Family Policies and Child Skill Accumulation*

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Abstract

We analyze the effects of the Child Tax Credit and the Child Care and Development Fund, two major family policies in the United States, in an overlapping-generations framework where altruistic parents invest in their child's skill using parent time and purchased childcare. We incorporate realistic differences in the target populations and uptake rates for these two policies. We find that reducing uptake costs for the childcare subsidy yields larger welfare gains than raising the child tax credit level. However, these gains accrue more slowly over the transition because they are driven by child skill accumulation instead of increased parental leisure.

JEL codes: J13, J18, J24, D64.
Keywords: Childcare subsidy, Child tax credit, Early childhood, General equilibrium, Skill investment.

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1 Introduction

Economists have long acknowledged that policies related to children can bolster their accumulation of skill and improve labor market outcomes later in life (Leibowitz, 1974). Such government intervention may be welfare-improving because, for example, parents of children incur expenses which are not present at other points in the lifecycle while facing possibly binding borrowing constraints. Additionally, families may not internalize the social benefits from creating more productive future tax-payers and parents (Folbre, 1994). As one would expect given this environment, "family policies"—by which we mean policies that make transfers, in cash or in kind, to families with children—have been widespread across countries for some time (Kamerman, 2000; Olivetti and Petrongolo, 2017). In practice, implementation of these policies is accomplished through either the tax system or through a spending program that disburses transfers-in-kind or cash benefits via a bureau. In the United States, there tend to be much higher uptake rates among the eligible for policies implemented through the tax system compared to policies implemented through a spending program (Sommartino, Toder, and Maag, 2002). In the economic analysis of family policies, the macroeconomic approach has emphasized how government policy can address inefficiencies present in a competitive equilibrium. It has also sought to uncover the consequences of scaling up interventions previously studied with small treatment populations (Guner et al., 2020; Daruich, 2022; Zhou, 2022; Moschini, 2023). Among microeconomic analyses, as well as government reports on program spending, more attention is paid to the fact that not all of the eligible receive aid from a program (Johnson, Martin, and Brooks-Gunn, 2011; Crandall-Hollick, 2018; Chien, 2019a,b, 2020). By combining the insights of these two literatures within a macroeconomic framework, as we do in this paper, the economic analysis of family policies can offer more useful policy advice.

In this paper we study two major family policies in the United States—the federal childcare subsidy program and child tax credit—in the presence of child skill accumulation. In practice, these two policies have large and partially-overlapping eligible populations. They differ in the form of the transfer to families (cash or in-kind), as well as quantitatively in uptake rates among the eligible and aggregate spending. It is not ex ante obvious what the relative advantages of the two policies are. Consider an environment where altruistic parents use resources to invest in their child's skill. On the one hand, cash transfers to families with children via tax credits could direct resources to a point in the lifecycle where the marginal utility of consumption is high. In the presence of consumer borrowing constraints, such a policy can yield welfare gains. On the other hand, childcare subsidies can be beneficial to parents because they lower the cost of achieving a given child outcome and free up resources to finance more consumption or leisure for parents. Both programs may also encourage investment in child skill and thereby improve child labor market outcomes later in life. For example, the tax credit provides non-labor income which may be partially directed to investment in child skill, whereas the childcare subsidy lowers the relative price of investment in child skill and thereby leads altruistic parents to substitute towards child skill investment.

We proceed by embedding a childcare subsidy and a child tax credit into a general equilibrium, overlapping generations environment in which altruistic parents invest in their child's skill. This skill invesment combines parent time with time purchased on the market in the form of non-parental childcare. We endogenize the uptake for subsidized childcare by including a fixed cost for accessing the program. By contrast, uptake of the tax credit via the tax system is frictionless. We calibrate the model to target the correlation of child skill outcomes and family income, average labor supply, hours of childcare, childcare subsidy uptake rates, and income inequality observed in US data in the period from 2015 to 2017. With the estimated model, we perform two counterfactual experiments where we vary the amount of spending on the child tax credit or the childcare subsidy and document the economic effects. Changes in the size of the childcare subsidy are implemented by the government paying a portion of household's fixed cost of uptake for childcare subsidies, which represents making the subsidy easier to access by spending more on overall funding to reduce waitlists or raising the efficiency of bureaucratic infrastructure.[1] Spending on the child tax credit is increased by raising the level of the credit, widening the income range for eligibility, or both.

In our first counterfactual, we expand one policy at a time in order to examine the mechanisms behind the policy's aggregate effects. We find that both policies are qualitatively similar in that they redistribute from old to young adults. However, childcare subsidies act to raise output by subsidizing the relative price of skill investment, whereas increasing the child tax credit level bolsters leisure for adults with children at the expense of older consumers, with a smaller pass-through to investments in child skill. Each of the two policies yields welfare gains across steady-states, but welfare gains for childcare subsidies tend to be larger. We implement a welfare decomposition to attribute these changes to three components: those stemming from changes in the average levels of consumptions and leisure (level gains), those stemming from better child outcomes internalized by altruistic parents (altruism gains), and those due to changes in the distribution of consumption and leisure (distributional gains). We find that welfare changes from expansions of the child tax credit are driven by distributional gains; level gains contribute negatively to overall welfare changes. Expansions of the childcare subsidy program, by contrast, yields welfare gains driven by

[1] In the extreme, eliminating this fixed cost of uptake for households with a single large expense (rather than the government paying the fixed cost each period) is conceptually similar to switching from the spending program implementing the childcare subsidy to a fully refundable tax credit for childcare expenses. This statement abstracts from the timing of transfer disbursements. Additionaly, there is already a tax credit for dependent care in the US tax system which is nonrefundable. Because such a switch would be likely less costly than subsidizing the fixed cost of uptake in each period, our implementation gives lower bounds on welfare gains from eliminating the fixed cost of uptake.

an increase in the average level of consumption and leisure (level gains), which are mitigated by changes in the distribution of these two quantities. Altruism gains are larger after an expansion of the childcare subsidy because child skill outcomes improve more under that policy. We also examine welfare changes by age group and find that consumers whose children have left home suffer more from a child tax credit expansion than an expansion of childcare subsidies. This reflects the much larger tax burden necessary to finance the tax credit expansion. Lastly, we examine which general equilibrium adjustments drive the relatively higher welfare gains exhibited by a childcare subsidy expansion. We find that adjustments in the skill distribution of adults are most important for this result.

In our second counterfactual, we evaluate the effects of the 2018 expansion of the US child tax credit and compare it with a budget-equivalent expansion of uptake rates for childcare subsidies. The 2018 reform both increased the per-child credit amount and expanded the income range that received a positive child tax credit (Crandall-Hollick, 2018). We model this reform as a permanent change, and examine the effects over the transition to the new steady-state. By comparison, a budget-equivalent expansion of subsidized childcare yields larger welfare gains for new households in the long run, but smaller gains in the initial periods of the transition. Consumers at older ages suffer welfare losses under either policy, but for the childcare expansion these are mitigated over time as the economy converges to the new steady-state and the tax base expands.

The properties of the baseline equilibrium's childcare subsidy are modeled after the Child Care and Development Fund (CCDF), a US spending program, whereas those of the child tax credit are modeled after the Child Tax Credit/Additional Child Tax Credit in the US tax code (CTC/ACTC, hereafter CTC). The CCDF is a means-tested childcare subsidy with a work requirement for parents, available to families with children under 13, that exhibits uptake rates of about 13 percent among those defined as eligible using federal guidelines.[2,3] By contrast, the CTC is a partially refundable tax credit that reduces tax liabilities by a fixed amount per dependent child, and can be partially refunded to tax-payers as a cash transfer. The CTC is available to tax-filing households with children under 17, and is mostly received by middle-income households because the level of the credit is a function of household income: only households with taxable income between a lower and upper bound are eligible for a positive credit amount, with phase-in and phase-out regions at either end of the eligible income interval. The CTC is implemented via the tax system,

[2] Among households eligible for the CCDF, Johnson, Martin, and Brooks-Gunn (2011) find that relatively more advantaged households tend to receive the subsidy.

[3] We model the quality of subsidized childcare as identical to that of unsubsidized childcare. As noted in the meta-analysis of Mullins (2020), although the existing empirical literature finds somewhat mixed results on effects of subsidized childcare on child skill accumulation, the average treatment effect across studies of subsidized formal childcare is found to be positive, with the caveat that the programs being analyzed are usually targeted and not universal in eligibility.

and exhibits uptake rates among the eligible higher than 90 percent (Crandall-Hollick, 2018).

We endogenize uptake of the CCDF by means of a fixed cost that households must pay to access the childcare subsidy, whose value is calibrated to match observed uptake rates. This expense appears in the budget constraint of parenting households, and represents transaction costs associated with obtaining information about and accessing subsidized childcare. In contrast to an alternative specification with utility costs, our modeling choice yields a baseline equilibrium in which uptake patterns and aggregate CCDF spending patterns are consistent with their empirical counterparts. The consequences of this modeling choice for our main counterfactuals is examined in supporting analysis, where we show that the magnitude of welfare gains for reductions in the uptake cost is lower when the fixed cost is in units of consumption. This indicates that our preferred specification provides a more conservative assessment of welfare changes.[4]

This paper builds on previous work in Moschini (2023) by broadening the set of family policies under consideration to include a child tax credit similar to those of the US tax code, by endogenize childcare subsidy uptake, and by examining the transition path effects of policy changes. We also differ in that that we abstract from heterogeneity in family structures because our focus here is on the comparison of policies that differ in their design and method of implementation, rather than comparing the same policy targeted towards one- versus two-parent families.

Two other studies closely related to ours are Guner, Kaygusuz, and Ventura (2020) and Zhou (2022).[5] Guner, Kaygusuz, and Ventura (2020) examines a battery of family policies including childcare subsidies and child tax credits. The emphasis is on policy effects on parental labor supply; consistent with this purpose, the analysis accounts for the skill accumulation of parents rather than children. By contrast, we focus on child skill accumulation. We model childcare as an input into skill investment along with parental quality time, representing the time use of children as a primary determinant of their skill accumulation early in life. Childcare subsidies in our model therefore lower the relative price of investment in child skill and thereby incentivize altruistic parents to substitute towards spending on child skill accumulation, as in Moschini (2023). In this respect we also differ from Zhou (2022), which examines aggregate fertility responses to stylized family policies. Additionally, because of our interest on comparing specific policy reforms, we explicitly model relevant attributes of the child tax credit in the US tax code (such as the phasein and phaseout rates and income thresholds) which make the CTC a transfer whose level is hump-shaped in household income and which is primarily received by middle-income

[4] See Appendix C. Qualitative takeaways go through regardless of which fixed cost specification is used.

[5] Other structural studies of childcare subsidies which allow for endogenous skill accumulation of children include Bastani, Blomquist, and Micheletto (2020) and Ho and Pavoni (2020). Both perform a Mirrleesian analysis of optimal childcare subsidies; the former focuses on childcare quality choices, whereas the latter focuses on parental labor supply.

households (Goldin and Michelmore, 2022). These attributes are relevant for policy analysis: the phaseout region of the CTC distorts labor supply as households adjust their behavior to qualify for more of the credit, an effect that is mitigated when the phaseout income threshold is raised and magnified when the maximum level of the credit is increased. Importantly, we also differ from both Guner, Kaygusuz, and Ventura (2020) and Zhou (2022) in that we endogenize uptake of subsidized childcare, making explicit an additional distinction between policies based on how they are implemented in the United States (i.e., the tax system versus a spending program).

The paper proceeds as follows. Section 2 overviews the policy environment and Section 3 describes the model environment. Section 4 reports model parameterization; Section 5 examines properties of the baseline equilibrium. The model experiments and results are presented in Section 6. Section 7 concludes.

2 The Policy Environment

The policies we focus on are the Child Tax Credit, a feature of the US tax code, and the Child Care and Development Fund, a US spending program. In this Section, we describe the attributes of these two policies in more detail.

The Child Tax Credit The CTC is an example of a tax credit; after computing tax liability given taxable income, a tax credit is subtracted from the tax liability to reduce it. If the tax credit is greater than the tax liability, the question arises about what to do with the residual. A refundable tax credit rebates the residual to the taxpayer (sometimes partially); a nonrefundable tax credit does not. Tax credits are similar to cash transfers, especially if they are fully refundable; the more refundable a tax credit, the more taxpaying households with lower tax liabilities (lower incomes) receive spending from the policy (Goldin and Michelmore, 2022).

The CTC is a partially-refundable tax credit directed towards households with children.[6] Beginning in 1997 after ten years of public debate, the CTC was then expanded by legislation pased in 2001, 2010, 2017, and 2021 (Steuerle, 1990; Crandall-Hollick, 2021; Goldin and Michelmore, 2022). The CTC is similar to the better-studied Earned Income Tax Credit (EITC), in that eligibility is highly correlated with the presence of children (Marr, Huang, Sherman, and DeBot, 2015).[7] However, the EITC is several decades older than the CTC, and it is fully refundable. Another dif-

[6]In this paper, the program we refer to as the CTC the sum of the nonrefundable and refundable components of the child tax credit (Crandall-Hollick, 2018, 2021). In US government reports, the nonrefundable component of the tax credit for children is often called the "CTC", while the refundable component is often referred to as the Additional Child Tax Credit, or "ACTC".

[7]Technically, unlike the CTC a much reduced EITC is available for low-income households without children.

ference is that, while level of the CTC and the EITC are both hump-shaped in the taxable income of the household, the income threshold where the credit level begins to decrease is much higher for the CTC than for the EITC (Figure 1, Crandall-Hollick (2018)). In addition, only households with income above a threshold level qualify for the refundable portion of the CTC. Because of these properties, more families receive the CTC compared with the EITC, and CTC recipients of the CTC have higher income on average. However, total spending on the CTC is lower than the EITC because the credit level per recipient household is lower (Ackerman, Cooper, Rachel, and Tong, 2016).

As its name suggests, eligibility for the CTC is determined by the presence of children and the level of taxable household income. Children must be dependents and under the age of 17; taxable income must be low enough to qualify for the nonrefundable portion of the credit, and the refundable component is only positive if income exceeds a lower bound.

Uptake of the CTC is possible when an eligible taxpayer correctly completes their income tax form. Such a process identifies eligible households who then face a reduced tax liability or even receive a check for the refundable portion of the credit. Uptake among the eligible is estimated at greater than 90 percent in government reports (Crandall-Hollick, 2018).

The Child Care and Development Fund The CCDF in its current form began when the Personal Responsibility and Work Opportunity Reconciliation Act of 1996 consolidated four programs into one (Lynch, 2022).[8] The rules governing how funding is spent were authorized initially until 2020, after which they have been re-authorized annually by Congress. In practice, the CCDF gives block grants to states; states may then complement these funds with state money, sometimes from other federal funding streams such as Transfer Aid for Needy Families (TANF).[9] Some of these funds are used to pay portions of childcare expenses for recipient households; most children receiving the subsidy are aged 5 and under (Chien, 2019a,b, 2020). Conditional on receiving the CCDF subsidy, a household selects a qualifying childcare provider and is expected to provide a copayment for the cost of childcare, with the government financing the residual payment to the provider. The portion of childcare expenses shouldered by the CCDF is decreasing in household income because family copayment amounts are increasing in family income. Some CCDF funds are earmarked for enforcement of quality control of the childcare industry in the state, and childcare providers paid with CCDF funds must meet certain criteria that are intended to keep provider quality comparable to the market average.

[8]Since then, temporary extensions in funding continued until 2021, when the American Rescue Plan Act provided permanent annual appropriations.

[9]The funding given to states by the federal government has a mandatory component and a discretionary component. The discretionary component fluctuates more over time.

Eligibility of households with children under age 13 is determined by the resident parents engaging in an approved work-related activity and by the household income being below a certain threshold. The specific eligibility requirements must be at least as stringent as a broad policy laid out by the federal government, but most states have stricter rules. In particular, the federal government requires that household income be at or below 85 percent of the state median income for households of a similar size and composition; most states have income cutoffs set lower than this (Chien, 2019a,b, 2020). Overall, the CCDF in principle targets households with working parents, who have relatively low income compared to the population of households of similar size and composition in their state. In practice, the CCDF reaches households who meet these criteria and who also successfully take up the subsidy, which may require significant resources to accomplish.

For households hoping to receive the subsidy, applying for the CCDF involves contacting a social services agency, providing that agency with documentation of the their work-related activity and income level, and completing an interview with a social worker. Once eligibility is established and the subsidy received, eligibility is then re-evaluated at regular intervals thereafter, so that maintaining eligibility over several years usually involves the household incurring these transaction costs multiple times. Eligible households may also be placed on a waiting list, to be contacted when funds become available. Taken together, these frictions lower the net value of the subsidy for recipients.[10] It is important to note that the CCDF is not an entitlement, so if an eligible family does not receive the CCDF this is entirely in keeping with the mandate of the program in its current form. Indeed, government reports estimate uptake among the eligible at about 13 percent (Chien, 2019a,b, 2020).

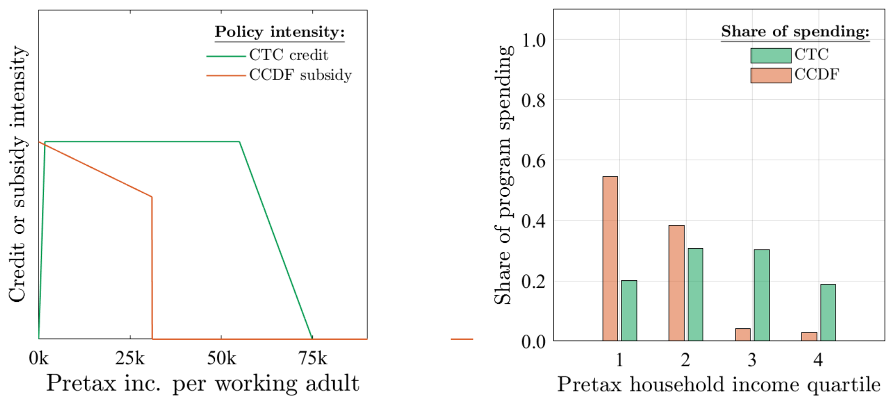
Comparison of policy target and recipient populations Figure 1a shows an approximation of the in CTC and CCDF intensities as a function of household income for recipient households with working parents (i.e., abstracting from the uptake and labor supply decision). These approximations reflect 2016 government policy and use the specific parameterizations of our model baseline. In the model's approximation, the CTC is humped-shaped in income and the CCDF subsidy intensity is decreasing in family income, reflecting the qualitative properties of the two policies discussed earlier in this Section.

Moving to aggregate spending on each policy, Figure 1b reports the share of total spending by household income quartile for the CTC and the CCDF. Here, households are assigned to quartiles using the distribution of Adjusted Gross Income in the 2016 tax year reported by IRS SOI Tax Stats (2016). Spending on the CTC is computed by aggregating spending on both the CTC and

[10]In addition, the rules for eligibility and applying for subsidy receipt vary across states, as do the rules for maintaing eligibility once qualified, so any migration across state lines means the family likely has to start from scratch.

the ACTC, for income levels within each income quartile using information from all tax returns in the 2016 tax year (Internal Revenue Service of the United States, Statistics of Income, 2023a). Spending by income quartile for the CCDF is computed by aggregating subsidies received by households as measured in CCDF Administrative Data 2016 FY.

