Family Policies and Child Skill Accumulation*

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August 25, 2024

Abstract

We analyze the economic effects of two major family policies in the United States, the Child Tax Credit and the Child Care and Development Fund childcare subsidy, in an overlapping-generations framework where altruistic parents invest in their child's skill using their own time and purchased childcare time. The model incorporates differences in the design of these policies and endogenizes low rates of childcare subsidy receipt by including application costs and subsequent rationing. We compare the effects of a recent child tax credit expansion with a spending-equivalent expansion of the childcare subsidy implemented by reducing access frictions. Across steady states, the childcare subsidy expansion generates a larger increase in average adult skill, which leads to larger welfare gains behind the veil of ignorance compared to the tax credit expansion. However, the two policies yield similar average welfare gains for adults who know their own skill level, and the tax credit benefits a larger share of this group.

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

*We are grateful to the editor and three anonymous reviewers for their constructive comments. We also thank Orazio Attanasio, Adam Blandin, Katarina Borovickova, Mary Ann Bronson, Bettina Bruggemann, Michael Carter, Diego Daruich, Nezih Guner, Christopher Herrington, Zachary Mahone, Andrea Moro, Joseph Mullins, Sergio Ocampo Diaz, Gajendran Raveendranathan, Todd Schoellman, Nicolas Trachter, and Chao Wei for helpful comments, as well as seminar participants at McMaster University and conference participants at LA Macro (Greenville, SC), I-85 Workshop (Richmond, VA), National Tax Association (Denver, CO), Southern Economics Association (New Orleans, LA), Midwest Macro Association (Chicago, IL), and the Society for Economic Dynamics (Barcelona, Spain). Qiong Liu provided help with the Panel Study of Income Dynamics for an earlier version of this paper. All errors are ours.

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1 Introduction

Economists have long acknowledged that aid to families with children can bolster children's accumulation of skill and improve the child's labor market outcomes later in life (Leibowitz, 1974). Indeed, "family policies"—that is, government transfers whose receipt or intensity is tied to the presence of children—have been common across countries in recent decades (Kamerman, 2000; Olivetti and Petrongolo, 2017). In the United States, family policies may be implemented through the tax system or via a spending program. In the latter case, a bureau evaluates applicants and grants access to aid after determining eligibility; in practice, spending programs entail a frictional process of application and receipt, and few among the eligible receive aid (Sommartino, Toder, and Maag, 2002; Johnson, Martin, and Brooks-Gunn, 2011).

In this paper, we focus on two major US family policies: the Child Tax Credit (CTC/ACTC, hereafter CTC), a cash transfer which is targeted to middle-income families and implemented via the tax system, and the Child Care and Development Fund (CCDF), a childcare subsidy which is targeted to the poor and implemented via a spending program. In recent years, annual spending on the CTC is higher than spending on the CCDF: $51.4 billion versus $5.5 billion per year, or 0.27 percent versus 0.03 percent of output, respectively.[1] This difference in spending is due to differences in eligibility rules, transfer levels for recipients, and access frictions associated with the CCDF's implementation method such as application costs and waiting lists (Guzman, 2019). Starting from this policy baseline, we examine the tradeoffs of expanding one policy versus the other. The specifics of the CTC expansion are drawn from the 2017 Tax Cuts and Jobs Act (TCJA), while the CCDF expansion reduces the frictions associated with application and receipt for that program. The two expansions result in the same change in total government spending as a percent of output.

We embed representations of the CTC and CCDF into an overlapping-generations model. Early in adulthood, all consumers become parents who altruistically invest in their child's initial skill using their own time and purchased childcare time; the child's initial skill is a stochastic draw for the parent, and the model allows for intergenerational transmission of skill. The CTC is accessed frictionlessly by the eligible, consistent with its implementation via the tax system. We represent the spending program implementation method of the CCDF by introducing a stochastic application cost (necessary but not sufficient for receipt), as well as a subsequent rationing stage in which an eligible applicant may be denied access to aid (e.g., never moving off a waiting list). The CCDF application cost, rationing outcome, and child initial skill endowment are realized in the first period of adulthood and are the only source of risk for adults. Consumers subsequently solve

[1] Statistics are in 2016 USD and computed as described in Appendix A.1. The cited CCDF spending is for children under 5.

a full life cycle problem that includes a retirement phase, during which they collect pensions from Social Security (SS) which are taxed. They cannot save, borrow, or make financial transfers to their children; there is no earnings risk; and the return per unit of skill in the labor market (the wage rate) is fixed. The government collects revenue via a flat consumption tax and a progressive labor income tax; the average income tax adjusts to balance the government's budget constraint in equilibrium. In the model, the income tax system represents federal taxes excluding the CTC and the Earned Income Tax Credit (EITC), which are instead modeled as distinct components of disposable income along with the cash benefit component of Temporary Aid for Needy Families (TANF).

Our main experiments compare the expansion of the CTC with that of the CCDF using three measures of welfare changes: first, behind the veil of ignorance at the start of adulthood; second, average changes for new adults conditional on adult skill; and, third, average changes for all adult ages conditional on adult skill. Across steady states, the CCDF expansion generates welfare gains behind the veil of ignorance that are larger than those of the CTC expansion (8.3 versus 2.5 percent of lifetime consumption, respectively). This is due to a larger increase in average adult skill from the CCDF compared to the CTC (6.9 versus less than 0.5 percent, respectively); for both policies, skill inequality also increases because lower percentiles of the skill distribution see relatively smaller gains. Despite the CCDF expansion generating larger increases in average adult skill, the average welfare change for new adults is similar for the CTC and CCDF (1.9 versus 2.1 percent, respectively) in part because the CCDF benefits a smaller share of adults. Average welfare changes for all adults are lower than for new adults, and exhibit small losses after the CTC expansion (-0.2 percent) with net effects of about zero after the CCDF expansion. This occurs because the labor income tax must rise after both expansions to balance the government's budget, which causes welfare losses among older consumers.

Welfare gains from expanding family policies are possible in our model for multiple reasons. For example, children cannot encourage their parent to spend more on skill investment by committing to reimburse these expenses later in life, and adults face life cycle borrowing constraints that prevent them from borrowing against future income to finance consumption when young. There is also some uninsurable risk for adults, which stems from stochastic CCDF application costs and child initial skill endowments, as well as CCDF rationing. The government can approximate some of the missing private markets through the tax and transfer system: for example, the CTC increases disposable income for young adults and taxes the income of all adults, shifting resources to earlier ages and addressing life cycle borrowing constraints. Of course, this cash transfer can also be spent on investment in child skill. As for the CCDF, this policy encourages spending on investment in child skill by lowering the expense of a given level of investment for recipients while taxing the income of all adults to recoup the costs; this addresses the inability of children to commit to repay their parents in order to motivate higher skill investment. At the same time, family resources freed up by the childcare subsidy can also be spent on parent consumption or to finance greater leisure when young. Hence, there is conceptual overlap across policies in terms of the missing market they address, which motivates our welfare decomposition exercise.

We offer insight into the market failures each family policy expansion addresses by implementing a decomposition of welfare gains behind the veil of ignorance that builds on the method of Guvenen, Kambourov, Kuruscu, Ocampo, and Chen (2023). Our decomposition identifies marginal contributions from four components: (i) changes in consumption age profiles; (ii) changes in average child skill outcomes; (iii) changes in average levels of consumption and non-leisure time; (iv) remaining adjustments. Benefits from the CTC expansion stem from redistribution of consumption towards earlier ages (component i), and from changes in the distribution of consumer types and changes in the expected returns to child skill outcomes (component iv).[2] By contrast, benefits from the CCDF expansion are driven by changes in the average levels of consumption and non-leisure time, which are possible because of large increases in average adult skill (component iii). Changes in average child skill outcomes (component ii) contribute positively to welfare gains from both expansions through their effect on the altruism term of parents, but more so for the CCDF. Our results lead us to view the CTC (to a greater extent than the CCDF) as addressing life cycle borrowing constraints by redistributing consumption to earlier ages, while we view the CCDF (to a greater extent than the CTC) as addressing the inability of children and adults to contract with one another in order to promote investment in child skill.

Two studies closely related to ours are Guner, Kaygusuz, and Ventura (2020) and Zhou (2022).[3] Guner et al. (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, their analysis accounts for the skill accumulation of parents rather than children. We focus instead on how policies interact with 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

[2]Parental altruism in our model means that parents internalize the expected lifetime utility of their child at the child skill outcome they finance with investment. This object can increase because the child's skill outcome increases (component ii) or because expected lifetime utility goes up at a given level of adult skill (component iv). Although changes in the distribution of quantities across consumers are also present in component (iv) they do not play a large role in this component's contribution towards CTC welfare gains.

[3]Other structural studies of childcare subsidies which allow for endogenous skill accumulation of children include Bastani, Blomquist, and Micheletto (2020), Ho and Pavoni (2020), and Daruich (2023). The first two perform a Mirrleesian analysis of optimal childcare subsidies; the former focuses on childcare quality choices, whereas the latter focuses on parental labor supply. The third study focuses on scaling up early childhood interventions such as Head Start rather than analyzing tax credits. Our discussion of missing markets in this paper draws on the analysis of Daruich (2023).

determinant of their skill accumulation early in life. In this respect we also differ from Zhou (2022), who examines aggregate fertility responses to stylized family policies. Because of our interest in comparing specific policy reforms in the United States, we explicitly model attributes of the CTC that make it a transfer whose level is hump-shaped in household income (Crandall-Hollick, 2018). These attributes are relevant for our policy analysis because changes along these margins are part of the TCJA expansion of the CTC that we simulate in our main policy experiments. Importantly, we also differ from both Guner et al. (2020) and Zhou (2022) in that we incorporate access frictions for subsidized childcare, making explicit an additional distinction between the CTC and CCDF: their implementation via the tax system versus a spending program, respectively.

This paper builds on Moschini (2023) by broadening the set of family policies under consideration to include a child tax credit as found in the US tax code, by partially endogenizing childcare subsidy receipt, by providing a welfare decomposition to aid in identifying and interpreting sources of welfare gains, and (in a supplemental exercise) by examining the transition path dynamics after each policy change. We abstract from heterogeneity in family structure; instead, our focus is on comparing spending-equivalent expansions of two existing policies, rather than comparing expansions of the same policy targeted towards one- versus two-parent families.

For tractability and interpretive clarity our model makes several simplifying assumptions, some of which may impact our results. For example, as noted earlier, in our model framework consumers cannot save, borrow, or make financial transfers to their children, there is no earnings risk, and the return to skill on the labor market is always the same. We discuss the possible impact of relaxing these assumptions in the conclusion.

The paper proceeds as follows. Section 2 overviews the policy environment, Section 3 describes the model, and Section 4 reports model parameterization. Section 5 examines properties of the baseline equilibrium, and Section 6 presents the model experiments and results. Section 7 concludes and suggests directions for future research.

2 The Policy Environment

This section describes the design, implementation method, and size of the CTC and the CCDF. For each policy, the distributions of spending and recipients for households with children under 5 are presented and discussed. Statistics quoted here are computed as explained in Appendix A.1.

The Child Tax Credit The CTC is a partially-refundable federal tax credit, introduced in 1997 and subsequently expanded in 2001, 2010, 2017, and 2021 (Steuerle, 1990; Crandall-Hollick, 2018, 2021; Goldin and Michelmore, 2022). A tax credit assigns a credit value that depends on taxpayer attributes, such as pretax income or the presence of children; the credit value is then subtracted from the tax liability. If the value of the credit exceeds the tax liability, then a refundable credit rebates at least some of the residual amount to the taxpayer, while a nonrefundable credit does not. Refundable credits may be either fully refundable, so that all of the residual amount is given to the taxpayer, or partially refundable, so that only a portion of the residual is rebated. Altogether, tax credits weakly increase disposable income and are similar to cash transfers. In practice, nonrefundable credits are limited in their ability to deliver transfers to the poor because they are bounded above by tax liabilities (which are low for poor taxpayers under progressive taxation), while fully refundable credits are more effective (Goldin and Michelmore, 2022). Partially refundable credits such as the CTC represent an intermediate case in this regard.[4]

The total CTC per qualifying child in the taxpayer household is the sum of a nonrefundable and a refundable component.[5] To be eligible for any credit, the taxpayer must have at least one dependent child under the age of 17, and taxable income must be within a certain range. As taxable income increases, the total CTC at first increases and then eventually decreases, making it a hump-shaped function of income (Crandall-Hollick, 2018).

The CTC is implemented through the tax system: receipt 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 and receive the refundable portion of the credit in cash; more than 90 percent of the eligible are estimated to receive CTC transfers (Crandall-Hollick, 2018). Over the 2015-2017 period, an average of $51.4 billion, or 0.27 percent of Gross Domestic Product (GDP), was spent on the nonrefundable and refundable components of the CTC combined, and an average 15 percent of tax filers received transfers from the policy (Internal Revenue Service of the United States, Statistics of Income, 2023a,b).

The Child Care and Development Fund The CCDF seeks to help working parents with child-care expenses; it began in its current form when the Personal Responsibility and Work Opportunity Reconciliation Act of 1996 consolidated four programs into one (Lynch, 2022).[6] The CCDF gives

[4] The CTC is similar to the better-studied Earned Income Tax Credit (EITC) in that the level of the credit is affected by the presence of children (Marr, Huang, Sherman, and DeBot, 2015). The EITC is several decades older than the CTC; the EITC credit level is related to the presence of children in that a much-reduced EITC is available for low-income households without children. Unlike the CTC, the EITC is fully refundable and begins to phase out at lower values of income than the CTC (Crandall-Hollick, 2018; Crandall-Hollick et al., 2021). Because of its attributes the EITC is received by lower-income families than the CTC.

[5] In US government reports, the nonrefundable component of the tax credit for children is called the "CTC", while the refundable component is referred to as the Additional Child Tax Credit, or "ACTC". In this paper we refer to the sum of these two components as the (total) CTC.

[6] The rules governing how funding is spent were initially authorized until 2020, after which they have been re-authorized annually by Congress. As for funding, temporary extensions in funding continued from 1996 until 2021, when the American Rescue Plan Act provided permanent annual appropriations.

block grants from the federal government to states; states then use these funds to subsidize child-care expenses for households with children under 13 years of age, although most children receiving the subsidy are under 5 (Chien, 2019a,b, 2020). To qualify to be paid with CCDF funds, childcare providers must meet certain criteria that are intended to keep provider quality comparable to the market average.

Conditional on receipt, the level of the CCDF transfer is the difference between total childcare expenses and the amount contributed by the recipient family (their "copayment", which is increasing in income); thus, the transfer level is decreasing in income and increasing in the quantity of childcare used. Eligibility is set at the state level and must be at least as stringent as federal guidelines, which require that households must contain young children, adults must work or engage in an approved work-related activity, and income must be at or below 85 percent of the state median income for households of a similar size and composition. Most states set a lower income cutoff than the federal guidelines (Chien, 2019a,b, 2020).

The CCDF is implemented via a spending program: to establish eligibility, applicants must contact a social services agency, provide documentation of their work-related activity and income level, and complete an interview with a social worker. Some eligible applicants never receive aid. Therefore, the aggregate amount of CCDF spending and mass of recipients reflects the combined effect of eligibility rules, application rates below 100 percent among the eligible, and rationing conditional on applying (e.g., never moving off of waiting lists). Among the eligible, previous studies have found that those with higher educational attainment (or higher resources) or who face lower application costs are more likely to apply; an estimated 16 percent of eligible applicants do not receive aid, and in practice this rationing outcome is largely uncorrelated with applicant characteristics (Johnson et al., 2011; Guzman, 2019). On an annual basis over the 2015-2017 period, CCDF spending on children under 5 (the majority of CCDF recipients) averaged \$5.5 billion or 0.03 percent of GDP (Chien, 2019a,b, 2020). Rates of receipt among the eligible are lower than the CTC: estimates indicate that between 10 and 23 percent receive aid.[7] Altogether, about 4 percent of all children under 5 received aid from the CCDF.

