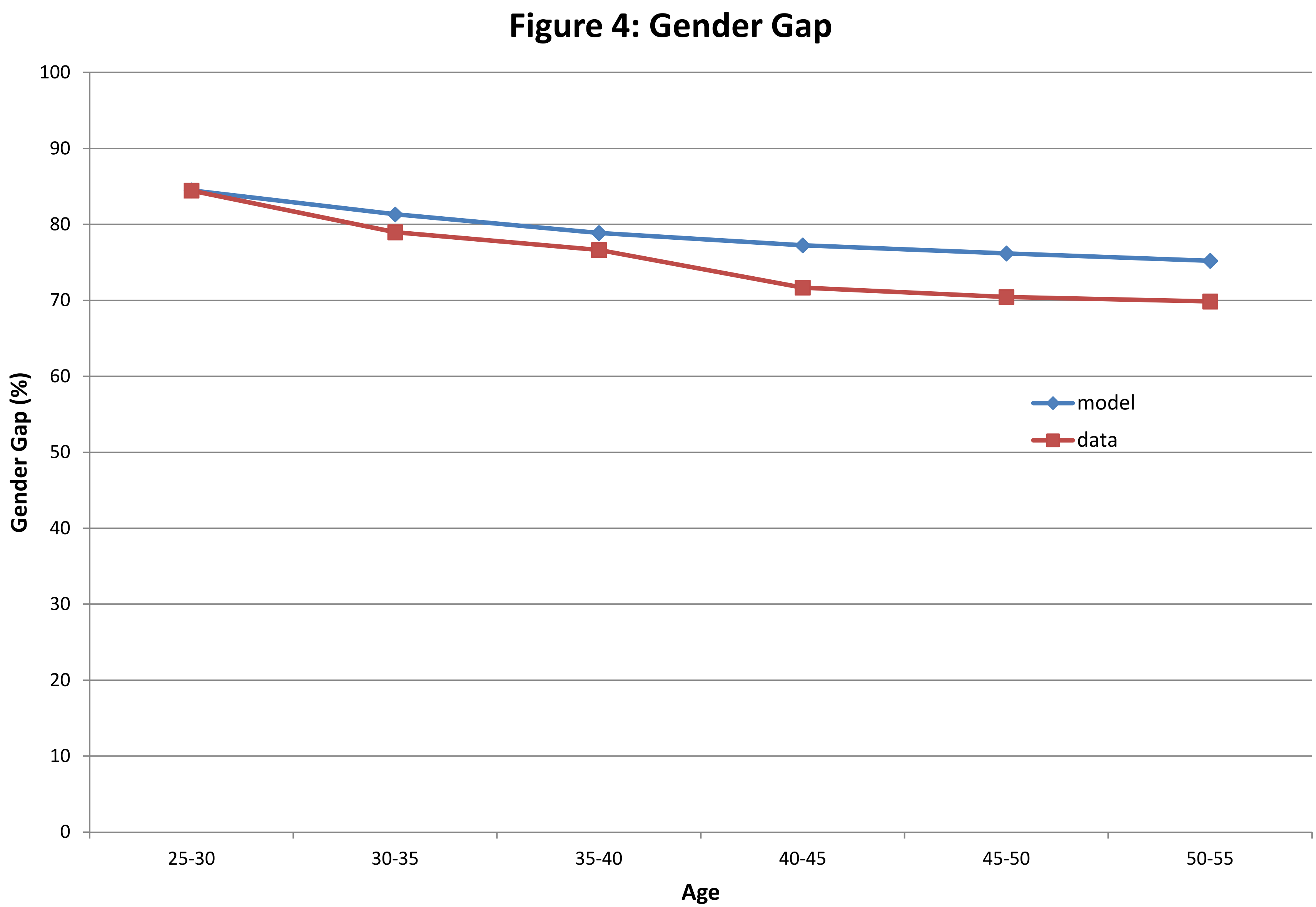


Figure 4: Gender Gap
100
90
80
70
60
50
40
30
20
10
0
Gender Gap (%)
model
data
25-30
30-35
35-40
40-45
45-50
50-55
Age

Appendix (not for publication)

for

Child-Related Transfers, Household Labor Supply and Welfare

by

Nezih Guner, Remzi Kaygusuz and Gustavo Ventura

9 Definition of Equilibrium

In this section, we define a stationary equilibrium for our economy. To this end, let $\mathbf{s}^M \equiv (x, z, \varepsilon_x, \varepsilon_z, q, b, g)$ be the vector of exogenous states for married households. Similarly, let $\mathbf{s}_f^S \equiv (x, \varepsilon_x, b, g)$ and $\mathbf{s}_m^S \equiv (z, \varepsilon_z)$ be the vector of exogenous variables for single females and single males, respectively. In equilibrium, factor markets clear. The aggregate state of this economy consists of distribution of households over their types, asset and human capital levels. Let the function $\psi_j^M(a, h, \mathbf{s}^M)$ denote the number of married individuals of age j with assets a, female human capital level h, and exogenous states $\mathbf{s}^M$. The function $\psi_{f,j}^S(a, h, \mathbf{s}_f^S)$, for single females, and the the function $\psi_{m,j}^S(a, \mathbf{s}_m^S)$, for single males, are defined similarly. Note that household assets, a, and female human capital levels, h, are continuous decisions. Let $a \in A = [0, \overline{a}]$ and $H = [0, \overline{h}]$ be the sets of possible assets and female human capital levels.

By construction, $M(x, z)$, the number married households of type (x, z), must satisfy for all ages

$$M(x, z) = \sum_{\varepsilon_x, \varepsilon_z, q, b, g} \int_{A \times H} \psi_j^M(a, h, \mathbf{s}^M) dh da.$$

Similarly, the fraction of single females and males must be consistent with the corresponding measures $\psi_{f,j}^S$ and $\psi_{m,j}^S$, i.e. for all ages, we have

$$\phi(x) = \sum_{\varepsilon_x, b, g} \int_{A \times H} \psi_{f,j}^S(a, h, \mathbf{s}_f^S) dh da,$$

and

$$\omega(z) = \sum_{\varepsilon_z} \int_A \psi_{m,j}^S(a, \mathbf{s}_m^S) da.$$

For married couples, let $\lambda^M_{b,g}(x,z)$ be the fraction of type-(x,z) couples who have child-bearing type b (where $b \in \{0,1,2\}$ denotes no children, early childbearing and late child-bearing, respectively) and informal care type g (where $g \in \{0,1\}$ indicates whether the household has access to informal care), with $\sum_{b,g} \lambda^M_{b,g}(x,z) = 1$. Similarly, let $\lambda^S_{b,g}(x)$ be the fraction of type-x single females who have childbearing type b and informal care type g, with $\sum_{b,g} \lambda^S_{b,g}(x) = 1$.

Let the decision rules associated with the dynamics programming problems outlined in Section 3.2 of the paper be denoted by $a^S_m(a,\mathbf{s}^S_m,j)$ and $l^S_m(a,\mathbf{s}^S_m,j)$ for single males, by $a^S_f(a,h,\mathbf{s}^S_f,j)$ and $l^S_f(a,h,\mathbf{s}^S_f,j)$ for single females, and by $a^M(a,h,\mathbf{s}^M,j)$, $l^M_f(a,h,\mathbf{s}^M,j)$ and $l^M_m(a,h,\mathbf{s}^M,j)$ for married couples.

Finally, let the functions $\mathfrak{h}^S(a,h,\mathbf{s}^S_f,j)$ and $\mathfrak{h}^M(a,h,\mathbf{s}^M,j)$ describe the age-j level of human capital for a single and married female, respectively. For $j>1$, they are defined as

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

and

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

Let $\chi\{.\}$ denote the indicator function.

The distribution functions $\psi^M_j(a,h,\mathbf{s}^M)$, $\psi^S_{f,j}(a,h,\mathbf{s}^S_f)$, and $\psi^S_{m,j}(a,\mathbf{s}^S_m)$ must obey the following recursions:

Married agents

$$\psi^M_j(a',h',\mathbf{s}^M) = \int_{A\times H} \psi^M_{j-1}(a,h,\mathbf{s}^M)\chi\{a^M(a,h,\mathbf{s}^M,\ j-1)=a',\ \mathfrak{h}^M(a,h,\mathbf{s}^M,j-1)=h'\}dhda, \tag{8}$$

for $j>1$, and

$$\psi^M_1(a,h,\mathbf{s}^M) = \begin{cases} M(x,z)\lambda^M_{b,g}(x,z)\zeta(q|z)\Xi(\varepsilon_x)\Xi(\varepsilon_z) \text{ if } a=0,\ h=\eta(x), \\ 0,\ \text{otherwise} \end{cases},$$

where $\eta(x)$ is a function that maps female types their initial human capital, $\zeta(q|z)$ is fraction of households that draw q (given z) and $\Xi(.)$ is the distribution function for within-education-group productivity shocks.

Single female agents

$$\psi^S_{f,j}(a', h', \mathbf{s}^S_f) = \int_{A\times H} \psi^S_{f,j-1}(a, h, \mathbf{s}^S_f)\chi\{a^S_f(a, h, \mathbf{s}^S_f,\ j-1) = a',\ \mathfrak{h}^S(a, h, \mathbf{s}^S_f, j-1) = h'\}dhda, \tag{9}$$

for $j > 1$, and

$$\psi^S_{f,1}(a, h, \mathbf{s}^S_f) = \begin{cases} \phi(x)\lambda^S_{b,g}(x)\Xi(\varepsilon_x) \text{ if } a = 0,\ h = \eta(x) \\ 0,\ \text{otherwise} \end{cases}.$$

<u>*Single male agents*</u>

$$\psi^S_{m,j}(a', \mathbf{s}^S_m) = \int_A \psi^S_{m,j-1}(a, \mathbf{s}^S_m)\chi\{a^S_m(a, \mathbf{s}^S_m,\ j-1) = a'\}da, \tag{10}$$

for $j > 1$, and

$$\psi^S_{m,1}(a, z) = \begin{cases} \omega(z)\Xi(\varepsilon_z) \text{ if } a = 0 \\ 0,\ \text{otherwise} \end{cases}.$$

Given distribution functions $\psi^M_j(a, h, \mathbf{s}^M)$, $\psi^S_{f,j}(a, h, \mathbf{s}^S_f)$, and $\psi^S_{m,j}(a, \mathbf{s}^S_m)$, aggregate capital (K) and aggregate labor (L) are given by

$$\begin{aligned} K &= \sum_j \mu_j[\sum_{\mathbf{s}^M} \int_{A\times H} a\psi^M_j(a, h, \mathbf{s}^M)dhda + \sum_{\mathbf{s}^S_m} \int_A a\psi^S_{m,j}(a, \mathbf{s}^S_m)da \\ &+ \sum_{\mathbf{s}^S_f} \int_{A\times H} a\psi^S_{f,j}(a, h, \mathbf{s}^S_f)dhda] \end{aligned} \tag{11}$$

and

$$\begin{aligned} L &= \sum_j \mu_j[\sum_{\mathbf{s}^M} \int_{A\times H} (h\varepsilon_x l^M_f(a, h, \mathbf{s}^M, j) \\ &\quad +\varpi_m(z, j))\varepsilon_z l^M_m(a, h, \mathbf{s}^M, j))\psi^M_j(a, h, \mathbf{s}^M)dhda \\ &+ \sum_{\mathbf{s}^S_m} \int_A \varpi_m(z, j)\varepsilon_z l^S_m(a, \mathbf{s}^S_m, j)\psi^S_m(a, \mathbf{s}^S_m)da \\ &\quad +\sum_{\mathbf{s}^S_f} \int_{A\times H} h\varepsilon_x l^S_f(a, h, \mathbf{s}^S_f, j)\psi^S_{f,j}(a, \mathbf{s}^S_f)dhda] \end{aligned} \tag{12}$$

Furthermore, labor used in the production of goods, L_g, equals

$$
\begin{aligned}
L_g &= L - [\sum_{\{\mathbf{s}^M|b\}}\sum_{b=1,2}\sum_{j=b,b+2}\mu_j \int_{A\times H} \chi\{l_f^M\}k(x,z,g)d(j+1-b,x,z,g) \\
& \psi_j^M(a,h,\mathbf{s}^M)dhda \\
&+ \sum_{\{\mathbf{s}_f^S|b\}}\sum_{b=1,2}\sum_{j=b,b+2}\mu_j \int_{A\times H} \chi\{l_f^S\}k(x)d(j+1-b,x,g)\psi_{f,j}^S(a,h,\mathbf{s}_f^S)dhda],
\end{aligned}
$$

where the term in brackets is the quantity of labor used in childcare services.