Reflecting the properties of the policies shown in Figure 1a, aggregate CTC spending is humped-shaped in household income, and is received by households with higher income levels than the CCDF. CCDF spending is decreasing in household income, with some spending going to the top two quartiles because of household size variation and other heterogeneity in the data that is abstracted from in the policy representation of Figure 1a. Nevertheless, the policy representations align well with aggregate spending patterns.[11]



(a) Policy intensity by income level

(b) Spending per income quartile

Figure 1: CTC and CCDF policy intensity and spending share: relationship with income

Notes: Figure 1 shows the model's approximation of the intensity of the CTC and CCDF as a function of income (Figure 1a) and the share of total CTC or CCDF spending by household income quartile for the 2016 fiscal year (Figure 1b). Source: policy intensity values are computed using values from Crandall-Hollick (2018) and author estimations using CCDF administrative data. Income thresholds for quartiles are from IRS SOI Tax Stats (2016); spending for the CCDF is from CCDF Administrative Data 2016 FY and from Internal Revenue Service of the United States, Statistics of Income (2023a) for the CTC.

Comparison of policy implementation methods One benefit of using the tax system to implement family policy objectives is that it is cheaper administratively and likely reaches a greater fraction of the eligible compared to a spending program implementation. However, using the tax system to identify needy households may also unintentionally benefit households who are not eligible, precisely because of the lack of bureaucratic barriers to uptake. By contrast, a spending-program approach tends to keep uptake among the eligible low, with higher administrative costs,

[11] The functions representing the CTC and CCDF policies are described in Section 3.1, and their parameterization is described in Section 4. For a more detailed description of the data and methodology underlying Figure 1b, see Appendix B.2.

but with fewer ineligible recipients. The properties of these alternative implementation methods are well-documented: choosing one or the other is a policy choice (Steuerle, 1990; Sommartino, Toder, and Maag, 2002). In the United States, there has been an increasing trend since the 1980s towards using the tax system to implement social policy objectives such as transfers to families with children. Our second experiment models the CTC expansion of the Tax Cuts and Jobs Act of 2017 that was implemented beginning in 2018—a case in point of this legislative trend.

3 The Model Environment

The model features heterogeneous consumers organized into households, the government, a representative final goods producer, and a representative childcare provider. Time is discrete and runs forever; each period lasts for five years.

Consumers live for $J = 13$ periods, corresponding to a lifespan of 65 years; Figure 2 illustrates the phases of a consumer's life. During the "childhood" phase, which lasts for the first $j_a = 4$ periods of life, consumers are children who do not make their own decisions. In period $j_a + 1$, consumers become adults indexed by productivity θ_a, and draw their child's initial skill draw, θ_k, i.i.d. from a distribution $\mu_k(\theta_k)$ (mnemonic: $k =$"kid"). The "parenthood" phase lasts the first j_a periods of adulthood, and during this time parents split consumption with their child. During the first period of parenthood, consumers decide how much to spend on consumption, c, and non-parental childcare, n, as well as how to allocate their time between hours supplied on the market as labor, ℓ, quality time with their child, q, and leisure. For the rest of parenthood after $j_a + 1$, q and n are no longer in the choice set. Beginning at age 40-45, during the "empty nester" phase, the child has left the household and the consumer solves a standard consumption-leisure decision problem until death.

Parent choices about their child's time use, q and n, together with the child's skill endowment, determine the child's adult level of skill, θ_k^a, via child skill accumulation during early childhood. When choosing their child's time use, parents weigh the relative productivities of the two investment inputs while minimizing the cost of financing a desired skill level of investment and outcome for their child. The marginal product of each investment input is mediated by the skill investment technology, defined in Section 3.1.3. Taking cost-minization as given, the optimal level of investment is in turn chosen to balance the marginal benefit of a better future outcome for the child against the marginal cost in terms of foregone consumption and leisure for the parent. Parents invest in their child's skill because they are altruistic—they care about their child's expected lifetime utility, which is increasing in the child's level of skill as an adult.[12] Via this investment decision,

[12]The expectation is taken over the initial skill draw of the adults grandchildren.

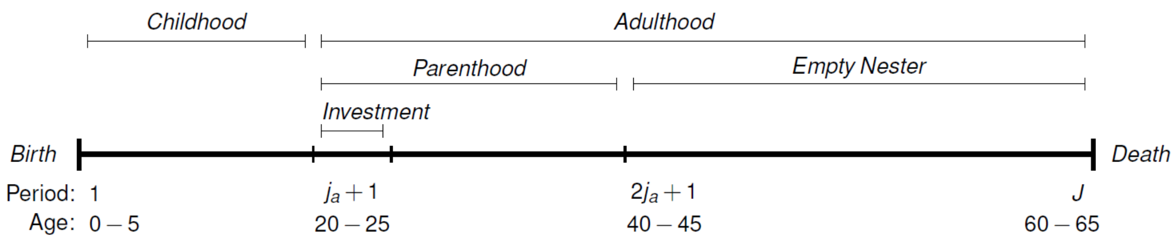


Figure 2: Consumer lifecycle

Notes: Figure 2 shows the consumer's lifecycle from birth to death. At birth the individual draw's an intial skill endowment and a parent. Childhood lasts the first j_a periods, corresponding to the first twenty years of life, where the first period of childhood corresponds to early childhood. Adulthood begins in period $j_a + 1$ and lasts until death. The first j_a periods of adulthood correspond to parenthood. At the start of the first period of parenthood, when the consumer is aged 20-25, the adult draws their child's skill endowment and then invests in their child's skill for one period, splitting consumption with their child for the remainder of parenthood. After their child leaves their household, the consumer is an empty-nester who lives alone and works until they die at age 65 after period J of their lifecycle.

the distribution of adult skill in the population, $\mu_a(\theta_a)$, is endogenous in the sense that it reflects the skill investment decisions of parents in the previous generation.

The final goods producer uses a linear production technology that takes efficiency units of labor, H, as its sole input: $Y = H$.

The childcare provider offers a perfectly elastic supply of childcare with productivity θ_n at price p. The price of childcare is set as a constant fraction ϕ of the average pre-tax wage of adults with young children: $p = \phi \int_{\theta_a} w\mu_a(\theta_a)\, d\theta_a$.

Finally, the government raises revenue from a flat consumption tax, τ_c, and a progressive income tax explained in Section 3.1. It uses this revenue to purchases a fixed fraction of output for government consumption and to finance a system of transfers to families with young children who meet eligibility requirements. The government also finances a system of means-tested childcare subsidies, $\tau_n(y)$; eligible households must pay a fixed cost ξ in consumption units to access the subsidy, although this fixed cost payment does not contribute to government revenue. The government can make uptake less costly for eligible families by subsidizing the fixed cost with τ_ξ.

3.1 Functional forms

3.1.1 Government policy

Government tax policy determines the mapping from pre-tax to after-tax income. It is specified by the income tax progressivity parameter, τ_y^p, as well as vectors of parameters for the CTC, $\vec{\pi}_C$, and the EITC, $\vec{\pi}_E$. The government also sets a vector of parameters governing TANF, which we model as a transfer to non-working parents of young children, $\vec{\pi}_T$. Lastly, the government sets a vector of parameters for the non-parental childcare subsidy (the CCDF), $\vec{\pi}_N$.

The income tax and transfer system Given a level of labor supply ℓ, an adult with skill θ_a at age j has pre-tax income $y = w\theta_a\ell$ and after-tax income given by

$$y_{AT,j}\left(y, \vec{\pi}_C, \vec{\pi}_E, \vec{\pi}_T\right) \equiv \begin{cases} (1-\tau_y)\,(y)^{1-\tau_y^p} + CTC_j\left(y, \vec{\pi}_C\right) + EITC_j\left(y, \vec{\pi}_E\right) & \text{if } y > 0 \\ TANF_j\left(y, \vec{\pi}_T\right) & \text{if } y = 0 \end{cases} \quad (1)$$

where the functional form of the income tax system follows Heathcote, Storesletten, and Violante (2017). The policies on the right-hand-side of (1) depend on the earned income of the consumer, their age, and the relevant vector of government policy parameters.

If a household's income or age is such that they are not eligibile for a transfer, then the value of that transfer is set to 0. Note that we do not estimate τ_y^p by consumer age; instead, we separate out the CTC and EITC in the budget constraint because they depend on the presence and age of children, and also because their net effect on the disposible income of the consumer may make it higher than pre-tax income that is equal to 0 (i.e., the EITC is a fully refundable tax credit that is much more generous to families with children).[13]

TANF as we model it here offers cash transfers to non-working families with young children. This represents the cash assistance component of the US funding stream of the same name that is partially spent on such lump-sum transfers. Because children are present at the same ages in all households of the model, TANF is an age-dependent transfer policy in the model. We therefore model it separately from the initial income tax system.

Next, we provide the functional form for the CTC and its vector of parameters, followed by a description of the CCDF and its parameterization. Details for the EITC and TANF policies are available in Appendix A.

The Child Tax Credit The CTC is calculated per qualifying child as the sum of a nonrefundable component and a refundable component (Crandall-Hollick, 2018, 2021). The nonrefundable component offsets the tax liability; the refundable component of a tax credit can be received even by a household with zero tax liability. Both components depend on pre-tax income and whether there

[13]This differentiates the EITC and CTC from the Child Care and Dependent Tax Credit, which is nonrefundable and is left embedded in the estimation of τ_y^p.

is a child under 17 in the house (i.e., the parents are aged $j_a - 1$ or less).

$$CTC_j\left(y,\vec{\pi}_C\right) \;=\; \begin{cases} CTC_j^{nref}\left(y,\vec{\pi}_C\right) + CTC_j^{ref}\left(y,\vec{\pi}_C\right) & \text{if } j \in [1, j_a - 1] \\ 0 & \text{otherwise} \end{cases} \tag{2}$$

The non-refundable tax credit the household is eligible for, κ_{aux}^{nref}, is the difference between the maximum nonrefundable amount, $\overline{\kappa}_{nref} = \Theta_{\kappa,nref} y_{p50}$, and a term that phases out the tax credit at a rate β_{out} once income is above the phaseout threshold $\underline{y}_{nref} = \Theta_{y,nref} y_{p50}$. Note that both the transfer level and the income cutoffs are set proportional to the median income in the population y_{p50}.

$$\kappa_{aux}^{nref} \equiv \begin{cases} \overline{\kappa}_{nref} & \text{if } y < \underline{y}_{nref} \\ \overline{\kappa}_{nref} - \beta_{out}\left(y - \underline{y}_{nref}\right) & \text{if } y \geq \underline{y}_{nref} \end{cases}$$

The non-refundable component is bounded above by the income tax liability, $y - (1-\tau_y)\, y^{1-\tau_y^p}$,

$$CTC_j^{nref}\left(y,\vec{\pi}_C\right) \;\equiv\; \min\left\{\kappa_{aux}^{nref},\, y - (1-\tau_y)\, y^{1-\tau_y^p}\right\}$$

The difference between the tax credit the household is eligible for and the household's nonrefundable component is the upper bound for the refundable portion of the CTC and is denoted κ_{aux}^{ref}, which can be at most the maximum refundable credit $\overline{\kappa}_{ref} = \Theta_{\kappa,ref} y_{p50}$:

$$\kappa_{aux}^{ref} \equiv \min\left\{\overline{\kappa}_{ref},\, \kappa_{aux}^{nref} - CTC_j^{nref}\left(y,\vec{\pi}_C\right)\right\}$$

For households with income above the refundability threshold $\underline{y}_{ref} = \Theta_{y,ref} y_{p50}$, the refundable portion of the CTC is the minimum of κ_{aux}^{ref} and a fraction β_{in} of income above the refundability threshold, where β_{in} is the phase-in rate.

$$CTC_j^{ref}\left(y,\vec{\pi}_C\right) \;\equiv\; \begin{cases} \min\left\{\kappa_{aux}^{ref},\, \beta_{in}\left(y - \underline{y}_{ref}\right)\right\} & \text{if } y \geq \underline{y}_{ref} \\ 0 & \text{otherwise} \end{cases}$$

If $\overline{\kappa}_{nref} = \overline{\kappa}_{ref}$ then the CTC is "fully refundable"; if $\overline{\kappa}_{nref} > \overline{\kappa}_{ref}$ then it is "partially refundable". The vector of parameters governing this policy is therefore given by
$\vec{\pi}_C = [\Theta_{\kappa,nref}, \Theta_{\kappa,ref}, \beta_{out}, \Theta_{y,nref}, \beta_{in}, \Theta_{y,ref}]$.

The Child Care and Development Fund From the perspective of the government, the CCDF transfer to a given household depends on: $R \in \{0, 1\}$, the subsidy uptake decision of the household; n, the number of hours of childcare the household chooses; and y, the household's pre-tax income which determines their eligibility for the subsidy as well as the subsidy's intensity. Specifically, if the household chooses to take out the subsidy, the CCDF pays a proportion τ_ξ of the fixed cost of subsidy uptake plus a proportion $\tau_n(y) = \beta_{0,n} + \beta_{1,n}\left(\frac{y}{0.85y_{p50}}\right)$ of childcare expenses, conditional on income being below a threshold income level, $\overline{y}_n = \Theta_{y,n} y_{p50}$:

$$CCDF_j(R, n, y, \vec{\pi}_N) = \begin{cases} R[\tau_\xi \xi + \tau_n(y) pn] & \text{if } y \in (0, \overline{y}_n] \\ 0 & \text{otherwise} \end{cases} \tag{3}$$

The vector of parameters governing this policy is given by $\vec{\pi}_N = [\tau_\xi, \beta_{0,n}, \beta_{1,n}, \Theta_{y,n}]$.

3.1.2 Consumer preferences

The utility function u_j takes as inputs consumption, c, and leisure, $1 - \ell - q$, where ℓ is labor supply and q is quality time the parent spends with the child. It also is affected by a consumption equivalence scale, Ψ_j, which reflects the presence of a child in the household at certain ages:

$$u_j\left(\frac{c}{\Psi_j}, 1 - \ell - q\right) = (1 - \psi)\ln\left(\frac{c}{\Psi_j}\right) + \psi \ln(1 - \ell - q) \tag{4}$$

3.1.3 Skill investment technology

The skill investment technology consists of a dynamic and a static function. The dynamic function combines investment, I, and the child's stock of skill today, θ_k to generate the stock of skill tomorrow, θ_k^a:

$$\theta_k^a = f(\theta_k, I(q, n|\theta_a)) = \left[(1 - \upsilon)(\theta_k)^{\frac{\chi-1}{\chi}} + \upsilon(\lambda_I I(q, n|\theta_a))^{\frac{\chi-1}{\chi}}\right]^{\frac{\chi}{\chi-1}} \tag{5}$$

Here, υ and χ are the CES share parameter for investment and the elasticity of substitution between the stock of skill and investment, respectively. The parameter λ_I scales the units of investment into the space of skill.

The static function combines investment inputs (parent time and market time) within a period to generate investment:

$$I(q, n|\theta_a) = \left[\gamma(\theta_a q)^{\frac{\nu-1}{\nu}} + (1 - \gamma)(\theta_n n)^{\frac{\nu-1}{\nu}}\right]^{\frac{\nu}{\nu-1}} \tag{6}$$

In this specification, γ is the CES share parameter on the efficiency units of parent quality time investment input, and ν is the CES elasticity parameter between efficiency units of parent time and efficiency units of childcare time.

3.1.4 The initial skill distribution

The distribution $\mu_k(\theta_k)$ is assumed to be a uniform distribution. The difference between the upper and lower bounds of the support for this distribution, $\overline{\Delta\theta_k}$, determines the variance of the initial skill distribution.

3.2 Agent problems

The child care provider and production firm solve simple problems provided in the model overview earlier in this section; below we detail the consumer and government problems.

3.2.1 Consumers

In the first period of adulthood, when $j = j_a + 1$, the consumer is indexed by their own skill and their child's initial skill endowment. They choose a feasible adult skill outcome for their child, a level of household consumption, labor supply, and whether or not to take out the childcare subsidy. Note that households only receive a subsidy after paying the fixed cost if their pre-tax income makes them eligible.

$$\begin{aligned}
V_j(\theta_a, \theta_k) &= \max_{\theta_k^a, c, \ell, R} u\left(\frac{c}{\Psi_j}, 1 - \ell - q\right) + bV_k^a(\theta_k^a) + \beta V_{j+1}(\theta_a) \\
(1 + \tau_c) c + pn + R\xi &\leq y_{AT,j}(y, \vec{\pi}_C, \vec{\pi}_E, \vec{\pi}_T) + CCDF_j(R, n, y, \vec{\pi}_N) \\
\theta_k^a &\equiv f(\theta_k, I(q, n|\theta_a))
\end{aligned} \tag{7}$$

where $q + n \leq 1$, $q + \ell \leq 1$, $c, \ell, q, n \geq 0$, and $R \in \{0, 1\}$. Any candidate adult skill level for the child implies levels of parent quality time and childcare time, implicitly chosen to minimize the cost of achieving the targeted level of skill given the investment technology. These quantities are therefore not modeled as a separate choice in (7).

In later periods of life, the consumer chooses consumption and labor supply, although they continue to split consumption with their child up to and including period $j = 2j_a$.[14]

$$\begin{aligned}
V_j(\theta_a) &= \max_{c, \ell} u\left(\frac{c}{\Psi_j}, 1 - \ell\right) + \mathbb{I}_{j<J} \beta V_{j+1}(\theta_a) \\
(1 + \tau_c) c &\leq y_{AT,j}(y, \vec{\pi}_C, \vec{\pi}_E, \vec{\pi}_T)
\end{aligned} \tag{8}$$

[14]Because the CCDF takes a value of 0 in these periods, it is omitted from the budget constraint.

In the last period of life, when $j = J$, the continuation value drops out of the objective function. Note that, for these ages, the child's initial skill endowment no longer affects the choice set or objective function of the adult parent and therefore no longer indexes the value function of the household.

3.2.2 The government

The government implements the CCDF, CTC, EITC, and TANF, and also finances government consumption expenditure that is set as a fraction Θ_G of output. In the model, receipt of the CTC and EITC is automatic, reflecting the fact that these programs are implemented through the tax system (Falk and Landers, 2022). Receipt of TANF is also assumed to be frictionless and only for non-working households with young children; this is a simplification of the broader US funding stream with the same name.[15] The net revenue from an optimizing household of type z_j is

$$\begin{aligned} Rev\left(z_j|\lambda_y,\vec{\pi}_C,\vec{\pi}_N,\vec{\pi}_E,\vec{\pi}_T\right) \equiv\ & y_j^*\left(z_j\right)-\left(1-\tau_y\right)\left(y_j^*\left(z_j\right)\right)^{1-\tau_y^p} \\ & -CTC_j\left(y_j^*\left(z_j\right),\vec{\pi}_C\right)-CCDF_j\left(R_j^*\left(z_j\right),n_j^*\left(z_j\right),y_j^*\left(z_j\right),\vec{\pi}_N\right) \\ & -EITC_j\left(y_j^*\left(z_j\right),\vec{\pi}_E\right)-TANF_j\left(y_j^*\left(z_j\right),\vec{\pi}_T\right) \end{aligned}$$

where a superscript $*$ denotes the optimal choice of the corresponding variable by a consumer aged j with type z_j, where z_j is (θ_a, θ_k) for age $j = 1$ and θ_a otherwise. Government budget balancing requires τ_y^* such that in equilibrium the following equation holds:

$$\frac{\sum_{j=j_a+1}^{J}\int_{z_j}\left[Rev\left(z_j|\tau_y^*,\vec{\pi}_C,\vec{\pi}_E,\vec{\pi}_T,\vec{\pi}_N\right)\right]\Omega\left(j,z_j\right)dj\,dz_j}{\sum_{j=j_a+1}^{J}\int_{z_j}\left[y_j^*\left(z_j\right)\right]\Omega\left(j,z_j\right)dj\,dz_j} = \Theta_G \tag{9}$$

Here, the joint distribution over household types, $\Omega(j, z_j)$, is given by:

$$\Omega\left(j,z_j\right) = \begin{cases} \mu_a\left(\theta_a\right)\mu_k\left(\theta_k\right)\frac{1}{J-j_a} & \text{if } j=j_a+1 \\ \mu_a\left(\theta_a\right)\frac{1}{J-j_a} & \text{if } j>j_a+1 \end{cases}$$

3.3 Definition of a stationary steady-state equilibrium

Given an initial distribution of skill endowments $\mu_k(\theta_k)$, a goods production technology $Y = H$, a childcare pricing rule ϕ, and a government policy $\{\vec{\pi}_C, \vec{\pi}_N, \vec{\pi}_E, \vec{\pi}_T\}$, a stationary steady-state equilibrium is defined as:

1. agent choices and objective functions (consumers, goods producer, and childcare provider)

[15] Spending on the TANF program as we model it is small in the data, and not the focus of our analysis in this paper.