Implementation methods and recent policy trends Compared to using the tax system, a spending program introduces more frictions in the process of application and receipt ("access frictions"); the properties of these alternative implementation methods are well-documented, and selecting one

[7]Together, rationing and application rates of less than 100 percent result in a low rate of aid receipt among the CCDF eligibile (the CCDF is not an entitlement, so this pattern is consistent with its mandate). For example, government reports estimate that 15 percent of federally eligible children, or 23 percent of state-eligible children, receive the CCDF (Chien, 2019a,b, 2020). In these reports, eligibility is determined using realized income. An alternative is to define the eligible using potential earnings at some fixed level of labor supply. Using this approach, Guzman (2019) estimates that share of eligible families receiving CCDF aid is around 10 percent.

or the other is a policy design choice (Steuerle, 1990; Sommartino et al., 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. A case in point of this legislative trend is the 2017 Tax Cuts and Jobs Act, which expanded the CTC.

The distribution of CTC and CCDF spending and recipients Our focus is on how transfers from the CTC and CCDF interact with child skill accumulation during early childhood, when the child is under age 5. For households with children in this age range, we compute the distribution over income quartiles of spending and recipients for the CTC and CCDF. We pool 2015, 2016, and 2017 waves from the Annual Socio-economic Supplement of the Current Population Survey or CPS ASEC (Flood et al., 2024) for data on the CTC, and use CCDF Administrative Data for the 2016 fiscal year for data on the CCDF. Quartile thresholds are estimated using the distribution of income in the CPS ASEC sample of households with children under 5. For further details, see Appendixes A.1.2 and A.1.3.

Figure 1 displays the distribution of spending (left) and recipients (right) for the CTC and the CCDF (in green and pink, respectively). CTC spending and recipients are concentrated in the two middle income quartiles, while CCDF spending and recipients are concentrated in the first two quartiles. These patterns reflect that the CTC is more generous towards taxpayes with higher tax liabilities and income below an upper bound (second and third quartiles), while the CCDF offers a subsidy for childcare expenses to applicants with income below an upper bound (first and second quartiles).[8] Note that the CCDF's frictional implementation method also affects the realized distribution of transfers and recipients for this policy.

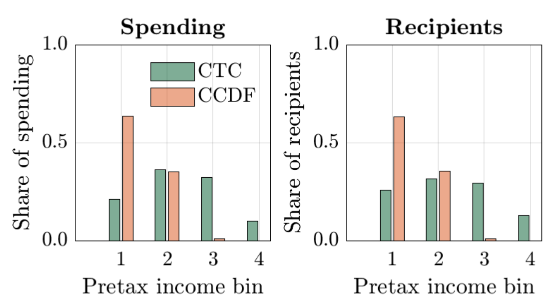


Figure 1: CTC and CCDF distribution of spending and recipients

Notes: Figure 1 reports the discretized distribution of total spending (left) and recipients (right) by pretax income quartile. For both panels the CTC is in green and the CCDF is in pink. Quartile thresholds are estimated using income of households with children under 5 from the CPS ASEC. Source: CPS ASEC and CCDF administrative data.

In the next section, we specify a model that embeds representations of the CTC and CCDF, as well

[8]The a small share of CCDF spending that goes to the third quartile is likely due to variations across states in the type of income that counts for eligibility.

as the EITC, TANF, and SS pensions.

3 The Model Environment

The model contains four types of agents: heterogeneous consumers organized into families, the government, a final goods producer, and a childcare provider.

Consumers solve a life cycle problem as illustrated in Figure 2. Time is discrete with five-year periods and runs forever; consumers live for 75 years and experience 11 periods of adulthood starting at age $j = 1$ when they are 20 years old, prior to which they are a child. Only adults (not children) make decisions. Each consumer becomes the parent of one child at $j = 1$; ages 1 to 4 are the "parenthood" phase, ages 5 to 9 are the "empty nester" phase, and ages 10 and 11 are the "retirement" phase. The first period of adulthood is a special part of the parenthood phase, the "investment" phase, in which parents invest in their child's skill while their child is under 5 years old.

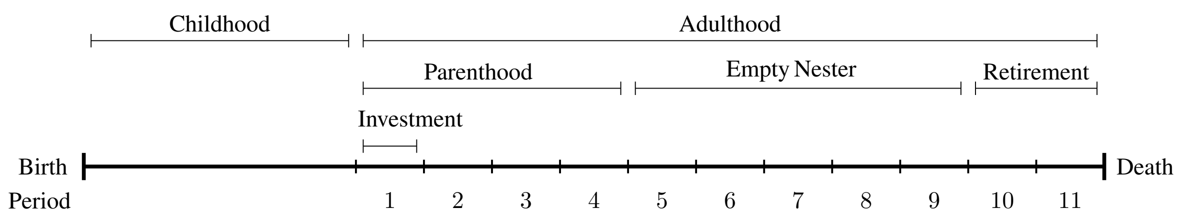


Figure 2: Phases of the consumer's life cycle

Adults choose how much to spend on consumption and, before the retirement phase, how many hours of labor to supply. In the first period of adulthood consumers additionally choose whether to apply for access to a childcare subsidy (the CCDF); application is costly and yields uncertain benefits. They also choose how much to invest in their child's skill using their own time and non-parental childcare time purchased on the market. Skill investment, together with the child's skill endowment, determines the skill level with which the child later begins adulthood. The way investment affects skill is governed by childhood skill accumulation technologies, which parents take as given. Parents are willing to finance costly skill investment expenses because they internalize the effect that skill has on their child's expected lifetime utility in an imperfectly altruistic way. In this model, consumers may not choose to save or borrow, and they cannot make contracts with their children.

At the start of adulthood, consumers are indexed by their adult skill θ_a. The distribution of adult skill at age $j = 1$, $\mu(\theta_a)$, is endogenous in the sense that it incorporates the skill investment decisions of parents. After the first period of adulthood, skill grows exogenously so that at each age j it is given by the function $\tilde{\theta}(j, \theta_a)$. At each age of adulthood consumers may differ in their own skill level, but when deciding how much to invest in their child's skill there is additional heterogeneity among adults: adults at age $j = 1$ are also indexed by their child's initial skill endowment, θ_k (mnemonic: $k =$"kid"), their cost of applying for the CCDF, ξ, their application decision, $\delta \in \{0, 1\}$, and whether or not they are offerred the CCDF, $R \in \{0, 1\}$.

During adulthood, consumers may receive transfers from the government which depend on their age (thereby reflecting the presence of children, and whether or not they are retired), whether or not their work, and their level of pretax income (which is entirely made up of earnings). These transfers are allocated by a set of four family policies (the CTC, CCDF, EITC, and TANF) as well as SS pensions; each of the five transfer policies is associated with a vector of policy parameters ($\vec{\pi}_C, \vec{\pi}_N, \vec{\pi}_E, \vec{\pi}_T$, and $\vec{\pi}_P$, respectively). Besides these transfer programs, the government also finances government consumption, set as an exogenous share Θ_G of output. Revenue to finance this spending is raised via a flat consumption tax, τ_c, and a progressive income tax. The income tax collects revenue from pretax income, y, according to $y - \lambda_y y^{1-\tau_y}$, with fixed degree of progressivity given by τ_y that represents the effect of taxes apart from refundable credits. The government adjusts the average income tax, λ_y, to balance its budget. The summary vector $\vec{\pi}_G$ collects all fixed government policy parameters as well as λ_y.

The CCDF is unique among the model's five transfer policies because it is implemented via a spending program, as reflected by two frictions that are encountered in an ordered way during the application process. First, consumers must pay a stochastic cost to apply which does not contribute to government revenue. Second, there is a subsequent rationing stage where applicants may be denied the CCDF with some probability (which is the same for everyone). All other transfer policies are frictionless. The CCDF is also unique among transfer policies in this model in that it is a form of "transfer in kind", in the sense that it is intended to lower the cost of a specific type of expenditure for the consumer, whereas all the other transfers are in cash.

The final goods producer uses a linear production technology that takes efficiency units of labor, H, as its sole input: $Y = H$. The wage rate per efficiency unit of labor supply is therefore equal to 1 and left out of expressions for wages and earnings; in this sense, this model is in partial equilibrium with respect to the wage rate.

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 aged $j = 1$, so that $p = \phi \int_{\theta_a} \theta_a \mu(\theta_a) \, d\theta_a$. This is the only childcare provider in the economy; subsidized childcare and unsubsidized childcare have the same productivity and pre-subsidy price.

The remainder of this section provides more details about the model: Consumer value functions are described in Section 3.1, Section 3.2 describes government transfer policies, and Section 3.3 defines the stationary steady state equilibrium.

3.1 Consumer life cycle problems

3.1.1 The first period of adulthood ($j = 1$)

Each consumer begins adulthood taking their adult skill level θ_a as given. The first period of adulthood is divided into two stages: in stage 1, consumers choose whether or not to apply for the CCDF before they know their rationing outcome or their child's initial skill endowment; in stage 2, the consumer draws their rationing outcome and their child's initial skill, and solves their constrained optimization problem for the investment phase.

Stage 1: Given θ_a, the expected lifetime utility at the start of stage 1 takes an unconditional expectation with respect to ξ, their cost of applying for the CCDF:

$$V_1(\theta_a) = \mathbb{E}_\xi\left[\tilde{V}(\theta_a, \xi)\right] \tag{1}$$

Next, the consumer draws ξ from a log-normal distribution that is the same for all consumers: $\log(\xi) \sim \mathbb{N}\left(\mu_\xi, \sigma_\xi^2\right)$. Given $\{\theta_a, \xi\}$, the consumer makes the CCDF application decision $\delta \in \{0, 1\}$ by maximizing the expected value in stage 2:

$$\tilde{V}(\theta_a, \xi) = \max_{\delta \in \{0,1\}} \{\mathbb{E}_{R,\theta_k}[V(j, \theta_a, \xi, \delta, R, \theta_k)]\} \tag{2}$$

Here, the consumer internalizes that at the start of stage 2 the CCDF rationing outcome R is equal to 1 with probability ϕ_n and zero otherwise, where $R = 1$ indicates a that an applicant is granted access to the CCDF. The child's initial skill endowment, θ_k, is drawn from a conditional log-normal distribution where the conditional mean depends on parent skill: $\log(\theta_k) \sim \mathbb{N}\left(\mu_k + \rho_k\left(\theta_a - \overline{\theta}_a\right), \sigma_k^2\right)$, where $\overline{\theta}_a = \int_{\theta_a} \theta_a \mu(\theta_a)\, d\theta_a$.

The outcome of R and θ_k affect the value of applying for the CCDF: if $\delta = 1$ but $R = 0$, then the application cost was incurred with no benefit, whereas if $\delta = 1$ and $R = 1$, then the CCDF will lower the costs of investment and free up resources for consumption at a given level of investment and labor supply (assuming labor supply is chosen to maintain eligibility). At the same time, if $\delta = 0$, then the value of R has no impact on the consumer.

Stage 2: At the start of stage 2, the consumer draws R and θ_k. Given $\{\theta_a, \xi, \delta, R, \theta_k\}$, consumers solve the investment problem by choosing a level of household consumption, c, labor supply, ℓ, non-parental childcare time, n, and parent quality time with their child, q:

$$\begin{aligned} V(j,\theta_a,\xi,\delta,R,\theta_k) &= \max_{c,\ell,n,q\geq 0}\ \ln\left(\frac{c}{\Lambda_j}\right)-\psi\frac{(\ell+q)^{1+\frac{1}{\omega}}}{1+\frac{1}{\omega}}+bV_k(\theta_k^a)+\beta V(j+1,\theta_a) \quad (3)\\ s.t. & \\ (1+\tau_c)c+pn+\delta\xi &\leq y_d(y\mid j,\theta_a,\vec{\pi}_G)+\delta CCDF(y,n\mid j,\xi,R,p,\vec{\pi}_N)\\ y &= \theta_a\ell\\ \theta_k^a &= f_s(n,q\mid\theta_a,\theta_k) \end{aligned}$$

where $q+n\leq 1$ and $q+\ell\leq 1$. Here, and in each subsequent period before retirement, labor is restricted to a discrete set of choices, $\ell\in\{\ell_i\}_i$, where each element is between 0 and 1. The age $j=1$ consumer cares about their own utility, their child's skill outcome, and their own continuation value. For a given level of labor supply, the consumer spends their resources on consumption (which is taxed, and shared with their child according to the equivalence scale Λ_j), childcare expenses, and their CCDF application cost (if $\delta=1$). Disposable income, $y_d(y\mid j,\theta_a,\vec{\pi}_G)$, represents the net effect of income taxes as well as the CTC, EITC, and TANF on pretax income; its specific form is provided in equation (9) of Section 3.2. Pretax income y is determined by adult skill and labor supply. In a way that depends on their pretax income (and embeds a working requirement) a CCDF applicant may also be partially reimbursed for childcare expenses from the CCDF if $R=1$. Finally, the technology $f_s(n,q\mid\theta_a,\theta_k)$ governs how investment inputs chosen by the parent combine with the child's initial skill endowment to generate the child's skill level as an adult. We discuss this function and its role in consumer optimization next.

The skill investment decision: costs, benefits, and technology When choosing how much to invest in their child's skill in stage 2 of period 1, parents proceed in two steps. First, they minimize the cost of achieving each feasible skill outcome θ_k^a. Cost minimization weighs the relative prices and productivities of n and q given their type θ_a and the market's productivity of purchased childcare, θ_n; for a family type, it establishes the cheapest combination of n and q to achieve θ_k^a. Second, parents choose the optimal child skill outcome to balance the marginal costs of raising the child's skill outcome against the marginal benefit. The marginal costs reflect cost-minimization; the marginal benefit arises because parents are altruistic, as per the term $bV_k^a(\cdot)$.

The altruism term is the product of two components: the parent's expectation of their child's lifetime utility at a candidate outcome in stage 1 of $j=1$, $V_k^a(\cdot)$, and the altruism coefficient, b, which weights the well-being of the child relative to the parent's well-being. Parents are imperfectly altruistic towards their child in the sense that they also care about themselves; for example, setting $b=\beta$ (or equal to 1) does not imply that the objective of the parent and the child coincide perfectly, because children do not care about the utility their parents get from consumption or the disutility they get from non-leisure time. Motivating costly investment via altruism, as we do here (as opposed to specifying a term that gives fixed benefits to a given skill outcome) allows the expected return to the child's skill for the parents to adjust as the environment changes. For example, adult skill may have a different effect on expected lifetime utility if the tax rate rises to finance expanded transfer policies.

Returning to the cost-minimization step of investment optimization, this process takes as a constraint the technology that maps investment inputs to skill outcomes, which in this model consists of two nested CES functions represented by $f_s\left(n, q \mid \theta_a, \theta_k\right)$. The outermost aggregator is the dynamic function, which combines investment, $I\left(n, q \mid \theta_a\right)$, and the child's initial skill endowment, θ_k, to generate the skill outcome that the child will take into adulthood:

$$f_s\left(n, q \mid \theta_a, \theta_k\right) = \lambda_\theta \left[(1-\upsilon)\left(\theta_k\right)^{\frac{\chi-1}{\chi}} + \upsilon I\left(n, q \mid \theta_a\right)^{\frac{\chi-1}{\chi}}\right]^{\frac{\chi}{\chi-1}} \tag{4}$$

Here, υ and χ are the CES share parameter for investment and the elasticity of substitution between the child's stock of skill and investment, respectively, while λ_θ scales the output into the space of adult skill. The level of investment is determined by the innermost aggregator, $I\left(n, q \mid \theta_a\right)$, which combines investment inputs n and q within a period:

$$I\left(n, q \mid \theta_a\right) = \left[(1-\gamma)\left(\theta_n n\right)^{\frac{\nu-1}{\nu}} + \gamma\left(\theta_a q\right)^{\frac{\nu-1}{\nu}}\right]^{\frac{\nu}{\nu-1}} \tag{5}$$

In this specification, γ is the CES share parameter on the efficiency units of parent quality time investment input, and ν is the elasticity of substitution between efficiency units of parental time and efficiency units of childcare time. The arguments of the CES aggregator are efficiency units of each input, where θ_a is the productivity of quality time and θ_n is the productivity of non-parental childcare time.

As a thought experiment, one can imagine that given the prices of parental quality time and non-parental childcare time we construct a composite price index in the manner of Moschini (2023). This price index will depend on the prices of q and n and the parameters of the technology that maps investment inputs to the level of investment that they generate. As the price of n falls due to a childcare subsidy, this passes through to the composite price index for investment to an extent mediated by the parameters of (5) and thereby lowers the relative price of investing in child skill compared to other sources of utility. As a result, a substitution effect arises, causing consumers to shift towards the now relatively cheaper source of utility: better child skill outcomes.