In equilibrium, total taxes must cover government expenditures, G, total government spending on childcare subsidies, C, and total transfers, TR. That is,

$$
\begin{aligned}
G + C + TR &= \sum_j \mu_j [\sum_{\mathbf{s}^M} \int_{A\times H} T^M(I, k(x,z))\psi_j^M(a,h,\mathbf{s}^M)\ dh\ da \\
&+ \sum_{\mathbf{s}_m^S} \int_A T^S(I,0)\psi_{m,j}^S(a,\mathbf{s}_m^S)\ da \\
&+ \sum_{\mathbf{s}_m^S} \int_{A\times H} T^S(I,k(x))\psi_{f,j}^S(a,h,\mathbf{s}_f^S)\ dh\ da] + \tau_k r K,
\end{aligned} \tag{13}
$$

where I represents a household's total income as defined earlier in the description of the individual and household problems. The total government expenditure on child care subsidies is given by

$$
\begin{aligned}
C &= \theta \sum_{\{\mathbf{s}^M|b\}}\sum_{b=1,2}\sum_{j=b,b+2}\mu_j \int_{A\times H} \chi(I,\widehat{I},l_f^M)k(x,z)wd(j+1-b,x,z,g)\psi_j^M(a,h,\mathbf{s}^M)\ dh\ da \\
&+ \theta \sum_{\{\mathbf{s}_f^S|b\}}\sum_{b=1,2}\sum_{j=b,b+2}\mu_j \int_{A\times H} \chi(I,\widehat{I},l_f^S)wk(x)d(j+1-b,x,g)\psi_{f,j}^S(a,h,\mathbf{s}_f^S)\ dh\ da],
\end{aligned}
$$

where the indicator function $\chi(I,\widehat{I},l)$ indicates whether a household qualifies for a subsidy. It equals 1 if $I \leq \widehat{I}$ and $l > 0$, and 0 otherwise.

In turn, aggregate transfers are given by

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

where D stands for childcare expenditures, as defined earlier in the description of the household problems.

Finally, the social security budget must balance

$$\begin{aligned} & \sum_{j \geq J_R} \mu_j [\sum_{\mathbf{s}^M} \int_{A \times H} p^M(x,z) \psi_j^M(a,h,\mathbf{s}^M) dhda + \sum_{\mathbf{s}_f^S} \int_{A \times H} p_f^S(x) \psi_{f,j}^S(a,h,\mathbf{s}_f^S) dhda \\ & + \sum_{\mathbf{s}_m^S} \int_A p_m^S(z) \psi_{m,j}^S(a,\mathbf{s}_m^S) \ da] \qquad (14) \\ = & \ \tau_p w L. \end{aligned}$$

Equilibrium Definition For a given government consumption level G, social security tax benefits $p^M(x,z)$, $p_f^S(x)$ and $p_m^S(z)$, tax functions $T^S(.)$, $T^M(.)$, a payroll tax rate τ_p, a capital tax rate τ_k, transfer function $TR_f^S(.)$, $TR_m^S(.)$, $TR^M(.)$, and an exogenous demographic structure represented by $\Omega(z)$, $\Phi(x)$, $M(x,z)$, and μ_j, a *stationary equilibrium* consists of prices r and w, aggregate capital (K), aggregate labor (L), labor used in the production of goods (L_g), household decision rules $a_m^S(a,\mathbf{s}_m^S,j)$, $l_m^S(a,\mathbf{s}_m^S,j)$ for single males, $a_f^S(a,h,\mathbf{s}_f^S,j)$ and $l_f^S(a,h,\mathbf{s}_f^S,j)$ for single females, and $a^M(a,h,\mathbf{s}^M,j)$, $l_f^M(a,h,\mathbf{s}^M,j)$ and $l_m^M(a,h,\mathbf{s}^M,j)$, and functions $\psi_j^M(a,h,\mathbf{s}^M)$, $\psi_{f,j}^S(a,h,\mathbf{s}_f^S)$, and $\psi_{m,j}^S(a,\mathbf{s}_m^S)$, such that

1. Given tax rules and factor prices, the decision rules of households are optimal.
2. Factor prices are competitively determined; i.e. $w = F_2(K,L_g)$, and $r = F_1(K,L_g) - \delta_k$.
3. Factor markets clear; i.e. equations (11) and (12) hold.
4. The functions ψ_j^M, $\psi_{f,j}^S$, and $\psi_{m,j}^S$ are consistent with individual decisions, i.e. they are defined by equations (8), (9), and (10).
5. The government and social security budgets are balanced; i.e. equations (13) and (14) hold.

10 Parameter Values

This section contains Figure A1 and Tables A1-A10 that were described in Section 4 (Parameter Values) of the paper. It also details the mapping of the model to data for taxes and transfers.

Income Taxes To construct income tax functions for married and single individuals, we follow Guner et al (2014) and estimate *effective tax rates* as a function of reported income, marital status and the number of children. The underlying data is tax-return, micro-data from Internal Revenue Service for the year 2000 (Statistics of Income Public Use Tax File). For married households, the estimated tax functions correspond to the legal category *married filing jointly.* For singles without children, tax functions correspond to the legal category of *single* households; for singles with children, tax functions correspond to the legal category *head of household.*[40] To estimate the tax functions for a household with a certain number of children, married or not, the sample is further restricted by the number of dependent children for tax purposes.

Since the EITC, CTC and CDCTC are explicitly modelled in the benchmark economy, we consider tax liabilities in the *absence of these credits.* To this end, let I stands for multiples of mean household income in the data. That is, a value of I equal to 2 implies an actual level of income that is twice the magnitude of mean household income in the data, and we denote by $\widetilde{t}(I)$ the corresponding tax liabilities after any tax credits. Tax credits reduce the tax liability first to zero and if there is any refundable credit left, the household receives a transfer. Let $credit(I)$ be the total credits without any refunds, which we can identify in the IRS micro tax data. Taxes in the absence of credits is then given by $t(I) = \widetilde{t}(I) + credit(I)$.

As in Guner et al (2014) we posit

$$t(I) = \eta_1 + \eta_2 \log(I),$$

and the total tax liabilities amount to $t(I) \times I \times mean\ household\ income$.

Estimates for η_1 and η_2 are contained in Table A11 for different tax functions we use in our quantitative analysis. Given the number of children that different types of households have in Table A7, we estimate tax functions for households with zero, two and three children. We then round the number of children from Table A7 to the nearest integer and assign the appropriate tax function to each household.

Figure A2 displays estimated average and marginal tax rates for different multiples of household income for married and single households with two children. Our estimates imply that a married household at around mean income faces an average tax rate of about 9.1% and marginal tax rate of 14.7%. As a comparison, a single household around mean income faces average and marginal tax rates of 8.0% and 11.5%, respectively. At twice the mean

[40] We use the 'head of household' category for singles with children, since in practice it is clearly advantageous for most unmarried individuals with dependent children to file under this category. For instance, the standard deduction is larger than for the 'single' category, and a larger portion of income is subject to lower marginal tax rates.

income level, the average and marginal rates for a married household amount to 20.3% and 25.3%, respectively, while a single household at the mean income level has an average tax rate of 15% and a marginal tax rate of 18.5%.

Social Security and Capital Taxation We calculate $\tau_p = 0.086$, as the average value of the social security contributions as a fraction of aggregate labor income for 1990-2000 period.[41] Using the 2008 U.S. Census we calculate total Social Security benefits for all single and married households.[42] Tables A12 and A13 show Social Security benefits, normalized by the level corresponding to single males of the lowest type. Given τ_p, the value of the benefit for a single retired male of the lowest type, $p_m^S(x_1)$, is chosen to balance the budget for the social security system. The implied value of $p_m^S(x_1)$ for the benchmark economy is about 18.1% of the average household income in the economy.

We use τ_k to proxy the U.S. corporate income tax. We estimate this tax rate as the one that reproduces the observed level of tax collections out of corporate income taxes after the major reforms of 1986. such tax collections averaged about 1.92% of GDP for 1987-2000 period. Using the technology parameters we calibrate in conjunction with our notion of output (business GDP), we obtain $\tau_k = 0.097$.

Child and Dependent Care Tax Credit (CDCTC) The Child and Dependent Care Tax Credit (CDCTC) provides a tax credit to offset child care costs for families with working parents. The CDCTC is calculated as a percentage of the qualified child care expenditures.

For a married couple with k children, the qualified expenditure is calculated as follows

$$\text{Expense } = min\{d_{CDCTC} \times \min\{k, 2\}, earnings_1, earnings_2, d\},$$

where $earnings_1$ and $earnings_2$ are the earnings of the household head and his/her spouse and d is the child care expenditure (net of any childcare subsidy that a household might qualify). Note that a married couple household can have qualified expenses only if both the husband and the wife have non-zero earnings. The child care expenditures for the calculation of the CDCTC are capped at d_{CDCTC} per child per year, with a maximum of $2 \times d_{DCCTC}$.

For a single female household, the equivalent formula is given by

$$\text{Expense } = min\{d_{CDCTC} \times \min\{k, 2\}, earnings, d\}.$$

[41] The contributions considered are those from the Old Age, Survivors and DI programs. The Data comes from the Social Security Bulletin, Annual Statistical Supplement, 2005, Tables 4.A.3.

[42] Social Security income is all pre-tax income from Social Security pensions, survivors benefits, or permanent disability insurance. Since Social Security payments are reduced for those with earnings, we restrict our sample to those above age 70. For married couples we sum the social security payments of husbands and wives.

In 2004, d_{CDCTC} was set \$3000, i.e. maximum qualified expenditure for households with more than 1 child was capped at \$6,000. In multiples of mean household income in the US (\$60464), d_{CDCTC} was equal to 0.0496, i.e. about 5% of mean household income in the US.

A household, however, only receives a fraction $\theta_{CDCTC}(I)$ of qualified expenses. The rate, θ_{CDCTC}, is a declining function of household income. It is set at 35% for households whose income is below \$15,000 ($\widehat{I}_{CDCTC}$), and after this point the rate declines by 1% for each extra \$2,000 that the household earns down to a minimum of 20%.

Hence, the potential $CDCTC$ that a household can receive is then given by

$$CDCTC_{potential}(I) = \text{Expense} \times \theta_{CDCTC}(I), \tag{15}$$

with

$$\theta_{CDCTC}(I) = \begin{cases} 0.35, \text{ if } I \leq \widehat{I}_{CDCTC} \\ 0.35 - \min\{[\text{integer}(\frac{I-\widehat{I}_{CDCTC}}{0.033}) + 1] \times 0.01, 0.15\}, \text{ otherwise} \end{cases},$$

where $\widehat{I}_{CDCTC}$ is equal to 0.248 is in multiples of mean household income in the U.S. in 2004. Figures A3 and A4 show $\theta_{CDCTC}(I)$ and $CDCTC_{potential}(I)$.[43] In Section 6.2 of the paper, when we expand the CDCTC program, the entire schedule in equation (15) is multiplied by a constant.

Child Tax Credit (CTC) In contrast to the CDCTC, the Child Tax Credit (CTC) provides each household below a certain income level with a tax credit, *independent* of whether the household incurs any childcare costs. The credit starts at d_{CTC} per each qualified child in the household and remains constant until the household income reaches a certain income limit, $\widehat{I}_{CTC}$. In 2004, d_{CTC} was \$1,000 and the income limits were \$75,000 and \$110,000 for single and married couple households, respectively. Beyond the income limit, the credit starts declining at a 5% rate until it is completely phased out when the household income is \$115,000 and \$150,000 for single and married couple households, respectively.