2. consumer expectations about lifetime utility given a child's adult skill outcome, $V_k^a\left(\theta_k^a\right)$.

3. an adult skill distribution $\mu_a\left(\theta_a\right)$

4. an average income tax rate τ_y

5. a wage rate w

such that

1. agents optimize taking prices as given

2. consumer expectations are rational

3. the distribution of adult skill is stationary

4. the government balances its budget constraint

5. the labor market clears

When all of these conditions hold, the goods market clears by construction. Assumptions about the production firm's technology imply that the wage rate is always equal to 1. Assumptions about the childcare provider's pricing rule implies that the price of childcare depends entirely on the distribution of skill among parenting adults, while its perfectly elastic supply allows the market for childcare to clear simultaneously.

4 Model Parameterization

The model parameters can be separated in those estimated outside of the model, shown in Table 1, and those calibrated inside of the model, shown in Table 2.

Panel A of Table 1 reports parameters related to government revenue and consumption, as well as demographics. The consumption tax rate, τ_c, is estimated using Organization of Economic Cooperation and Development (OECD) data for the years 2015-2017, applying the method of Mendoza, Razin, and Tesar (1994). The income tax progressivity, τ_y^p, is estimated using microdata from PSID (2015-2017).[16] The parameter τ_y^p represents the progressivity of the tax system after netting out the CTC and the EITC, the two largest family policies implemented through the tax system in terms of spending.[17] Details of the estimation for the consumption and income tax

[16]We also estimate this parameter using aggregate data underlying the figures for the 2016 fiscal year in U.S. Congressional Budget Office (2019), applying the method of Heathcote, Storesletten, and Violante (2017). These two estimation methods yield very similar progressivity parameter values.

[17]Specifically, the progressivity parameter in our specification represents the effects of deductions, federal tax rates, and the Supplemental Nutition Assistance Program (SNAP), as well as the effect of state tax rates and Federal Insurance Contributions Act (FICA - i.e., payroll taxes). In our approach, refundable tax credits are not embedded

parameters are provided in Appendix B.1. The third row of Panel A reports the share of output that goes towards government consumption, as estimated using data from the Bureau of Economic Analysis for the period 2015-2017. The discount rate, β, is set to an annual value of 0.96. Finally, the consumption-equivalence scales, Ψ_j, are set to 1.3 when there is a child in the household and 1 thereafter, following the 1994 OECD scales based on the findings of Hagenaars, de Vos, and Zaidi (1994).

Panel B of Table 1 contains values for the parameters governing the CTC for the 2016 Fiscal Year, chosen to match value reported in Crandall-Hollick (2018) converted into per-parent terms.[18] Dollar values are in 2016 USD, and are mapped into the model by multiplying their level by the ratio of median income in the model to median household income in the US in 2016, $y_{p50,US}$, from Guzman (2017).

Panel C contains the CCDF policy parameters for the 2016 Fiscal Year; the government is assumed to offer no subsidy for the uptake cost in the baseline. For eligible recipients, the subsidy on childcare expenses is decreasing in household income, reflecting estimation results presented in Appendix B.1.3. The eligibility threshold is set at the 27th percentile of income for households raising young children in the model, $y_{p27,par}$, to match the across-state average of income eligibility cutoffs estimated using information from government reports (Chien, 2019a,b, 2020) .

The parameters for the two remaining policies, the EITC and TANF (Panel D), are estimated using information from Crandall-Hollick et al. (2021) and Office of Family Assistance (2015), respectively; specific parameter values are reported in Appendix A.1 and Appendix A.2. Finally, in Panel E, the skill accumulation technology parameters are set to values estimated in Moschini (2023) and averages of the parameters estimated there using family-structure population shares, as described in Appendix B.1.5.

There are five parameters that are calibrated jointly inside of the model, presented in Table 2: the marginal utility of leisure, ψ, the investment productivity, λ_I, the degree of altruism, b, the fixed cost of taking up the child care subsidy, ξ, and the variance of the initial skill distribution which is determined by $\overline{\Delta\theta_k}$, the difference between the lower and upper bound of the distribution of initial skill endowments. Although all of these parameters affect the five target moments to some extent, in Panel A they are presented in the same row as the moment they are chosen to match. The first three target moments are from Moschini (2023), and the fourth is computed using information from Federal Interagency Forum on Child and Family Statistics (2017) and Office of Child Care, Administration for Children and Families (2023a,b). The last moment is the average of the annual

in the tax rate but are explicitly modeled.

[18] When values are different for single parents and couples, a weighted sum using the population shares from Table 1 of Moschini (2023) is used for the parameterization, as we do not model family structure heterogeneity.

Table 1: Externally estimated parameters

Symbol	Parameter description	Data source	Parameter value
Panel A: Government policy, preferences, and demographics			
τ_c	Consumption tax rate	See Appendix B.1.1	0.043
τ_y	Income tax progressivity	See Appendix B.1.2	0.110
Θ_G	Gov. consumption (% GDP)	BEA (2022a) and BEA (2022b)	0.140
$\{\Psi_j\}_{j=1}^{J}$	Consumption-equiv. scales	Hagenaars et al. (1994)	$1 + 0.3 \times \mathbb{I}_{j \leq j_a}$
β	Patience	Assumption	0.96^5
j_a, J	Length of childhood and lifetime	Assumption (20 and 65 years)	4, 13
Panel B: CTC policy $\vec{\pi}_C$			
$\Theta_{\kappa,nref}$	Max. non-refundable credit ratio	Crandall-Hollick (2018) and Guzman (2017)	$\frac{\$1{,}000}{y_{p50,US}}$
$\Theta_{\kappa,ref}$	Max. refundable credit ratio		$\frac{\$1{,}000}{y_{p50,US}}$
β_{out}	Phaseout rate		0.050
$\Theta_{y,nref}$	Phaseout threshold ratio		$\frac{\$59{,}200}{y_{p50,US}}$
β_{in}	Phasein rate		0.150
$\Theta_{y,ref}$	Refundability threshold ratio		$\frac{\$1{,}815}{y_{p50,US}}$
Panel C: CCDF policy $\vec{\pi}_N$			
τ_ξ	Uptake cost subsidy	Assumption	0
$\beta_{0,n}, \beta_{1,n}$	Childcare subsidy function	See Appendix B.1.3	$(0.999, -0.44)$
$\Theta_{y,n}$	Eligibility threshold ratio	Chien (2019a,b, 2020) and Guzman (2017)	$\frac{y_{p27,par}}{y_{p50,US}}$
Panel D: other tax system policies			
$\vec{\pi}_E$	EITC policy	Crandall-Hollick et al. (2021)	See Appendix A.1
$\vec{\pi}_T$	TANF policy	Office of Family Assistance (2015)	See Appendix A.2
Panel E: Skill accumulation technology parameters			
Dynamic equation			
χ	Elasticity of substitution	Moschini (2023)	0.380
υ	Share on investment		0.490
Static equation			
ν	Elasticity of substitution	See Appendix B.1.5	0.560
γ	Share on parent time		0.410

Notes: Table 1 reports externally estimated parameter symbols, descriptions, data sources, and values.

p50-p10 logged income ratio for the United States from 2015 to 2017, using values from GRID (2015-2017). The calibrated model aligns well with the data in terms of the baseline equilibrium's labor supply, use of childcare time, correlation of child skill outcomes with family income, the share of all families using subsidized childcare, and the difference between the 50th and 10th percentiles of the pre-tax log income distribution in the United States. [19] Note that 3.5 percent of all families receiving childcare subsidies corresponds to about 13 percent of the eligible taking up the CCDF.

[19]This method of disciplining properties of the initial skill distribution using earnings inequality is based on Huggett, Ventura, and Yaron (2006), while that the assumption that all parents draw their child's initial skill endowment from the same distribution is based on the findings of Moschini (2023).

Panel B of Table 2 reports parameters whose values are set proportional to other equilibrium quantities in the baseline and held fixed in the counterfactual experiments. The childcare productivity, θ_n, is calibrated so that the expected logged ratio of parental and nonparental childcare time is equal to 0 for working parents. The pre-subsidy price ratio between non-parental and parental time, ϕ, is chosen so that in the baseline equilibrium the average post-subsidy and after-tax price ratio of investment inputs chosen by working parents matches what is observed in the data from Table 2 of Moschini (2023).

Table 2: Internally calibrated parameters

	Parameter		Moments		
Symbol	**Description**	**Value**	**Description**	**Data**	**Model**
Panel A: Parameters calibrated jointly					
ψ	Marginal utility of leisure	0.639	Average hours worked	0.330	0.330
λ_I	Investment productivity	7.858	Average non-parental childcare hours	0.307	0.307
b	Altruism parameter	$0.371 \times \beta$	Corr. child skill outcomes and family income	0.320	0.320
ξ	Fixed cost of CCDF uptake (% y_{p50})	0.128	Share families receiving CCDF	0.035	0.036
$\overline{\Delta\theta_k}$	Variance of μ_k (θ_k)	9.169	p50-p10 log income	1.403	1.404
Panel B: Parameters set proportional to other equilibrium objects					
θ_n	Child care productivity	4.014	Average productivity of working parents		
ϕ	Pricing ratio for n	0.160	Post-policy input price ratio		

Notes: Table 2 presents internally calibrated parameters.

The calibrated fixed cost of subsidized childcare uptake warrants particular attention. We find a value of 12.8% of median income, which corresponds to $7,375 in 2016 USD.[20] Average childcare expenses in the model's baseline population are on the order of 15% of median household income, which falls within the range of 8 to 19 percent documented for the US in 2018 by Landivar, Graf, and Rayo (2023); this corresponds to a value of $8,643 in 2016 US dollars for average childcare expenses of households raising young children (eligible and ineligible). The economic magnitude of this calibrated fixed cost indicates that, in order to match observed low uptake rates, the costs of barriers to uptake must be high enough to offset the value of the subsidy for many eligible households. This is a model insight into uptake costs which are difficult to measure empirically.[21] Indeed, as we will show in the following Section, in the baseline equilibrium the eligible households who are willing to pay this uptake cost have more resources and higher childcare expenses, which makes paying the fixed cost worthwhile for them.

[20]This uses a 2016 median household income of $57,617.

[21]Recall that our interpretation of this fixed cost is that it includes the effect of waiting times on the net value of the CCDF subsidy; to our knowledge, there is no public dataset on CCDF waitlist length or average wait times. If such a dataset exhisted it would need to pool information from across all states receiving CCDF block grant funds.

5 Properties of the Baseline Equilibrium

The calibrated baseline equilibrium exhibits several properties which are relevant for our policy experiments. In this section we begin by examining the composition of baseline childcare subsidy recipients, and, by implication, the composition of families on the margin for childcare subsidy uptake. Next, we turn to the distribution of program spending across household income quartiles in the model and compare it with the data. The way each program affects individual consumer problems in the model allows the distribution of spending over income quartiles to capture the main properties of the data as presented in Section 2. Finally, we report the size of spending on the CTC, CCDF, EITC, and TANF as a fraction of output in the baseline equilibrium to show that the size of each is very similar to the data despite being untargeted. This indicates that the household-level modeling of eligibility and program intensity, combined with the extent of heterogeneity across households, is sufficient to capture the relative size of each program.

Childcare subsidy uptake patterns In Figure 3, we show which household types (indexed by adult skill, θ_a, and child skill endowment, θ_k) are eligible for the childcare subsidy (light blue region) compared to those who choose to pay the fixed cost and take up the subsidy (dark blue region). In the baseline equilibrium, eligible households with higher child skill tend to take up the subsidy, because the complementarity of skill and investment means that these are the eligible households investing the most in their children and therefore planning to spend the most on childcare. This uptake pattern is also qualitatively consistent with the results of Johnson, Martin, and Brooks-Gunn (2011), which indicate that those receiving the CCDF have relatively more resources compared to the pool of eligible non-recipients. Through the lens of the model, this corresponds to eligible households with relatively higher θ_a values comprising the pool of CCDF recipients. The close relationship between adult skill and income in the model, combined with the negative relationship between CCDF subsidy intensity and recipient income, leads aggregate spending patterns to align with our empirical findings in Section 2.[22]

The composition of CCDF recipients in the baseline equilibrium provides intuition for the counterfactual experiment results. For example, subsidizing the fixed cost of uptake will gradually expand the pool of CCDF recipients, starting with the marginal families who lie closer in the type space to the baseline subsidy recipients as shown in Figure 3. At the same time, the highest welfare gains are achieved from reaching the families with low θ_a and high θ_k, due to complementarity between investment and skill in the dynamic skill production function combined with limited resources

[22] Appendix C compares the our baseline specification with an alternative model framework featuring a utility cost of uptake: besides offering a better fit with spending patterns in the data, our preferred specification provides a lower bound for the welfare gains of reductions in the fixed cost of childcare subsidy uptake.

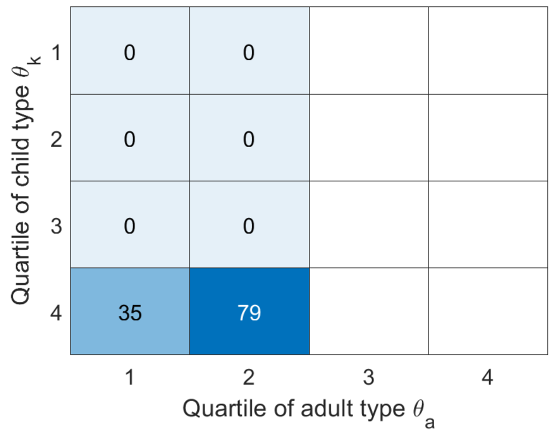


Figure 3: CCDF uptake rates by household type

Notes: Figure 3 shows the uptake rate, conditional on eligibility, for the CCDF. Uptake rates are reported for the discretized joint distribution over household types in period $j_a + 1$ of the lifecycle, with adult skill type θ_a on the x-axis and child skill endowment θ_k on the y-axis. Shaded cells denote positive within-cell eligibility rates using realized pretax income, with the uptake rate (percentage of eligible taking up the CCDF) written inside of the cell.

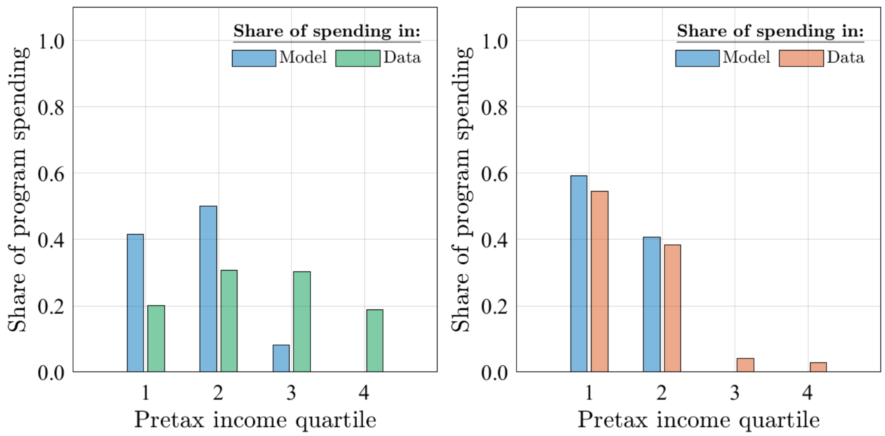
among low-skill parents.[23] Figure 3 indicates these are the families relatively close to the baseline recipients in the type space, so that it will not be necessary to completely eliminate uptake costs to affect these households. Another implication of this CCDF uptake pattern in the baseline equilibrium is that, when the fixed cost is subsidized, inflows into subsidy uptake will arrive from families with relatively lower income who will receive a more generous CCDF subsidy. This increases the expense of such an expansion not just through the fixed cost subsidy but also through the higher cost to the government of subsidizing childcare for the new recipient families.

Child-related program spending patterns Figure 4 shows how spending on each program is allocated across pretax income quartiles in the population. It also includes empirical counterparts for these spending patterns, replicated from Figure 1 of Section 2.

For the CTC (left panel), spending in the model baseline is hump-shaped in income. Compared to the data, the model also captures the property that the second and third income quartiles together receive most of CTC spending, although it understates the extent to which higher income households receive spending from the CTC. Spending on the CCDF (right panel) in the model baseline equilibrium is decreasing in household income and concentrated in the first and second income quartiles, qualitatively aligning with aggregate spending in the data. Although eligible households who take up the subsidy have relatively higher adult skill levels in the model's baseline equilibrium (Figure 3), poor households who take up CCDF aid tend to receive large amounts of it because the

[23] The fact that there is always a sizable mass of low-skill parents with high-skill children is a consequence of the zero correlation coefficient between child skill at 9 months and parent income reported in Moschini (2023).

subsidy intensity is higher for lower-income households (Table 2). This is why aggregate spending on the first income quartile is quite high in the baseline.



(a) Child Tax Credit

(b) Child Care and Development Fund

Figure 4: Share of program spending by income quartile of recipients

Notes: Share of program spending going to each income quartile for the Child Tax Credit (Figure 4a) and the Child Care and Development Fund (Figure 4b) in the model baseline equilibrium. Data values for both programs are replicated from Figure 1. The y-axis of each graph is the share of program spending going to a given income quartile; the x-axis is the income quartile assigned using the distribution of income for all households.

Program size Table 3 reports the size of the CTC, CCDF, EITC, and TANF programs in the baseline model equilibrium and compares them with their empirical counterparts. For both data and model moments, the size is measured by aggregate spending on the policy normalized by gross domestic product. Although they are untargeted, the model aligns well with the data for these moments. Details on computation of data moments are in Appendix B.1.4.[24]

Table 3: Program size in model baseline and in US data

	Program size		
Program	**Model**	**Data**	**Data source**
Child Tax Credit	0.301	0.287	IRS SOI (2017), Table 3.3
Child Care and Development Fund	0.079	0.053	Chien (2019a,b, 2020)
Earned Income Tax Credit	0.347	0.347	IRS SOI (2017), Table 2.5
Transfer Aid for Needy Families	0.023	0.022	Office of Family Assistance (2015)

Notes: Table 3 reports the size of each program in the baseline economy and the size of the program in US data during the period 2015-2017, as well as the source of this empirical moment. All program sizes are in percentage of output (model) or of average US GDP from 2015 to 2017 (data), from BEA (2022a).

[24]The CCDF is slightly larger in the model than in the data because we assume that there is a single price of childcare; this inflates the size of the CCDF because in the data the average childcare price of those receiving the CCDF is lower than the average price in the population, as shown in Moschini (2023).