As for the dynamic function of equation (4), this technology has the property that higher initial skill endowments have a higher marginal product of investment. To preview an attribute of the model baseline equilibrium, children with higher skill endowments will receive more investment from their parent, all else equal; this pattern is consistent with empirical findings in Datar et al. (2010); Frijters et al. (2013); Grätz and Torche (2016) and Attanasio et al. (2020), among others. When children with high skill endowments are born to parents with low adult skill levels, the level of investment chosen by the parent leaves room for a great deal of improvement in children's skill outcomes, improvement which increased transfers from family policies can instigate.

3.1.2 Remainder of life cycle ($2 \leq j \leq 11$)

After the first period of adulthood, the consumer's level of adult skill is governed by the function $\tilde{\theta}(j, \theta_a)$, a third-order polynomial given by:

$$\tilde{\theta}(j, \theta_a) = \left(1 + \beta_1^{age}(j-1) + \beta_2^{age}(j-1)^2 + \beta_3^{age}(j-1)^3\right)\theta_a \tag{6}$$

Note that $\tilde{\theta}(1, \theta_a) = \theta_a$, consistent with the constraints of the $j = 1$ value function of (3). Although skill grows over the life cycle, because age and θ_a are sufficient to determine what the skill level for any consumer is, the consumer is nevertheless indexed by $\{j, \theta_a\}$ at ages $2 \leq j \leq 11$.

Working ages For $2 \leq j \leq 9$, the consumer solves the problem in (7). They choose consumption and labor supply and continue to split consumption with their child up to and including period $j = 4$, after which the adult lives alone and $\Lambda_j = 1$.

$$\begin{aligned} V(j, \theta_a) &= \max_{c,\ell \geq 0} \ln\left(\frac{c}{\Lambda_j}\right) - \psi \frac{\ell^{1+\frac{1}{\omega}}}{1+\frac{1}{\omega}} + \beta V(j+1, \theta_a) \\ s.t. & \\ (1+\tau_c)c &\leq y_d(y \mid j, \theta_a, \vec{\pi}_G) \\ y &= \tilde{\theta}_a(j, \theta_a)\ell \end{aligned} \tag{7}$$

Retirement phase When $10 \leq j \leq 11$, the consumer solves the problem in (8), in which there is no disutility of labor and they earn no pretax income because they do not work, and the continuation value drops out of the objective function in the last period of life.

$$\begin{aligned} V(j, \theta_a) &= \ln\left(\frac{c}{\Lambda_j}\right) + \mathbb{I}_{j<11}\beta V(j+1, \theta_a) \\ s.t. & \\ (1+\tau_c)c &\leq y_d(0 \mid j, \theta_a, \vec{\pi}_G) \end{aligned} \tag{8}$$

Because there is no borrowing or saving in this model, the consumer's disposable income during retirement is equal to their after-tax SS pension, which is embedded in y_d.

3.2 Government policies

Section 3.2.1 defines disposable income; in addition, the functional forms and policy parameter vectors of the CTC and CCDF are defined and qualitative illustrations of each transfer as a function of pretax income are provided for intuition. Because the transfer value at a given level of income depends on parameterization, these figures are stylized and do not include dollar values. We then outline the structure of the three remaining transfer policies, the EITC, TANF, and SS, whose specific functional forms and policy parameter vectors are provided in Appendixes A.2.4, A.2.5, and A.2.6, respectively. Section 3.2.2 summarizes the work- and age-eligibility requirements of the five transfer programs in our model. The extent of means-testing (i.e., their income eligibility rules) is a consequence of specific parameterizations and its discussion is deferred until the model parameterization of Section 4. The government's budget constraint is defined in Appendix B.2.

3.2.1 Government tax and transfer policies

Disposable income is a function that conditions on whether or not the consumer works, which in our model is equivalent to whether or not y is positive:

$$y_d\left(y \mid j, \theta_a, \vec{\pi}_G\right) = \begin{cases} \lambda_y y^{1-\tau_y} + CTC\left(y \mid j, \lambda_y, \tau_y, \vec{\pi}_C\right) + EITC\left(y \mid j, \vec{\pi}_E\right) & \text{if } y > 0 \\ TANF\left(j, \vec{\pi}_T\right) + SS\left(j, \theta_a, \lambda_y, \tau_y, \vec{\pi}_P\right) & \text{if } y = 0 \end{cases} \tag{9}$$

where, when $y > 0$, the first term on the right-hand side represents after-tax income and takes its functional form from Heathcote, Storesletten, and Violante (2017). The second and third terms are the CTC and the EITC, which depend on the earned pretax income, the age age of the consumer, and the relevant vector of policy parameters. Note that the CTC is also affected by the income tax liability governed by λ_y and τ_y. In the second line, when $y = 0$, the consumer receives either TANF or an after-tax SS pension: TANF is available to consumers with young children, and SS pensions are available to retirees. If the consumer is not eligible for a transfer as represented in equation (9) due to age or income level, then the value of that transfer is set to zero.

It is important to note that the tax parameters τ_y and λ_y are independent of the age of the consumer and represent the effect of the income tax system before incorporating the CTC and EITC, which are refundable tax credits whose receipt or intensity is tied to the presence of children.[9] In the

[9]Any completely nonrefundable tax credits, for example the Child Care and Dependent Tax Credit, are left embedded in the estimation of τ_y. Note that the size of this credit is small.

model parameterization of Section 4, we explain how we assign a value to τ_y by estimating the progressivity of the tax system before refundable credits are applied.

Next, we explain the five transfer policies that the government operates. We begin with the CCDF, which is not included in the definition of disposable income and instead enters the budget constraint of the consumer in (3) as a separate term.

The Child Care and Development Fund We represent the CCDF as a proportional subsidy for market-based childcare for families with young children; our specification captures the fact that only lower-income families are eligible and that poorer recipients get more aid at a fixed level of childcare use. It also captures the fact that the level of the CCDF transfer received is increasing in the quantity of childcare used. The total value of the CCDF transfer is:

$$CCDF\left(y, n \mid j, \xi, R, p, \vec{\pi}_N\right) = \begin{cases} pnR\mathbb{I}_{y \in (0, \overline{y}_N)} \tau_N\left(y \mid \vec{\pi}_N\right) + \min\left\{\kappa_N, \xi\right\} & \text{if } j = 1 \\ 0 & \text{otherwise} \end{cases} \tag{10}$$

This transfer only takes a positive value for families with children age 5, so that $j = 1$; if this condition is met, then the transfer is the sum of a proportion of childcare expenses (first term) and a reimbursement for the application cost (second term).

Childcare expenses are determined by the price of childcare, p, and the quantity of childcare purchased, n; subsidized care providers are not different from unsubsidized ones in our model environment. If $R = 1$ and the income of the family is above 0 (i.e., the parent works) and below an eligibility threshold $\overline{y}_N$, then the government pays a portion of childcare expenses, determined as described in the next paragraph. The income eligibility threshold is set to a percentile Θ_N of the income distribution for parents raising children under age 10 and adjusts in equilibrium. This reflects that the income eligibility requirement of the CCDF are related to median income for similar families in practice, where“similar” families are parents with children aged under the statutory eligibility cutoff of 13 (here, we approximate with the closest age threshold of 10 given the model's 5-year periods). Note, however, that in this model childcare is only used before the child is 5 years old, and therefore this is the age range where the CCDF can be received in our model.

The CCDF subsidy rate, $\tau_n\left(y \mid \vec{\pi}_N\right)$, is a linear function of pretax income normalized by median income $\overline{y}_{pop}$:

$$\tau_N\left(y \mid \vec{\pi}_N\right) = \max\left\{\beta_{N,0} + \beta_{N,1}\left(\frac{y}{\overline{y}_{pop}}\right), 0\right\} \tag{11}$$

where the subsidy rate is bounded below by zero. The linear relationship with income represented in equation (11) is how our model allows for the subsidy rate to be decreasing in income and increasing in the number of hours of childcare used, rather than literally modeling the family copayment. We normalize with respect to the median income of the population so that, as the economy grows, what matters for the CCDF subsidy rate is how poor one is relative to the median rather than how poor one is in absolute. Across equilibria, one needs the same change in income as a percent of median income in order to get the same change in the subsidy rate; without this attribute, if the economy grew by enough, only those with income in the lowest part of the income distribution would get a positive subsidy rate, while the higher-income eligible might instead be assigned a subsidy rate of zero even if their income is below $\overline{y}_N$.

Turning to the second term in equation (10) when $j = 1$, an CCDF applicant receives a reimbursement (sometimes referred to as an application cost subsidy) of up to κ_N of the application cost, regardless of the CCDF rationing outcome. This reimbursement is not affected by income, and is normalized to zero in the baseline economy. We vary this parameter in our main counterfactual experiment when we expand the CCDF; changing the application cost reimbursement represents a reduction in the frictions faced when seeking to access CCDF aid. Note that, because the amount of this reimbursement is never more than the cost of applying, this component of the CCDF is never a net-positive cash transfer to the applicant family; we therefore view a nonzero value for κ_N as not changing the transfer-in-kind attribute of the CCDF.

From equations (10) and (11), the vector of CCDF parameters is: $\vec{\pi}_N = [\Theta_N, \beta_{N,0}, \beta_{N,1}, \kappa_N]$. Figure 3 illustrates the linear subsidy rate of the CCDF as a function of income for an arbitrary set of parameters, holding fixed median income $\overline{y}_{pop}$. Specifically, the term being graphed is $\mathbb{I}_{y\in(0,\overline{y}_N)}\tau_N\left(y \mid \vec{\pi}_N\right)$ from equation (10), using the functional form of equation (11). This term incorporates the upper and lower bounds on pretax income for eligibility, shown in the subscript of the term $\mathbb{I}_{y\in(0,\overline{y}_N)}$, where the lower bound is equivalent to a work requirement because it imposes that earnings be greater than zero. In the figure, the subsidy rate is set to zero at either end of the range of eligible incomes, as indicated by with the hollow square and circle at either end of the sloped line. For eligible incomes $y \in (0, \overline{y}_N)$, the subsidy rate $\tau_N\left(y \mid \vec{\pi}_N\right)$ is shown to be decreasing in income ($\beta_{N,1} < 0$) and to have a nonzero y-intercept ($\beta_{N,0} > 0$). Scaling Figure 3's subsidy rate by the family's childcare expenses would yield the transfer level that the family receives from the CCDF. The term $\min\left\{\kappa_N, \xi\right\}$ from equation (10) is not graphically illustrated because it is normalized to zero in the baseline economy

The Child Tax Credit Our model representation of the CTC follows the statutory structure of this tax credit. The CTC only takes positive values when j is between 1 and 3, so that the child under age 15 (the closest age threshold to 17, the statutory upper bound on child age, given 5-year periods). The credit level per child is calculated as the sum of a nonrefundable component and a

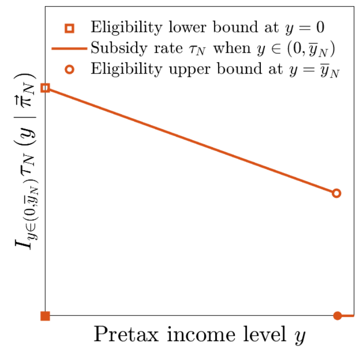


Figure 3: Stylized illustration of the CCDF subsidy rate including income eligibility requirements

Notes: Figure 3 illustrates the subsidy rate of the CCDF as a function of income for an arbitrary set of parameters, holding fixed median income $\overline{y}_{pop}$. Because this illustration is pre-parameterization and intended to be qualitative, the x- and y-axis values are not labeled except for the point where both values are zero.

refundable component:

$$CTC\left(y \mid j, \lambda_y, \tau_y, \vec{\pi}_C\right) = \begin{cases} CTC_n\left(y \mid \lambda_y, \tau_y, \vec{\pi}_C\right) + CTC_r\left(y \mid \lambda_y, \tau_y, \vec{\pi}_C\right) & \text{if } j = 1, 2, \text{ or } 3 \\ 0 & \text{otherwise} \end{cases} \tag{12}$$

Both components depend on pre-tax income; because this is a partially refundable credit, the income tax liability will affect its level, and therefore λ_y and τ_y appear as arguments in equation (12). The non-refundable component is equal to the lower bound of two constraints and is required to be nonnegative:

$$CTC_n\left(y \mid \lambda_y, \tau_y, \vec{\pi}_C\right) = \max\left\{\min\left(\overline{\kappa}_{C,n} - \beta_{C,n}\left(y - \overline{y}_{C,n}\right)\mathbb{I}_{y>\overline{y}_{C,n}}, y - \lambda_y y^{1-\tau_y}\right), 0\right\} \tag{13}$$

Moving from left to right on the right-hand side of equation (13), the first constraint is the maximum nonrefundable amount. This amount begins at a value $\overline{\kappa}_{C,n}$ and phases out at a rate $\beta_{C,n}$ for every additional dollar of earnings once income exceeds the phaseout threshold, $\overline{y}_{C,n}$. The second constraint is the consumer's income tax liability before tax credits. If the minimum of these two constraints is negative, then the nonrefundable component of the CTC is set to zero.

Here, the maximum credit level and phaseout threshold are set as constant fractions of median income, $\overline{y}_{pop}$, so that their levels in units of consumption adjust in equilibrium. Specifically, $\overline{\kappa}_{C,n} \equiv \Theta_{C,\kappa,n}\overline{y}_{pop}$ and $\overline{y}_{C,n} \equiv \Theta_{C,y,n}\overline{y}_{pop}$.

The refundable component of the tax credit is equal to the lower bound of three constraints and is also required to be nonnegative:

$$CTC_r\left(y \mid \lambda_y, \tau_y, \vec{\pi}_C\right) = \max\left\{\min\left(\overline{\kappa}_{C,r}, \overline{\kappa}_{C,n} - CTC_n\left(y \mid \lambda_y, \tau_y, \vec{\pi}_C\right), \beta_{C,r}\left(y - \overline{y}_{C,r}\right)\right), 0\right\} \tag{14}$$

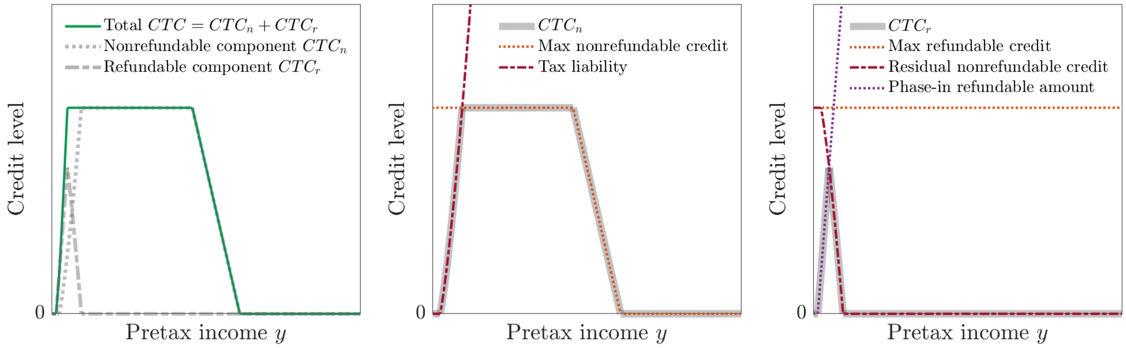
Moving from left to right on the right-hand side of equation (14), the first constraint is the level of the maximum refundable credit, $\overline{\kappa}_{C,r}$; the second constraint is the difference between the maximum nonrefundable credit and the realized value of the nonrefundable component; and the third constraint is the refundable amount, set to the refundability rate, $\beta_{C,r}$, multiplied by the difference between pretax income and the refundability threshold, $\overline{y}_{C,r}$. If the minimum of these three constraints is negative, then the refundable component of the CTC is set to zero. Similar to the non-refundable component, the maximum refundable credit and refundability threshold are parameterized as constant fractions of median income, so that $\overline{\kappa}_{C,r} \equiv \Theta_{C,\kappa,r}\overline{y}_{pop}$ and $\overline{y}_{C,r} \equiv \Theta_{C,y,r}\overline{y}_{pop}$.