For a household with income level I (again indicated as a multiple of mean household income in the economy) and k children, the *potential CTC* is given by

$$CTC_{potential}(I) = \max\{[k \times 0.0165 - \max(I - \widehat{I}_{CTC}, 0) \times 0.05], 0\}, \tag{16}$$

with

$$\widehat{I}_{CTC} = \begin{cases} 1.819, \text{ if married filing jointly} \\ 1.240, \text{ if single} \end{cases},$$

[43]The simulations for Figure A4 are done under the assumption that at each income level, the husband and the wife earns 60% and 40% of the household income, respectively, and the households spend 10% of their income on childcare.

where again the maximum amount of credit per child, 0.0165, and income limits, 1.819 and 1.240, are in multiples of mean household income in the U.S. in 2004. Figure A5 shows $CTC_{potential}(I)$ for a household with 2 children. In Section 6.2 of the paper, when we expand the CTC program, we multiply d_{CTC} by a constant.

Both the CTC and the CDCTC are *non-refundable*, as a result, how much of the potential credit a household actually gets depends on its total tax liabilities and total tax credits (CTC plus CDCTC).

Let $Credit_{potential}(I) = CTC_{potential}(I) + CDCTC_{potential}(I)$ and $Taxes(I)$ be the total potential tax credits and the tax liabilities of the household. Then,

$$CDCTC_{actual}(I) = \begin{cases} CDCTC_{potential}(I), \text{ if } Taxes(I) > Credit_{potential}(I) \\ \max\{Taxes(I) - CDCTC_{potential}(I), 0\}, \text{ if } Taxes(I) < Credit_{potential}(I) \\ \qquad \text{and } CDCTC_{potential}(I) > Taxes(I) \\ CDCTC_{potential}(I), \text{ if } Taxes(I) < Credits_{potential}(I) \\ \qquad \text{but } CDCTC_{potential}(I) < Taxes(I) \end{cases},$$

and

$$CTC_{actual}(I) = \begin{cases} CTC_{potential}(I), \text{ if } Taxes(I) > Credits_{potential}(I) \\ 0, \text{ if } Taxes(I) < Credits_{potential}(I) \\ \qquad \text{and } CDCTC_{potential}(I) > Taxes(I) \\ = Taxes(I) - CDCTC_{potential}(I), \text{ if } Taxes(I) < Credits_{potential}(I) \\ \qquad \text{but } CDCTC_{potential}(I) < Taxes(I) \end{cases}$$

Hence, if the tax liabilities of a household are larger than the total potential credit implied by the CTC and the CDCTC, the household receives the full credit and its tax liabilities are reduced by $CTC_{potential} + CDCTC_{potential}$. If the total potential credits are larger than tax liabilities, then the household only receives a credit up to its tax liabilities. As a result, the households with low tax liabilities do not benefit from the CTC or CDCTC. This is partially compensated by the Additional Child Tax Credit (ACTC), which gives a household additional tax credits if its potential child tax credit is higher than the actual child tax credits it receives. In order to qualify for the ACTC, however, a household must have earnings above $10,750. Thus, a household with very low earnings does not qualify for the ACTC.

Given CTC_{actual} and CTC_{credit}, the ACTC is calculated as

$$ACTC(I) = \begin{cases} \min\{\max[(earnings - 0.178), 0] * 0.15, CTC_{potential}(I) - CTC_{actual}(I)\} \\ \qquad \text{if } CTC_{actual}(I) \leq CTC_{credit}\ (I) \\ 0, \text{ otherwise} \end{cases}.$$

Figure A6 illustrates the sum of $CDCTC_{actual}(I)$, $CTC_{actual}(I)$ and $ACTC$ that a household receives.

Earned Income Tax Credits (EITC) The Earned Income Tax Credit is a fully refundable tax credit that subsidizes low income working families. The EITC amounts to a fixed fraction of a family's earnings until earnings reach a certain threshold. Then, it stays at a maximum level, and when the earnings reach a second threshold, the credit starts to decline, so that beyond a certain earnings the household does not receive any credits. The amount of maximum credits, income thresholds, as well as the rate at which the credits declines depend on the tax filing status of the household (married vs. single) as well on the number of children. To qualify for the EITC, the capital income of a household must also be below a certain threshold, which was \$2,650 in 2004.

In 2004, for a married couple with 0 (2 or 3) children, the EITC started at \$2 (\$10) and increased by 7.6 (39.9) cents for each extra \$ in earnings up to a maximum credit of \$3,900 (\$4,300). Then the credit stays at this level until the household earnings are \$7,375 (\$15025). After this level of earnings, the credit starts declining are a rate 7.6 (21) cents for each extra \$ in earnings until it becomes zero for earrings above \$12,490 (\$35,458). The formula for a single household with 0 (2 or 3) children are very similar.

We calculate the level of $EITC$ as a function of earnings with the following formula,

$$\begin{aligned} EITC &= \max\{CAP\text{-}\max\{slope_1 \times (bend_1 - earnings), 0\} \\ &\quad - \max\{slope_2 \times (earnings - bend_2), 0\}, 0\}, \end{aligned}$$

where CAP, the maximum credit level, $bend_1$ and $bend_2$, the threshold levels, and $slope_1$ and $slope_2$, the rate at which credit increase and decline are given by (as a fraction of mean household income in 2014):

	CAP	$slope_1$	$bend_1$	$slope_2$	$bend_2$
Married					
No ch.	0.006	0.076	0.085	0.076	0.122
2 or 3 ch.	0.071	0.399	0.178	0.21	0.248
Single					
No ch.	0.006	0.076	0.085	0.076	0.105
2 or 3 ch.	0.071	0.399	0.178	0.21	0.232

Figure A7 shows the EITC as a function of household income and the tax filing status. As with taxes, we use the nearest integer for the number of children in Table A7 to determine the relevant EITC schedule for a household.

Means-Tested Transfers We use the 2004 wave of the Survey of Income and Program Participation (SIPP) to approximate a welfare schedule as a function of labor earnings for different household types. The sample of household heads aged 25-54 spans 876,277 observations across 24,392 households. Per household there are between 1 and 48 monthly observations with an average of nearly 36 monthly observations per household. The SIPP is a panel surveying households every three months retrospectively for each of the past three months. We compute the average amount of monthly welfare payments and monthly labor earnings, both corrected for inflation, for each household. The welfare payments include the following main means-tested programs: Supplemental Social Security Income (SSSI), Temporary Assistance for Needy Families (TANF formerly AFDC), Supplemental Nutrition Assistance Program (SNAP formerly food stamps), Supplemental Nutrition Program for Women, Infants, and Children (WIC), and Housing Assistance.[44] For a description of these programs, see Scholz, Moffitt and Cowan (2009).

We then estimate an "effective transfer function" (conditional on marital status and the number of children). We assume that these functions take the following form

$$TR(I) = \begin{cases} \omega_0 \text{ if } I = 0 \\ \max\{0, \alpha_0 - \alpha_1 I\} \text{ if } I > 0 \end{cases},$$

where ω_0 is the transfers for a household with zero income and α_1 is the benefits reduction rate.

In order to determine ω_0, we simply calculate the average amount of welfare payments for households with zero non-transfer income. Then we estimate an OLS regression of welfare payments on household non-transfer income to determine α_0 and α_1. In Table A14 shows the estimated values of ω_0, α_1 and α_2 by marital status and the number of children. Figures A8 and A9 shows the welfare payments as a function of household income for married and single female households, respectively.

11 Depreciation Rate of Human Capital

In order to compute the depreciation of human capital of females associated to not participating in the labor market, δ_x in the model economy, we use the Panel Study of Income Dynamics (PSID). We consider all women between ages 25 and 45 for the 1979-1997 period. The final data is dictated by the fact that after 1997 the PSID becomes biannually. For each female in the sample, we record all labor market transitions from "Employment" to "Out of the Labor Force" and back to "Employment", as well as the number of years she stays out of

[44]The SIPP only provides the information of whether a household receives Housing Assistance, but does not contain information on actual payments. We use the methodology of Scholz, Moffitt and Cowan (2009) to impute Housing Assistance reception. For all other transfer programs, the SIPP provides information on the actual amount received.

the labor force. We also compute her hourly real wages (in 2010 dollars) the year before she went out of labor force and the year she enters the labor force again. We consider a female as out of labor force if her yearly hours worked is less than 500 and drop observation with an hourly wage that is lower than half of the of minimum wage (\$7.25 in 2010).

The depreciation rate is then is calculated as

$$\delta = \frac{log(wage_{after}) - log(wage_{before})}{n},$$

where n is the number of years a female stays out of the labor force. We compute δ for two groups: skilled (college and above) and unskilled (some college or below). All outliers with $\delta > 0.5$ are dropped.

The values reported in the text, $\delta_x = 0.009$ for unskilled women and $\delta_x = 0.022$ for skilled women, correspond to the median values computed using the procedure described above.

12 Additional Childcare Subsidy Experiments

In this section, we present additional childcare subsidy experiments via changes in eligibility into the subsidy scheme (i.e. changing $\widehat{I}$) and/or via variation in the subsidy rate (i.e. changing θ). Given the benchmark values of $\widehat{I}$, 21% of mean household income, and θ, 75%, we consider eligibility levels of 50% and 100% and subsidy rates of 50%, 75% and 100%. Results are presented in Table A15. The case when the childcare subsidies are universal, i.e. $\widehat{I}$ is arbitrarily large, are presented in Section 6.1 of the paper.

Relaxing eligibility constraints has substantial consequences on certain aggregates. Under the benchmark subsidy rate (75%), increasing the threshold $\widehat{I}$ from the benchmark value (21% of mean household income) to 50% and 100% of mean household income increases the participation rate of married females by 2.4%, 6.6%, respectively. The effects on aggregate work hours are negligible at a threshold of about one-half mean household income, but become positive when the threshold equals mean household income. Changes in output across steady states are negative for 50% and 100% levels of eligibility.[45]

The effects driven by changes in the subsidy rate for given levels of eligibility are also substantial, and in line with the results that we document in Table 3 in the paper for the case of universal subsidies.

[45] As in the main experiments in the paper, the measure of output that we report pertains to output for consumption and investment, and does *not* include the value of childcare services.

13 Cross-Country Evidence on Participation Rates and Hours Worked

Our model predicts that upon expansion (univeralization) of childcare subsidies, the participation rate of married females increases and hours worked (conditional on working) decline. Cross-country evidence is consistent with these predictions of the model economy.

Figure A10 summarizes this evidence, showing the relation between public spending on childcare and the two measures of labor supply of married females aforementioned. We measure public spending on childcare as the total public spending on childcare as a percentage of GDP (calculated as the sum of public spending on childcare plus pre-primary education).[46] The hours for married female labor force participation and hours are taken those used by Bick and Fuchs-Schundeln (2016), who provided us for the data in Figure 3 in their paper. Participation is positively related to spending (correlation: 0.7) and hours worked are negatively related (correlation: -0.3).

14 Findings on Participation Rates by Childbearing Status and Education

We provide further results for changes in participation rates of married females in Table A16. The table shows results according to education, as well as for education and childbearing status. Even conditional on education, the effects on participation are larger for early childbearers. Early childbearers have a longer working life after their childbearing years and hence more to benefit from increasing their participation.

15 Discussion and Robustness

In this section, we provide further details on the effects of different model features on our main results that were presented in Section 6.3 and 6.4 of the paper.

The Role of Endogenous Skills Table A17 shows the results of our main experiments, expansions of child care subsidies, the CTC and the CDCTC, when we shut down the endogenous skill channel. In each experiment, we assume that married female of a given type has exogenously the *same* skill profile that she had in the benchmark economy. Hence,

[46] Table PF3.1 (Public spending on childcare and early education) available in OECD Family Database, http://www.oecd.org/els/family/database.htm. We use the sum of spending on childcare plus pre-primary education in order to maximize the number of countries in the sample.

her skills do not change if she chooses to change her participation decision in response to the policy change. We summarize our findings in Table A16. As we detail in the paper, without the endogenous changes in skills, the labor supply by married females increases much less than it does in the baseline experiments.

The Role of the Reallocation of Hours Worked Within Couples As we have discuss in the paper, the expansion of childcare subsidies or the CTCDC generate a reallocation of hours worked in married couples, from males to females. This reallocation is arguably important: males are on average more skilled than females and in our baseline experiments, and as we document in Table 4 per-worker hours of males drop by about 1.2% under universal subsidies at a 75% rate and by 1.5% under the revenue-equivalent expansion of the CDCTC program.