6 Experiments and Results

We perform two sets of experiments with the calibrated model. Section 6.1 evaluates the effects of expanding the CTC or the CCDF, holding the other program fixed at its baseline. The purpose of this exercise is to illustrate how each policy affects the model economy when spending on it is increased.[25] Section 6.2 reports the effects of the 2018 expansion in the CTC and compares it with an expansion of the CCDF that uses the same additional percentage of output.

Implementation In Section 6.1, the government expands the CTC by raising both the nonrefundable and the refundable per-child maximum amounts ($\overline{\kappa}_{nref}$ and $\overline{\kappa}_{ref}$, respectively) by the same proportion relative to their baseline values. This policy margin is changed because it allows for a larger range of total spending on the program to be implemented (i.e., compared to raising the phaseout threshold). This flexibility allows us to calibrate the CTC policy to match a desired level of total spending on the CTC and CCDF, combined, for comparability across program expansions. In Section 6.2, however, the CTC is expanded in a way that reflects the actual changes to the program as described in Crandall-Hollick (2018). This expansion combines an increase in the credit level with an increase the phaseout threshold for income, as well as a slight decrease in the refundability threshold for income.

In both experiments, expansions of the CCDF are implemented by subsidizing the fixed cost of uptake by setting $\tau_{\xi} > 0$ while leaving unchanged the intensity of the subsidy at a given level of income and the income eligibility threshold.

Measuring welfare changes When analyzing welfare changes across equilibria, we report two main measures: CE_1 and $\overline{CE}_2$. CE_1 is defined as

$$CE_1 \equiv \exp\left[\frac{W_{eq} - W_0}{(1-\lambda)\sum_{j=1}^{J}\beta^{j-1}}\right]$$

where W_{eq} is the expected lifetime utility of adult households with type $z_{j_a+1} = (\theta_a, \theta_k)$, using the distribution over types in the referenced equilibrium eq to compute W_{eq}. $\overline{CE}_2$, meanwhile, is the weighted average across types of $CE_2\left(j, z_j\right) \equiv \exp\left[\frac{V_j^{eq}(z_j) - V_j^{0}(z_j)}{(1-\lambda)\sum_{age=j}^{J}\beta^{age-j}}\right]$, evaluated at $j = j_a + 1$ and using the the distribution over types in the new equilibrium eq to aggregate $CE_2\left(j, z_j\right)$.

[25] Appendix C.2 reports the effects of reallocating economic resources towards either the CTC or the CCDF, holding fixed the total share of output spent on both programs; this illuminates the opportunity cost of funds spent on either program, in terms of resources not available for the other.

Specifically:

$$\overline{CE}_2 \equiv \int_{z_{j_a+1}} CE_2\left(j_a+1, z_{j_a+1}\right)\Omega\left(j_a+1, z_{j_a+1}\right)dz_{j_a+1}$$

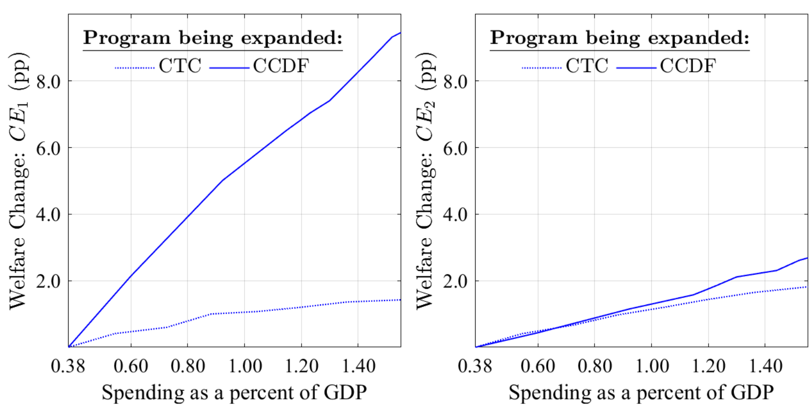
When reporting age-specific welfare changes, we leave the age argument as a variable in the expectation and denote the result $\overline{CE}_2\left(j\right)$, defined as:

$$\overline{CE}_2\left(j\right) \equiv \int_{z_j} CE_2\left(j, z_j\right)\Omega\left(j, z_j\right)dz_j$$

When decompositions of welfare changes are reported, we use the method of Guvenen, Kambourov, Kuruscu, Ocampo, and Chen (2023). Appendix D provides more details on the computation of welfare changes and their decomposition.

6.1 The effects of expanding each program

Figure 5 shows the welfare gains of gradually expanding the CTC tax credit per child and of subsidizing the uptake cost for the CCDF, using welfare metric CE_1 (left) and $\overline{CE}_2$ (right). The percent of output spent on the two programs combined is affected directly by raising the per-child credit for the CTC or increasing the subsidy on fixed costs for the CCDF; using the spending percentage value for the x-axis allows expansions of both programs to be presented on the same graph. The upper bound on the x-axis is the share of GDP spent on the two programs, combined, when the fixed cost of the CCDF is eliminated. As the Figure indicates, welfare gains behind the veil of ignorance are always higher after expansions of the CCDF, while the average welfare change across types is at first slightly larger after CTC expansions.



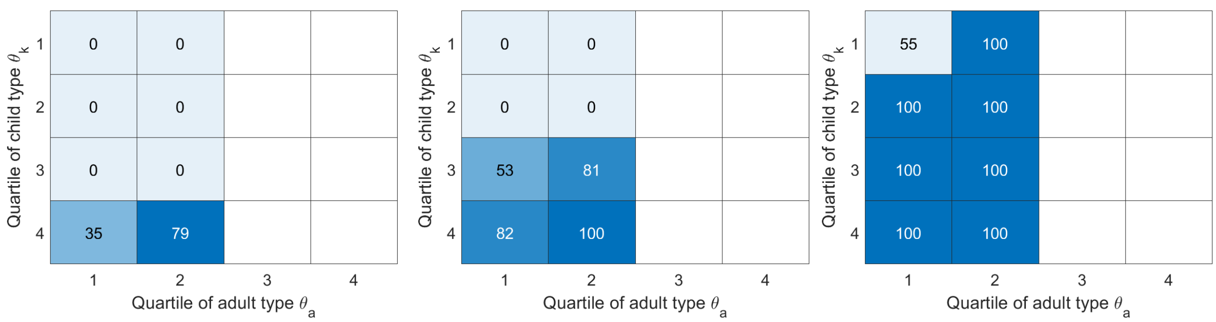
(a) Welfare change: CE_1

(b) Welfare change: $\overline{CE}_2$

Figure 5: Welfare changes as each program is expanded

Notes: Welfare changes due to raising CTC credit amount and subsidizing the CCDF uptake cost, using welfare metric CE_1 (Figure 5a) and $\overline{CE}_2$ (Figure 5b). The x-axis is the percent of GDP spent on the CTC and CCDF, combined.

In the baseline equilibrium, households who are at the margin for childcare subsidy takeup are characterized by relatively higher adult and child skill, compared to the pool of eligible households. As the subsidy rate on the fixed cost of uptake increases (and the share of GDP spent on the subsidy increases), the marginal households change in composition: they are worse off financially (lower parent skill) and their children are lower-skilled. To demonstrate this point, Figure 6 shows how CCDF uptake decisions respond as the subsidy on uptake fixed costs gradually increases. At small subsidy rates, inflows into subsidy receipt arrive from households with relatively lower θ_k's (Figure 6b). Households with low θ_a and high θ_k, however, do change their uptake decisions to a greater extent at intermediate subsidy rates (Figure 6c).



(a) No subsidy (b) 10 % subsidy (c) 50 % subsidy

Figure 6: CCDF uptake rates as fixed-cost subsidy increases

Notes: Figure 6 shows the uptake rate, conditional on eligibility, for the CCDF with no subsidy on the fixed cost of uptake (Figure 6a), a 10 percent subsidy (Figure 6b), and a 50 percent subsidy (Figure 6c). Uptake rates are reported for the discretized joint distribution over household types at $j = j_a + 1$, (θ_a, θ_k), with θ_a on the x-axis and θ_k on the y-axis. Shaded cells denote positive within-cell eligibility rates using realized pretax income, with the uptake rate (percentage of eligible taking up the CCDF) written inside of the cell.

We next examine changes in aggregate quantities after expansions of the each program so that the change in government spending on the CTC and CCDF combined is equivalent to the change after a 100-percent subsidy of the fixed cost for CCDF uptake.For the CTC, this requires a 4.36-fold expansion in the CTC credit level. Table 4 reports changes across stationary steady states in various equilibrium quantities relative to the baseline economy, as well as the resulting welfare changes.

When the CTC per-child credit is expanded, the percent of output spent on the CTC increases by 1.24 percentage points (column 1 of Panel A in Table 4). The CCDF also expands slightly, as more eligible families can pay the fixed cost or finance more spending on childcare with CTC funds. The increased government spending causes a sizable increase in the average tax rate. Note that the CTC is by its nature a transfer only to parents raising children; older consumers face a higher tax rate without the higher transfer. Parent quality time decreases and non-parental child care decreases as

Table 4: Effects of expanding each program

Comparison across steady states			Δ after expanding:	
Category	**Variable**	**Baseline**	**(1) CTC**	**(2) CCDF**
Panel A: Program size and tax rate	Child Tax Credit (% Y)	0.30	1.24	0.03
Δ units: percentage point change	Child Care and Development Fund (% Y)	0.08	0.01	1.22
	CTC + CCDF (% Y)	0.38	1.25	1.25
	Income tax rate (at ave. inc. initial ss)	9.06	1.41	0.84
Panel B: Aggregate quantities	Quality time (parents only)	0.09	-1.13	-1.58
Δ units: percent change	Non-parental childcare (parents only)	0.31	-1.77	37.38
	Consumption	1.41	-1.66	4.99
	Leisure	0.66	0.40	0.39
	Labor supply	0.33	-0.77	-0.72
	Output	1.67	-1.67	6.21
Panel C: Welfare changes	CE_1		1.50	9.78
Δ units: percent change	$\overline{CE}_2$		1.91	2.87

Notes: Table 4 reports changes in aggregate quantities and welfare for expansions of the CTC (column 1) and CCDF (column 2) that result in the same percent of output being spent on both programs as eliminating the uptake cost of the CCDF. Specifically, in column (1) the per-child credit is $\overline{\kappa}_{nref} = \overline{\kappa}_{ref} = 4.678 \times \overline{\kappa}_{baseline}$, and in column (2) $\tau_\xi = 1$. For both columns, the change in spending on both programs as a percent of GDP is the same. Changes are relative to the baseline equilibrium ("Baseline").

well (Panel B). These changes reflect a decrease in skill investment, resulting in a slightly lower stock of skill in the new steady state and compounding the increase in income taxes necessary to finance the CTC expansion. The lower relative price of leisure along with the distortionary effect of the child tax credit leads consumers to reduce labor supply by 0.77 percent. In the new steady state, the drop in labor supply compounds the decrease in the stock of skill, which leads to a fall in output of 1.67 percent. The effect of these changes in quantities on welfare can be seen in Panel C: whether measured behind the veil of ignorance (CE_1) or using the average change across types for new adult households ($\overline{CE}_2$), the CTC expansion generates welfare gains because it raises leisure even as it lowers output overall.

In column (2) of Table 4, we see that when the CCDF is expanded by lowering uptake costs, this causes an increase in the size of both programs. The CCDF expands in size because the government is subsiziding the fixed cost of uptake for eligible families, which raises uptake rates; the CTC, meanwhile, expands because family incomes move above the refundability threshold $\underline{y}_{ref}$. The effect of subsidizing non-parental childcare is that it increases investment in children and changes the composition of investment inputs: non-parental childcare increases dramatically, by more than 37 percent, while parental quality time slightly decreases. The tax rate increases to finance the increased government spending, but the higher level of skill in the economy leads to an increase in both consumption and leisure. Although labor supply falls by 0.72 percent, output nevertheless rises by 6.21 percent because the increase in the stock of skill offsets the adjustment in consumer time away form labor supply. Overall, welfare increases by a larger amount behind the veil of ignorance (a 9.78 percent change) when the CCDF is expanded compared to an expansion in the CTC. Welfare gains measured by $\overline{CE}_2$ are also higher after the CCDF expansion. The reason CE_1 is so much higher than $\overline{CE}_2$ in column (2) is that the CCDF expansion provides insurance against poor outcomes for one's children, which is only internalized before the revelation of household type. This is illustrated further in the welfare decomposition, which we turn to next.[26]

In order to clarify differences in the source of welfare gains from each policy expansion, Table 5 decomposes changes from expanding the CTC, in column (1), or the CCDF, in column (2), into three components: welfare changes due to changes in the average level of consumption and leisure only, in the altruism term, and in the distribution of consumption and leisure (Appendix D.3 explains the calculations in more detail). Panel A reports the decomposition for CE_1; Panel B shows the decomposition results for $\overline{CE}_2$. In both panels, it is evident that gains from CTC expansions are mainly due to changes in the distribution of consumption and leisure across households, while gains from expansions in the CCDF are mainly stemming from changes in the average levels of consumption and leisure. Changes in the altruism term, reflecting improved child lifetime outcomes, play qualitatively similar roles in welfare changes across columns (1) and (2). Unsurprisingly, the effect of changes in the altruism term is larger for the expansion in the CCDF, as child outcomes improve more in that counterfactual.

Table 5: Decomposing welfare changes

Welfare measure	**Component**	**(1) CTC**	**(2) CCDF**
Panel A: Components of CE_1	Levels of consumption and leisure	-0.96	5.71
	Altruism term	0.17	9.41
	Distribution	2.31	-5.08
	Total	1.50	9.78
Panel B: Components of $\overline{CE}_2$	Levels of consumption and leisure	-0.96	5.71
	Altruism term	0.46	2.56
	Distribution	2.44	-5.15
	Total	1.91	2.87

Notes: Table 5 decomposes welfare changes from Panel C of Table 4 into three components. The total welfare change corresponds to the values in Panel C of Table 4.

The main takeaway of the preceeding analysis is that raising the child tax credit level acts to redistribute from the old to the young but contracts the economy. Ultimately, this reduces consumption and labor supply in the long run even as it raises leisure. Welfare gains from this program stem from redistributing from the old to the young; Figure 7 illustrates the redistribution across ages, reporting values for $\overline{CE}_2\,(j)$ for each adult age group. Welfare changes are very negative for

[26] Appendix C.3 reports the effects of changing margins other than the uptake cost for the childcare subsidy policy.

consumers who are not investing in children or who do not receive the tax credit.

By comparison, childcare subsidies stimulate investment in child skill. In the new steady state, this results in a larger stock of skill, and therefore higher output even as labor supply decreases slightly. Altruistic links across generations make welfare gains behind the veil of ignorance from this program quite high. Expanding childcare subsidies also partially pays for itself by expanding the income tax base, while expanding the child tax credit level has the opposite effect. Because of this difference, the same increase in government spending requires a smaller increase in the average income tax rate in column (2) of Table 4, compared to column (1). Accordingly, Figure 7 shows that welfare losses in the new steady state for older consumers are lower after an expansion of the CCDF compared to losses for these ages after a large expansion in the CTC.

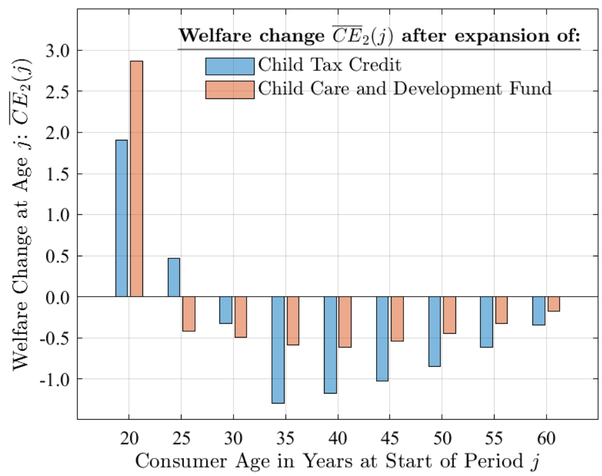


Figure 7: Welfare changes by age

Notes: Figure 7 shows the age-specific welfare changes averaged across types, computed across steady states after expanding the CTC or the CCDF. These welfare changes reflect the same exercise as is analyzed in Table 4 and Table 5.

To examine the role of general-equilibrium adjustments in generating the results of Table 4, Table 6 shows how welfare changes after each program's expansion differ when the skill distribution $\mu_a(\theta_a)$ is held fixed at the baseline distribution, the altruism term $V_k^a(\theta_k^a)$ is held fixed at its baseline value, and the average labor income tax parameter τ_y is held fixed at its baseline value. If the welfare gain is higher when the general equilibrium object is held fixed (relative to the general equilibrium welfare change), this indicates the adjustments in that object act to mitigate welfare gains in general equilibrium and vice-versa.

Beginning with the first row of 6, which reports welfare changes behind the veil of ignorance as measured by CE_1, we find that when the CTC is expanded, all three general equilibrium adjustments act to mitigate its benefits to some extent, but adjustments in the tax rate have the greatest effect. Without accounting for such adjustments in the income tax rate, welfare gains would be more than twice as high. When the CCDF is expanded, welfare changes are magnified by adjustments in the skill distribution (and to a lesser extent the altruism term), but mitigated by adjustments in the income tax rate.

Moving to the second row of Table 6, which reports population-weighted averages of type-specific changes for new households as measured by $\overline{CE}_2$, the results differ in that for expansions of the CTC equilibrium adjustments in the altruism term act to magnify rather than mitigate general-equilibrium welfare gains. For CCDF expansions, the altruism term now acts to magnify welfare gains, whereas results for the other equilibrium objects are unchanged qualitatively although the magnitudes differ.

Comparing outcomes across policies, the results of Table 6 indicate that the skill distribution is the most important object to endogenize in general equilibrium, in the sense that if this was held fixed the ranking of the two programs by welfare gains would be reversed. Although adjustments in the other two general equilibrium objects do play a significant role in terms of the magnitudes of welfare changes, the welfare ranking of the two policy changes would not be affected if either object was held fixed.

Table 6: Role of general equilibrium adjustments

Comparison across equilibria	**Δ after expanding the CTC**				**Δ after expanding the CCDF**			
Equ. object held fixed	**None (GE)**	$\mu_a(\theta)$	$V_k^a(\cdot)$	τ_y	**None (GE)**	$\mu_a(\theta)$	$V_k^a(\cdot)$	τ_y
CE_1	1.50	1.91	2.16	3.87	9.78	1.51	9.34	11.67
$\overline{CE}_2$	1.91	1.94	1.37	4.10	2.87	1.65	1.99	4.59

Notes: Table 6 reports welfare changes of the experiments in Table 4, when the economy moves to a new equilibrium where the skill distribution $\mu_a(\theta)$ is held fixed at the baseline distribution, the altruism term's value function $V_k^a(\cdot)$ is held fixed at the baseline function, and the average labor income tax τ_y is held fixed at its baseline value, for each program's expansion.

6.2 The 2018 expansion of the Child Tax Credit

The final policy experiment evaluates an actual policy change: the 2018 expansion of the Child Tax Credit. This expansion raised the maximum nonrefundable credit level per child, $\overline{\kappa}_{nref}$, from \$1,000 to \$2,000 and the maximum refundable credit per child, $\overline{\kappa}_{ref}$, from \$1,000 to \$1,400. The change also lowered the refundability threshold $\underline{y}_{ref}$ from \$1,815 to \$1,513 and raising the phase-out threshold $\underline{y}_{nref}$ from \$59,200 to \$200,000 (per resident parent). Figure 8 illustrates how the 2018 expansion in the CTC affected the income levels eligible for a positive credit and the magnitude of the credit at each income level; the expansion broadened the income interval receiving a positive credit from the CTC.