The vector of CTC parameters is given by: $\vec{\pi}_C = \{\beta_{C,n}, \beta_{C,r}, \Theta_{C,\kappa,n}, \Theta_{C,\kappa,r}, \Theta_{C,y,n}, \Theta_{C,y,r}\}$. This vector combines parameters that appear in equations (12), (13), and (14). To illustrate the form of the CTC, Figure 4 displays the total CTC transfer and its two components, each as a function of income. Specifically, Figure 4a shows the total tax credit of equation (12) (solid line), which is the sum of its two components (dashed lines); Figure 4b illustrates the nonrefundable component of equation (13); and, Figure 4c illustrates the refundable component of equation (14). Each component (thick grey line) is the minimum of a set of constraints (dashed lines), which are listed in the Figure's legend in the same order as in the component's equation in the text. Additionally, each component is bounded below by zero.

Remaining transfer policies: EITC, TANF, and SS The EITC is similar to the CTC in that it phases in to a maximum credit value and then phases out as earned income increases; however, it differs structurally in three main ways. First, the EITC is fully refundable and starts to phase in with the first dollar of earnings, so that consumers receive the full value of the credit regardless of their tax liability as soon as they start working; second, it is available when $1 \leq j \leq 4$, which includes the last period of the parenting phase; and, third, it is available in a reduced form for working adults whose children have left home (when $4 < j \leq 9$). As with the CTC, the maximum credit level and phaseout income threshold of the EITC are parameterized as fractions of median income in equilibrium. For further details, see Appendix A.2.4.

TANF is modeled as a cash benefits available to non-working parents age $j = 1$ (that is, with children under 5). The level of the transfer for TANF is set as a constant fraction of median income in equilibrium. For further details, see Appendix A.2.5.

Lastly, SS pensions are indexed by the adult skill of the consumer; their after-tax value is deter-



(a) Total CTC (b) CTC_n (c) CTC_r

Figure 4: Stylized illustration of the total CTC and its two components

Notes: Figure 4 illustrates the total CTC of equation (12) in Figure 4a (solid line, with its two components as dashed lines). The nonrefundable component of equation (13) is shown in Figure 4b, and the refundable component of equation (14) in Figure 4c. Each component (thick grey line) is the minimum of a set of constraints (dashed lines), which are listed in the legend in the same order as in the component's equation in the main text. Additionally, each component is bounded below by zero. Because this illustration is pre-parameterization and intended to be qualitative, the x- and y-axis values are not labeled except for the point where both values are zero.

mined by a pretax benefit that replaces the average earnings of the skill type in equilibrium at a fixed rate, the share of the pretax benefit that is taxed, and the income tax charged by the government on the taxed portion of the benefit which is governed by λ_y and τ_y. Pensions are available during the retirement phase when $10 \leq j \leq 11$. For further details, see Appendix A.2.6.

3.2.2 Eligibility for transfers in the model by work status and age

Before parameterization, we can make statements summarizing the work and age eligibility rules of the model's five transfer policies: the CTC, CCDF, EITC, TANF, and SS pensions. TANF and SS are only received by non-working adults (that is, with zero pretax income); by contrast, the CTC, EITC, and CCDF require that consumers work (that is, have positive pretax income) to receive a transfer. As for age-eligibility, Figure 5 lists the set of tranfers that a consumer could receive at each age j, assuming that their working status makes them eligible. Conditional on being work- and age-eligible, the level of the transfer as a function of recipient attributes depends on the consumer's realized income and the specific parameters of each policy. Although not reflected in this figure, y could be such that the transfer takes a value of zero even if the consumer is work- and age-eligible.

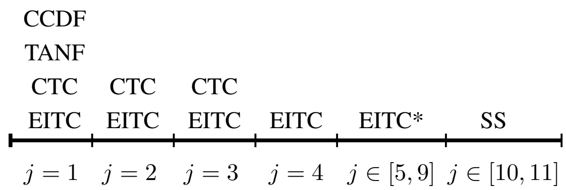


Figure 5: Transfer policy age eligibility

Notes: Figure 5 lists, for each age j, the transfers from which a consumer might receive aid, assuming work eligibility. EITC* denotes the reduced EITC available to adults without children at home.

3.3 Stationary steady state equilibrium

Given a conditional distribution of initial skill endowments for each adult skill, a distribution of CCDF application costs, a goods production technology, a childcare pricing rule, and a set of government policy vectors and tax parameters, a stationary steady state equilibrium is agent choices and objective functions, consumer expectations about lifetime utility at each skill level, $V_k^a(\cdot)$, a skill distribution among new adults, $\mu(\theta_a)$, and an average income tax rate, λ_y, such that agents optimize, expectations are rational, the skill distribution is stationary, and the government balances its budget constraint. An extended equilibrium definition is provided in Appendix B.3.

4 Model Parameterization

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

Panel A of Table 1 reports parameters related to government taxation and consumption as well as consumer demographics and preferences. Unless otherwise noted, we parameterize to the years 2015-2017. The consumption tax rate, τ_c, is estimated using Organization of Economic Cooperation and Development (OECD) data as described in Appendix A.2.1. The income tax progressivity parameter, τ_y, is estimated using the CPS ASEC as described in Appendix A.2.2. Crucially, we estimate the progressivity of the tax system to reflect the effect of the federal tax system excluding the CTC and EITC; these refundable credits, along with other family policy transfers, are modeled as separate objects in the consumer's budget constraint. Government consumption as a share of output, Θ_G, is estimated using data from the Bureau of Economic Analysis (BEA) reported in BEA Table 1.1.10 (2024). The elasticity of non-leisure time, ω, is set to 1.5, the midpoint of range of Frisch elasticity values used in the macroeconomic literature reported in Keane and Rogerson (2015). The vector of age-specific consumption-equivalence scales, $\{\Lambda_j\}$, accounts for the presence of a child following the 1994 OECD modifed scales based on the findings of Hagenaars, de Vos, and Zaidi (1994). The unconditional average of the log child skill endowments, μ_k, is normalized to 0. The discount rate, β, is set to be consistent with an annual value of 0.96 and the model's period length of five years. Lastly, the discrete set of labor supply options, $\{\ell_i\}_i$, is assumed to take values at 8-hour intervals from 0 to 48 percent of the time endowment (which corresponds to 100 hours per week).

Panel B of Table 1 contains values for the parameters governing the CTC for the 2016 Fiscal Year, set using values contained in the Congressional Research Service (CRS) report by Crandall-Hollick (2018). Dollar amounts are for one child, converted into per-parent terms and then averaged across married and single households using shares from Table 1 of Moschini (2023). Next, dollar values are expressed as ratios of median household income. This normalization divides by a value of $57,657 in 2016 USD, which is the average of annual values over the 2015-2016 period from American Community Survey briefs published by the United States Census Bureau (Guzman, 2017, 2018), converted to 2016 dollars using the Consumer Price Index (CPI) (Bureau of Labor Statistics, U.S. Department of Labor, 2024). Rates are averaged across single and married filing jointly values, using the same population shares as used for dollar amounts. Overall, the parameterized CTC targets working adults with children under 15 who are closer to the middle of the income distribution.

Panel C contains the CCDF policy parameters. The parameters governing the childcare subsidy rate are estimated using CCDF administrative data, and the eligibility threshold percentile is set to 27 to match the across-state average computed using Government Accountability Office (GAO) reports Chien (2019a,b, 2020). Both estimations are described in more detail in Appendix A.2.3. The share of applicants offered aid (as opposed to being rationed out) is set to the national estimate using data from the National Survey for America's Families (NSAF) found in Guzman (2019), while we estimate the variance of CCDF application costs using across-state variation in application rates found in the same publication. Lastly, the government reimbursement for the CCDF application cost is normalized to zero in the baseline. Overall, note that the parameterized transfer policies in our model are such that the CCDF targets working adults with young children who are relatively poor.

Panel D contains the three remaining policies: EITC, TANF, and SS. The policy parameters for the EITC are set using information from the CRS report Crandall-Hollick et al. (2021); parameters for TANF are set using a report from the the Administration for Children and Families (ACF), a subsidiary of the US Department of Health and Human Services (Office of Family Assistance, 2015). Finally, parameters for the SS pension program are set using information found in Social Security Administration (SSA) reports (Social Security Administration of the United States, 2016b,a) and tabulations from U.S. Bureau of Economic Analysis (BEA) (2023b,a). The specific parameters of the EITC, TANF, and SS are reported in their respective appendix; qualitatively, the EITC targets working adults who are relatively poor (in contrast to the CTC), while TANF targets non-working adults when they are young, and SS pensions are restricted to non-working adults during the retirement phase, so that both TANF and SS pensions are targeted towards the poor.

Finally, in Panel E, we report parameters related to skill accumulation during early childhood and adulthood. Beginning with the technologies governing skill accumulation during early childhood, we set these parameters using estimates based on data from the Early Childhood Longitudinal Survey - Birth Cohort (ECLS-B) data in Moschini (2023), as described in Appendix A.2.7. We parameterize the third-order polynomial that governs the age profile of skill (which is the same as wages in our framework), $\tilde{\theta}\left(j, \theta_a\right)$ as explained in Appendix A.2.8, using a calibration that targets wage growth moments estimated using US Census data in Lagakos, Moll, Porzio, Qian, and Schoellman (2018).

Qualitatively, the technology parameter values for early childhood in Panel E indicate that investment technology exhibits CES complementarity between investment inputs (governed by ν), as well as between investment and the current stock of child skill (governed by χ). Given the functional form that we assume, the marginal product of investment is increasing in the level of initial skill for any value of ξ; however, the elasticity of the marginal product of investment does depend on ξ and is increasing in the initial skill of the child when $\xi < 1$, as is the case in our parameterization. In our model, the higher the child's initial skill endowment, the larger the marginal product of investment during early childhood; the extent to which high- and low-skill parents face high returns to investment depends on the correlation of the initial child skill endowment with the parent's skill. The CES share on investment, υ, is 0.49, indicating that both investment and the initial skill endowment of the child play a large role in determining the child's skill outcome. The CES share on parental quality time, γ, indicates that both parental and non-parental childcare time play a role in generating investment. This means that subsidies to childcare's price have the potential to reduce investment's composite price index significantly, thereby motivating a substitution towards skill investment by the household and a consequent improvement in skill outcomes for the child.

Moving to parameters whose values are estimated inside the model, Panel A of Table 2 presents seven parameters that are calibrated jointly to bring seven model moments as close as possible to their empirical counterparts: the marginal disutility of non-leisure time, ψ, the skill scaling factor, λ_θ, the degree of altruism, b, the fixed cost of taking up the childcare subsidy, ξ, the variance of the initial skill distribution, σ_k^2, the intergenerational persistence of mean skill, ρ_k, and the SS pension replace rate, ϕ_P. Although all of these parameters may affect any of the target moments to some extent, in Panel A parameters are presented in the same row as the moment used to update them during the calibration procedure.

Table 1: Externally estimated parameters

Symbol	Parameter description	Data source	Parameter value
Panel A: Government tax and consumption policy, demographics, preferences			
τ_c	Consumption tax rate	OECD	0.043
τ_y	Income tax progressivity	CPS ASEC	0.061
Θ_G	Government consumption (share output)	BEA	0.175
ω	Elasticity of non-leisure time	Assumption	1.5
$\{\Lambda_j\}$	Consumption-equivalence scales	OECD	$1+\mathbb{I}_{j\leq 4}0.3$
μ_k	Unconditional average log (θ_k)	Normalization	0
β	Patience	Assumption	0.815
$\{\ell_i\}_i$	Labor supply choice set	Assumption	$\{0.08\,(i-1)\}_{i=1}^{7}$
Panel B: CTC policy $\vec{\pi}_C$			
$\Theta_{C,\kappa,n}$	Maximum non-refundable credit ratio	CRS and US Census, normalized*	$\$1,000$
$\Theta_{C,\kappa,r}$	Maximum refundable credit ratio		$\$1,000$
$\Theta_{C,y,r}$	Refundability threshold ratio		$\$1,815$
$\Theta_{C,y,n}$	Phase-out threshold ratio		$\$59,200$
$\beta_{C,n},\beta_{C,r}$	Phase-out and phase-in rates		$(0.150, 0.050)$
Panel C: CCDF policy $\vec{\pi}_N$			
$\beta_{N,0},\beta_{N,1}$	Childcare subsidy function	CCDF administrative data	$(0.957, -0.348)$
Θ_N	Eligibility threshold percentile	GAO	27
ϕ_N	Rationing: share recipients | applied	NSAF	0.840
σ^2_ξ	Variance of fixed cost distribution	NSAF	0.114
κ_N	Uptake cost subsidy	Normalization	0
Panel D: EITC, TANF, and SS policies			
$\vec{\pi}_E$	EITC policy vector	CRS	See Appendix A.2.4
$\vec{\pi}_T$	TANF policy vector	ACF	See Appendix A.2.5
$\vec{\pi}_P$	SS policy vector	BEA and SSA	See Appendix A.2.6
Panel E: Skill accumulation			
Early childhood			
χ	Elasticity of substitution I and θ_k	ECLS-B	0.380
υ	Share on I		0.490
ν	Elasticity of substitution q and n		0.560
γ	Share on q		0.410
Adulthood			
$\beta_1^{age},\beta_2^{age},\beta_3^{age}$	Life cycle wage profile	US Census	$(0.509, -0.090, 0.005)$

Notes: Table 1 reports externally estimated parameter symbols, descriptions, data sources, and values.* Panel B dollar values are normalized by US median household income, computed as described in the text.

The first moment in Panel A is computed for adults aged between 25 and 55 using the CPS ASEC. The second moment averages values from Moschini (2023) across family structures using population weights, while the third moment is directly reported in the same study. The fourth is computed using information on the number of households with children under five, the number of households receiving CCDF funds, and the share of CCDF recipient households with children under five for the 2017 fiscal year (Federal Interagency Forum on Child and Family Statistics, 2017; Office of Child Care, Administration for Children and Families, 2023a,b). The fifth target moment is the difference between the 50th and 10th percentiles of the logged pretax income distribution for the United States, averaged over its annual values for 2015, 2016, and 2017, using values from the Global Repository of Income Dynamics database (GRID 2015-2017).[10] Next is the the correlation

[10]This method of disciplining properties of the initial skill distribution using moments on earnings inequality is based on Huggett, Ventura, and Yaron (2006).

between maternal cognitive skill and child cognitive skill when the child is 1 year old, set to the value reported in the online appendix of Cunha, Heckman, and Schennach (2010). Finally, we discipline the replacement rate for SS pensions using tabulations from the National Income and Product Accounts (NIPA), specifically BEA Table 1.1.5 (2022a) and BEA Table 1.2.1 (2022c). Overall, the calibrated model aligns well with the data.

We choose the target moments in Panel A of Table 2 because we want the model baseline equilibrium to reflect the following broad attributes of reality (with the relevant target moment provided in parentheses). First, the pass-through of skill to output for prime working-age adults (average labor supply, ages 25-55). Second, the intensity of childcare usage (average hours of childcare time for children under 5). Third, the degree of intergenerational mobility, reflecting the payoff-relevance of being born to one kind of parent versus another in terms of the effect it has on expected well-being during adulthood (the correlation of child skill outcomes at age 5 and family income).[11] Fourth, the extent of access to CCDF aid (the share of families with young children receiving the CCDF). Fifth, the extent of heterogeneity among poor young adults who are potentially eligible for family transfers (the p50-p10 log income difference, ages 25-34). Sixth, the degree to which children with high potential skill outcomes are present among the poor (the correlation of initial child skill and parent adult skill). Finally, the amount of resources spent on SS pensions (share of output spent on SS). Appendix C.1 provides additional details on the internal calibration; in Appendixes C.5.1 and C.5.2 we perform robustness exercises where we change the set of target moments and examine the impact on our main results.

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 productivities is equal to zero for working parents, to be consistent with the identification of skill technology parameters. 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 with children under 5 matches what is observed in the data as reported in Table 2 of Moschini (2023).

[11] We report a robusteness for our main exercises in Appendix C.5.2 in which we target an alternative statistic to measure intergenerational mobility, the rank-rank correlation of family income for the core sample of Table 1 from Chetty et al. (2014). Our main results are unchanged.