In order to quantify the importance of these reallocation, we compute stationary equilibria when we expand childcare subsidies, the CTC and the CDCTC while keeping the labor supply decisions of married males at their benchmark values. Table A18 shows the results. With labor supply decisions of married males fixed, households find optimal not to increase married female labor supply as much as they do in the benchmark economy. As a result, their labor force participation and hours increase less with more generous childcare subsidies than in our baseline experiments, although the increase is very comparable with our benchmark results. With universal subsidies, the participation rate increases by about 8.5% versus an increase of about 8.8% in the baseline experiment. The expansion of the CDCTC also gives quite similar results, 4.9% versus 5.2%.

Given that the labor supply of males is fixed and that they are on average more skilled than females, total output increases more with the expansion of subsidies or the CDCTC program. With the universal subsidies, the increase in output amounts to about 1.5% – it is 0.4% in the baseline experiments. The output increase by 0.9% with the expansion of the CTCDC, while it declined by 0.4% in our benchmark experiments. On the other hand, by the same logic, the negative effects of the CTC on output are now more muted. In the benchmark experiments, the expansion of the CTC reduced the aggregate output by 1.2%, while the reduction is only 0.3% when we do not allow married males to adjust their labor supply.

We conclude that the reallocation of hours within married couples in response to the expansion of subsidies is not an important mechanism underlying our findings on labor force participation. Nonetheless, given the importance of male skills in determining the size of the aggregate labor input, the ability of households to substitute work hours from men to women in response to the expansion of subsidies is quantitatively important for the output effects.

Expanding Child-Related Transfers in a Closed Economy The benchmark experiments in Section 6 of the paper are done under the assumption of a small-open economy, where the rate of return on capital, and thus the wage rate, are unchanged across steady states. In this section we study the importance of this assumption by replicating our experiments under a closed economy assumption, where the factor prices adjust to changes in factor supplied. The results are documented in Table A19. As the table shows, the differences with the benchmark experiments are very small, and not important at all.

The key reason for these findings is that policies that lead to changes in the size of the labor input – accompanied by small changes in distortionary taxes to finance them – lead to essentially no changes in capital to output ratios and therefore, factor prices. Since factor prices are constant by assumption in the small open-economy case, this (benchmark) case is an excellent approximation to the aggregate effects of transfers to households with children.

Imperfect Substitutability of Skills In our benchmark model, all efficiency units are perfect substitutes in production. We now investigate the extent to which our results depend on this assumption. For this purposes, we extend the model to account for imperfect substitution between labor types in the production of consumption and investment goods. We consider a version of the model with two 'types' of labor; *skilled* labor and *unskilled* labor. Production of childcare services requires only unskilled labor.

We empirically identify the skilled group with college and more than college labor. The unskilled group is the rest: less than college, high school and less than high school. Consumption and investment goods are produced according to

$$Y = F(K, S, U) \quad = \quad K^{\alpha} L_g^{1-\alpha} \tag{17}$$

with

$$L_g \equiv (\nu S^{\rho} + (1-\nu) U^{\rho})^{\frac{1}{\rho}}, \quad \rho \in (-\infty, 1)$$

The elasticity of substitution between labor of different types is constant and given by

$$\sigma = \frac{1}{1-\rho}$$

Notice that when $\rho \to 0$, L becomes a Cobb-Douglas aggregator. If $\rho \to 1$, then efficiency units are perfect substitutes, which is the case we address in the paper text.

The assumption on the production technology implies that there are two rental prices for labor, w^S and w^U. As childcare services are produced with unskilled labor, the price one unit of childcare services is the wage rate of unskilled labor.

Note that the model has to be calibrated again. To select ρ, we use standard estimates of the elasticity of substitution that suggest a value of 1.5 – see Katz and Murphy (1992) and Heckman, Lochner and Taber (1998). This dictates $\rho = 1/3$. To calibrate the share parameter ν, we force the model to reproduce the *skill premium* in the data, defined as per-worker earnings of workers in the skilled category to per-worker earnings of workers in the unskilled category. For this statistic, we target a value of 1.8. The calibrated value of ν is 0.4816.[47]

Table A20 shows the main results from the experiments under imperfect substitutability of skills. As the table shows, the changes are the same in direction, and similar in terms of magnitudes with respect to the benchmark case. For instance, under the expansion of childcare subsidies, the participation rate of married females goes up by 8.8% in the benchmark case. When skills are imperfect substitutes, the corresponding increase is 8.5%.

Table A20 also shows the effects on the implied skill premium. As the table shows, the effects are of second order, reflecting the countervailing changes taking place in terms of the relative sizes of skilled and unskilled labor. At most, in the case of the CTC expansion, the skill premium increases by 0.8%. Overall, we conclude from these findings that our benchmark results are robust to an extension of our model with imperfectly substitutability of labor types in production.

[47] The empirical target for the skill premium is from our calculations using data from the 2005 American Community Survey (ACS). We restrict the sample to the civilian adult population of both sexes, between ages 25 and 54 who work full time, and excludes those who are unpaid workers or make less than half of the minimum wage. Full time workers are defined as those who work at least 35 hours per week and 40 weeks per year. We estimate a value tightly centered around 1.8, when we include self-employed individuals or not.

References

[1] Bick, Alexander and Nicola Fuchs-Schundeln (2016). “Taxation and Labor Supply of Married Couples across Countries: A Macroeconomic Analysis." Working Paper.

[2] Heckman, James, Lance Lochner and Christopher Taber. “Explaining Rising Wage Inequality: Explorations With A Dynamic General Equilibrium Model Of Labor Earnings With Heterogeneous Agents," *Review of Economic Dynamics*, 1998, vol. 1, no. 1 (January 1998), 1-58.

[3] Katz, Lawrence and Kevin Murphy, “Changes in Relative Wages, 1963-1987: Supply and Demand Factors," *The Quarterly Journal of Economics*, vol. 107, no. 1 (February 1992), 35-78.

Table A1: Initial Productivity Levels, by Type and Gender

	males (z)	females (x)	x/z
< HS	0.511	0.426	0.813
HS	0.668	0.542	0.811
SC	0.728	0.639	0.878
COL	1.039	0.809	0.779
COL+	1.287	1.065	0.828

Note: Entries are the productivity levels of males and females, ages 25-29, using 2008 data from the CPS March Supplement. These levels are constructed as weekly wages for each type –see text for details.

Table A2: Labor Market Productivity Process for Females (α_J^x)

	Types				
Age	<HS	HS	SC	COL	COL+
25-29	0.038	0.114	0.194	0.213	0.254
30-34	0.041	0.086	0.125	0.140	0.157
35-39	0.042	0.063	0.077	0.091	0.095
40-44	0.044	0.044	0.038	0.053	0.048
45-49	0.045	0.027	0.003	0.020	0.007
50-54	0.046	0.012	-0.031	-0.010	-0.033
55-60	0.047	-0.003	-0.069	-0.042	-0.078

Note: Entries are the parameters α_j^x for the process governing labor efficiency units of females over the life cycle – see equation(7) in the text. These parameters are the growth rates of male wages.

Table A3: Distribution of Married Working Households by Type

	Females				
Males	<HS	HS	SC	COL	COL+
< HS	5.77	2.35	2.65	.047	0.12
HS	0.19	7.21	7.80	2.31	0.70
SC	1.49	5.34	16.85	6.82	2.38
COL	0.29	1.27	5.41	11.18	4.83
COL+	0.06	0.36	1.54	5.01	5.87

Note: Entries show the fraction of marriages out of the total married pool, by wife and husband educational categories. The data used is from the 2008 U.S. Census, ages 30-39. Entries add up to 100. –see text for details.

Table A4: Fraction of Agents by Type, Gender and Marital Status

	Males			Females		
	All	Married	Singles	All	Married	Singles
< HS	11.72	8.41	3.31	9.77	7.03	2.74
HS	20.30	14.75	5.54	16.98	12.21	4.77
SC	33.37	24.29	9.08	35.48	25.31	10.17
COL	22.51	17.10	5.41	24.17	19.06	5.11
COL+	12.12	9.49	2.63	13.6	10.27	3.33

Note: Entries show the fraction of individuals in each educational category, by marital status, constructed under the assumption of a stationary population structure –see text for details.

Table A5: Childbearing Status, Single Females

	Childless	Early	Late
< HS	27.72	62.04	10.24
HS	26.68	59.95	13.37
SC	32.39	53.38	14.23
COL	53.75	30.50	15.75
COL+	56.17	23.06	20.77

Note: Entries show the distribution of childbearing among single females, using data from the CPS-June supplement. See text for details.

Table A6: Childbearing Status, Married Couples

	Childless					Early					
	Females						Females				
Male	<HS	HS	SC	COL	COL+	male	<HS	HS	SC	COL	COL+
< HS	6.75	8.23	8.60	13.37	15.51	< HS	74.92	67.55	62.64	46.31	18.61
HS	9.04	10.60	8.76	14.76	12.66	HS	70.03	63.33	60.10	43.39	40.98
SC	6.82	10.52	9.53	12.66	13.08	SC	72.49	58.36	60.93	41.10	32.37
COL	3.52	9.36	10.35	11.57	11.24	COL	43.39	56.99	43.17	32.55	21.36
COL+	5.90	10.57	9.55	9.45	13.28	COL+	46.42	52.85	36.36	30.57	15.52

Note: Entries show the distribution of childbearing among married couples. For childlessness, data used is from the U.S. Census. For early childbearing, the data used is from the CPS-June supplement. Values for late childbearing can be obtained residually for each cell. See text for details.

Table A7: Fertility Differences

Singles		Married					
			Females				
		Male	<HS	HS	SC	COL	COL+
< HS	2.72	< HS	2.74	2.52	2.27	1.97	2.08
HS	2.19	HS	2.73	2.27	2.15	2.10	1.97
SC	2.00	SC	2.68	2.27	2.23	2.07	1.89
COL	1.84	COL	3.01	2.34	2.27	1.97	1.87
COL+	1.65	COL+	2.22	2.26	2.43	2.18	1.90

Note: Entries show, conditional on having children, the total number of children different types of households have by age 40-44. The authors' calculations from the 2008 CPS-June supplement. See text for details.

Table A8: Fraction of Households Using Informal Care

	Young Children			Older Children	
	Single	Married		Single	Married
< HS	0.216	0.464	< HS	0.01	0.12
HS	0.133	0.309	HS	0.16	0.04
SC	0.271	0.301	SC	0.18	0.06
COL	0.232	0.183	COL	0.04	0.05
COL+	0.076	0.161	COL+	0.01	0.03

Note: Entries show the fraction of households with young and old children, by the marital status of the household, with access to informal childcare. These are authors' calculations from Bureau of Census data and the Survey of Income and Program Participation (SIPP). See text for details.

Table A9: Child Care Cost Differences by Education

	Young Children					Older Children	
	Informal		Formal			Single	Married
	Single	Married	Single	Married			
< HS	1.06	1.25	1	2.05	< HS	1	1.12
HS	1.16	1.27	1.53	1.75	HS	1.20	1.41
SC	1.28	1.17	2.17	2.10	SC	1.58	1.22
COL	1.88	1.59	2.62	2.10	COL	1.58	1.55
COL+	1.87	2.16	2.94	3.32	COL+	2.14	1.82

Note: Entries show child care costs for young (0-4 years old) and older (5-14 years old) children, relative to a single female household with less than high school education, for different households. The authors' calculations from SIPP. See text for details.

Table A10: Labor Force Participation of Married Females, 25-54

	Females				
Males	<HS	HS	SC	COL	COL+
$<$ HS	44.0	64.8	71.3	76.9	79.2
HS	49.4	70.8	77.2	85.1	90.6
SC	51.7	69.9	75.8	83.5	90.4
COL	47.1	64.0	68.6	73.0	82.9
COL+	42.8	55.4	60.6	62.7	76.7
Total	46.4	68.8	73.9	74.9	81.9

Note: Each entry shows the labor force participation of married females ages 25 to 54, calculated from the 2008 U.S. Census. The outer row shows the weighted average for a fixed male or female type.