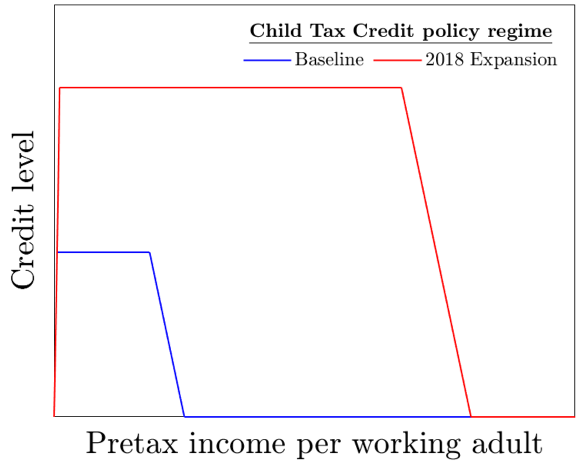


Figure 8: Child Tax Credit properties across policy regimes

Notes: Figure 8 shows how the 2018 CTC expansion affected the properties of the Child Tax Credit in terms of the income levels eligible for the credit and the magnitude of the credit.

In column (1) of Table 7 we report changes in economic variables after the economy has moved to the new steady state with the 2018 CTC policy in place. The CTC expansion results in an increase in the size of the child tax credit of about 0.75 percent of output, and a slight increase in the size of the CCDF. The income tax must increase to finance this rise in expenditures. Investment in child skill rises slightly, because the CTC provides financing for parents to shift towards non-parental childcare time while reducing quality time. Consumers substitute from consumption towards leisure, in light of higher tax rates, and labor supply falls. The increase in skill slightly dominates the fall in labor supply, so that output rises by 0.03 percent. The resulting welfare gains are 1.66 percent of lifetime consumption behind the veil of ignorance, with slightly smaller gains of 1.09 percent when measured as the average across household types for new adults.

Column (2) reports the effects of subsidizing the fixed cost of uptake for the CCDF until the total expenditures on the CCDF and CTC combined are the same as in column (1). The CTC policy in column (2), however, is held at its baseline parameterization. To meet this requirement, the subsidy on uptake costs for the CCDF must be 56 percent. The resulting expansion of the childcare subsidy uptake raises both programs' size relative to the baseline and increases the percent of families with young children who receive it to 25 percent. Despite requiring the same fraction of output in additional government spending, the CCDF expansion in column (2) requires a smaller rise in the average income tax rate compared to the CTC expansion in column (1). Unsurprisingly, with an expansion in the size of the childcare subsidy program families shift away from parent time and towards non-parental childcare time when investing in their children. Overall, investment increases, allowing both consumption and leisure to increase as the stock of skill in the economy expands. Labor supply falls, but not by enough to offset the expansion in the stock of skill, so that overall output rises by 4.99 percent. Welfare in this alternative policy increases by much more than in column (1): behind the veil of ignorance, welfare gains are 6.82 percent of lifetime consumption, while averaged across household types in the first period of adulthood the gains are 1.66 percent.

A more traditional approach to expansions of CCDF spending, discussed in detail in Appendix C.4, yields a more ambiguous welfare ranking compared to the 2018 CTC expansion. In particular, compared to the effects of the 2018 CTC expansion, welfare gains from expanding the CCDF by making the subsidy intensity less means-tested are substantially larger behind the veil of ignorance (CE_1), but lower when averaging across types ($\overline{CE}_2$).

The net effect of the 2018 CTC expansion combines the effect of an increase in the child tax credit with a decrease in the refundability income threshold and an increase in the phaseout income threshold. The effects of an increase in the level of the credit were explored in Section 6.1, while the effects of the other two changes in the 2018 expansion are examined in more detail in Appendix C.5, which studies each policy margin's change in isolation. The main takeaway of that analysis is that the increase in the credit level and the increase in the phaseout threshold drive almost all of the total effects of the 2018 CTC expansion. The effect of the phaseout threshold increase are to raise investment and output in the long run, while raising the credit level has the opposite effect. The effects differ because raising the credit level distorts the labor supply decision of households downward as they seek to qualify for more of the credit, while raising the income threshold mitigates this effect at higher income levels and raises labor supply. Taken together, the two changes almost cancel out with regards to changes in output. This is why the level of output slightly increases in column (1) of Table 7 whereas it decreases in column (1) of Table 4 in Section 6.1, although in both cases spending on the CTC is increased.

Comparisons of steady states can mask transitional dynamics which would reveal that seemingly appealing policies are actually not viable alternatives to the status quo. Table 8 reports welfare changes over the transition path from the baseline equilibrium to the two new steady states discussed in Table 7. Panel A of Table 8 reports welfare changes using $\overline{CE}_2$ during the first five years of the transition to the new steady state, for new adult households and all households alive. Panels B and C report welfare changes for these two groups 20 and 50 years into the transition, respectively; Panel D reports the same metrics 100 years later, at the end of the transition, which match the values in Panel C of Table 7.

After the 2018 expansion in the CTC, welfare changes were very similar initially to what they would be at the new steady state (column 1 of Table 8). Initially, new adult households benefit

Table 7: Specific reform: 2018 Child Tax Credit expansion

Comparison across steady states		**△ after expanding:**	
Category	**Variable**	**(1) CTC**	**(2) CCDF**
Panel A: Program size and tax rate	Child Tax Credit (% Y)	0.75	0.04
△ units: percentage point change	Child Care and Development Fund (% Y)	0.07	0.78
	CTC + CCDF (% Y)	0.81	0.81
	Income tax rate (at ave. inc. initial ss)	0.89	0.52
Panel B: Aggregate quantities	Quality time (parents only)	-0.59	-0.50
△ units: percent change	Non-parental childcare (parents only)	3.26	25.50
	Consumption	-0.09	4.00
	Leisure	0.27	0.26
	Labor supply	-0.52	-0.51
	Output	0.03	4.89
Panel C: Welfare changes	CE_1	1.66	6.80
△ units: percent change	$\overline{CE}_2$	1.09	1.73

Notes: Table 7 reports changes in aggregate quantities and welfare predicted by the model after the 2018 expansion of the CTC (column 1) and an equivalent expansion of government spending where the additional funds are spent on the CCDF instead (column 2). Specifically, in column (1) changes are as described in the main text, and in column (2) $\tau_\xi = 0.558$.

(Panel A), seeing welfare gains averaged across household types of 1.05 percent. However, all consumers alive during the transition actually suffer welfare losses of 0.55 percent of lifetime consumption, because this welfare measure includes effects on the elderly who do not receive the tax credit but have to finance the expense by paying higher income taxes. Over the course of the transition to the new steady state, these welfare changes are largely unchanged (Panels B, C, and D).

By contrast, column (2) shows that the welfare gains take longer to reach their full level after an expansion of the CCDF requiring the same increase in government spending. The initial welfare gains for new households, shown in Panel A, are 1.21 percent of lifetime consumption; for all those alive during the transition, welfare gains for this policy are actually slightly more negative than the expansion of the CTC in the initial periods of the transition.[27] These welfare losses arise for similar reasons as in column (1): those without children face higher income taxes and receive no direct benefits from the expansion. Unlike the CTC, however, the welfare losses for all ages are reduced to 0.19 percent of lifetime consumption by 20 years into the transition (Panel B), and 0.13 percent by the end of the transition (Panels C and D). This is because the stock of skill in the economy sizeably increases after one generation, raising output and dampening the increase in the income tax rate. Average across types, welfare gains for new households increase within 20 years, from 1.21 to 1.73 percent of lifetime consumption, reaching most of their long-run value within that medium-run time frame.

[27]The welfare losses are larger initially for the CCDF because the CTC is available to adults for the first three periods of life, while the CCDF only affects investment in the first period.

Table 8: Welfare changes over the transition: 2018 Child Tax Credit expansion

Transition path analysis			**Δ after expanding:**	
Period of transition	**Group**	**Welfare metric**	**(1) CTC**	**(2) CCDF**
Panel A: 5 years into transition	New households	$\overline{CE}_2$	1.05	1.21
	All households	Ave. $\overline{CE}_{2,t}\,(j;t)$	-0.55	-0.71
Panel B: 20 years into transition	New households	$\overline{CE}_2$	1.08	1.71
	All households	Ave. $\overline{CE}_{2,t}\,(j;t)$	-0.49	-0.19
Panel C: 50 years into transition	New households	$\overline{CE}_2$	1.09	1.73
	All households	Ave. $\overline{CE}_{2,t}\,(j;t)$	-0.48	-0.13
Panel D: 100 years into transition	New households	$\overline{CE}_2$	1.09	1.73
	All households	Ave. $\overline{CE}_{2,t}\,(j;t)$	-0.48	-0.13

Notes: Table 8 reports welfare changes of the experiments in Table 7, using $\overline{CE}_2$ for new households ($j = 1$) and averaging across $CE_{2,t}\,(j, z_j; t)$ for all households alive at a given period t of the transition to find $\overline{CE}_{2,t}\,(j;t)$ and reporting the average of that metric in the second row of each panel. The results are reported 5 years into the transition (Panel A) and after 20, 50, and 100 years into the transition (Panels B, C, and D, respectively) as the economy adjusts to the new steady state. The values in the first row of Panel D in Table 8 correspond to those in the last row of Panel C, Table 7.

The results of Tables 7 and 8 indicate that the 2018 expansion of the CTC generated smaller welfare losses for all households alive during the transition, but smaller welfare gains for new households, compared to the spending-equivalent CCDF expansion. After several decades, however, the CCDF expansion causes the stock of skill in the economy to expand, lessening the tax burden on older consumers and raising the welfare gains for new households.

7 Conclusion

In this paper, we compare two major family policies in the United States: the Child Tax Credit and the Child Care and Development Fund. These programs differ not only in their target population and design, but also in the uptake rate among the eligible, which is high for the CTC and quite low for the CCDF. We explicitly model these differences in realistic representations of the two family policies, and embed these policies into an overlapping generations framework that accounts for endogenous child skill accumulation. In our framework, policy changes affect child skill accumulation because of changes in the composite price index of skill investment, as well as via income effects. Uptake of the childcare subsidy is endogenously low in our framework, despite the subsidy being very generous, due to a fixed cost of uptake in consumption units.

In counterfactual experiments, we establish that expanding the childcare subsidy by increasing uptake among CCDF-eligible households would yield welfare gains that are larger than expansions of the CTC at similar government expense, while also sizably raising output in the long run. Consistent with this, we find that gains from a CTC expansion arise mostly because of changes in the distribution of consumption and leisure across households; gains from a CCDF expansion arise from changes in the average level of these two quantities in the economy. Welfare gains from CCDF expansions take a generation to fully accrue, however, because they stem from expansions in the stock of skill in future generations. By contrast, most of the welfare gains from the CTC expansion are realized immediately.

In the United States, child care subsidies exhibit low uptake rates among the eligible. Increasing uptake rates by reducing uptake costs for childcare subsidies represents spending to remove uptake barriers due to bureaucracy and underfunding which, for example, gives rise to waiting lists. Given recent expansions of the Child Tax Credit, and the relatively larger welfare gains from reducing CCDF uptake costs that we find in our analysis, policy makers should consider making childcare subsidy uptake less costly for eligible households.

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Online Appendix

"Family Policies and Child Skill Accumulation"

by Emily G. Moschini and Monica Tran-Xuan

Contents

A Program Descriptions

The details of the Child Care and Development Fund (CCDF) and the Child Tax Credit/ Additional Child Tax Credit (CTC) are described in the main text. The baseline model also incorporates the fully refundable EITC and cash transfers to unemployed parents from TANF, whose parameters of these policies are held at their baseline values in counterfactual experiments. Next, we describe the specification of the EITC and and TANF policies in the model and explain how they are parameterized.

A.1 The Earned Income Tax Credit

The EITC provides a fully refundable tax credit to families who have positive but low taxable income in a way that depends on the presence of children in the household (Crandall-Hollick, 2018, 2021). In effect, the EITC acts like a wage subsidy to low-income workers. For a family with pretax income y, the EITC takes the form presented in equation (10) below.

$$EITC_j\left(y,\vec{\pi}_E\right) = \begin{cases} \beta_{in,j}\left(j\right)\times y & \text{if } y \leq \underline{y}_{EI,j} \\ \overline{\kappa}_{max,j} & \text{if } y \in \left(\underline{y}_{EI,j}, \underline{y}_{out,j}\right] \\ \max\left\{\overline{\kappa}_{max,j} - \beta_{out,j}\times\left(y - \underline{y}_{out,j}\right), 0\right\} & \text{if } y \in \left(\underline{y}_{out,j}, \overline{y}_{max,j}\right] \\ 0 & \text{otherwise} \end{cases} \quad (10)$$

Here, the transfer level and income thresholds are expressed as fractions of median income, so that $\overline{\kappa}_{max,j} = \Theta_{\kappa,j}\times y_{p50}$, $\underline{y}_{EI,j} = \Theta_{EI,j}\times y_{p50}$, $\underline{y}_{out,j} = \Theta_{out,j}\times y_{p50}$, and $\underline{y}_{max,j} = \Theta_{max,j}\times y_{p50}$. The vector of parameters governing this policy is a set of parameters for each age j, $\overrightarrow{\pi}_E\left(j\right) = \left[\Theta_{\kappa,j}, \beta_{in}, \beta_{out}, \Theta_{EI,j}, \Theta_{out,j}, \Theta_{max,j}\right]$. The values of the policy parameters for the EITC depend on whether or not there are children in the taxpayer's household under the age of 19 and are reported in Table A.9. Specifically, the parameterization uses values from Table 1 of Crandall-Hollick et al. (2021), for single filers and married joint filers with 0 or 1 child, averaged using population weights for each family structure from Moschini (2023).

Table A.9: EITC policy parameters for 2015-17

		Parameter value	
Symbol	**Parameter description**	**Children under 18** ($j \leq j_a$)	**No children under 18** ($j > j_a$)
$\Theta_{\kappa,j}$	Max. credit amount	$\frac{\$3{,}091}{y_{p50,US}}$	$\frac{\$325}{y_{p50,US}}$
$\beta_{in,j}$	Credit rate	0.40	0.0765
$\beta_{out,j}$	Phaseout rate	0.2106	0.0765
$\Theta_{EI,j}$	Earned income threshold	$\frac{\$8{,}954}{y_{p50,US}}$	$\frac{\$4{,}253}{y_{p50,US}}$
$\Theta_{out,j}$	Phaseout threshold	$\frac{\$14{,}021}{y_{p50,US}}$	$\frac{\$7{,}645}{y_{p50,US}}$
$\Theta_{max,j}$	Zero credit threshold	$\frac{\$31{,}028}{y_{p50,US}}$	$\frac{\$11{,}898}{y_{p50,US}}$

Notes: Table A.9 reports parameter values $\overrightarrow{\pi}_{EITC}(j)$ for the EITC in the baseline economy. Source: Table 1, Crandall-Hollick et al. (2021), single filers and married joint filers with 0 or 1 child, averaged using population weights for each family structure from Moschini (2023). Numerator values are converted from 2020 dollars to 2016 dollars using the Consumer Price Index. The 2016 median household income in the US, $y_{p50,US}$, is from Guzman (2017).

A.2 Transfer Aid for Needy Families

Even by the standards of the United States, TANF in reality is an especially complex funding stream. In this paper, "TANF" refers to the direct cash payment component of the constellation of uses for TANF funding in practice: In reality, not only do TANF funds provide direct cash payments, but they can also fund state tax credits and childcare expense aid. However, the main categories TANF money is spent on are basic assistance (cash transfers), child care, and "other services" (Figure 1, Office of Family Assistance (2016)). In fact, there are no federal rules governing how TANF funding is spent by states, but all states use some portion of these funds for cash transfers (Office of Family Assistance, 2015).

Although TANF uptake rates less than one are abstracted from in the main text, it seems that the "eligibile" are those the state defines as needy families, and that uptake among this population is quite low on average. For example, Table A-1 in Falk and Landers (2022) shows that as a percentage of all poor children TANF child recipients make up about 16 percent in 2021, but 35 percent in 2001, indicating that not only is coverege far below 100% but that it has fluctuated over time.

As noted in Falk and Landers (2022), in practice if families have income other than TANF then they receive a reduced benefit. In the main text, the policy referred to as "TANF" plays the role of supporting non-working families with young children with cash transfers, so we are abstracting from any TANF benefit receipt when there are other sources of income present. On paper TANF transfers are meant to facilitate family adults working for pay. In practice, the "all families work participation standard" does not require that all recipients of TANF work, just some fraction of them at the state level. If a given state does not meet this work participation standard, that state is *at risk* of being penalized with reduced TANF funds. It is very common for states to not meet this work participation requirement (see Figure 4 in Falk and Landers (2022) for the all-family work participation rate).

In the model of the main text, the transfer function $TANF$ gives a lump-sum amount κ_{TANF} to non-working families with young children:

$$TANF_j\left(y, \vec{\pi}_T\right) \quad = \quad \begin{cases} \kappa_{TANF} & \text{if } y = 0 \text{ and } j = 1 \\ 0 & \text{otherwise} \end{cases} \tag{11}$$

Here, the transfer level is set as a fraction of median income, so that $\kappa^{TANF} = \Theta_{TANF} y_{p50}$ The vector of parameters governing this policy is $\overrightarrow{\pi}_{TANF} = [\Theta_{TANF}]$.

Table A.10: TANF policy parameters for 2015-17

Symbol	**Parameter description**	**No children under 17** $(j > 3)$
Θ_{TANF}	Cash transfer ratio	$\frac{\$4{,}776}{y_{p50,US}}$

Notes: Table A.10 reports parameter values $\overrightarrow{\pi}_{TANF}$ for TANF in the baseline economy. The numerator is the monthly amount of cash assistance received by families in the 2015 FY converted to annual amount. The denominator is the median income for US households in the period 2015-2017. Sources: Office of Family Assistance (2015) and Guzman (2017).

B Parameterization and Data

B.1 Externally estimated parameters

This section provides more details on how the values for the externally estimated parameters of Table 1 are computed.

B.1.1 Consumption taxes

The consumption tax rate is estimated by applying the method of Mendoza, Razin, and Tesar (1994) to data for the United States in the period 2015 to 2017 (the referenced paper only provides estimates until 1988). Specifically, we apply equation (5) from Mendoza, Razin, and Tesar (1994) to data from OECD Stat (2015-2017) and OECD GRSD (2015-2017), for each year of the period of interest, and then average the annual tax rate across the three years.

$$\tau_{c,t} \quad = \quad 100 \times \frac{5110_t + 5121_t}{C_t + G_t - GW_t - 5110_t - 5121_t}$$

The t in the subscript of each variable denotes the year. The 4-digit numbers in this expression are variable names in the OECD data corresponding to "General taxes on goods and services" (5110) and "Excises" (5121).

Table B.1: Consumption tax rate estimation

		Year			
Variable	**Description**	**2015**	**2016**	**2017**	**Source**
Panel A: Total tax revenue (all levels of government)					
5110	General taxes on goods and services	374	385	406	Manual extraction
5121	Excises	157	159	162	Manual extraction
Panel B: Final consumption expenditure					
C	Private	11,892	12,292	12,819	Table 5
G	Government	2,609	2,663	2,727	Table 11
Panel C: Compensation of employees by source					
GW	Paid by producers of gov't services	1,758	1,799	1,846	Table 11
$\tau_{c,t}$	Annual estimated tax rate (pp)	4.35	4.31	4.32	
τ_c	Estimated consumption tax rate (pp)	4.33			

Notes: Table B.1 reports the components for annual estimations of the consumption tax rate. Data in Panel A are pulled from OECD GRSD (2015-2017), while Panels B and C are from OECD Stat (2015-2017). Dollar values are in billions of current USD for that year in this table (pulled in units of millions of current USD). Note that because the dollar values in this table are rounded the annual estimated tax rate for 2017 reported in the Table is 0.01 smaller than the implied value from table numbers reported here.