Table 2: Internally estimated parameters

Category	Sym.	Parameter description	Value	Moment description	Data	Model
Panel A: Jointly calibrated	ψ	Marginal disutility non-leisure time	6.71	Age 25-55 ave. hours labor ℓ	0.31	0.31
	λ_θ	Skill scaling factor	4.83	Age 20 ave. hours childcare n	0.31	0.31
	b	Altruism coefficient (share β)	0.33	Age 20 Corr(θ_k^{a*}, y^*)	0.32	0.32
	μ_ξ	Ave. application cost (share $\overline{y}_{pop}$)	0.14	Age 20 share receiving CCDF	0.04	0.04
	σ_k^2	Var. of log (θ_k)	1.03	Age 25-34 log (y) p50-p10	1.39	1.39
	ρ_k	Intergenerational persistence of skill	0.09	Age 20 Corr(θ_k, θ_a)	0.06	0.06
	ϕ_P	SS replacement rate	0.20	SS spending (share output)	0.05	0.05
Panel B: Set proportionally	θ_n	Child care productivity	0.70	Age 20 workers ave. log prod. ratio	0.00	0.00
	ϕ	Pre-policy price for n	0.15	Age 20 workers price ratio	0.18	0.18

Notes: Table 2 presents internally estimated parameters. Panel A contains parameters calibrated jointly inside the model; Panel B contains parameters set proportional to endogenous objects in the baseline equilibrium.

5 Properties of the Baseline Equilibrium

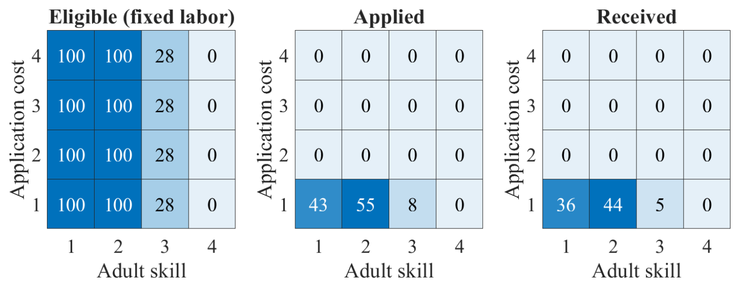
5.1 Selection into CCDF application and receipt

Figure 6 displays the within-cell percentage who are eligible for, apply for, and receive CCDF aid by quartiles of application cost and adult skill in Figure 6a and by quartiles of child initial skill endowment and adult skill in Figure 6b. Comparing patterns of application and receipt in our baseline equilibrium with the findings of previous studies is a useful way to examine whether consumers in our model exhibit reasonable patterns of sorting into CCDF receipt. Here, following the method of Guzman (2019), we define the eligible by comparing potential income at a fixed level of 16 hours of labor supply to the income eligibility threshold of the CCDF in the baseline equilibrium; subsidy receipt requires application, being offered aid, and that the consumer choose a level of labor supply that makes them eligible for a positive transfer.[12] Quartiles are assigned using unconditional distributions for each variable in the baseline equilibrium.

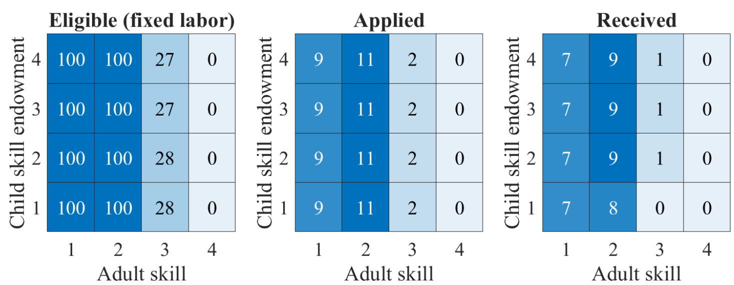
Among the eligible, Figure 6a indicates that CCDF applicants and recipients tend to have low application costs; given application costs, they also tend to have relatively higher adult skill. Figure 6b indicates that application and receipt are not strongly related to the child's initial skill endowment; this weak relationship is a consequence of CCDF application decisions occuring before the draw of the child's initial skill endowment (the correlation of initial child skill with adult skill is low, and that parents cannot precisely predict their child's initial skill). However, a low degree of selection into CCDF receipt by θ_k does arise after the application decision. This is due to adults who, after their draws of R and θ_k are realized, choose a level of labor supply too high to qualify for CCDF aid. This situation arises among applicants with high θ_a and low θ_k combinations, for

[12]The patterns of selection into CCDF receipt documented here are also apparent if we use realized income to define eligibility.

whom it not worthwhile to distort labor supply downward in order to be eligible for CCDF aid: the opportunity cost of labor supply is increasing in θ_a and the optimal level of investment is increasing in θ_k, where the second pattern is demonstrated in Figure C.2a of Appendix C.2.



(a) By application cost and adult skill



(b) By child initial skill endowment and adult skill

Figure 6: Selection into CCDF application and receipt

Notes: Figure 6 displays the within-cell percentage who are eligible for, applying for, and receiving CCDF aid for two discretized joint distributions. Figure 6a displays rates by CCDF application cost and adult skill; Figure 6b displays rates by child initial skill endowment and adult skill. Quartiles are assigned using the unconditional distributions in the baseline equilibrium.

The patterns of selection into CCDF application and receipt shown in Figure 6 are qualitatively consistent with the results of Johnson et al. (2011), which indicate that those receiving the CCDF have relatively more resources compared to the pool of eligible non-recipients (higher θ_a), and the results of Guzman (2019), which indicate that higher-educated parents (higher θ_a) and those facing lower application costs (lower ξ) are more likely to apply for the CCDF. There is little evidence in the literature on selection by initial child skill endowments into CCDF application and receipt and the model baseline exhibits only slight positive selection along this margin. This selection is driven by higher investment in children with higher initial skill endowments, a mechanism consistent with the findings of Datar, Kilburn, and Loughran (2010), Frijters, Johnston, Shah, and Shields (2013), Grätz and Torche (2016), and Attanasio, Cattan, Fitzsimons, Meghir, and Rubio-Codina (2020), among others.

5.2 Distributions of CTC and CCDF spending and recipients

Figure 7 shows how spending on the CTC and CCDF is allocated across pretax income quartiles for families with children under 5 in the baseline equilibrium, which is the population of interest for child skill accumulation in our model environment. It also includes empirical counterparts for these spending patterns, replicated from Figure 1 of Section 2. These spending patterns are useful to determine whether the model baseline captures the relative degree of means-testing of the CTC and CCDF, given our parameterization choices, the endogenous income distribution, and the endogenous decision to apply for and take up the CCDF subsidy and how much childcare to use upon receipt. For the remaining two family policies, Appendix C.2.4 shows the distribution of spending for the EITC, which aligns well with the data. We do not report the spending distribution of TANF because it is concentrated in the bottom income quartile by construction (only non-working parents with children may receive TANF in our model).

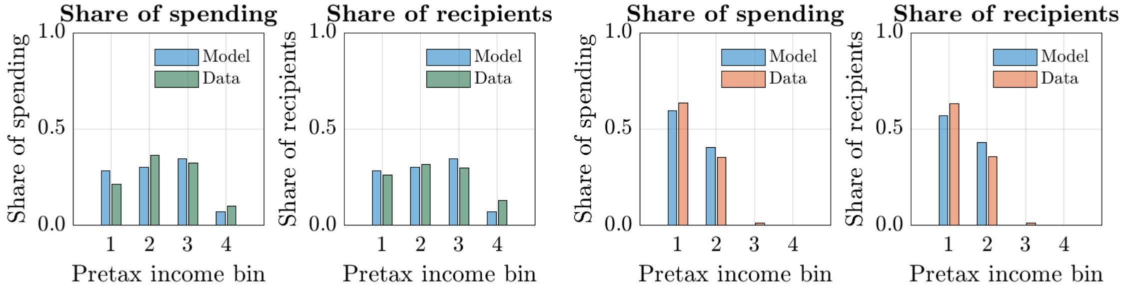
Figure 7a illustrates the distribution of spending on the CTC. The model captures the property that the second and third income quartiles together receive most of CTC spending, both in dollar terms (left panel) and as a share of recipients (right panel). Figure 7b illustrates the distribution of spending on the CCDF. The model captures the fact that spending is concentrated in the bottom two income quartiles for this policy, both in dollar terms (left panel) and in terms of the distribution of recipients (right panel). Compared to the CTC, in both the model and the data the CCDF is more means-tested in the sense that spending goes to relatively poorer parents with young children.[13]

5.3 Government spending on family policies

Table 3 reports the size of government spending on the four family policies (CTC, CCDF, EITC, and TANF) in the model's baseline equilibrium and in the data. This comparison is useful because it verifies that the size of these policies relative to the rest of the economy is reasonable. Empirical moments are computed as explained in Appendix A.1; all spending amounts are expressed as a percentage of output (model) or of average US GDP from 2015 to 2017 (data) computed from BEA Table 1.1.5 (2022a). Note that spending on SS pensions, the remaining transfer policy, is targeted in our model calibration.

Although the moments of Table 3 are untargeted, the model aligns rather well with the data. The

[13] To explore an alternative model specification with different implications for sorting into CCDF receipt and the distribution of aggregate spending, in Appendix C.5.3 we posit a model where application costs are in utils, recalibrate the model, and demonstrate that selection favors lower-skilled adults in the baseline equilibrium (in contrast to our preferred specification with application costs in the budget constraint). With application costs in utils, the CCDF spending distribution is counterfactually concentrated in the first income quartile. We repeat our main experiments in the modified framework; skill gains from the CCDF expansion are higher, but our main results are qualitatively unchanged.



(a) Child Tax Credit (b) Child Care and Development Fund

Figure 7: Distributions of spending and recipients by income quartile

Notes: Figure 7 presents, for households with children under 5 in the model baseline equilibrium, the share of program spending (left panel) and share of recipients (right panel) going to each income quartile for the CTC (Figure 7a) and the CCDF (Figure 7b). The y-axis of each graph is the share of total spending or share of total recipients; the x-axis is the income quartile assigned using the distribution of income for households with children under 5.

model slightly overstates spending on the EITC and CCDF; proportionally, the largest difference is in total CCDF spending. To investigate the source of this discrepancy, in Table C.13 of Appendix C.2.2, we compare CCDF recipient attributes in the model baseline with observable moments computed using CCDF administrative data combined with information from CPS ASEC. We find that the income of the average CCDF recipient, compared to the income of the average parent with a child under 5, is similar in the model baseline and in the data. Conditional on receiving the subsidy, the magnitude of the transfer is slightly higher in the model than in the data; this is partly due to the subsidy intensity (which we approximate with a linear function) being slightly higher conditional on receipt than in the data, but it is likely also due to our abstracting from heterogeneity in childcare prices which tend to be lower among the poor (Moschini, 2023). As for the mass of transfer recipients for each policy, these are presented in Appendix C.2.3; the model baseline exhibits a good fit to the data along this dimension.

Table 3: Government spending in model baseline and in US data

Policy	**Data**	**Model**	**Data source**
Child Tax Credit (CTC)	0.27	0.27	IRS SOI (2017), Table 3.3
Child Care and Development Fund (CCDF)	0.03	0.06	Chien (2019a,b, 2020)
Earned Income Tax Credit (EITC)	0.35	0.39	IRS SOI (2017), Table 3.3
Temporary Assistance for Needy Families (TANF)	0.02	0.02	Office of Family Assistance (2015)

Notes: Table 3 reports the spending on each family policy in the baseline economy and in US data during the period 2015-2017, as well as the source of this empirical moment. All spending amounts are expressed as a percentage of output (model) or US GDP (data).

6 Experiments and Results

This section compares the effects of spending-equivalent expansions of the CTC and the CCDF. Section 6.1 describes how the policy expansions are implement; Section 6.2 explains our three main measures of welfare changes. In Section 6.3.1, we report changes across stationary steady states in aggregate variables and welfare, while in Section 6.3.2 we discuss changes in the distribution of adult skill and sources of gains in average adult skill. Section 6.3.3 decomposes welfare gains behind the veil of ignorance from each expansion into marginal constributions from four components.

6.1 Implementation of policy expansions

The CTC expansion is based on the 2017 Tax Cuts and Jobs Act changes to the CTC, described in Crandall-Hollick (2018): the Act increased both the maximum nonrefundable and refundable credit levels, increased the phase-out threshold, and decreased the refundability threshold, which we convert into changes in $\Theta_{C,\kappa,n}$, $\Theta_{C,\kappa,r}$, $\Theta_{C,y,n}$, and $\Theta_{C,y,r}$.[14] Figure 8 illustrates how this expansion affects our model representation of the CTC, scaled into US dollars using median household income. The CCDF expansion is implemented by eliminating rationing (that is, setting $\phi_N = 1$ so

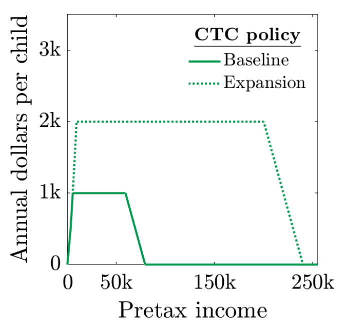


Figure 8: CTC transfer level in the baseline and after its expansion

Notes: Figure 8 illustrates the CTC in the baseline (solid line) and after its expansion (dotted line). Income and transfer dollar values are expressed in 2016 USD by scaling using median household income.

that application guarantees receipt) and subsidizing application costs by raising the policy instrument κ_N from equation (10) until total government spending on all expenditures, expressed as a

[14]The specifics of this conversion are as follows. The changes to the CTC affected both single tax filers and those married filing jointly. As with the baseline CTC, we average across tax filing statuses using population weights, so that dollar value changes to the CTC are as follows: the expansion increases the maximum credit level, $\overline{\kappa}_n$, from \$1,000 to \$2,000; increases the maximum refundable credit level, $\overline{\kappa}_r$, from \$1,000 to \$1,400; decreases the refundability threshold, $\underline{y}_{C,r}$, from \$1,815 to \$1,513; and increases the phase-out threshold, $\underline{y}_{C,n}$, from \$59,200 to \$200,000. We convert dollar changes to changes in $\Theta_{C,\kappa,n}$, $\Theta_{C,\kappa,r}$, $\Theta_{C,y,n}$, and $\Theta_{C,y,r}$ by dividing by median household income, estimated as described in Section 4.

percent of GDP, is equivalent to the CTC expansion. This equivalence in government spending is how we render the two expansions comparable.

6.2 Measures of welfare changes

We measure welfare changes in consumption-equivalent units in three ways: (a) behind the veil of ignorance; (b) on average for new adults (age $j = 1$) who know their own skill; and, (c) on average across all adults who know their own skill. For (b) and (c), we also report the share who experience welfare gains; no one is indifferent. Here, we extend the notation of the model section to reflect the government policy that indexes each equilibrium: Φ denotes the baseline equilibrium and Φ' denotes the new equilibrium. Expressions for consumption-equivalent welfare changes reflect the utility function of Section 3.

Behind the veil of ignorance Welfare changes behind the veil of ignorance are constructed in the following way. First, we construct expected utility behind the veil of ignorance in the baseline equilibrium by integrating the expected utility at stage 1 of period $j = 1$, $V_1(\theta_a \mid \Phi)$ as defined in equation (1), over θ_a using the distribution of adult skill in the baseline equilibrium: $\mathbb{E}_{\theta_a} V_1(\theta_a \mid \Phi) = \int_{\theta_a} V_1(\theta_a \mid \Phi)\, \mu(\theta_a \mid \Phi)\, \theta_a$. Similarly, the expected utility behind the veil of ignorance in the new steady state is: $\mathbb{E}_{\theta_a} V_1(\theta_a \mid \Phi') = \int_{\theta_a} V_1(\theta_a \mid \Phi')\, \mu(\theta_a \mid \Phi')\, \theta_a$. We then calculate the consumption-equivalent change in the expected lifetime utility behind the veil of ignorance that results when moving from the baseline equilibrium Φ to the new equilibrium Φ':

$$W_V(\Phi, \Phi') = 100 \times \left[\exp\left(\frac{\mathbb{E}_{\theta_a} V_1(\theta_a \mid \Phi') - \mathbb{E}_{\theta_a} V_1(\theta_a \mid \Phi)}{\sum_{age=1}^{J} \beta^{age-1}} \right) - 1 \right] \tag{15}$$

When we report welfare changes "behind the veil of ignorance" (measure a) we report $W_V(\Phi, \Phi')$ directly. This welfare measure represents changes in the expected utility of being a new adult entering the labor market in the final steady state as opposed to the initial equilibrium, with no information about one's own skill level: $W_V(\Phi, \Phi')$ does not take individual attributes as arguments because it does not condition on them.