Table A11: Tax Functions

Estimates	Married			Single		
	(no child)	(2 child.)	(3 child.)	(no child)	(2 child.)	(3 child.)
η_1	0.096	0.091	0.082	0.121	0.080	0.069
η_2	0.053	0.056	0.056	0.035	0.035	0.032

Note: Entries show the parameter estimates for the postulated tax function. These result from regressing effective average tax rates against household income, using 2000 micro data from the U.S. Internal Revenue Service. For singles with two children, the data used pertains to the 'Head of Household' category – see text for details.

Table A12: Social Security Benefits, Singles

	Males	Females
$<$ HS	1	0.858
HS	1.126	0.999
SC	1.184	1.050
COL	1.274	1.063
COL+	1.282	1.122

Note: Entries show Social Security benefits, normalized by the mean Social Security income of the lowest type male, using data from the 2008 U.S. Census. See text for details.

Table A13: Social Security Benefits, Married Couples

	Females				
Males	$<$HS	HS	SC	COL	COL+
$<$ HS	1.708	1.873	1.904	1.890	1.911
HS	1.870	1.989	2.042	2.065	2.095
SC	1.887	2.018	2.040	2.101	2.249
COL	1.912	2.140	2.196	2.224	2.321
COL+	2.091	2.149	2.234	2.300	2.365

Note: Entries show the Social Security income, normalized by the Social Security income of the single lowest type male, using data from the 2008 U.S. Census. See text for details.

Table A14: Welfare System

Estimates	Married			Single		
	(no child)	(2 child.)	(3 child.)	(no child)	(2 child.)	(3 child.)
ω_0	0.063	0.090	0.143	0.090	0.116	0.152
α_1	0.023	0.043	0.065	0.044	0.101	0.125
α_2	-0.017	-0.033	-0.053	-0.042	-0.091	-0.118

Note: Entries correspond to the parameters summarizing our description of a host of transfer and social insurance programs ('welfare system'). Data comes from the 2004 wave of the SIPP. See text for details.

Table A15: Additional Childcare Subsidy Experiments (%)

	$\widehat{I}$= 1/2 mean income			$\widehat{I}$=		
	50%	75%	100%	50%	75%	100%
Participation Married Females	1.6	2.4	3.4	4.5	6.6	8.6
Total Hours	0.2	0.1	-0.1	0.6	0.8	0.9
Total Hours (MF)	1.0	1.5	2.0	3.5	5.0	6.2
Hours per worker (f)	-0.3	-0.8	-1.6	-0.8	-1.3	-2.1
Hours per worker (m)	-0.5	-1.0	-1.2	-1.0	-1.5	-2.0
Output	-0.4	-0.8	-1.0	-0.6	-0.8	-0.8
Tax Rate	0.3	0.5	0.7	0.6	0.95	1.3
Effects on Participation:						
By Education						
< HS	8.7	13.5	18.1	13.2	20.6	27.0
HS	3.2	4.5	6.2	7.1	11.0	14.0
SC	1.1	1.8	2.7	4.5	7.0	8.5
COL	0.4	0.7	1.1	2.5	3.5	5.2
COL+	0.0	0.1	0.2	0.9	1.5	2.0
By Child Bearing Status						
Early	2.8	4.3	6.1	7.4	11.0	14.2
Late	0.6	1.1	1.5	2.6	4.0	5.0

Note: Entries show effects across steady states on selected variables driven by the expansion of childcare subsidies. The values for "Tax Rate" correspond the values that are necessary to achieve revenue neutrality. See text for details.

Table A16: Effects on Participation by Education and Childbearing Status (%)

	Universal Subsidies (75%)	CTC Expansion	CDCTC Expansion
By Education			
< HS	21.5	-3.8	21.6
HS	12.1	-1.8	10.5
SC	8.0	-2.1	5.2
COL	7.4	-0.9	3.5
COL+	4.7	-0.5	1.5
By Education and Child Bearing Status			
Early Childbearing			
< HS	24.4	-6.4	23.7
HS	15.1	-5.3	10.0
SC	10.4	-4.4	5.8
COL	11.2	-1.6	6.1
COL+	7.3	-1.5	2.6
ALL	12.6	-2.6	9.4
Late Childbearing			
< HS	21.9	-4.0	20.1
HS	11.1	-3.2	7.9
SC	6.7	-1.4	3.9
COL	6.7	-0.9	3.0
COL+	4.7	-0.4	1.4
ALL	7.2	-1.0	4.1

Note: Entries show effects (percentage changes) across steady states on participation rates of married females by the universalization of childcare subsidies, and the expansions of the CTC and the CDCTC programs. Effects on participation rates are shown by education (top panel), and by child bearing and education levels combined (bottom panel). See text for details.

Table A17: Policy Experiments:
Role of Endogenous Skill Accumulation (%)

	Universal Subsidies (75%)	CTC Expansion	CDCTC Expansion
Participation Married Females	4.7	-4.1	1.7
Total Hours	0.3	-2.2	-0.5
Total Hours (MF)	2.5	-4.5	0.4
Hours per worker (f)	-1.8	-1.8	-2.1
Output	-5.1	-5.5	-4.8
Tax Rate (%)	2.2	2.2	2.2
Effects on Participation:			
By Education			
< HS	14.5	-10.9	10.0
HS	7.9	-5.4	3.9
SC	3.9	-4.3	1.0
COL	3.1	-2.9	0.3
COL+	1.9	-1.3	0.0
By Child Bearing Status			
Early	6.5	-6.2	2.5
Late	3.8	-3.0	1.1

Note: Entries show effects across steady states on selected variables driven by the expansion of child-related transfers, when female skills are fixed at their benchmark values. The values for "Tax Rate" correspond the values that are necessary to achieve revenue neutrality. See text for details.

Table A18: Policy Experiments Under
Fixed Labor Supply of Males ((%)

	Universal Subsidies (75%)	CTC Expansion	CDCTC Expansion
Participation Married Females	8.5	-1.1	4.9
Total Hours	1.7	-1.1	0.5
Total Hours (MF)	6.6	-1.6	3.5
Hours per worker (f)	-1.3	-1.3	-1.8
Output	1.5	-0.3	0.9
Tax Rate (%)	1.0	1.0	1.0
Effects on Participation:			
By Education			
< HS	20.9	-2.5	19.1
HS	11.8	-2.8	7.5
SC	7.7	-1.1	4.2
COL	7.0	-0.1	3.3
COL+	4.1	-0.5	1.2
By Child Bearing Status			
Early	12.2	-1.6	7.7
Late	6.8	-0.8	3.4

Note: Entries show effects across steady states on selected variables driven by the expansion of child-related transfers, when the labor supply of married males is fixed at their benchmark values. The values for "Tax Rate" correspond the values that are necessary to achieve revenue neutrality. See text for details.

Table A19: Policy Experiments in a
Closed Ecomomy (%)

	Universal Subsidies (75%)	CTC Expansion	CDCTC Expansion
Participation Married Females	8.9	-2.0	4.9
Total Hours	1.4	-1.4	0.1
Total Hours (MF)	7.2	-2.7	3.6
Hours per worker (f)	-1.3	-1.6	-1.8
Output	0.2	-1.4	-0.6
Tax Rate (%)	1.2	1.2	1.2
Effects on Participation:			
By Education			
< HS	21.7	-4.8	18.8
HS	12.3	-3.7	7.9
SC	8.0	-2.4	4.1
COL	7.4	-0.8	3.2
COL+	4.7	-0.6	1.4
By Child Bearing Status			
Early	12.7	-3.5	7.5
Late	7.3	-1.0	3.6

Note: Entries show effects across steady states on selected variables driven by the expansion of child-related transfers in a closed economy. The values for "Tax Rate" correspond the values that are necessary to achieve revenue neutrality. See text for details.

Table A20: Policy Experiments Under Imperfect Skill Substitutability (%)

	Universal Subsidies (75%)	CTC Expansion	CDCTC Expansion
Participation Married Females	8.5	-2.3	4.4
Total Hours	1.4	-1.6	-0.1
Total Hours (MF)	6.8	-3.0	2.9
Hours per worker (f)	-1.1	-1.9	-1.9
Output	0.6	-1.1	-0.2
Skill Premium	-0.2	0.8	0.3
Tax Rate (%)	1.2	1.2	1.2
Effects on Participation:			
By Education			
< HS	22.1	-5.8	18.3
HS	11.7	-3.2	6.4
SC	7.9	-2.7	3.7
COL	6.5	-1.2	2.5
COL+	4.7	-0.4	1.6
By Child Bearing Status			
Early	12.2	-3.8	6.8
Late	6.9	-1.1	3.0

Note: Entries show effects across steady states on selected variables driven by the expansion of child-related transfers when skills are imperfect substitutes in production. The variable 'skill premium' corresponds to the per-worker earnings of skilled workers relative to unskilled workers. The values for "Tax Rate" correspond the values that are necessary to achieve revenue neutrality. See text for details.

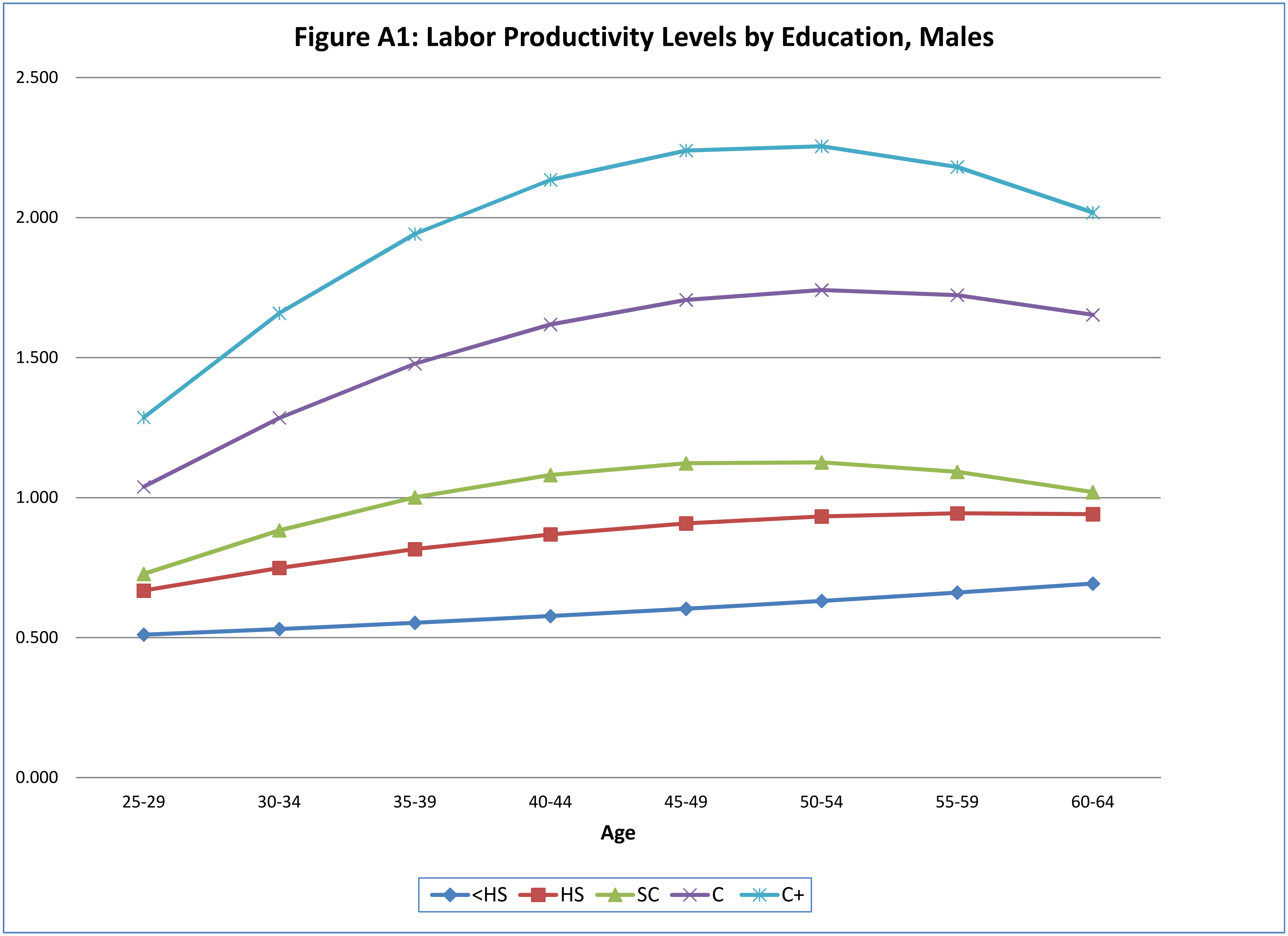


Figure A1: Labor Productivity Levels by Education, Males
2.500
2.000
1.500
1.000
0.500
0.000
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
Age
<HS
HS
SC
C
C+