B.1.2 Income tax progressivity

We estimate the degree of income tax progressivity, not including transfers to the old, Medicaid, or TANF transferred to households with positive income from other sources, and net of the CTC and EITC, using two methods which yield the same result.

Using PSID data Our preferred method for estimating the degree of income tax progressivity suitable for our model specification using data from the PSID (Survey Research Center, Institute for Social Research, 2023). The tax function on total income is $T(y) = y - (1-\tau_y)y^{1-\tau_y^p}$, where τ_y^p captures the degree of progressivity. This tax specification implies that the relationship between pre-tax income and post-tax income is

$$\log(y - T(y)) = \log(1-\tau_y) + (1-\tau_y^p)\log(y)$$

Using the above equation, we regress the logarithm of post-tax household income on a constant and the logarithm of pre-tax household income. The coefficient on the logarithm of pre-tax household income gives us the estimated tax progressivity τ_y^p.

We use the PSID data from 2015 to 2017 and the TAXSIM program by the NBER to estimate tax progressivity (Feenberg and Coutts, 1993). We extend the program written by Kimberlin et al. (2015) that prepares the inputs for TAXSIM for households in the PSID for the survey years 2015 and 2017. The program identifies multiple tax units within each PSID family unit.[28] Finally, the total PSID family unit tax is the sum of taxes for all tax units present within the family unit. We follow this method instead of a more simplified approach of treating family unit as a whole tax unit because this method allows us to have a more accurate measure of income taxes and child-related tax credits for low-income households. Low-income households generally face a small income tax liability, pay high payroll taxes, and receive significantly large amount of tax credits that are child related, such as the EITC and the CTC. The method carefully assigns children to appropriate tax units using relationship codes. The method also accounts for self-employment and immigrant legal status, which is important for determining work eligibility in receiving tax credits.

We estimate the tax progressivity excluding the effect of child-related policies. To do so, we compute measures of pre-tax income and post-tax income that excludes the effect of children. We exclude the effect of children by comparing taxes in the bechmark case, in which the TAXSIM inputs for the number of chidren and child care amount are from the PSID data, to taxes in the no-dependent case, in which the TAXSIM inputs for the number of children and the child care amount are zero for all tax units.

Pre-tax income is the federal adjusted gross income computed by TAXSIM in the no-dependent case. Gross income includes labor earnings, self-employment income, asset income from business, income from interests, dividends, and rents, plus taxable transfer income (Social Security, pension, other retirement income, annuities, and unemployment income).

Post-tax income is pre-tax income minus tax liabilities plus nontaxable transfers. Taxes include federal and state income taxes and FICA tax, adjusted for the amount of CTC and EITC. The adjustment of CTC and EITC for federal and state taxes is the difference between the benchmark and no-dependent amounts. This calculation implies that we only exclude the amounts of CTC and EITC that are child related. Nontaxable transfers include welfare, Social Security, VA pension, worker's compensation and child support. We exclude TANF in the transfers.

Our sample selection focuses on the working population. In particular, we restrict our sample to households with heads aged 25-60 and at least the head or the cohabitator of the household earns more than the equivalent of part-time work at the minimum wage. We exclude households in the top 1% and bottom 1% of pre-tax income. Table B.2 reports the sample size after each step of

[28]The tax units are head (with head dependents), cohabitor (with cohabitor dependents), joint/married (with head and legal wife dependents), and ofum (with all adults besides the head, cohabitor, and all children not assigned to the head or cohabitor).

sample selection. We begin with 165,146 households for the 2015-2017 surveys. The selection results in a sample of 38,160 households.

Table B.2: Estimating income tax progressivity in the PSID: estimation sample

Category	**Sample size**
Raw sample	165,146
After sample selection	
Ages 25-60	44,599
Part-time miminum wage income	39,189
Excluding pre-tax income outliers	38,160

Notes: Table B.2 reports the sample size before and after each step of sample selection; sample counts refer to number of households. The first row shows the original PSID sample for 2015-2017. The final row gives the size of the sample used in the tax progressivity estimation.

Table B.3 reports the results for the tax progressivity estimation including and excluding child-related policies. Both estimates for tax progressivity are statistically significant. The estimate of tax progressivity including all child-related polices is $\tau_y^p = 0.20$, which is qualitatively consistent to the findings of Heathcote et al. (2017). We find that the estimate of tax progressivity excluding child-related policies is $\tau_y^p = 0.11$. Our results are consistent with the estimates using CBO data, report in the next section.

Table B.3: Estimating income tax progressivity in the PSID: estimation results

	When child-related policies are:	
Parameter	**Included**	**Excluded**
Implied $\hat{\tau}_y^p$	0.20 (0.001)	0.11 (0.001)

Notes: Table B.3 reports the estimation results of tax progressivity for the cases including and excluding the effects of child-related policies from after-tax income. Standard errors are in parentheses. Data is from PSID 2015-2017 and calculated with NBER TAXSIM. The dependent variable is logarithm of post-tax income and the independent variable is the logarithm of pre-tax income.

Using CBO data An alternative method for estimating the degree of income tax progressivity uses aggregate data published by the Congressional Budget Office. To estimate the income tax progressivity, τ_y^p, with this method we apply the robustness method of Heathcote, Storesletten, and Violante (2017) to data underlying the exhibits for U.S. Congressional Budget Office (2019), specifically data underlying Figures 1, 3, 4, and 14 of that publication as reported in U.S. Congressional Budget Office (2016). We use the data underlying figures from the CBO report to find the baseline federal tax rate (column 1 in Table B.4), as well as the transfer rate from refundable tax credits (column 2), and TANF, Medicaid, Supplemental Nutrition Assistance Program (SNAP), and Supplemental Security Income (SSI) in columns (3), (4), (5) and (6), respectively. We compute the empirical equivalent of the net tax rate for our model as the federal tax rate (which includes refundable credits as reported in column 1) plus the transfer rate from refundable credits, minus the transfer rate from SNAP and SSI and report this net tax rate in column (7). Average pretax income in column (8) is logged in column (9) and logged after-tax income reported in column (10) is computed by taking the log of the net tax rate in column (7) applied to the pretax income of column (8). The specific figures in U.S. Congressional Budget Office (2019) whose underlying data provides the empirical moments are: for column (1), Figure 4; for column (2), Figure 14; For columns (3)-(6), Figure 3; and, for column (8), Figure 1.

Table B.4: Estimating income tax progressivity using CBO data: estimation data

Percentiles		**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
Min	Max	Fed. tax	Ref. tax credits	TANF	Medicaid	SNAP	SSI	Net tax	Ave. Y	log (Y)	log (Y_{AT})
99	100	33.3						33.3	1789	3.25	3.08
96	99	26.8						26.8	360	2.56	2.42
91	95	23.6						23.6	218	2.34	2.22
81	90	21.2						21.2	160	2.20	2.10
60	80	17.9						17.9	110	2.04	1.96
40	60	13.9	1.7	0.5	3.7			15.6	72	1.86	1.78
20	40	9.4	3.8	2.0	11.2	1.2	0.9	11.1	45	1.65	1.60
0	20	1.7	12	10.1	46.7	8.4	6.4	-1.1	21	1.32	1.33

Notes: Table B.4 reports the components for the estimation of the income tax progressivity parameter τ_y. Data is from 2016 and dollar values in column (8) are in millions of current USD. After-tax income is defined as $Y_{AT} \equiv (1 - \text{Net tax})$, where the net tax rate is defined as $(7) \equiv (1) + (2) - (5) - (6)$.

To estimate τ_y^p, we derive the estimation equation from the relationship $Y_{AT} = (1 - \tau_y)\, Y^{1-\tau_y^p}$. Taking the log of both sides yields $\log(Y_{AT}) = \log(1 - \tau_y) + \left(1 - \tau_y^p\right)\log(Y)$. This yields the estimation equation:

$$\log(Y_{AT}) \quad = \quad \beta_0 + \beta_1 \log(Y)$$

where $\beta_1 = \left(1 - \tau_y^p\right)$. We therefore regress column (10) from Table B.4 on column (9), using population shares for each row as weights (which are implied by percentiles in that row). The results are presented in Table B.5. The estimated value for τ_y^p is 0.11, whose standard error is computed using the delta method.

Table B.5: Income tax progressivity estimation results

Coefficient	$\log(Y_{AT})$
β_1	0.890 (0.009)
β_0	0.139 (0.018)
Implied $\hat{\tau}_y^p$	0.110 (0.009)

Notes: Table B.5 reports estimation results. Standard errors are in parentheses; coefficients are significant at the 0.1 percent significance level.

B.1.3 The Child Care and Development Fund subsidy rate

The largest federal childcare subsidy program is CCDF. The federal government sets broad criteria for eligibility and states are allowed to apply additional requirements. Federal guidelines require that family income be below 85 percent of state median income to be eligible for subsidy receipt (Lynch, 2022; Stevens et al., 2017).

Conditional on eligibility and uptake, the average subsidy is 81 percent of childcare expenses as calculated using CCDF Administrative Data 2016 FY and reported in Table B.6. The subsidy rate is constructed by taking the ratio of the copayment to the sum of total payments made for the family to the childcare provider and the copayment, and subtracting that from 1. In the estimation sample, observations are included for households earning income from employment only, whose subsidy-recipient child is under 5 years old, and for whom we observe income, state of residency, and family structure. We drop observations where the reported hours in childcare exceed the assumed time endowment of the child, where the copayment exceeds family income, and where the reason for receiving the subsidy is something other than allowing the parent to work. We also restrict attention to families who are eligible according to federal income cutoffs.

Table B.6: Estimation Sample Moments

	mean	median	sd
Subsidy rate	0.81	0.84	0.17
Monthly income	1,888	1,810	812
Number of kids	2.04	2.00	1.10
Single mothers (share)	0.88		
Observations	29,549		

Notes: Table B.6 reports summary statistics for the CCDF policy estimation sample. Income is in 2016 USD. Source: CCDF Administrative Data 2016 FY.

To account for the intensity of the subsidy varying with family income in our specification of this policy (due to larger copayments for richer families), we discipline the relationship between subsidy intensity and family income by performing the following estimation. The independent variable in the regression is given by the ratio of household income and state median income; the denominator is from US Census Bureau and Social Explorer (2023). The regression equation is

$$\text{Subsidy rate}_i \quad = \quad \beta_{0,n} + \beta_{1,n} \left(\frac{\text{Monthly income}_i}{0.85 \times \text{State median income}_i} \right) + \epsilon_i$$

where ϵ_i is normally distributed with mean 0. The results of estimating the above model on the sample summarized in Table B.6 are presented in Table B.7.

Table B.7: Estimation Results

Coefficient	**Value**
$\beta_{1,n}$	-0.439 (0.005)
$\beta_{0,n}$	1.000 (0.002)
Observations	29,549

Notes: Table B.7 reports estimation results for the CCDF's baseline policy. Standard errors are in parentheses. Source: CCDF Administrative Data 2016 FY.

B.1.4 Program size

In Table 3 of the main text we report the size of the CTC, CCDF, EITC and TANF programs in US data. Each of these program sizes is reported as a percentage of the average annual US GDP from 2015 to 2017 in 2016 dollars, which is $\$18,724$ billion. The remainder of this section explains in more detail how each program size is computed.

Child Tax Credit Using moments from Figure 2 in Crandall-Hollick (2018), the money spent on the CTC in 2015 is reported as 53.7 billion in 2015 USD. After converting to 2016 dollars using the Consumer Price Index or CPI (1.01), the size of this program is 0.29 percent of GDP.

Child Care Development Fund The size of the CCDF is computed using the reported size of the program from the 2015, 2016, and 2017 fiscal year reported in Chien (2019a,b) and Chien (2020): 10.2 billion, 9.9 billion, and 9.7 billion for the 3 fiscal years, respectively. From each of these reports we convert these dollar amounts into 2016 dollars and express them as a percentage of 2016 GDP in each fiscal year. Lastly, we then take the average cross the 3 fiscal years: 0.053 percent of GDP.

Earned Income Tax Credit Using IRS SOI (2017), Table 2.5 , the size of the EITC is 66.4 billion in 2017 USD. After converting to 2016 dollars using the CPI (0.98), the size of this program is 0.35 percent of GDP.

Transfer Aid for Needy Families Using Row 1 of Figure 1-A in Office of Family Assistance (2015), (federal TANF and State MOE expenditures and transfers: basic assistance, all funds) the size of TANF is 7.9 billion in 2015 dollars. Converting to 2016 dollars with CPI (1.01), we account for the fact that we model the portion of TANF spent on non-working adults only by multiplying this by 1 minus the particupation rate for TANF recipients (100-48.4 = 51.6 percent). The result is the size of the TANF program we model in the data: 0.022 percent of GDP.

B.1.5 Parameterization of skill investment technology

Our method for parameterizing the skill investment (static) technology capitalizes on household optimization and draws on moments and point estimates for one- and two-parent families in Moschini (2023). Consider the cost-minimization problem of a parent choosing q and n to finance a level of investment I, where w_q is the price of parent time and p_n the price of non-parental childcare time faced by the family.

$$\begin{array}{ll} \min\limits_{q,n} & w_q q + p_n n \\ s.t. & I(q,n) \geq I \end{array}$$

where the investment technology is given in equation (6) of the main text. Taking first-order conditions with respect to the investment inputs yields:

$$\begin{array}{ll} [q] & w_q = \mu \dfrac{\partial I(q,n)}{\partial q} \\ [n] & p_n = \mu \dfrac{\partial I(q,n)}{\partial n} \end{array}$$

taking the ratio of these equations and cancelling terms, then logging both sides, yields the following relationship between prices and quantities when families cost-minimize:

$$\ln\left(\frac{n}{q}\right) = \nu \ln\left(\frac{w_q}{p_n}\right) + \nu \ln\left(\frac{1-\gamma}{\gamma}\right) + (1-\nu)\ln\left(\frac{\theta_q}{\theta_n}\right)$$

As in Moschini (2023), most datasets do not allow the econometrician to observe $\frac{\theta_q}{\theta_n}$ at the family level. If one assumes that the average value in the population of the term $(1-\nu)\ln\left(\frac{\theta_q}{\theta_n}\right)$ is equal to 0, which requires that for a population distribution with population weights ω_i, $\sum_i \omega_i \ln\left(\frac{\theta_{q,i}}{\theta_{n,i}}\right) = 0$, then for any observation i:

$$\ln\left(\frac{n_i}{q_i}\right) = \nu \ln\left(\frac{w_{q,i}}{p_{n,i}}\right) + \nu \ln\left(\frac{1-\gamma}{\gamma}\right) + (1-\nu)\ln\left(\frac{\theta_{q,i}}{\theta_{n,i}}\right)$$

This implies that after taking the weighted sum over all observations the following equation holds:

$$\begin{aligned}\sum_i \omega_i \ln\left(\frac{n_i}{q_i}\right) &= \sum_i \omega_i \left[\nu \ln\left(\frac{w_{q,i}}{p_{n,i}}\right) + \nu \ln\left(\frac{1-\gamma}{\gamma}\right) + (1-\nu)\ln\left(\frac{\theta_{q,i}}{\theta_{n,i}}\right)\right] \\ \sum_i \omega_i \ln\left(\frac{n_i}{q_i}\right) &= \nu \sum_i \omega_i \ln\left(\frac{w_{q,i}}{p_{n,i}}\right) + \nu \ln\left(\frac{1-\gamma}{\gamma}\right)\end{aligned}$$

With data on prices and quantities at the household-child level, this is one equation with two unknowns, γ and ν. Holding fixed that parameter ν, one can find an expression for γ in terms of ν and the average values of quantities and prices observed in the data:

$$\gamma = \frac{1}{1+\exp\left(\left[\sum_i \omega_i \left[\frac{1}{\nu}\ln\left(\frac{n_i}{q_i}\right) - \ln\left(\frac{w_{q,i}}{p_{n,i}}\right)\right]\right]\right)}$$

Because in Moschini (2023) the elasticity parameter ν is not statistically different across family structures, we assign ν as the population-weighted average of estimates from Moschini (2023), 0.56. Because we do not use restricted child-level data in this paper, we then use population-weighted averages for prices and quantities reported in Table 2 of Moschini (2023) and evaluate the above expression to find the implied value for γ, 0.32.

B.2 Distribution of program spending by income quartile

The Child Tax Credit We measure the spending of CTC/ACTC using data from Internal Revenue Service of the United States, Statistics of Income (2023a) for the 2016 year (2017 tax returns). Using quartile thresholds for AGI reported in IRS SOI Tax Stats (2016), we aggregate rows of in Internal Revenue Service of the United States, Statistics of Income (2023a) within each quartile to find the total combined spending on the CTC and ACTC for that quartile. When the income bins in Internal Revenue Service of the United States, Statistics of Income (2023a) do not align closely with the AGI quartile thresholds from IRS SOI Tax Stats (2016), we assign a proportional fraction of the spending from the adjacent bin to the quartile. This assumes that spending is distributed evenly within an income bin. We then compute share of total spending for the CTC/ACTC by income quartiles; Table B.8 reports the income cutoffs and fractions of spending per income quartile. Note that in the main text we use “CTC” to refer to CTC and ACTC, combined.

The Child Care and Development Fund To estimate the distribution of CCDF spending over income quartiles, we first assign households from CCDF Administrative Data 2016 FY to income bins using thresholds from IRS SOI Tax Stats (2016). Next, we restrict to households where reported hours in childcare do not exceed 100 hours a week, who receive a positive subsidy, who

Table B.8: Distribution of CTC.ACTC spending

Income quartile	**Income range (2016 USD)**	**Percentage of CTC spending**
1	0–19,989	20.11
2	19,989–40,919	30.79
3	40,919–81,629	30.33
4	81,629 and above	18.78

Notes: Table B.8 reports the income cutoffs and the percentage of CTC.ACTC spending for each income bin. Data sources are Internal Revenue Service of the United States, Statistics of Income (2023a) and IRS SOI Tax Stats (2016).

report nonmissing income, and whose required copayment does not exceed their reported income. We begin with 98,478 observations, and the selection results in a sample of 96,204 valid observations. Table B.9 reports the income cutoffs and fractions of CCDF spending per income bin, where dollars are aggregated using family-child weights.

Table B.9: Distribution of CCDF spending: results

Income quartile	**Income range (2016 USD)**	**Percentage of CCDF spending**
1	0–19,989	54.59
2	19,989–40,919	38.46
3	40,919–81,629	4.11
4	81,629 and above	2.84

Notes: Table B.9 reports the income cutoffs and the percentage of CCDF spending for each income bin.