Adults with a given skill level Welfare changes for adults at each age are constructed holding fixed age j and adult skill θ_a. When computing these changes, for age $j = 1$ we use the stage 1 expected value function of a new adult defined in equation (1), which only depends on θ_a. For older ages, there is no risk and we use the value function for that age which is indexed by only age and adult skill. Specifically, this welfare measure is constructed as follows:

$$W_A\left(j,\theta_a,\Phi,\Phi'\right)=\begin{cases}100\times\left[\exp\left(\frac{V_1(\theta_a|\Phi')-V_1(\theta_a|\Phi)}{\sum_{age=j}^{J}\beta^{age-j}}\right)-1\right] & \text{if } j=1\\ 100\times\left[\exp\left(\frac{V(j,\theta_a|\Phi')-V(j,\theta_a|\Phi)}{\sum_{age=j}^{J}\beta^{age-j}}\right)-1\right] & \text{otherwise}\end{cases} \tag{16}$$

When we report welfare changes for "New adults," (measure b) we refer to the average of (16) across θ_a when $j=1$, $\int_{\theta a} W_A\left(1,\theta_a,\Phi,\Phi'\right)\mu\left(\theta_a \mid \Phi'\right)d\theta_a$, where we integrate using the distribution over adult skill levels in the new equilibrium. The share of new adults who experience welfare gains integrates over an indicator for positive welfare changes: $\int_{\theta a}\mathbb{I}_{W_A(1,\theta_a,\Phi,\Phi')>0}\mu\left(\theta_a \mid \Phi'\right)d\theta_a$.

By welfare changes for "All adults," (measure c) we refer to $\sum_{j=1}^{J}\frac{1}{11}\int_{\theta a} W_A\left(j,\theta_a,\Phi,\Phi'\right)\mu\left(\theta_a \mid \Phi'\right)d\theta_a$, which is computed by integrating (16) for each age using the distribution over adult skill levels in the new equilibrium and then averaging across ages. The share of all adults who experience welfare gains is: $\sum_{j=1}^{J}\frac{1}{11}\int_{\theta a}\mathbb{I}_{W_A(j,\theta_a,\Phi,\Phi')>0}\mu\left(\theta_a \mid \Phi'\right)d\theta_a$.

Note that, in contrast to the welfare function computed behind the veil of ignorance in equation (15), the welfare measure of equation (16) represents changes in well-being for adults who internalize their skill level but take expectations over other elements of their type space. For $j=1$, the welfare measure in equation (16) incorporates the fact that, once an adult knows their skill level, they do not value a higher average skill among adults as they would behind the veil of ignorance; instead, a higher average skill level affects them indirectly, for example through the income tax rate. In addition, a high-skill adult values expanding transfers to the poor to the extent that it affects their potentially low-skill children, but understands that they will not benefit from it directly (and may have to pay higher taxes). For older ages, the welfare measure of equation (16) also incorporates losses to adults who are too old to benefit from expanded family policies but nevertheless have to pay a higher tax rate compared to the initial equilibrium, or face a different pension level due to changes in labor supply. From a political economy standpoint, of the welfare change metrics that we use in this section, we consider the share of all adults who benefit from a policy change to most closely reflect the preferences of voters in the economy in a given equilibrium.

6.3 Results

6.3.1 Changes in aggregate variables and welfare

Table 4 reports changes across steady states in aggregate variables and welfare. First, we report levels of each variable in the baseline equilibrium. Next, column (1) contains changes after the CTC expansion; in column (2), we report changes after the expansion in the CCDF. The units of these changes are noted in each panel: Panel A reports percentage point changes in government spending as a percent of output and the income tax rate evaluated at the baseline equilibrium's average pretax income level; Panel B reports percent changes in aggregate quantities, specifically average adult skill, average labor supply, output, and average consumption; using the three welfare measures explained in Section 6.2, Panel C reports welfare changes, and Panel D reports the share of new adults and all adults who gain in each equilibrium (no one is indifferent, so the share who lose is one minus this share).

Table 4: Changes in aggregates and welfare across steady states

Variable category	Variable description	Baseline	(1) CTC	(2) CCDF
Panel A: Government	Government expenditures	22.62	0.54	0.54
Δ units: percentage point change	Average tax rate (at y_{ave} baseline SS)	17.68	0.53	0.23
Panel B: Aggregate quantities	Average adult skill	0.94	0.51	6.85
Δ units: percent change	Labor supply	0.31	0.14	-0.61
	Output	0.43	0.52	6.61
	Consumption	0.35	0.49	6.02
Panel C: Welfare change in levels	Behind the veil of ignorance	0.00	2.45	8.28
Δ units: percent of lifetime consumption	New adults	0.00	1.87	2.11
	All adults	0.00	-0.18	0.00
Panel D: Share who gain	New adults	0.00	1.00	0.66
Δ units: share of group	All adults	0.00	0.22	0.15

Notes: Table 4 reports baseline values and changes in aggregates and welfare predicted by the model after the expansion of the CTC (column 1) and a spending-equivalent expansion of the CCDF (column 2). Specifically, in column (1) changes are as described in the main text, and in column (2) $\kappa_N = 0.375 \times \mu_\xi$ and $\phi_N = 1$.

Beginning with Panel A of column (1), the CTC expansion increases total government spending by 0.54 percentage points; total government spending includes spending on all transfer programs and government consumption, and reflects changes in any of those expenditures that may result from the policy change. To balance the government's budget, the income tax increases; evaluated at the average income in the baseline equilibrium, this increase is 0.53 percentage points. In Panel B, the average skill of adults increases by 0.51 percent, because some of the additional transfers received by parenting families are directed toward investment in child skill. Average labor supply rises very slightly, by 0.14 percent: this net change reflects an increased incentive to move into work for families whose children are young enough (due to the increased generosity of the CTC), and an incentive to distort labor supply downwards to qualify for a higher transfer from the credit (which is hump-shaped in income as shown in Figure 8) as well as in response to higher income taxes. Overall, output increases by 0.52 percent and consumption increases by 0.49 percent. Welfare gains in Panel C are 2.45 percent behind the veil of ignorance, 1.87 percent on average across new adults, and -0.18 pecent on average across all adults. Gains behind the veil of ignorance are higher than gains for new adults because the former internalizes increases in average adult skill, while gains for new adults are higher than gains for all adults because older consumers pay higher taxes without receiving transfers and their welfare declines in equilibrium.[15] Panel D reflects redistribution across ages: all new adults benefit from the CTC expansion, but only about 1 in 5 of all adults in the economy do (recall that, in the model, the CTC is available to adults until their child turns 15, contingent on meeting income requirements).

Moving to Panel A of column (2), the CCDF expansion increases total government spending by the same amount as in column (1) by setting $\phi_N = 1$ and $\kappa_N = 0.375 \times \mu_\xi$. However, the government's budget is balanced with a tax rate increase of only 0.23 percentage points, lower than the tax increase in column (1). This is possible because the increase in the average skill of adults is higher, at 6.85 percent (Panel B). Average labor supply declines slightly, by 0.61 percent; this change is the net effect of some adults distorting their labor supply downward in order to qualify for the CCDF and other adults raising labor supply by joining the labor force to meet the CCDF work requirement, as well as downward adjustments in response to increased tax rates. Overall, output increases by 6.61 percent and consumption by 6.02 percent. Welfare gains in Panel C are 8.28 percent behind the veil of ignorance, 2.11 percent averaging across new adults, and about zero averaging across all adults. Gains behind the veil of ignorance are higher than in column (1) because of the larger increase in the average skill of adults; average welfare gains for new adults and all adults are similar across the two expansions, although slightly higher for the CCDF. In Panel D, a smaller share of new adults and all adults benefit from the CCDF expansion (66 and 15 percent, respectively) compared to the CTC expansion of column (1). Note that the increase in the size of the economy in column (2) means that other transfer programs also expand, which acts to boost the share of adults who experience welfare gains in column (2).

To summarize, behind the veil of ignorance, the CCDF expansion is preferred because of larger increases in average adult skill. New adults prefer the CTC expansion because a larger share of of new adults experience welfare gain, although on average the level of gains is slightly lower than gains from the CCDF. The majority of adults experience welfare losses from expansions in family policies, because in our model most adults do not have chidren and therefore do not receive transfers from family policies and do not anticipate receiving such transfers in the future; at the same time, they must pay higher taxes. From a political economy standpoint, if the adult population in the final steady state voted, neither the CTC nor the CCDF would be expanded. If adults had to choose to expand one policy or the other, they would choose the CTC.

Our method for expanding each policy utilizes more than one policy margin. In Appendix C.3.2 we examine the role of each margin: for the CTC expansion, the rise in the credit level and phaseout threshold drive most of the welfare gains, while for the CCDF expansion the application cost sub-

[15] Technically, the EITC in our model economy makes small transfers to those who have no children at home. However, this portion of the EITC has stringent eligibility requirements and is received by few adults.

sidy makes the largest contribution. Here, we have also targeted a specific change in government spending; in Appendix C.4.1, we gradually expand each policy to show that the pattern of welfare gains documented in Panel C of Table 4 holds true over a wide range of spending-equivalent expansions.

As for the specific policy margins of each expansion, the changes to the CTC are drawn from legislation, while the combination of policy margins used to expand the CCDF is our modeling choice. In Appendix C.4.2, we compare the CCDF expansion of the main text with two alternative spending-equivalent CCDF expansions: first, one that only subsidizes application costs; and, second, an expansion that maintains work requirements but eliminates means testing by removing the income eligibility threshold and setting the subsidy to a flat rate which is calibrated to target government spending. The second alternative expansion represents a more traditional expansion of the CCDF, in the sense that it does not reduce the frictions associated with implementation via a spending program.[16] Of these three CCDF expansions, that of column (2) in Table 4 yields the largest welfare gains and the traditional expansion yields the lowest gains. This is because reducing application costs generates CCDF inflows from lower-skill adults, while a traditional expansion that leaves these application costs unchanged generates inflows from higher-skilled adults who can afford to pay application costs. Thus, after a traditional expansion, the poor face an increased tax burden that is not accompanied by increased transfers, which reduces welfare gains.

6.3.2 Changes in the distribution of adult skill and sources of skill gains

As shown in Panel A of Table 5, the variance of log skill increases after both expansions, although to a larger extent after the CCDF expansion. This increase indicates that the rise in average adult skill is not shared equally over the skill distribution. To attribute these changes in the variance to parts of the skill distribution, we first divide the distribution of log skill into deciles and then take the difference between the 10th and 1st, 10th and 5th, and 5th and 1st within-decile averages in each equilibrium. Panel B reports the changes in these statistics compared to the baseline: both policies give rise to an increase in inequality because lower percentiles of the skill distribution see small gains relative to higher percentiles. After the CTC expansion, inequality among higher percentiles decreases while inequality among lower percentiles increases by a similar amount. By comparison, the increase in inequality among lower percentiles of the skill distribution after the CCDF expansion is much greater in magnitude, indicating that the lowest skill percentiles are left behind to a greater extent and driving the larger increase in variance of log skill for this policy.

[16] We could instead subsidized the application costs in combination with a different policy margin. To motivate our choice in this respect, in Appendix C.3.3 we compare the welfare gains of expansions of the CCDF before subsidizing application costs; of the margins we consider, eliminating rationing generates the largest welfare gain.

Table 5: Changes in the distribution of adult skill across steady states

Variable category	Variable description	Baseline	(1) CTC	(2) CCDF
Panel A: Mean and overall inequality	Average	0.938	0.510	6.849
Δ units: percent change (mean) and levels (variance of log)	Variance of log	0.654	0.002	0.038
Panel B: Decile dispersion (log skill)	10th-1st	2.604	-0.001	0.032
Δ units: levels	10th-5th	1.308	-0.014	-0.018
	5th-1st	1.296	0.013	0.050

Notes: Table 5 reports statistics related to the distribution of skill in the baseline and changes relative to the baseline in these statistics after an expansion in (1) the CTC and (2) the CCDF.

In Appendix C.2.1, we show that the average child skill outcome is increasing in the child's initial skill endowment in the baseline equilibrium. However, the gradient of this increase is less steep for children with low-skill parents, indicating that there is room for improvement in the outcomes of children in high-θ_k, low-θ_a families. In Appendix C.3.4, we show that gains in child skill outcomes under both the CTC and CCDF expansions are concentrated among families with low θ_a and high θ_k types.[17] The mass of these high-skill-gain families is determined by the correlation between θ_k and θ_a, which suggests that this correlation is related to the overall changes in average adult skill after each policy is expanded. In our benchmark calibration, our target value for this correlation is set to 0.06, the correlation between child and mother cognitive skill reported in the online appendix of the well-known study of Cunha et al. (2010); the correlation is computed uses nationally-representative US data collected when the child is around 12 months old. We choose this value for our calibration target because it reflects nationally representative data, the child is young enough to be interpreted as close to birth, and because the target value lies between the values of conceptually similar statistics computed in Moschini (2023) (using data on 9-month-old children) and in Attanasio et al. (2020) (using data on 18-month-old children). The estimates from these three studies differ in the data set used, measures of skill, and age of the children when the skills are measured; with such caveats in mind, the overall pattern that emerges is that the measured correlation of child skill and parent skill or income is far less than 1 and is increasing as the child progresses through early childhood.

This pattern is consistent with a low initial correlation combined with endogenous skill investment. One concern, however, is that measurement error at very early ages may bias estimated correlations downward, while a calibration target measured later during early childhood is a conceptually less accurate empirical counterpart to the model object we seek to discipline. Putting the latter concern to the side, a higher initial correlation coefficient would reduce the mass of families that experience

[17] In Appendix C.3.4 we also report gains in child skill outcomes when we additionally eliminate means-testing after the CCDF expansion. Even when high-θ_a families have access to childcare subsidies, high-skill-gain families remain concentrated among high-θ_k, low-θ_a families.

high skill gains from the CCDF expansion and possibly narrow the gap in welfare gains behind the veil of ignorance between the CTC and CCDF expansions. To investigate this mechanism, in Appendix C.5.1 we recalibrate to the higher correlation coefficient of Attanasio et al. (2020), equal to 0.18, and rerun our main experiments. As expected, we find that in the recalibrated environment the CCDF expansion yields lower gains in average adult skill and lower welfare gains behind the veil of ignorance, compared to the CCDF expansion of Table 4. However, qualitatively the takeaways are unchanged: compared to the CTC expansion, adult skill gains are higher after the CCDF expansion, the CCDF is preferred to the CTC behind the veil of ignorance, and adults who know their own type on average experience similar welfare gains across the two policies.[18]

6.3.3 Decomposition of welfare changes behind the veil of ignorance

To identify the sources of welfare gains from each policy expansion, we decompose welfare changes behind the veil of ignorance from Panel C in Table 4 into marginal contributions from four components: (i) changes in the age profile of consumption while holding fixed aggregate consumption at its baseline value; (ii) changes in the average altruism term value due to changes in child skill outcomes; (iii) changes in the average levels of consumption and non-leisure time; and, (iv) a distributional component that embeds remaining adjustments, including changes in the effect of skill on expected lifetime utility in the altruism term of parents, how quantities are distributed across types, and changes in the distribution of types in the economy. Here, due to the policies we examine, we isolate the effect of changes in the age profile of consumption (component i), generalizing the welfare decomposition of Guvenen et al. (2023); the implementation of our decomposition is described in Appendix B.4. Table 6 presents the decomposition results.

For the CTC, the largest contributions to welfare gains stem from changes in the distributional component (iv) followed by the age profile of consumption (component i). Changes in the age profile of consumption (component i) reflect redistribution of consumption towards younger adults, facilitated by the CTC. The distributional component (component iv) embeds several adjustments, but here mostly reflects changes in the distribution of types and changes in the effect of a given child skill outcome on expected lifetime utility in the altruism term of parents. The former effect is positive because the adult skill distribution shifts towards types that benefit more from the CTC expansion, compared to the baseline distribution. The latter effect is positive because adults internalize that, at a given skill outcome, their child will also benefit from the CTC.[19] Changes in

[18] Because measured correlation coefficients tend to increase as the child ages, there may be higher estimates of the correlation between the skills of young children and those of their parents, not discussed in Appendix C.3.4, when measured even later during early childhood. At some point, however, concerns about reasonably interpreting the correlation coefficient as measuring initial conditions start to outweigh concerns about measurement error, especially if one believes (consistent with the premise of this paper) that endogenous investment affects child skill accumulation.