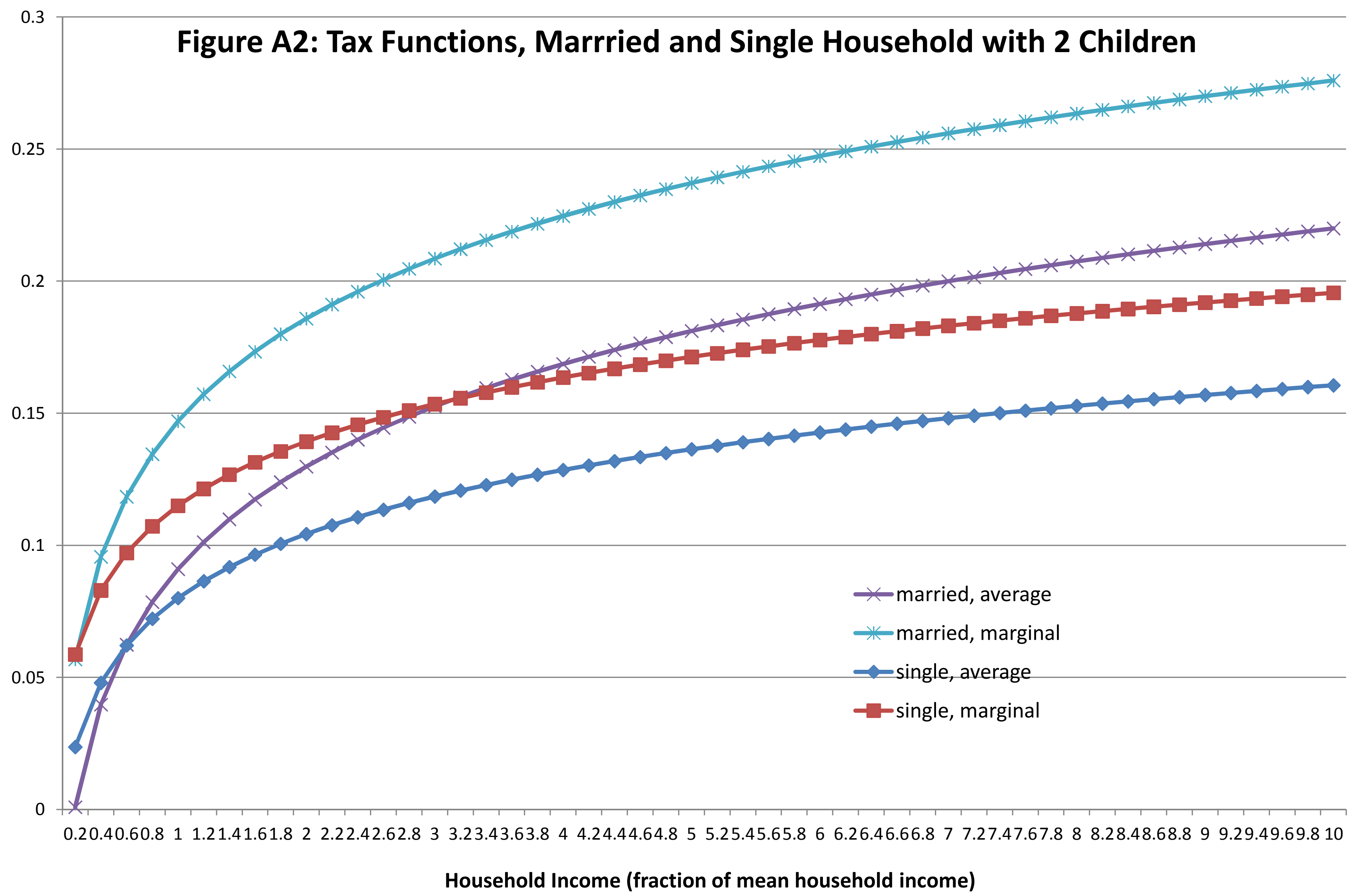


Figure A2: Tax Functions, Marrried and Single Household with 2 Children
0.3
0.25
0.2
0.15
0.1
0.05
0
0.20.40.60.8 1 1.21.41.61.8 2 2.22.42.62.8 3 3.23.43.63.8 4 4.24.44.64.8 5 5.25.45.65.8 6 6.26.46.66.8 7 7.27.47.67.8 8 8.28.48.68.8 9 9.29.49.69.8 10
Household Income (fraction of mean household income)
married, average
married, marginal
single, average
single, marginal

Figure A3: Fraction of Child Care Expenses Credited with the CDCTC

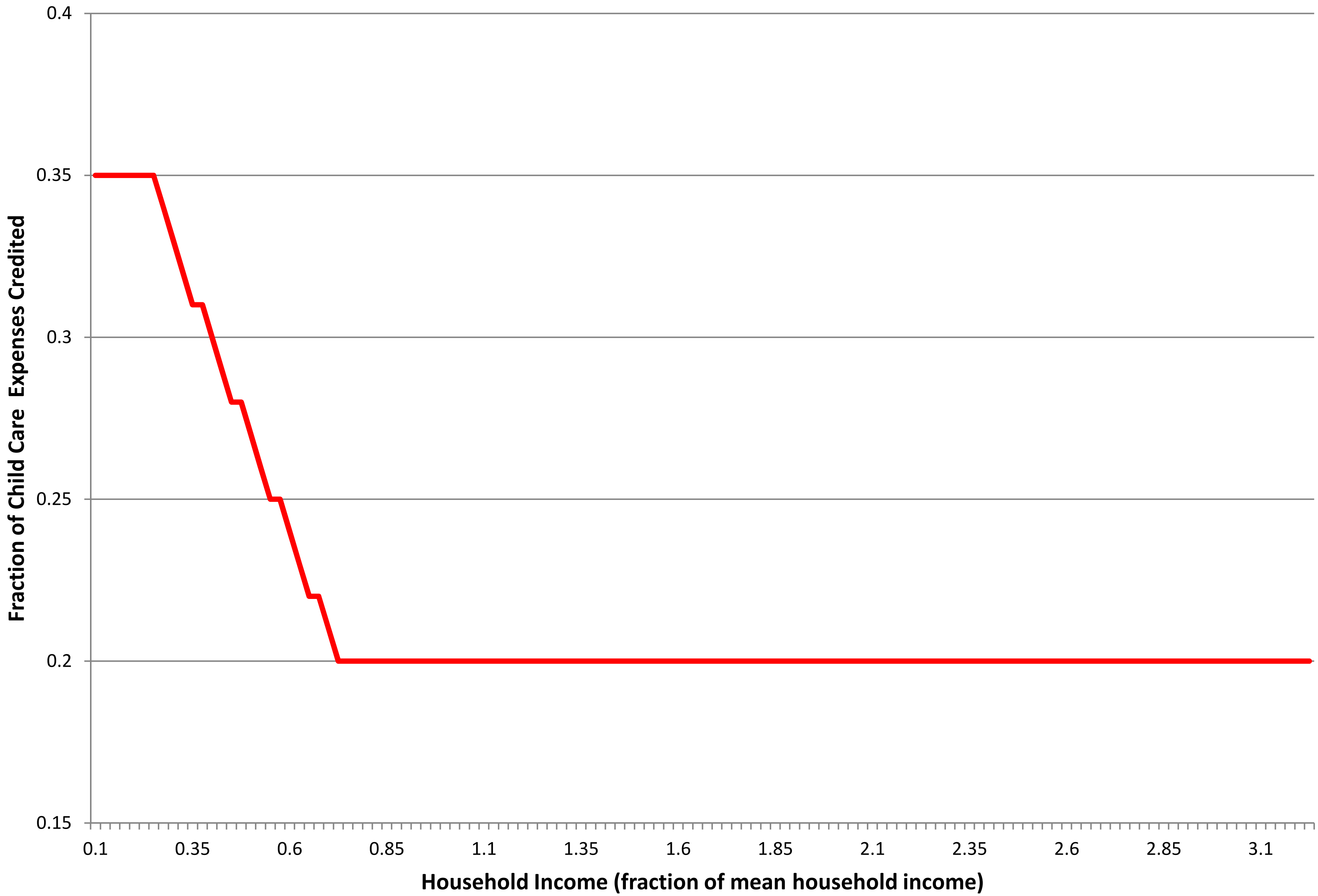


Figure A4: Potential CDCTC

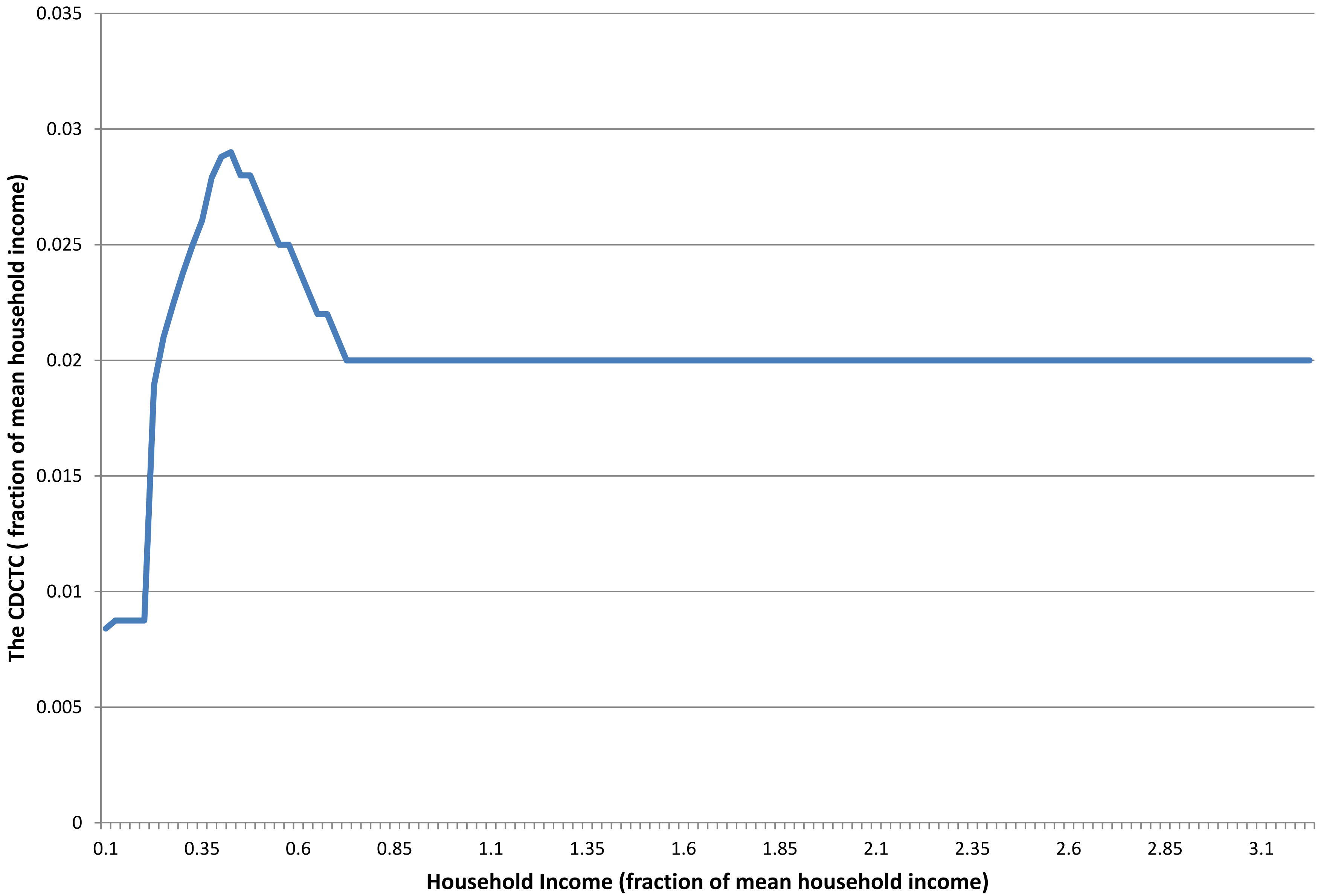


Figure A5: Potential Child Tax Credit (a household with 2 children)