C Model and Results

C.1 Fixed cost of childcare uptake

One modeling decision that affects our results is the how to motivate the low uptake rates for the Child Care and Development Fund (childcare subsidy) in the baseline equilibrium. In the main text, we use a fixed cost of uptake that appears in the budget constraint of the consumer in units of consumption. An alternative would be to use a utility fixed cost that appears in the objective function and penalizes utility when the childcare subsidy is used. This modeling choice is sometimes referred to as a “stigma cost” in the literature. To see how it contrasts with our preferred specification, consider a modified model environment where the consumer problem is expanded to include a utility fixed cost of childcare subsidy uptake. Specifically, the parenting problem for consumers age $j = j_a + 1$ given by:

$$\begin{aligned}
V_j(\theta_a, \theta_k) &= \max_{\theta_k^a, c, \ell, R} u\left(\frac{c}{\Psi_j}, 1 - \ell - q\right) + bV_k^a(\theta_k^a) + \beta V_{j+1}(\theta_a) - \xi_u R \\
(1+\tau_k)c + pn + R\xi &\leq y_{AT,j}(y, \vec{\pi}_C, \vec{\pi}_E, \vec{\pi}_T) + CCDF_j(R, n, y, \vec{\pi}_N) \qquad (12) \\
\theta_k^a &\equiv f(\theta_k, I(q, n|\theta_a))
\end{aligned}$$

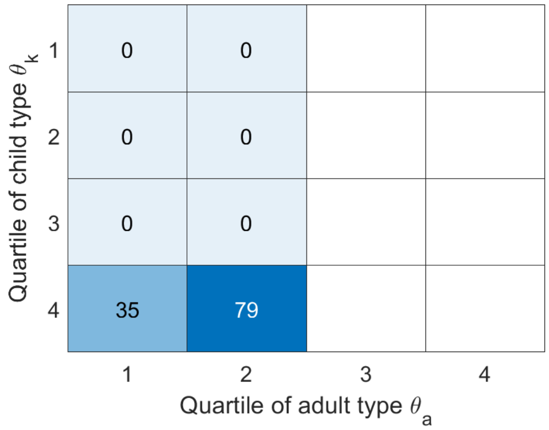
where $q + n \leq 1$, $q + \ell \leq 1$, $c, \ell, q, n \geq 0$, and $R \in \{0, 1\}$. To examine the implications of choosing one specification over the other, here we add a utility cost ξ_u that households must pay if they take out the subsidy. We recalibrate the model with $\xi = 0$, choosing ξ_u to match the CCDF uptake rate; the results are shown in Table C.1.

Table C.1: Internally calibrated parameters with utility cost of uptake

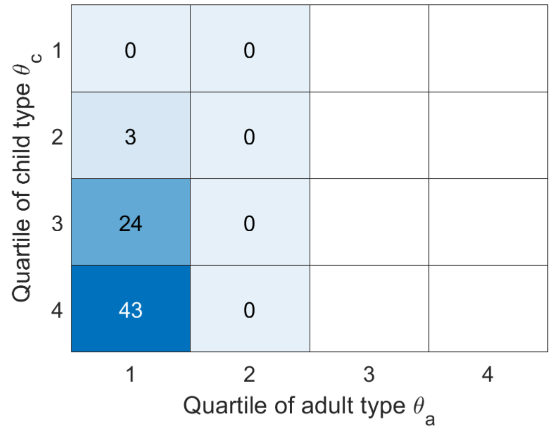
	Parameter		Moments		
Symbol	**Description**	**Value**	**Description**	**Data**	**Model**
Panel A: Parameters calibrated jointly					
ψ	Marginal utility of leisure	0.639	Average hours worked	0.330	0.330
λ_I	Investment productivity	7.699	Average non-parental childcare hours	0.307	0.307
b	Altruism parameter	$0.330 \times \beta$	Corr. child skill outcomes and family income	0.320	0.321
ξ_u	Fixed cost of CCDF uptake	0.225	Share families receiving CCDF	0.035	0.035
$\overline{\Delta\theta_k}$	Variance of $\mu_k(\theta_k)$	9.078	p50-p10 log income	1.403	1.406
Panel B: Parameters set proportional to other equilibrium objects					
θ_n	Child care productivity	3.876	Average productivity of working parents		
ϕ	Pricing ratio for n	0.161	Post-policy input price ratio		

Notes: Table C.1 presents internally calibrated parameters using the framework with a utility cost for CCDF uptake.

As mentioned in the main text, one implication of how we model the fixed cost of uptake is the composition of families using the childcare subsidy in the baseline economy, which has implications for the effects of policy changes. Figure C.1 compares the household types who use the CCDF in the baseline (left panel) versus an alternative model using a utility cost and calibrated to match the same moments (right panel). The two frameworks differ in terms of the adult skill endowment θ_a that characterizes households using the subsidy in the baseline equilibrium: in the preferred specification they are mostly high-skill, while in the alternative specification they are low-skill. We chose the consumption-units fixed cost of uptake in light of our empirical evidence, presented in Figure 1 of the main text. This also qualitatively aligns with the findings of Johnson, Martin, and Brooks-Gunn (2011), who show that eligible families who take up the subsidy tend to have higher levels of education. Through our model's lens, the findings of the latter study translate to relatively higher levels of parent skill among eligible subsidy recipients.



(a) Consumption fixed cost



(b) Utility fixed cost

Figure C.1: Uptake rates and eligibility across model specifications

Notes: Figure C.1 shows uptake rates and eligibility by adult skill quartile (x-axis) and child skill quartile (y-axis) in baseline equilibrium using a fixed cost in foregone consumption (Figure C.1a) and a fixed cost in utils (Figure C.1b).

The differing type-composition for CCDF subsidy recipients means that, when low uptake is motivated by a utility fixed cost, the CCDF goes to the lowest income quartile in the baseline equilibrium. This can be seen in Figure C.2 which compares the baseline income composition of CCDF recipients with the same statistics for the model in the main text. Note that, comparing across the two specifications, the model of the main text is a closer match with the distribution of CCDF spending over income quartiles, replicated here from Figure 1b in the main text.

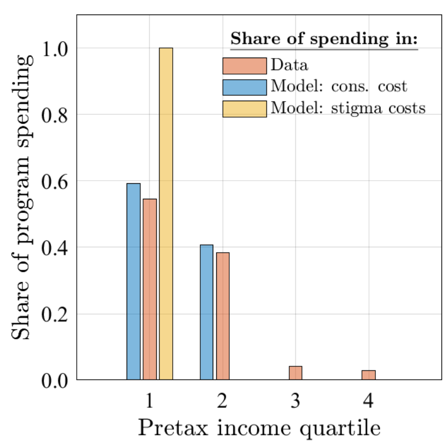


Figure C.2: Program spending by income quartile across model specifications versus data

Notes: Figure C.2 reports the share of program spending by income quartile in the baseline equilibrium using a consumption fixed cost and a utility fixed cost in utils. It also displays spending by income quartile in the data for comparison, replicated from Figure 1b in the main text.

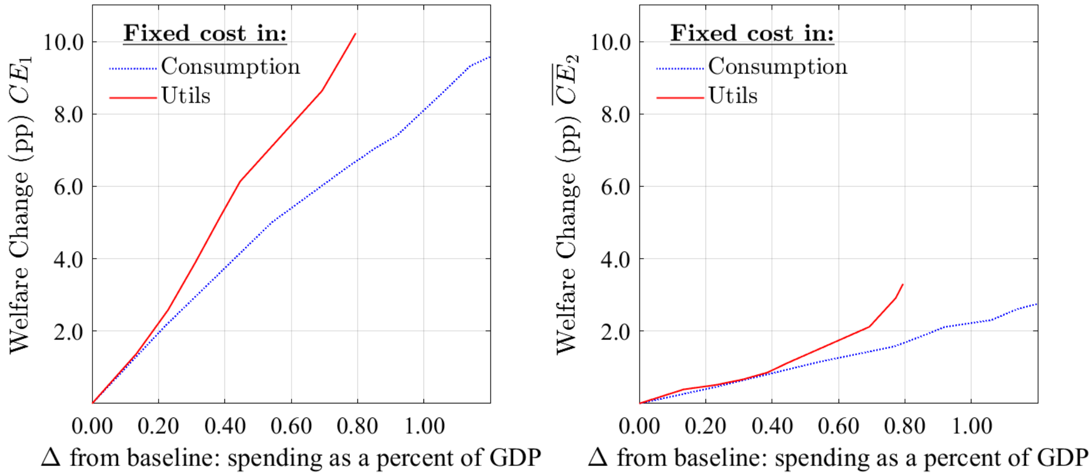
Comparing welfare benefits of eliminating subsidy uptake costs across the two model frameworks in Table C.2, we see that welfare gains from eliminating CCDF uptake frictions are slightly larger when low uptake rates are motivated with a fixed cost in utils, because there is no cost to society from eliminating the friction in column (2) while there is in column (1). Although the mechanisms at work are evidently similar as shown by Panels B and C of Table C.2, the two specifications differ in their implications is in the welfare gains for a given expansion in government spending on child-related policies. This insight combines information from Panels A and C, which show that for very similar welfare gains the utility cost specification requires a smaller increase in government spending.

Table C.2: Effects of elimiting fixed cost of uptake for CCDF

Comparison across steady-states		**Consumption cost**		**Utility cost**	
Category	**Variable**	**Baseline**	**(1) Δ**	**Baseline**	**(2) Δ**
Panel A: Program size and tax rate	Child Tax Credit (% Y)	0.30	0.03	0.31	0.03
△ units: percentage point change	Child Care and Development Fund (% Y)	0.08	1.22	0.13	0.76
	CTC + CCDF (% Y)	0.38	1.25	0.44	0.79
	Income tax rate (at ave. inc. initial ss)	9.06	0.84	9.50	0.29
Panel B: Aggregate quantities	Quality time (parents only)	0.09	-1.58	0.09	-1.17
△ units: percent change	Non-parental childcare (parents only)	0.31	37.38	0.31	34.47
	Consumption	1.41	4.99	1.35	5.86
	Leisure	0.66	0.39	0.66	0.31
	Labor supply	0.33	-0.72	0.33	-0.59
	Output	1.67	6.21	1.60	6.59
Panel C: Welfare changes	CE_1		9.78		10.23
△ units: percent change	$\overline{CE}_2$		2.87		3.30

Notes: Table C.2 reports changes in aggregate quantities and welfare for eliminating the fixed cost of uptake for the CCDF when it is in terms of foregone consumption (column 1) and utils (column 2), relative to the baseline equilibrium. Levels in the baseline equilibrium are also reported for the two models since they represent different calibrations.

Figure C.3 shows welfare changes across the two model frameworks as government spending on the CTC and CCDF combined is gradually increased. Figure C.3a reports welfare changes across specifications for CE_1, while Figure C.3b reports welfare changes using $\overline{CE}_2$. At a given level of spending, welfare changes are always higher for the specification where the fixed cost of uptake is in utils, compared to our preferred specification where it is in units of consumption. In the framework with a fixed cost in utils, reducing the cost of uptake reaches the neediest families immedialy because subsidy recipients were relatively poorer in the baseline. Welfare gains are accordingly higher as the subsidy is reduced in this alternative specification. One thing to keep in mind when comparing these welfare gains is that, with a fixed cost in units of consumption, the government assumes a portion of this fixed cost when reducing it. Reducing or eliminating a utility cost is “free” because the model is silent on how much it would cost to make this change.



(a) Change in CE_1 across specifications (b) Change in $\overline{CE}_2$ across specifications

Figure C.3: Welfare changes across specifications as CCDF fixed cost is gradually reduced.

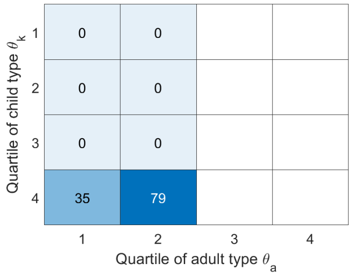
Notes: Welfare changes due to reducing the CCDF uptake cost when it is in terms of foregone consumption or in utils, using CE_1 (Figure C.3a) and $\overline{CE}_2$ (Figure C.3b).

Another reason the welfare gains are higher at a given level of spending in a model with utility costs is the composition of households that switch to subsidy uptake as the fixed cost is gradually reduced. This is illustrated in Figure C.4, which compares the CCDF uptake response to small changes in the uptake cost across the two model specifications. The first row of the figure is the model of the main text where the fixed cost is in units of foregone consumption. The second row is the alternative specification where the fixed cost is a utility cost in utils. As the fixed cost of uptake gradually decreases (moving from left to right within each row) the uptake rate gradually increases, but the composition of new households using subsidized childcare is characterized by lower θ_a and higher θ_k for the utility cost model, compared to the consumption cost framework of the main text.

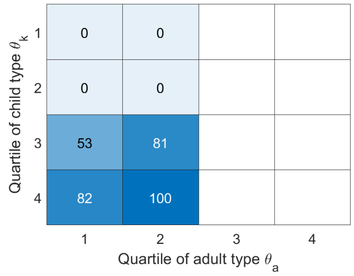
To summarize, compared to an alternative framework with utility costs for CCDF uptake, the model specification of the main text offers a better fit to untargeted moments and provides a lower bound on welfare gains from expansions in government spending on the CCDF.

C.2 The effects of reallocating resources across programs

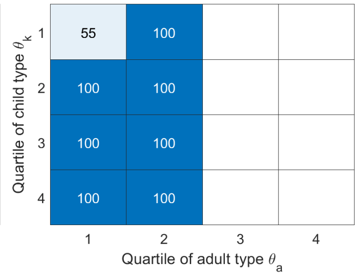
What is the opportunity cost of expenditures on either the CTC or the CCDF in the baseline economy, in terms of spending on the other program instead? Table C.3 presents results from two exercises that address this question, where the total percent of output spent on the two programs combined is held fixed at its baseline value, but only one program is financed at a time. To meet



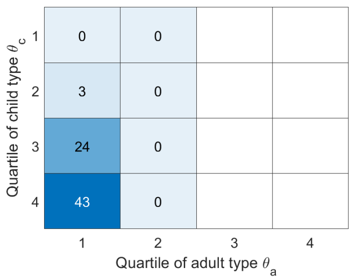
(a) Consumption: No subsidy



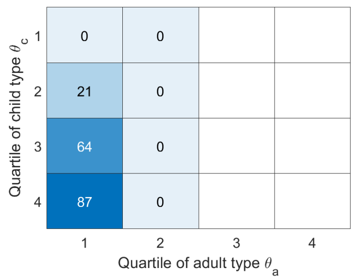
(b) Consumption: 10 % subsidy



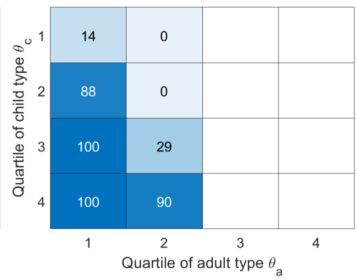
(c) Consumption: 50 % subsidy



(d) Utils: Baseline cost



(e) Utils: 10 % reduction



(f) Utils: 50 % reduction

Figure C.4: CCDF uptake rates as fixed-cost of CCDF uptake gradually decreases

Notes: The first row of Figure C.4 replicates Figure 6 in the main text; it shows the uptake rate, conditional on eligibility, for the CCDF with no subsidy on the fixed cost of uptake (Figure C.4a), a 10 percent subsidy (Figure C.4b), and a 50 percent subsidy (Figure C.4c). The second row shows CCDF uptake rates from the model with utility costs, in the baseline equilibrium (Figure C.4d), a 10 percent reduction in the utility cost (Figure C.4e), and a 50 percent reduction in the utility cost (Figure C.4f). Uptake rates are reported for the discretized joint distribution over household types at $j = 1$, (θ_a, θ_k), with θ_a on the x-axis and θ_k on the y-axis. Shaded cells denote positive within-cell eligibility rates using realized pretax income, with the uptake rate (percentage of eligible taking up the CCDF) written inside of the cell.

this restriction, the CTC per-child credits must be expanded by a factor of 1.25 times their baseline values, and the subsidy on uptake costs for the CCDF must be 15 percent.

As shown in column (1), when the childcare subsidy is eliminated the CTC is expanded a proportional amount, the average income tax rate has to *increase* to finance the change. This happens because eliminating the childcare subsidy causes a slight a drop in childcare use which parent quality time does not compensate for, leading to a drop in skill and a contraction of the income tax base in the new steady state. The slightly higher tax rate causes consumers to shift from consumption to leisure as the latter's relative price falls. The drop in skill is compounded by a fall in labor supply, so that output also falls by 1.11 percent. Overall, behind the veil of ignorance this causes welfare losses of 0.42 percent, because of drops in child outcomes and levels of consumption. However, the average across type-specific welfare changes indicates small welfare gains of 0.21 percent of lifetime consumption.

Column (2), meanwhile, shows that the corresponding reallocation of resources to the CCDF allows the income tax rate to fall by 0.23 percentage points. Although not reported in the table, this increase in funding for the childcare subsidy program corresponds to expanding the share of all families with young children who receive the subsidy from 3.6 percent to 15 percent. The resulting rise in non-parental childcare time indicate a higher level of investment and a rise in the stock of skill (parent quality time falls slightly as investment input composition adjusts, but overall investment increases). Consumption rises while leisure falls, and labor supply rises. Overall, the rise in skill combined with an increase in labor supply drives an increase in output of 3.53 percent. Welfare effects reflect the better expected adult outcomes in the new economy: behind the veil of ignorance consumers gain 2.13 percent of lifetime consumption. Nevertheless, averaging across household types shows a small welfare loss of -0.30 percent, because families that benefited from the CTC in the baseline equilibrium no longer do so.

To summarize, redistributing funds from the CTC towards a policy which more specifically targeted the skill investment margin is beneficial behind the veil of ignorance, while a redistribution of resources away from the child care subsidy program causes small welfare losses behind the veil of ignorance, despite the small mass of childcare subsidy recipients in the baseline equilibrium.

Table C.3: Government spending-neutral reallocation of resources

Comparison across steady-states		**△ after reallocating to:**	
Category	**Variable**	**(1) CTC**	**(2) CCDF**
Panel A: Program size and tax rate	Child Tax Credit (% Y)	0.08	-0.30
△ units: percentage point change	Child Care and Development Fund (% Y)	-0.08	0.30
	CTC + CCDF (% Y)	0	0
	Income tax rate (at ave. inc. initial ss)	0.13	-0.23
Panel B: Aggregate quantities	Quality time (parents only)	-0.01	-0.70
△ units: percent change	Non-parental childcare (parents only)	-3.21	12.11
	Consumption	-0.99	3.12
	Leisure	0.08	-0.41
	Labor supply	-0.16	0.85
	Output	-1.11	3.53
Panel C: Welfare changes	CE_1	-0.42	2.13
△ units: percent change	$\overline{CE}_2$	0.21	-0.30

Notes: Table C.3 reports changes in aggregate quantities and welfare when government spending on both the CTC and CCDF in the baseline is reallocated entirely to the CTC (column 1) or the CCDF (column 2). Specifically, in column (1) the per-child credit is $\overline{\kappa}_{nref} = \overline{\kappa}_{ref} = 1.249 \times \overline{\kappa}_{baseline}$, and in column (2) $\tau_{\xi} = 0.147$.

C.3 Comparing CCDF policy margins

In the main text, expansions of the CCDF are implemented by subsidizing the uptake cost for subsidized childcare. Leaving the fixed cost at its baseline value and increasing CCDF subsidy spending in other ways is explored further in Table C.4. If one makes all levels of income eligible for the subsidy while holding fixed the subsidy's relationship with income (column 1), only 4.19 percent of families with young children take up the subsidy. This small expansion in uptake is due the decreasing subsidy intensity as a function of income which remains unchanged from the baseline in this experiment. The fixed cost is too large to be offset by the value of the subsidy for higher-income families that are newly eligible in this counterfactual. Alternatively, if one eliminates the subsidy's relationship with income by setting it a flat rate equal to the average value in the data, while leaving the income threshold unchanged (column 2), spending increases by more because uptake of the CCDF rises to 8.98 percent. Combining these two changes (column 3) raises uptake to 64.8 percent, because the increased generosity of the subsidy at higher, newly eligible income levels incentivizes uptake. However, low-income families who were always eligible still face a substantial barrier to childcare subsidy uptake, and now pay higher taxes (as do older consumers), making welfare gains averaged across household types ($\overline{CE}_2$) negative.