[19] As its definition indicates, component (iv) also reflects changes in the allocation of quantities across types, for

average child skill outcomes and average levels of consumption and non-leisure time (components ii and iii, respectively) also make positive, albeit smaller, contributions to overall welfare gains.[20]

For the CCDF, the largest contribution stems from changes in the average levels of consumption and non-leisure quantities (component iii). Specifically, average consumption in the economy as a whole goes up relative to the baseline because adults have higher skill levels on average in the new economy; at the same time, average labor supply slightly decreases (for example because adults age $j = 1$ distort labor downward to qualify for the CCDF). Changes in the average altruism term due to changes in child skill outcomes (component ii) also contribute positively. In contrast to the CTC, changes in the age profile of consumption (component i) and other adjustments (component iv) act to slightly reduce welfare gains from the CCDF expansion. Component (i) is slightly negative because the share of aggregate consumption going to age $j = 1$ decreases as CCDF recipients substitute away from consumption and towards investment in child skill. Contributions from remaining adjustments (component iv) represent the net effect of several changes. A large share of adults experience welfare losses after the CCDF expansion, and the net negative contribution of this component reflects these unequal gains across consumers; at the same time, the other shifts incorporated in component (iv) act to reduce the magnitude of its negative contribution.

Table 6: Contributions to welfare gains behind the veil of ignorance

Policy	(i) Age	(ii) Child	(iii) Levels	(iv) Dist.	Total
CTC	0.33	0.06	0.18	0.42	1.00
CCDF	-0.02	0.19	0.84	-0.02	1.00

Notes: Table decomposes the sources of welfare gains behind the veil of ignorance across steady states after the CTC expansion (first row) and the CCDF expansion (second row). Columns (i) to (iv) marginally introduce an additional change in the economy; for the welfare metric in each row, the cell reports the share of the total welfare change explained by the contribution of the column. The marginal contributions are described in the main text. The last column emphasizes that these shares sum to one. Column titles are abbreviations of what each component represents; see the text for details.

Comparing across policies, the contribution of changes in the age profile of consumption is more important for welfare gains from the CTC, while the contribution from changes in the level of consumption is more important for welfare gains from the CCDF. This highlights that the CTC redistributes consumption to earlier in life and thereby addresses the inability of consumers to borrow against their future income to finance consumption when young. By comparison, the CCDF

example shifts to more or less beneficial combinations of consumption and labor supply than what is implied by the proportional changes implemented in other components of the decomposition. However, the contribution of these adjustments to welfare changes is small for the CTC expansion.

[20]Parental altruism means that parents partially internalize the expected lifetime utility of their child at the child skill outcome they choose. This object can increase because the child's skill outcome increases (component ii) or because expected lifetime utility goes up at a given child skill outcome, as reflected by component (iv).

encourages investment in child skill, raising the average level of consumption in the economy by raising the average skill of adults. We intuitively connect this to the inability of children to motivate more investment in their skill from their parents: the CCDF can be viewed as a subsidy to skill investment that acts to partially address this missing market between generations. Additionally, using welfare changes behind the veil of ignorance from Table 4 to scale up the shares of Table 6 suggests that, in our environment, policies which partially compensate for children's inability to motivate additional skill investment (such as the CCDF) will tend to yield larger welfare gains compared to policies that, to a greater extent, partially compensate for life cycle borrowing constraints in adulthood by redistributing consumption to earlier ages (such as the CTC).

In Appendix C.3.5, we examine the contribution of aggregate equilibrium adjustments to welfare changes in general equilibrium. Without equilibrium adjustments in the adult skill distribution, behind the veil of ignorance the CTC would be preferred to the CCDF; this finding is consistent with the marginal contribution of changes in average levels of consumption and non-leisure time documented in the decomposition of Table 6. As for average welfare for new adults and all adults, without equilibrium adjustments in income taxes or the scaling of other transfer policies, the CTC would be preferred (for new adults) or generate almost identical welfare changes (for all adults) compared to the CCDF expansion.

In Appendix C.3.6, we report general-equilibrium changes in our three welfare metrics over the transition to the new steady state. Early in the transition, gains from the CTC expansion exceed those of the CCDF expansion. It takes at least a generation (20 years) after the period in which the policy change is introduced for the CCDF welfare gains to exceed gains from the CTC; the first cohort of treated children with higher skill outcomes need to age into the labor market, have their own children, and start paying taxes. By contrast, gains from the CTC are close to their long-run value soon after the policy change; they are less dependent on the skill composition of adults, which is a slow-moving object. The share of adults (both new adults and overall) who benefit from each policy expansion is higher for the CTC compared to the CCDF, both early in the transition and at the long-run steady state.

7 Conclusion and Directions for Future Research

In this paper, we compare spending-equivalent expansions of the CTC and CCDF, two major family policies in the United States. Across steady states, the CCDF expansion yields larger welfare gains behind the veil of ignorance compared to the CTC, driven by larger increases in average adult skill. The increase in adult skill for both policies is higher among children with higher initial skill endowments; adult skill inequality increases under both policies, but more so for the CCDF.

Average welfare gains for new adults and all adults are similar across the two policy expansions, while a larger share of both new adults and all adults benefit from the expansion of the CTC. To articulate differences in the sources of welfare gains across the two policies, we decompose welfare gains behind the veil of ignorance and find that redistribution of consumption across ages drives a relatively larger share of welfare gains after the CTC expansion, while changes in the average level of consumption and non-leisure time (reflecting higher adult skill) contribute relatively more to welfare gains from the CCDF expansion.

There is clearly potential for future research on family policies to offer useful insights for policy makers. In our analysis, we have emphasized frictions associated with the implementation method of childcare subsidies in the United States, and explored alternative expansions of family policies taking these frictions into account. In the process, we make several assumptions in our model framework, which include no borrowing or saving, no financial transfers to children, no earnings risk, and a fixed pretax return to skill (wage rate) on the labor market. Future work might consider in more detail the impact of accounting for these features. As suggested by our decomposition of welfare gains from the CTC, allowing consumers to borrow would most likely reduce welfare gains from expanding the CTC by facilitating consumption-smoothing across ages via the private market (although if borrowing on the private market carries a default premium, then the CTC could still offer a less costly way to borrow against one's future income). Allowing consumers to save could also reduce the benefits of family policies: adults might set aside part of the transfer to finance tax liabilities later in life or, if allowed to delay fertility, could accrue savings before parenthood and reduce the need for additional resources when the child is young. Financial transfers from parents to children could be financed with set-aside earnings or government transfers, and could be used to encourage college enrollment (complementing skill investment) or to compensate for low initial skill endowments (substituting skill investment). Earnings risk would relax the link between adult skill and expected lifetime utility and possibly reduce the impact of transfer policies that seek to encourage investment in child skill. Lastly, if the pre-tax return to adult skill is allowed to vary, this would likely reduce the pass-through of increases in average adult skill to the income tax base, raise the tax burden on older consumers, and lower welfare gains under either family policy expansion that we consider here.

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Online Appendix for:

"Family Policies and Child Skill Accumulation"

by Emily G. Moschini and Monica Tran-Xuan

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A Data and Parameterization

A.1 Transfer policies: spending and recipients

A.1.1 Total transfer policy spending and recipients

In Table 3 of the main text we report the size of the CTC, CCDF, EITC, and TANF in US data; spending on SS in the data is used as a calibration target in Table 2. For these five transfer policies, in this appendix we report total size of spending in aggregate dollar amounts and as a percentage of output (in the latter case a number less than 1 indicates a fraction of a percent), computed for 2015 to 2017 and averaged across years. Annual output is measured using annual GDP from BEA Table 1.1.5 (2022a). The remainder of this section explains in more detail the sources used to compute the size of each policy and our results. Here and elsewhere in this appendix, when we adjust dollar values for inflation we use annual averages of the Consumer Price Index (CPI) (Bureau of Labor Statistics, U.S. Department of Labor, 2024).

Child Tax Credit Using Table 3.3 fromInternal Revenue Service of the United States, Statistics of Income (2023a,b), the size of the combined spending on CTC and ACTC per year is, on average, \$51.4 billion in 2016 USD during the 2015-2017 period. The average percent of GDP spent per year on the CTC/ACTC (CTC in the main text) over this period is 0.27. The average share of tax filers receiving the CTC over this period was on average 0.15.

Earned Income Tax Credit Using Table 3.3 from Internal Revenue Service of the United States, Statistics of Income (2023a,b), the average size of annual spending on the EITC during the 2015-2017 period was \$67.1 billion in 2016 USD. The average percent of GDP spent annualy on the EITC over this time period is 0.35. The average share of all tax filers receiving the EITC in the 2015-2017 period was 0.18.

Child Care Development Fund The average amount spent on the CCDF per year over the 2015-2017 period was \$9.9 billion in 2016 USD, and the number of children receiving subsidies each year over this period was around 2 million (Chien, 2019a,b, 2020). The percentage of children being served by this program each year who are under 5 years old is on average 55 percent for each fiscal year, as shown in Table 9 of Administration for Children & Families (2024a,b,c). This yields an estimate of \$5.5 billion in 2016 USD spent on children under 5 by the CCDF, or an average of 0.03 percent of GDP annually. Using the number of children in the CCDF eligible range from GAO reports, the share of all children under 5 receiving CCDF aid is 0.04. In the model there is one child per family, so 4 percent of children under 5 is the same as 4 percent of families with children under 5, which is the statistic we use as a target in our internal calibration.

Temporary Assistance for Needy Families Using reports from the ACF (Administration for Children & Families, 2024d,e), the amount spent on total (federal and state) basic assistance excluding relative foster care for non-working adults was about \$3.7 billion in 2016 USD, on average; this dollar value incorporates the share of TANF going to non-working adults uses the "participation rate" for TANF recipients reported in Office of Family Assistance (2015). The average percent of GDP spent on the component of TANF that we model each year is therefore 0.02. Because we model a component of the TANF funding stream, statistics on the number of families receiving this portion of the transfer are not available, but dividing the total spending by the annual amount implied by the annualized value of the monthly transfer per child (\$332) yields an average of about 1 million recipients per year. As a share the number of children under 5, this amounts to 0.03 (the number of children under 5 is drawn from the same source as the CCDF calculation).

Social Security As explained in the parameterization of the model in the main text, the size of SS is estimated using BEA data. Specifically, we divide government benefits to persons from BEA Table 1.2.1 (2022c) by the annual GDP in current dollars reported in BEA Table 1.1.5 (2022a). We then average across years. The amount spent on SS each year in the period 2015-2017 was \$895 billion in 2016 USD on average, representing an 4.8 percent of GPD per year.

A.1.2 Comparability of income measures in the model and the data

Our model environment accounts for pretax income, y, which is entirely made up of income from earnings. Our model also distinguishes between after-tax income, $\lambda_y y^{1-\tau_y}$, and disposable income, y_d, which is after-tax income plus cash transfers. Because our model has one adult per household, household income, individual income, and income at the level of the tax unit are all equivalent for a inside of the model.

We use two main sources of individual-level income data in this appendix: the Annual Socio-economic supplement to the Current Population Survey (CPS ASEC) for the years 2015, 2016, and 2017 from (Flood et al., 2024), and CCDF Administrative data for the 2016 FY from CCDF Administrative Data.

In the CPS ASEC, we observe several measures of income at the individual level and the household level, and we are able to construct an anologous measure of income at the tax unit level using the approach described in Appendix A.2.2. For our analysis of spending distributions, the income measure we focus on in the CPS ASEC is total pretax income from earnings at the individual level; we aggregate this to the tax unit level and use the distribution of earnings at the tax unit level to identify thresholds for the earnings distribution.[21] In the CCDF administrative data, we observe income from all sources at the family level (not at the level of the household or individual), along with several flags that identifies whether any portion of that income is from a particular source (earnings, government transfers, etc). The measure of income reported in the CCDF administrative data uses the measure that the state of residence for that individual uses to establish eligibility, so within the CCDF data what this variable is actually measuring may in fact vary across observations and cannot be separated into its components (that is earnings, transfers, and so on). We treat this variable as though it was the same as tax-unit level earnings constructed in the CPS. We do not have enough information in the CCDF administrative data to improve on this approximation. To summarize, with regards to spending distributions in the model and data we analyze both at the tax-unit level whenever possible.

A related point concerns our parameterization approach in situations where parameters for family policies differ across filing statuses (e.g., single versus married filing jointly). This occurs for the CTC and the EITC; to proceed, we convert income thresholds for those married and filing jointly into per-parent income levels, and then average across one- and two-parent families, because each family only has one parent in the model. Within the model parameterization, therefore, we convert family policy parameters related to income to be standardized at the per-parent level. Note that credit level values are per child in the data, and in the model there is one child per family, so no conversion is necessary.

This conversion to per-parent income values is relevant for the parameterization of the CTC and EITC. For the remaining three tranfser policies (CCDF, TANF, and SS) it is not relevant. It is not relevant for the CCDF for the following two reasons. First, in our model specification the eligibility threshold for income uses a percentile of the income distribution rather than a level, so we do not need to convert to per-parent terms. Besides embedding a normalization, this specification reflects the fact that, in practice, federal eligibility thresholds are set proportional to median income for similar families in the same state. Second, the CCDF subsidy rate conditional on receipt is assigned using a linear function of household income normalized by median income in the model. In our parameterization, these parameters were estimated as a function of family income normalized by median household income in the observation's state of residence using CCDF administrative data, so we think of this normalization as accounting for relative income given empirical household sizes that are not the same as our one-adult assumption in the model. Moving to TANF, we do not normalize to per-parent terms because we model only one component of the TANF funding stream in the data, a cash benefits transfer to non-working families at the family level. The level of the

[21] Although it uses the same CPS ASEC extract, our estimation of income tax progressivity is a separate exercise explained later in this appendix which uses adjusted gross income at the tax unit level.

cash transfer is estimated at the family level, and expressed as a fraction of median income in the parameterization. Lastly, this normalization is not relevant for SS pensions, which are disciplined using replacement rates rather than incomes at the household or family level, and therefore do not need to be normalized to per-adult terms.

A.1.3 Distribution of transfer spending and recipients: CTC, CCDF, and EITC

This section reports estimation procedures and results for the distribution of spending and transfer recipients across income quartiles for the CTC, EITC, and CCDF for families with children under the age of 5. We are most interested in the distributions of the CTC and CCDF in the main text, and include the EITC here for completeness. We do not estimate spending distributions for the remaining family policy, TANF, because we model only the component of TANF funding that is targeted to non-working parents which, by construction, concentrates all spending on that policy in the first income quartile. For a discussion of the measures of income that we observe in each dataset used here, see Appendix A.1.2.

The Child Tax Credit We measure the spending of CTC/ACTC using data from the CPS ASEC for the years 2015, 2016, and 2017—specifically, the same sample used to estimate the degree of income tax progressivity described in Appendix A.2.2, but further requiring that tax units have children under the age of 5. Using income from earnings and wages aggregated to the tax units level, we assign tax units in the CPS sample to one of four income bins and aggregate the total amount of the CTC received by each tax unit within each quartile. We then normalize by the total dollars of CTC spending across all quartiles. The distribution of recipients is computed in a similar way but uses recipien counts instead of transfer dollar amounts. Table A.1 reports the income cutoffs and fractions of CTC spending per income quartile; it also reports the share of total recipients of CTC transfers in each quartile in the last column. Note that, although here we use CTC/ACTC, in the main text we use "CTC" to refer to CTC and ACTC, combined.

Table A.1: Distribution of CTC/ACTC spending and recipients

Income quartile	**Lower bound**	**Upper bound**	**Spending**	**Recipients**
1	0	25,000	0.21	0.26
2	25,000	55,697	0.36	0.32
3	55,697	102,000	0.32	0.30
4	102,000	-	0.10	0.13

Notes: Table A.1 reports the income cutoffs and the share of CTC/ACTC spending for each income quartile. Data source: CPS ASEC, 2015-2017. Totals do not sum to 1 because of rounding.

The Child Care and Development Fund To estimate the distribution of CCDF spending over income quartiles, we use same CCDF administrative data sample as subsidy estimation described in Appendix A.2.3, and assign recipient families with children under 5 to income bins using the same income quartile thresholds as Table A.1. Table A.2 reports the share of total spending in the sample allocated to each income quartile; the share of recipients in each quartile and quartile thresholds are also reported in the table.

Table A.2: Distribution of CCDF spending and recipients

Income quartile	Lower bound	Upper bound	Spending	Recipients
1	0	25,000	0.64	0.63
2	25,000	55,697	0.35	0.36
3	55,697	102,000	0.01	0.01
4	102,000	-	0	0

Notes: Table A.2 reports the income cutoffs and the share of CCDF aggregate spending and recipients for each income quartile. Data source: CCDF Administrative data for the 2016 fiscal year. Totals do not sum to 1 because of rounding.