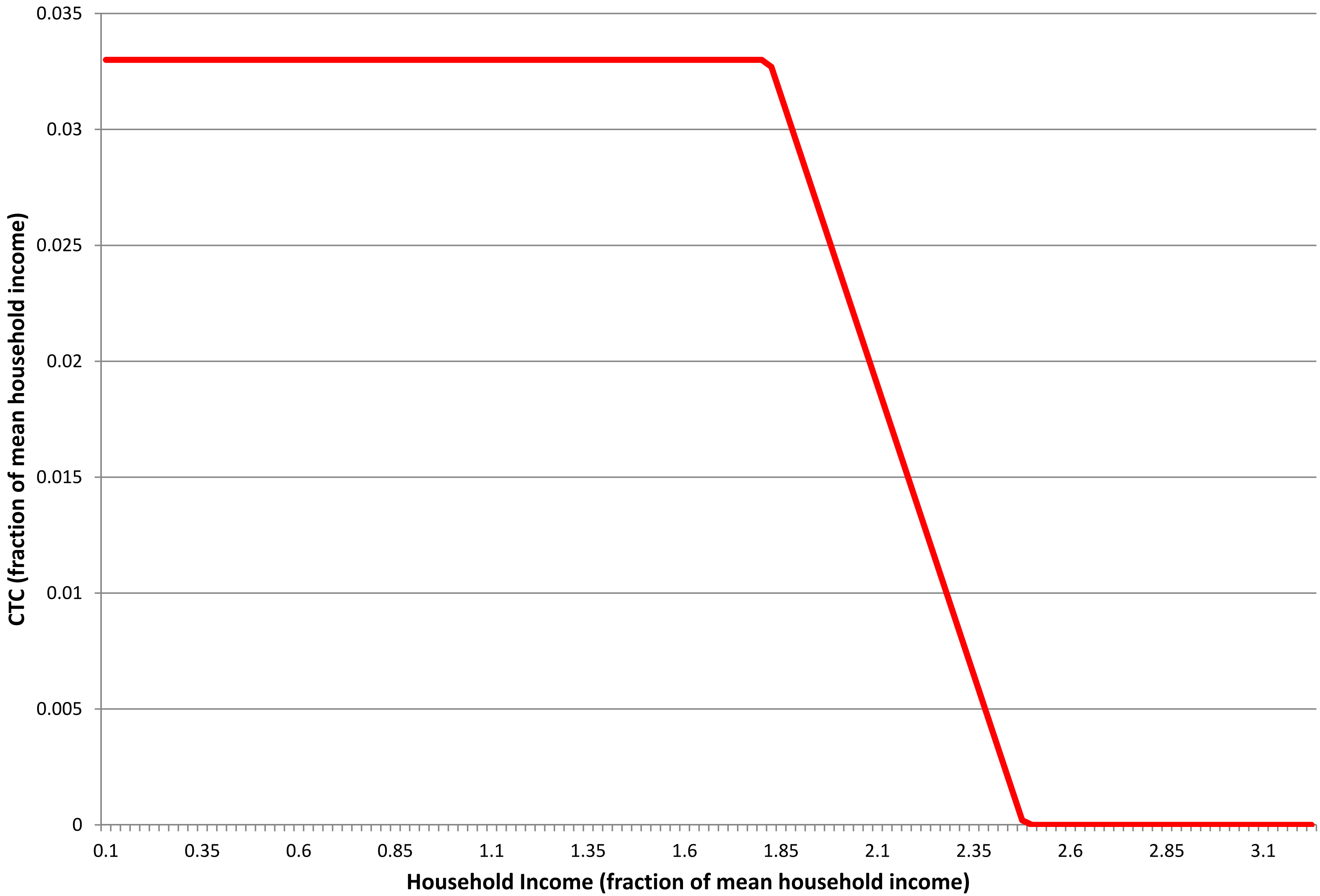
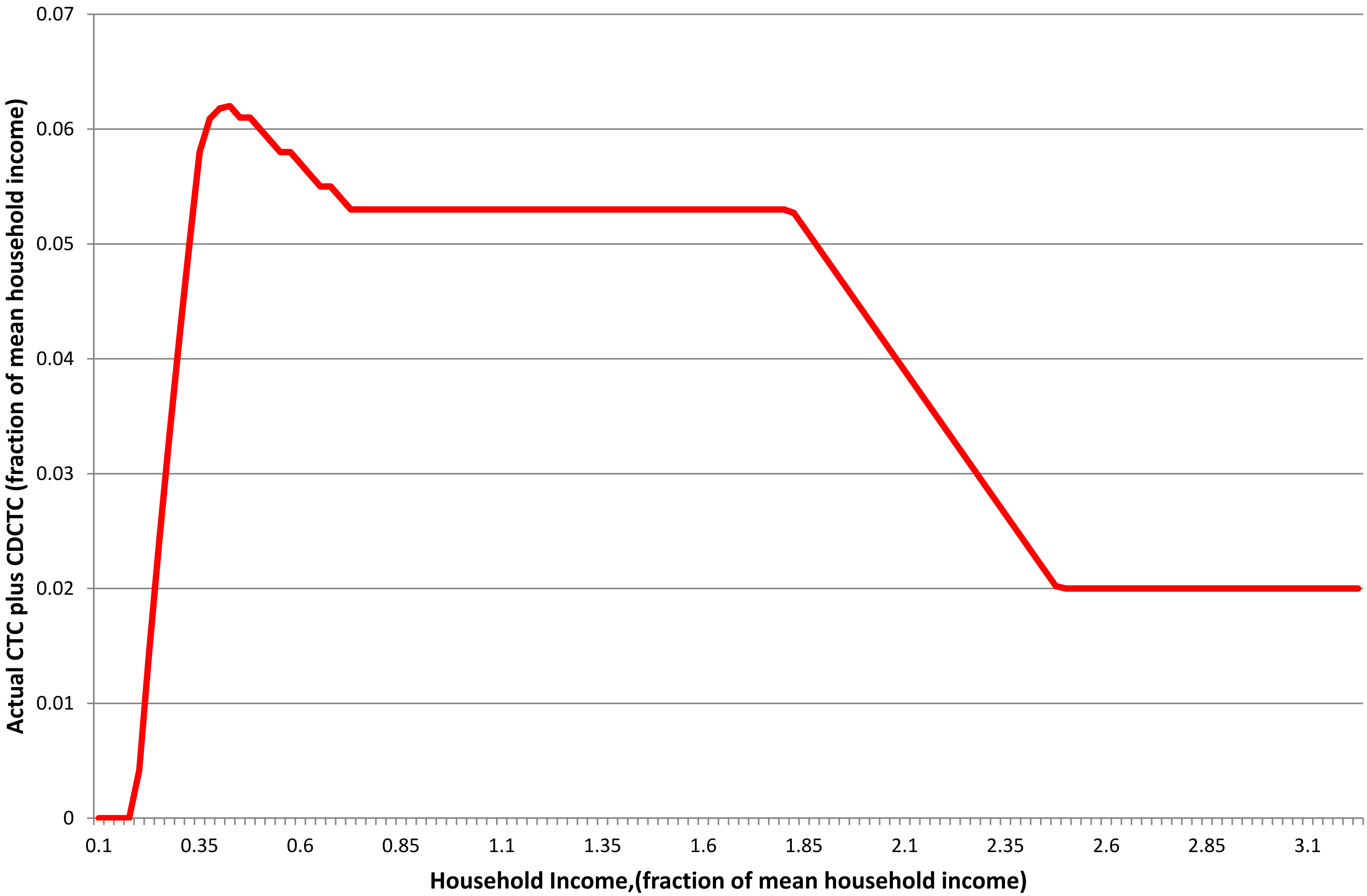


Figure A6: Actual CTC plus CDCTC



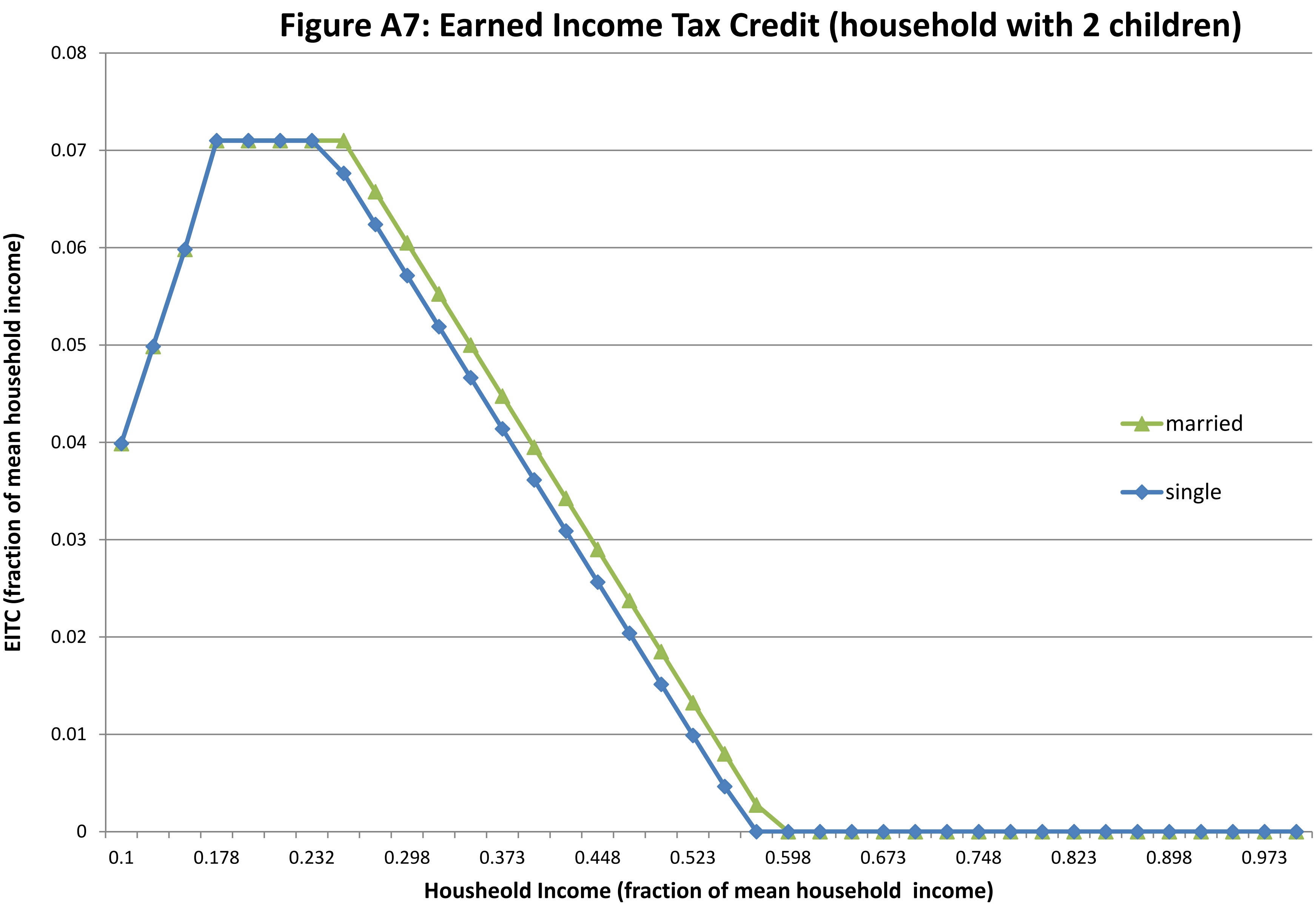


Figure A7: Earned Income Tax Credit (household with 2 children)
EITC (fraction of mean household income)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0.1
0.178
0.232
0.298
0.373
0.448
0.523
0.598
0.673
0.748
0.823
0.898
0.973
Housheold Income (fraction of mean household income)
married
single