Table C.4: Alternative CCDF policy margins

Comparison across steady-states			**$\triangle$ with new CCDF policy:**		
Category	**Variable**	**Baseline**	**(1) $\Theta_{y,n}$**	**(2) $\beta_{0,n}$**	**(3) Both**
Panel A: Program size, tax rate	CTC (% Y)	0.3	0	-0.01	-0.02
$\triangle$ units: percentage point change	CCDF (% Y)	0.08	0.01	0.18	2.18
	CTC + CCDF (% Y)	0.38	0.01	0.17	2.16
	Inc. tax rate (at ave. inc. initial ss)	9.06	0	0.03	1.54
Panel B: Agg. quantities	Quality time (parents only)	0.09	0.01	-0.52	-4.72
$\triangle$ units: percent change	Non-parental cc (parents only)	0.31	0.41	7.47	86.63
	Consumption	1.41	0.09	1.01	4.67
	Leisure	0.66	0	0	-0.01
	Labor supply	0.33	0	0.02	0.17
	Output	1.67	0.11	1.24	7.49
Panel C: Welfare changes	CE_1		0.06	0.81	4.74
$\triangle$ units: percent change	$\overline{CE}_2$		-0.01	0.01	-0.44

Notes: Table C.4 reports changes in aggregate quantities and welfare predicted by the model after changing three changes to the baseline CCDF policy. Column (1) shows the effect of eliminating the income threshold so that all working families are eligible ("$\Theta_{y,n}$"); column (2) shows the effects of eliminating the means-testing for subsidy intensity and setting the flat subsidy equal to its average value, $\beta_{0,n} = 0.81$, ("β_0");; column (3) shows the effects of combining the changes of both (1) and (2)' ("Both').

C.4 Alternative CCDF expansions: spending-equivalent to 2018 CTC

To see the relative potential of more traditional policy margins for expansions of the CCDF, in Table C.5 we compare the effects of the 2018 CTC expansion (column 1) with those of a subsidy to the fixed cost of CCDF uptake that is spending-equivalent (column 2) or an spending-equivalent expansion of the CCDF that uses a more traditional policy margin (column 3). Specifically, in column (3) we make the subsidy intensity upon receipt independent of income and recalibrate the level $\beta_{0,n}$ until spending reaches the desired level. No other changes are made to the CCDF policy in the economy of column (3).

We select the margin used in column (3) of Table C.5 using the following reasoning. As discussed in Appendix C.3, eliminating the income threshold for eligibility or setting the subsidy level to a flat rate equal to its average value have comparatively little effect. As is evident from the results presented in Appendix C.3, doing both of these changes at the same time increases spending by too much for the exercise at hand. In experiments not reported here, we establish that if the income eligiblity threshold is eliminated, re-calibrating the flat subsidy rate to match the increase in spending due to the 2018 CTC expansion yields $CE_1 = 1.09$ and $\overline{CE}_2 = -0.54$. Using this result in column (3) would artificially depracate traditional margins for CCDF expansion. This leads us to focus on reducing the magnitude of $\beta_{0,n}$ setting $\beta_{1,n}$ to 0, or reducing the magnitude of $\beta_{1,n}$ holding $\beta_{0,n}$ at its baseline value (in both cases holding the income eligibility threshold fixed). In Table C.5 we present the effects of recalibrating $\beta_{0,n}$; it is almost equivalent to instead recalibrate the value of $\beta_{1,n}$ to target the same moment as long as the income eligibility upper bound is left unchanged from its baseline value.

As shown in Panel C, a traditional method for expanding the CCDF yields welfare gains which compare more ambiguously with the 2018 CTC expansion, in contrast to a CCDF expansion financed by a fixed-cost subsidy. Specifically, the welfare gains measured behind the veil of ignorance (CE_1) still exceed those of the CTC expansion, but averaging type-specific gains across households ($\overline{CE}_2$) yields comparatively smaller gains (Panel C, column 3).

Table C.5: Alternative CCDF Expansions: Spending-Equivalent to 2018 CTC

Comparison across steady-states			**△ after CTC exp.:**	**△ after CCDF exp.:**	
Category	**Variable**	**Baseline**	**(1) 2018**	**(2) τ_ξ**	**(3) Trad.**
Panel A: Program size, tax rate	CTC (% Y)	0.3	0.75	0.04	0.04
△ units: percentage point change	CCDF (% Y)	0.08	0.07	0.78	0.78
	CTC + CCDF (% Y)	0.38	0.81	0.81	0.81
	Inc. tax rate (at ave. inc. initial ss)	9.06	0.89	0.52	0.55
Panel B: Agg. quantities	Quality time (parents only)	0.09	-0.59	-0.50	-1.48
△ units: percent change	Non-parental cc (parents only)	0.31	3.26	25.50	34.30
	Consumption	1.41	-0.09	4.00	3.38
	Leisure	0.66	0.27	0.26	0.19
	Labor supply	0.33	-0.52	-0.51	-0.33
	Output	1.67	0.03	4.89	4.34
Panel C: Welfare changes	CE_1		1.66	6.80	4.75
△ units: percent change	$\overline{CE}_2$		1.09	1.73	0.85

Notes: Table C.5 reports changes in aggregate quantities and welfare predicted by the model after (1) the 2018 CTC expansion, (2) - (3) two alternative policy changes to the CCDF that have the same spending as the 2018 CTC expansion.

C.5 Breakdown of policy margins in the 2018 Child Tax Credit expansion

The 2018 expansion of the Child Tax Credit involved modifications of more than the level of the credit: the eligibility threshold and phaseout threshold in income also changed. In the main text we compare an full subsidy of the fixed cost of childcare subsidy uptake with a spending-equivalent increase in the child tax credit level. We changed only the tax credit level for that exercise because the range of its effect on government spending is wider than an expansion in the range of income levels eligible for the CTC—at some point spending no longer increases as the income range that defines eligibility widens.

For the 2018 CTC expansion, one may wonder how much of the aggregate impact of the policy is driven by each component of the change. Table C.6 aims to shed light on this question, by isolating the effect of the rise in the credit level ($\overline{\kappa}$ in the table), the decrease in the income refundability threshold ($\underline{y}$ in the table), and the phasehout income threshold ($\overline{y}$ in the table). The stylized notation is a slight shift from the main text, but it allows all the counterfactuals to be presented in the same table. In column (1), the table shows steady-state changes for the full policy change. Columns (2) through (4) reflect changes when one component at a time of the reform is held fixed at its baseline value. The effect this has on changes in quantities is proportional to the role of that component in generating the full effect of the policy change. Another way to see this is to shift one component at a time to its new value, as shown in column (5) through (7).

The results in Table C.6 indicate that the increase in the phaseout threshold and the rise in the credit level together drive almost all of the impact of the reform. Although the increase in the phaseout threshold is not how we expand the CTC in Section 6.1 of the main text, it does play a major role in driving welfare gains from the 2018 CTC expansion. Incorporating this threshold in the model's representation of the Child Tax Credit is therefore useful because it allows us to incorporate the effect of a policy change along this margin.

Another takeaway of the results from these exercises is that raising the income threshold without changing the the other two instruments yields an increase in output via an expansion in the stock of skill (column 7). This occurs because removing the upper bound on income for eligibility removes a distortion on labor supply; households can now raise labor hours and still be eligible for the CTC. This contrasts with the dampening effect on output due to a rise in the credit level (column 5), which raises tax rates while also making the labor supply margin worse. The opposing forces of these two margins on output almost cancel out in the full CTC expansion, as shown in column (1). Welfare gains from raising the credit level and expanding the income phaseout threshold correspondingly stem from different sources: the former raises leisure while the latter raises consumption. They also have opposite effects on labor supply (raising the credit level lowers labor supply). The two changes together tend to raise leisure and lower consumption, while lowering labor supply, so that in this respect the rise in the credit level dominates.

Table C.6: Breakdown of policy changes in the 2018 Child Tax Credit expansion

Comparison across steady-states			**△ after holding fixed:**			**△ after changing only:**		
Category	**Variable**	**(1) Full**	**(2) $\overline{\kappa}$**	**(3) $\underline{y}$**	**(4) $\overline{y}$**	**(5) $\overline{\kappa}$**	**(6) $\underline{y}$**	**(7) $\overline{y}$**
Panel A: Program size, tax rate	CTC (% Y)	0.75	0.25	0.75	0.30	0.30	0	0.25
△ units: percentage point change	CCDF (% Y)	0.07	0.06	0.07	0	0	0	0.06
	CTC + CCDF (% Y)	0.81	0.31	0.81	0.30	0.30	0	0.31
	Inc. tax rate (at ave. inc. initial ss)	0.89	0.28	0.90	0.38	0.38	0	0.28
Panel B: Agg. quantities	Quality time (parents only)	-0.59	-0.12	-0.67	-0.46	-0.46	0	-0.12
△ units: percent change	Non-parental cc (parents only)	3.26	2.66	3.23	-0.56	-0.56	0	2.66
	Consumption	-0.09	0.80	-0.12	-0.76	-0.76	0	0.81
	Leisure	0.27	-0.02	0.25	0.26	0.25	0.02	-0.04
	Labor supply	-0.52	0.05	-0.47	-0.51	-0.48	-0.03	0.08
	Output	0.03	0.89	0	-0.76	-0.75	0	0.89
Panel C: Welfare changes	CE_1	1.66	1.09	1.60	0.27	0.25	0.01	1.06
△ units: percent change	$\overline{CE}_2$	1.09	0.55	1.06	0.46	0.45	0.01	0.54

Notes: Table C.6 reports changes in aggregate quantities and welfare predicted by the model after the 2018 expansion of the CTC (column 1) and policies where the credit level $\overline{\kappa}$, eligibility income treshold $\underline{y}$, and phaseout income threshold $\overline{y}$ are held fixed at their baseline value as the others are changed to their 2018 values (columns 2, 3, and 4), or each is changed to its 2018 value holding the other margins fixed (columns 5, 6, and 7 for the three margins, respectively).

D Measuring Welfare

All of the analytic expressions for consumption equivalent welfare changes impose that the utility function is $u(c,\ell) = (1-\psi)\ln(c) + \psi\ln(\ell)$. Also recall that

$$z_j \equiv \begin{cases} (\theta_a, \theta_k) & \text{if } j = j_a + 1 \\ \theta_a & \text{otherwise} \end{cases}$$

where θ_a is the adult skill endowment and θ_k is the child's initial skill endowment.

Notation Define additional notation used in this appendix as follows.

- Let $V_j^{eq}(z_j)$ denote the value function for type z_j at age j in equilibrium eq.
- Let $x_j^{eq}(z_j)$ be the policy function of type z_j for choice variable x at age j in equilibrium eq.
- Let $V_k^{a,eq}(\theta_k^{a,eq}(\theta_a,\theta_k))$ be the expected lifetime utility in equilbrium eq evaluated at the policy choice of type $z_{j_a+1} = (\theta_a,\theta_k)$ for child outcome in equilibrium eq.
- Let $V_j^{eq,t}(z_j)$ denote the value function for type z_j in period j of the lifecycle, at time t of

the transition from the baseline steady-state to equilibrium eq.

- Let X_{eq} as the aggregate value for quantity X in equilibrium eq.
- Let $\hat{x}_j^{eq}(z_j) \equiv \frac{X_{eq}}{X_{eq=0}} x_j^{eq=0}(z_j)$ for choice variables $x \in \{c, \ell\}$

D.1 Welfare changes across stationary steady-state equilibria

D.1.1 CE_1: Welfare change behind the veil of ignorance

Define

$$W_{eq} \equiv \int_{\theta_a, \theta_k} \left[V_{j_a+1}^{eq}(\theta_a, \theta_k)\right] \mu_a^{eq}(\theta_a) \mu_k^{eq}(\theta_k) \, d\theta_a d\theta_k$$

Then the consumption-equivalent welfare change behind the veil of ignorance of moving to equilibrium eq from equilibrium 0 is:

$$CE_1 \equiv \exp\left[\frac{W_{eq} - W_0}{(1-\lambda)\sum_{j=j_a+1}^{J} \beta^{j-j_a-1}}\right]$$

D.1.2 $CE_2(j, z_j)$: Welfare change given type z_j and age j

Define the type and age-specific consumption-equivalent welfare change of moving to equilibrium eq from equilibrium 0 as:

$$CE_2(j, z_j) \equiv \exp\left[\frac{V_j^{eq}(z_j) - V_j^0(z_j)}{(1-\lambda)\sum_{age=j}^{J} \beta^{age-j}}\right]$$

Note that the denominator incorporates the fact that the lifespan is shorter at older ages. Averaging over type-specific changes for new households yields:

$$\overline{CE}_2 \equiv \int_{z_{j_a+1}} CE_2(j_a+1, z_{j_a+1}) \, \Omega(j_a+1, z_{j_a+1}) \, dz_{j_a+1}$$

D.2 Welfare changes over the transition

The consumption equivalent welfare change for type z_j at period j of the lifecycle in time t of a transition from equilibrium 0 to equilibrium eq is:

$$CE_2^{TP}(j, z_j, t) \equiv \exp\left[\frac{V_j^{eq,t}(z_j) - V_j^{0,t}(z_j)}{(1-\lambda)\sum_{age=j}^{J} \beta^{age-j}}\right]$$

D.3 Decomposing welfare changes

Following Guvenen et al. (2023), construct two intermediate counterfactual value functions as follows:

$$\begin{aligned}
\hat{V}_j^{eq}(z_j) &= \sum_{age=j}^{J} \beta^{age-j}\left[(1-\lambda)\log\left(\frac{\hat{c}_j^{eq}(z_j)}{\Psi_j}\right)+\lambda\log\left(\hat{\ell}_j^{eq}(z_j)\right)\right] \\
&\quad +\mathbb{I}_{j=j_a+1} b V_k^{a,eq=0}\left(\theta_k^{a,0}(z_j)\right) \\
&= \sum_{age=j}^{J} \beta^{age-j}\left[(1-\lambda)\log\left(\frac{C_{eq}}{C_0}\right)+\lambda\log\left(\frac{L_{eq}}{L_0}\right)\right]+V_{j_a+1}^{eq=0}(z_j) \\
\tilde{V}_j^{eq}(z_j) &= \sum_{age=j}^{J} \beta^{age-j}\left[(1-\lambda)\log\left(\frac{c_j^{eq}(z_j)}{\Psi_j}\right)+\lambda\log\left(\ell_j^{eq}(z_j)\right)\right] \\
&\quad +\mathbb{I}_{j=j_a+1} b V_k^{a,eq=0}\left(\theta_k^{a,0}(z_j)\right) \\
&= V_j^{eq}(z_j)+\mathbb{I}_{j=j_a+1} b\left[V_k^{a,eq=0}\left(\theta_k^{a,0}(z_j)\right)-V_k^{a,eq}\left(\theta_k^{a,eq}(z_j)\right)\right]
\end{aligned}$$

Also construct the expected lifetime utility of each of these intermediate counterfactuals:

$$\begin{aligned}
\hat{W}_{eq} &\equiv \int_{\theta_a,\theta_k}\left[\hat{V}_{j_a+1}^{eq}(\theta_a,\theta_k)\right]\mu_a^{eq=0}(\theta_a)\,\mu_k^{eq=0}(\theta_k)\,d\theta_a d\theta_k \\
\tilde{W}_{eq} &\equiv \int_{\theta_a,\theta_k}\left[\tilde{V}_{j_a+1}^{eq}(\theta_a,\theta_k)\right]\mu_a^{eq}(\theta_a)\,\mu_k^{eq}(\theta_k)\,d\theta_a d\theta_k
\end{aligned}$$

D.3.1 CE_1: Decomposing welfare change behind the veil of ignorance

Consider the welfare effects $CE_1$of moving from the baseline equilibrium $eq = 0$ to a new steady-state, eq. These welfare changes can be decomposed into three components:

- Welfare gains from level changes: $CE_1^L \equiv \exp\left[\frac{\hat{W}_{eq}-W_0}{(1-\lambda)\sum_{j=j_a+1}^{J}\beta^{j-j_a-1}}\right]$
- Welfare gains from distributional changes: $CE_1^D \equiv \exp\left[\frac{\tilde{W}_{eq}-\hat{W}_{eq}}{(1-\lambda)\sum_{j=j_a+1}^{J}\beta^{j-j_a-1}}\right]$
- Welfare gains from the altruism term: $CE_1^A \equiv \exp\left[\frac{W_{eq}-\tilde{W}_{eq}}{(1-\lambda)\sum_{j=j_a+1}^{J}\beta^{j-j_a-1}}\right]$

Then we can write $CE_1^L \times CE_1^D \times CE_1^A = \exp\left[\frac{W_{eq}-W_0}{(1-\lambda)\sum_{j=j_a+1}^{J}\beta^{j-j_a-1}}\right] \equiv CE_1$.

D.3.2 $\overline{CE}_2$: Decomposing welfare changes of new households averaged across types

Consider the welfare effects $CE_2\left(j, z_j\right)$ of moving from the baseline equilibrium $eq = 0$ to a new steady-state, eq, for a consumer age j of type z_j. These type-specific welfare changes can be decomposed into three components:

- Welfare gains from level changes: $CE_2^L\left(j, z_j\right) \equiv \exp\left[\frac{\hat{V}_j^{eq}(z_j) - V_j^0(z_j)}{(1-\lambda)\sum_{age=j}^J \beta^{age-j}}\right]$
- Welfare gains from distributional changes: $CE_2^D\left(j, z_j\right) \equiv \exp\left[\frac{\tilde{V}_j^{eq}(z_j) - \hat{V}_k^{eq}(z_j)}{(1-\lambda)\sum_{age=j}^J \beta^{age-j}}\right]$
- Welfare gains from the altruism term: $CE_2^A\left(j, z_j\right) \equiv \exp\left[\frac{V_j^{eq}(z_j) - \tilde{V}_j^{eq}(z_j)}{(1-\lambda)\sum_{age=j}^J \beta^{age-j}}\right]$

We can then write $CE_2^L\left(j, z_j\right) \times CE_2^D\left(j, z_j\right) \times CE_2^A\left(j, z_j\right) = \exp\left[\frac{V_j^{eq}(z_j) - V_j^0(z_j)}{(1-\lambda)\sum_{age=j}^J \beta^{age-j}}\right] \equiv CE_2\left(j, z_j\right)$. The component of $\overline{CE}_2$ is constructed from type-specific changes by taking a weighted average using the endogenous distribution of adult skill in equilibrium eq.

D.3.3 Approximate additive separability of decomposition components

Consumption equivalent shifter CE_1 implies a percent change $\Delta = CE_1 - 1$. For the decomposition components, denote the percent change as Δ_x such that $CE_1^x = 1 + \Delta_x$. Then:

$$
\begin{aligned}
\log\left(CE_1^L \times CE_1^D \times CE_1^A\right) &= \log\left(CE_1\right) = \log\left(1+\Delta\right) \\
\log\left(CE_1^L \times CE_1^D \times CE_1^A\right) &= \log\left(CE_1^L\right) + \log\left(CE_1^D\right) + \log\left(CE_1^A\right) \\
\log\left(1+\Delta\right) &= \log\left(1+\Delta_L\right) + \log\left(1+\Delta_D\right) + \log\left(1+\Delta_A\right)
\end{aligned}
$$

and if Δ_x is small for each x then the standard log approximation for growth rates applies, so one can write the last line above as:

$$
\Delta \approx \Delta_L + \Delta_D + \Delta_A
$$

To conclude, although this decomposition is not strictly additive, it is approximately additive for small welfare changes. The approximation also holds for $CE_2\left(1, z_j\right)$.