Figure A8: Welfare Payments, Married Household

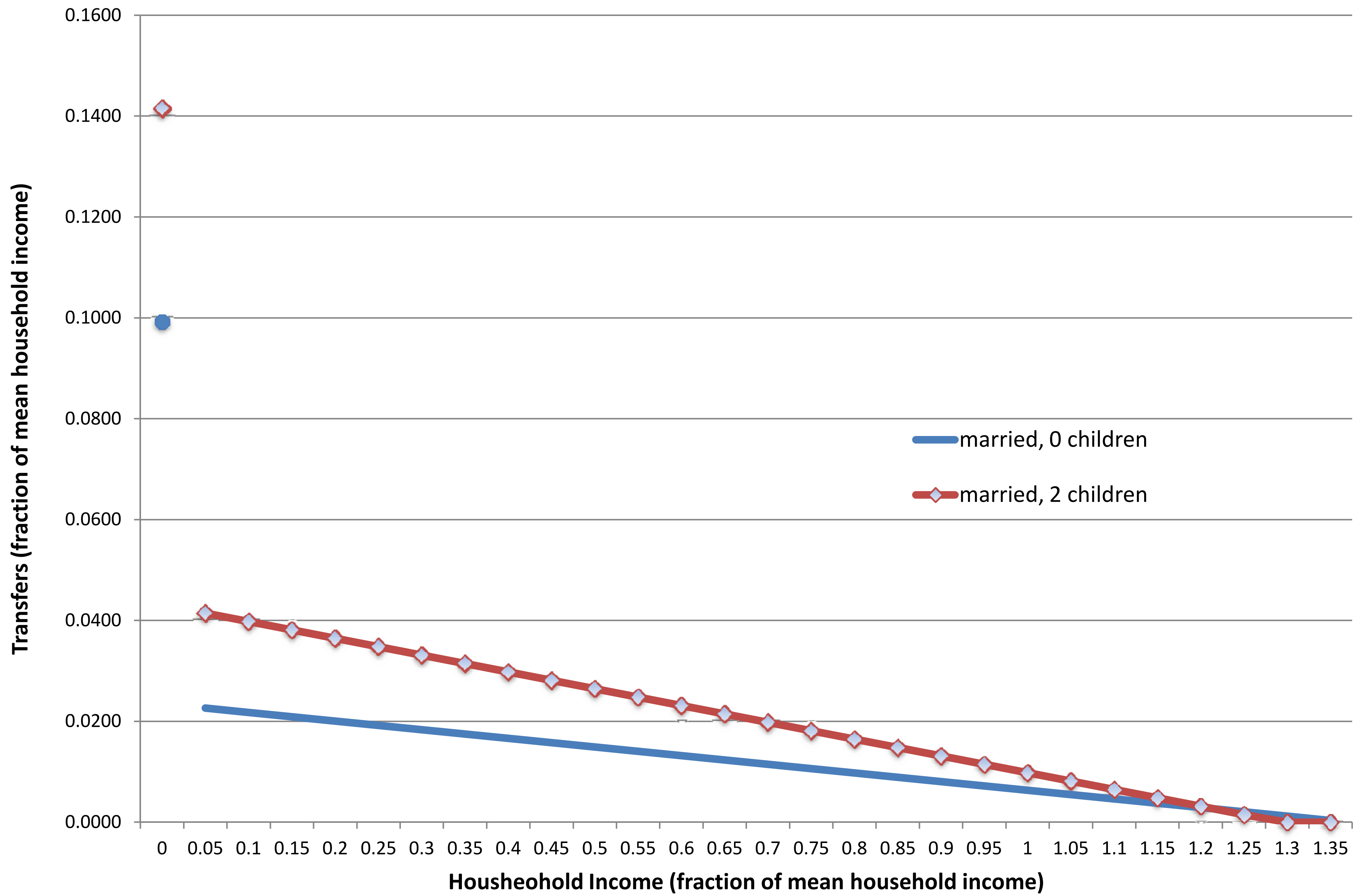
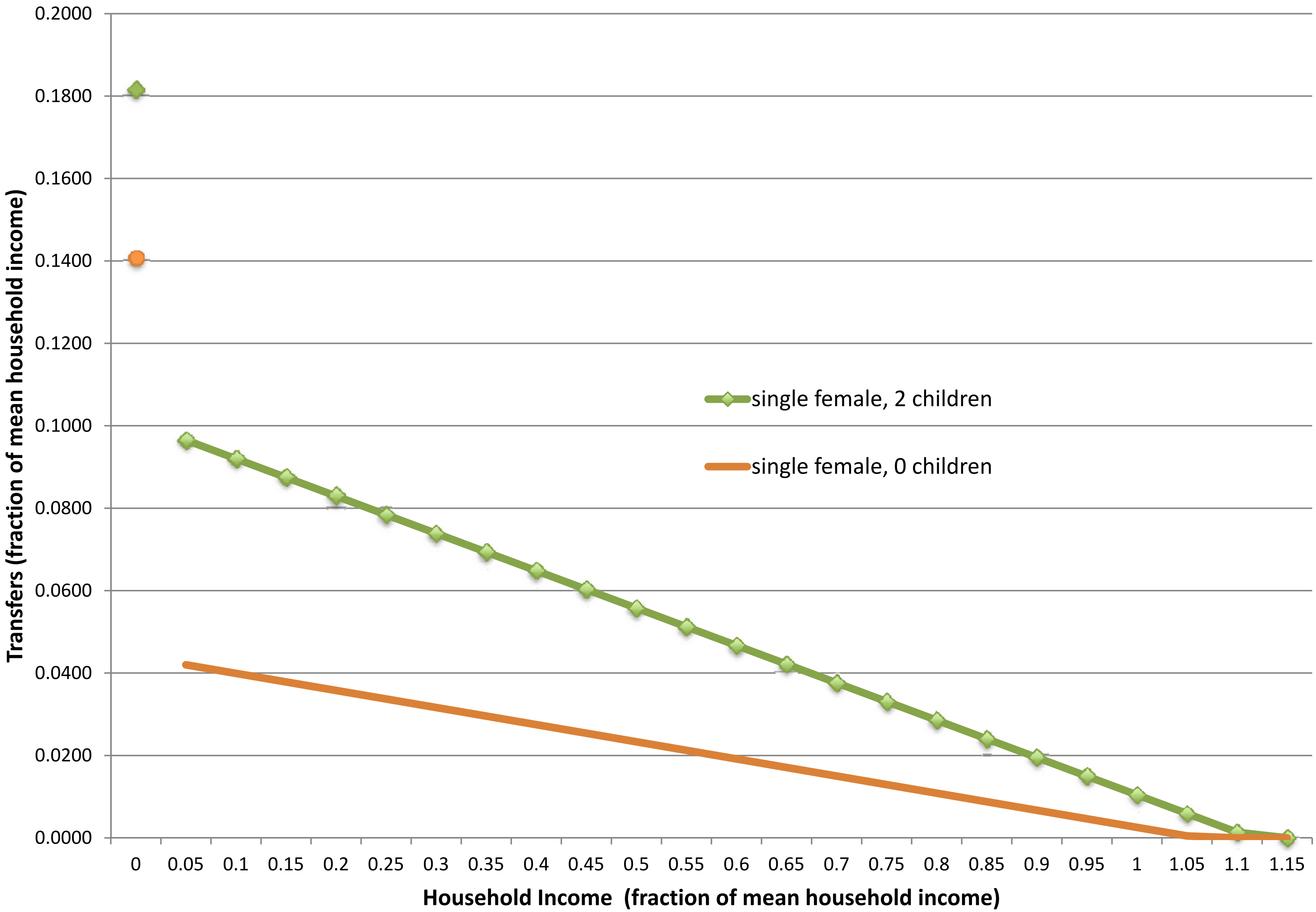


Figure A9: Welfare Payment, single females



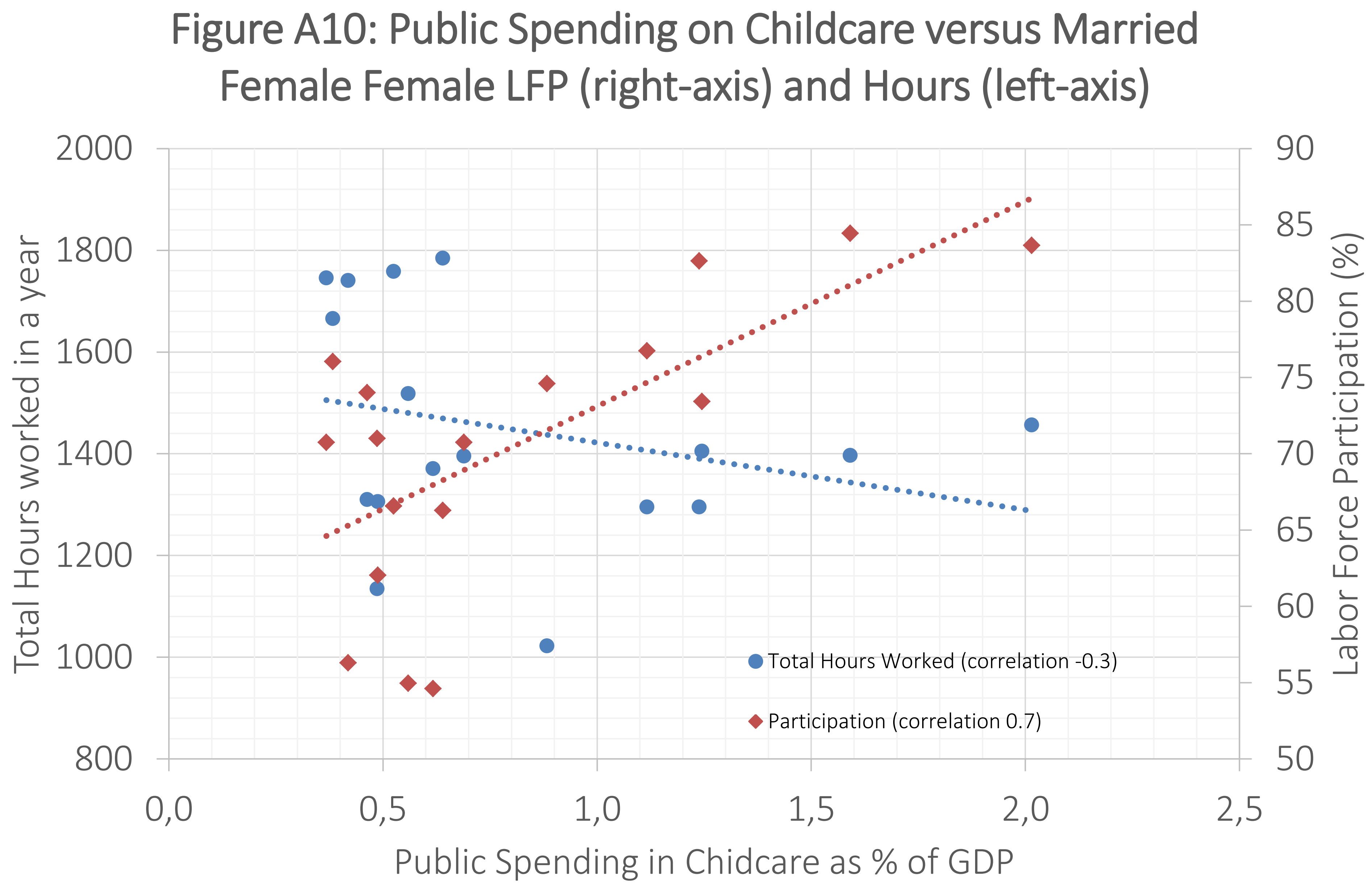


Figure A10: Public Spending on Childcare versus Married Female Female LFP (right-axis) and Hours (left-axis)
Total Hours worked in a year
2000
1800
1600
1400
1200
1000
800
Labor Force Participation (%)
90
85
80
75
70
65
60
55
50
0,0
0,5
1,0
1,5
2,0
2,5
Public Spending in Chidcare as % of GDP
Total Hours Worked (correlation -0.3)
Participation (correlation 0.7)