The Earned Income Tax Credit Using the same CPS data as the CTC spending distribution, we also compute spending for the EITC. Table A.3 reports the distribution of spending and recipients for the EITC.

Table A.3: Distribution of EITC spending and recipients

Income quartile	Lower bound	Upper bound	Spending	Recipients
1	0	25,000	0.65	0.56
2	25,000	55,697	0.35	0.44
3	55,697	102,000	0	0
4	102,000	-	0	0

Notes: Table A.3 reports the income cutoffs and the share of EITC spending and recipients for each income quartile. Data source: CPS ASEC, 2015-2017. Totals do not sum to 1 because of rounding.

A.2 Externally estimated parameters

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

A.2.1 Consumption tax rate

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. That is:

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

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 A.4: 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 A.4 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. Because the dollar values in this table are rounded, the annual estimated tax rate for 2017 is 0.01 smaller than the implied value using table numbers reported here.

A.2.2 Income tax progressivity

We estimate the degree of income tax progressivity as representing the combined effects of federal taxes and FICA, net of the CTC and EITC, using the Annual Socio-economic Supplement sample of the Current Population Survey (CPS ASEC). We perform a similar estimation using aggregate data from the Congressional Budget Office (CBO) and find similar results.

Using CPS ASEC data We estimate the income tax progressivity parameter in a way consistent with our model specification using data for the years 2015, 2016, and 2017 from the CPS ASEC.

Following Heathcote et al. (2017), the tax function on total income is $T(y) = y - \lambda_y y^{1-\tau_y}$, where τ_y captures the degree of progressivity. Taking the natural log of both sides, the tax specification implies that the relationship between pretax income y and after-tax income y_{AT} is

$$\log(y_{AT}) = \log(\lambda_y) + (1 - \tau_y)\log(y)$$

Using the above equation, we use an Ordinary Least Squares (OLS) estimator to estimate the slope coefficient that identifies τ_y.

The approach described so far is standard. However, our model environment requires that after-tax income reflect the net impact on taxable adjusted gross income at the tax unit level (taxable AGI) of FICA taxes and federal income taxes including nonrefundable credits but not including refundable credits (that is, the EITC and CTC). In many estimations of the progressivity of the US tax system, including that of Heathcote et al. (2017), the dependent variable is viewed as "post-government" income, and refundable credits and transfers like TANF are included in its value. In our case, we capitalize on tax variables reported in the CPS ASEC. We map from household- or individual-level variables to tax unit level by assigning all individuals in a household to a tax unit using variables recording family relationships and tax filing status included in the CPS. We adjust for inflation to 2016 dollars using the CPI.

For each tax unit, we set y to the taxable AGI for the main tax filer of each tax unit plus 50 percent of total FICA for the tax unit to represent employer contributions to FICA as in the replication package of Heathcote, Storesletten, and Violante (2017).[22] Note that, in Heathcote, Storesletten, and Violante (2017), y is referred to as "pre-government" income, a term which provides intuition for why we add back FICA contribution made by the employer to observed taxable AGI. Taxable AGI in the CPS measures total pretax taxable income after subtracting items such as individual retirement plan contributions, alimony payments, payments to medical savings accounts, and non-reimbursed employee business expenses. For each tax unit, we set y_{AT} to taxable AGI for the tax unit minus 50 percent of total FICA for the tax unit, to represent the employee contributions to FICA. We also subtract the federal tax liabilities after all credits are applied, but adding back the refundable credits that we model separately in the budget constraint (the CTC/ACTC and EITC). Note that federal tax liability is computed taking into account deductions which are not subtracted from taxable AGI. In our application, y_{AT} is closer to after-tax income than the "post-government" income discussed in Heathcote, Storesletten, and Violante (2017) (y_d is the object in our model that is more conceptually aligned with "post-government" income).

Using natural logs, we then estimate $\log(y_{AT}) = \beta_0 + \beta_1 \log(y)$ on the sample of tax units with at least one adult between the ages of 20 and 65, keeping one observation per tax unit and using household-level ASEC weights (the results are very similar when we estimate without weights).

[22] See lines 152 and 153 in the file Progressivity_US_psid_final.do of that replication package.

Table A.5 reports results from this estimation. We find that the progressivity of the tax system, taking into account federal taxes and nonrefundable credits, is about 0.06. This is a lower value than estimates which embed transfer policies like TANF or refundable credits like the CTC and EITC into the after-tax income, such as the 0.181 progressivity estimate of Heathcote et al. (2017). In our model these transfers appear separately in the budget constraint, and therefore the tax progressivity parameter needs to represent attributes of the US tax system that do not embed the effects of these transfers.

Table A.5: CPS ASEC estimating results: income tax progressivity

	$\log(y_{AT})$
$\log(y)$	0.939
	(0.000153)
Constant	0.478
	(0.00166)
$\hat{\tau}_y$	0.0606

Notes: Table A.5 reports estimation results with SEs in parentheses.

Using CBO data To estimate the income tax progressivity, τ_y with an alternative source of data, we apply the robustness method of Heathcote, Storesletten, and Violante (2017) to data from the U.S. Congressional Budget Office (2019), specifically data underlying Figures 1, 3, 4, and 14 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 A.6), 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, and report this net tax rate in column (7). Column (9) is the natural log of average pretax income in column (8), and logged after-tax income reported in column (10) is computed by taking the log of the after-tax net tax rate in column (7) applied to the average income before means-tested transfers and federal taxes reported in column (8). Note that column (8) is a measure of income that sums market income and social insurance benefits; the former includes labor income, business income, capital income and capital gains, income received in retirement for past services, and other nongovernmental income sources, while the latter contains benefits from Social Security, Medicare (measured at cost), unemployment insurance, and workers' compensation. Columns not used in the estimation are included in the table to illustrate their means-tested nature and provide intuition for how including them in after-tax income would affect the progressivity estimate (that is, doing so would increase the estimated value). 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 A.6: 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	13.2	45	1.65	1.60
0	20	1.7	12	10.1	46.7	8.4	6.4	13.7	21	1.32	1.33

Notes: Table A.6 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 $(7) \equiv (1) + (2)$.

To estimate τ_y using CBO data, we derive the estimation equation from the relationship $Y_{AT} = (\lambda_y)\, Y^{1-\tau_y}$. Taking the log of both sides yields the estimation equation:

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

where $\beta_1 = (1 - \tau_y)$. We therefore regress column (10) from Table A.6 on column (9) using an OLS estimator. The estimated values for τ_y using two approaches are presented in Table A.7: 0.054 using population shares as weights in column (1) and 0.065 without weights in column (2). These values bound the result from the CPS ASEC estimation, which is very similar with or without population weights (only the result with population weights is reported in the CPS estimation). Note that the CBO values we use to measure pretax income y in this estimation method is not exactly the same as the taxable AGI used to measure y in our CPS estimate, and the CBO does not precisely measure how refundable tax credits relate to taxable AGI in the data, hence small differences across estimation methods are not surprising.

Table A.7: CBO estimation results: income tax progressivity

	(1) Weights	(2) No weights
$\log(y)$	0.946	0.935
	(0.00997)	(0.00615)
Constant	0.0443	0.0882
	(0.0432)	(0.0315)
$\hat{\tau}_y$	0.0539	0.0652

Notes: Table A.7 reports estimation results with SEs in parentheses.

A.2.3 The CCDF income percentile eligibility threshold and subsidy rate

To estimate the average income percentile eligibility threshold, we scale the the federal eligibility ratio of median income, 0.85, by the ratio of state-eligible to federally-eligible children reported for the 2015-2017 period in Chien (2019a,b, 2020). We then multiply by 0.5 to get an estimate of the income percentile cutoff; our estimate is slightly less than the 27th percentile of income.

We discipline the CCDF subsidy rate conditional on receipt using CCDF administrative data for the 2016 fiscal year. In the estimation sample, we include observations for which income is positive and from employment only. We restrict attention to observations where income is only from employment because, to parameterize this policy, we want to estimate the effect of income from earnings and the subsidy rate. We only include observations for whom the reason for receiving the subsidy is allowing the parent to work (that is, not alternative approved activities like training or job search). We also restrict attention to observations whose subsidy-recipient children are all under 5 years old, and for whom we observe family size and family structure. We drop observations where we do not observe the state of residence and we also drop residents of Puerto Rico. Finally, we drop observations where the reported hours in childcare exceed the assumed time endowment of the child (100 hours), where the copayment exceeds family income, where the estimated subsidy rate is above 1. Summary statistics are reported in Table A.8.

Table A.8: CCDF subsidy rate estimation sample

	mean	median	sd
Total income for determining eligibility (monthly)y	1908.72	1765.00	993.07
Total CCDF payments by government (monthly)	615.56	545.00	404.21
Total copayment by family (monthly)	117.43	93.00	115.88
Observations	22,616		

Notes: Table A.8 reports summary statistics for the estimation sample for the CCDF subsidy rate. Income is in 2016 USD. Moments are weighted using annual adjusted weights for families/children served. Source:2016 FY CCDF aministrative data.

Next, we specify a linear relationship between income as a fraction of state median income (relative poverty) and the share of childcare expenses paid by the government (the subsidy rate). The relationship is:

$$\left(\frac{\text{Total childcare payments by government}}{\text{Total childcare expenses}}\right)_i = \beta_{N,0} + \beta_{N,1}\left(\frac{\text{Monthly income}}{\text{State median income}}\right)_i$$

where observations are at the family level. The numerator of the dependent variable is total childcare payments made by the CCDF for the family, and the denominator is the the sum of payments made by the government and the payments made by the family. We impute state median income from US Census Bureau and Social Explorer (2023) using the reported state of residence to the CCDF data. Using the sample of Table A.8, we estimate the slope and intercept of this linear relationship using an OLS estimator. The results are presented in Table A.9.

Table A.9: CCDF administrative data: subsidy rate estimation results

Coefficient	**Value**
$\beta_{N,0}$	0.957 (0.0074)
$\beta_{N,1}$	-0.348 (0.0161)
Observations	22,616

Notes: Table A.9 reports point estimates with SEs in parentheses.

A.2.4 The EITC

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, 2021). 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. In the model, this corresponds to whether or not the adult's age j is greater than 4. In practice, this policy is most generous to working adults with children, but also provides a small transfer to poor working adults without children. Accordingly, we model the EITC as the minimum of two constraints, whose parameters are indexed by j; the credit is also required to be nonnegative. The EITC can be written as:

$$EITC\left(y \mid j, \vec{\pi}_E\right) = \begin{cases} \max\left\{\min\left(\beta_{E,in,j}y, \overline{\kappa}_{E,j} - \beta_{E,out,j}\left(y - \overline{y}_{E,j}\right)\mathbb{I}_{y>\overline{y}_{E,j}}\right), 0\right\} & \text{if } j \leq 9 \\ 0 & \text{otherwise} \end{cases} \tag{17}$$

Moving from left to right on the right-hand side of equation (17), the first constraint is the phase-in amount, which takes a positive value for any positive earned income. The second constraint is the maximum credit value, which phases out for higher incomes. If the minimum of these two constraints is negative, then the EITC is set to zero. As with the CTC, the income thresholds and credit levels of the EITC are set as constant fractions of median income, so that their levels in units of consumption are allowed to adjust in equilibrium. Specifically: $\overline{\kappa}_{E,j} \equiv \Theta_{E,\kappa,j}\overline{y}_{pop}$, $\overline{y}_{E,j} \equiv \Theta_{E,y,j}\overline{y}_{pop}$. The vector of EITC parameters is therefore: $\vec{\pi}_E = \{\beta_{E,in,j}, \beta_{E,out,j}, \Theta_{E,\kappa,j}, \Theta_{E,y,j}\}$.

Parameters are reported in Table A.10. 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; values are mapped into the model using the same approach as the CTC described in the main text. Numerator values are converted to 2016 dollars using the CPI; in the denominator the 2016 median household income in the US, $\overline{y}_{US}$, is set to the average across 2015, 2016, and 2017 values in 2016 dollars calculated using data from Guzman (2017, 2018).

Table A.10: EITC policy parameters

Parameter symbol	Parameter description	Parameter value $(j \leq 4)$	$(j > 4)$
$\Theta_{E,\kappa,j}$	Max. credit amount	$\frac{\$2{,}865}{\overline{y}_{US}}$	$\frac{\$302}{\overline{y}_{US}}$
$\beta_{E,in,j}$	Credit rate (phase-in)	0.387	0.0765
$\beta_{E,out,j}$	Phase-out rate	0.2006	0.0765
$\Theta_{E,y,j}$	Phase-out threshold	$\frac{\$12{,}998}{\overline{y}_{US}}$	$\frac{\$7{,}086}{\overline{y}_{US}}$

Notes: Table A.10 reports parameter values $\vec{\pi}_E$. 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), normalized using median household income reported in Guzman (2017, 2018).

A.2.5 TANF

TANF is an especially complex funding stream. 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 that TANF money is spent on are basic assistance (cash transfers), childcare, 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). In principle, 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 addition, if families have income other than TANF, then they receive a reduced benefit (Falk and Landers, 2022).

In this paper, we model one component of the constellation of uses for TANF funding in reality. Specifically, 'TANF" in the model refers to direct cash payments to non-working families with young children:

$$TANF\,(j, \vec{\pi}_T) = \begin{cases} \kappa_T & \text{if } j = 1 \\ 0 & \text{otherwise} \end{cases} \tag{18}$$

The zero-income requirement is reflected in the definition of disposable income in equation (9) of the main text, so income is not an argument in equation (18). The TANF transfer is set as a constant fraction of median income: $\overline{\kappa}_T \equiv \Theta_T \overline{y}_{pop}$. The vector of TANF parameters is therefore:

$\vec{\pi}_T = \{\Theta_T\}$.

Table A.11 reports the estimated value for Θ_T, set using the annualized monthly cash transfer amount for families with one child from Office of Family Assistance (2015). We convert this annualized amount to 2016 dollars using the CPI and divide it by $\overline{y}_{US}$, the median household income in the US in 2016 dollars average across 2015, 2016, and 2017 values from Guzman (2017, 2018).

Table A.11: TANF policy parameters for 2015-17

Parameter symbol	Parameter description	Parameter value
Θ_T	Cash transfer ratio	$\frac{\$3{,}984}{\overline{y}_{US}}$

Notes: Table A.11 reports the externally estimated parameter value in $\vec{\pi}_T$.

A.2.6 Social Security pensions

SS pensions are set as a function of the highest years 35 years of earnings and are paid during retirement, which can begin at age 62 although 65 (or higher) is the age at which workers are entitled to their full benefit (the "full retirement age") Social Security Administration of the United States (2016b). Up to 85 percent of this pension can be taxed Social Security Administration of the United States (2016a). In the main text, the SS pensions are the only form of income during retirement; in reality, personal savings supplement this pension (and may also be taxed). In the model, SS benefits are given by:

$$SS\left(j, \theta_a, \lambda_y, \tau_y, \vec{\pi}_P\right) = \begin{cases} \left(1 - \phi_{P,tx}\right) \kappa_P\left(\theta_a, \vec{\pi}_P\right) + \lambda_y \left(\phi_{P,tx} \kappa_P\left(\theta_a, \vec{\pi}_P\right)\right)^{1-\tau_y} & \text{if } j \geq 10 \\ 0 & \text{otherwise} \end{cases} \tag{19}$$

Here, the pretax pension level $\kappa_P\left(\theta_a, \vec{\pi}_P\right)$ is determined for each θ_a in equilibrium using the replacement rate, ϕ_P, which multiplies average earnings for θ_a types in the 35 years before retirement. The SS benefit is also affected by the share of the pension that is taxed, $\phi_{P,tx}$. The vector of SS parameters is therefore: $\vec{\pi}_P = \{\phi_P, \phi_{P,tx}\}$.

As explained in Section 4, ϕ_P is calibrated within the model to match aggregate spending on SS as a share of output. We set $\phi_{P,tx}$ to the maximum share of the pension that may be taxed as stated in Social Security Administration of the United States (2016a), reported in Table A.12 below.

Table A.12: SS policy parameters for 2015-17

Parameter symbol	Parameter description	Parameter value
$\phi_{P,tx}$	Share taxed	0.85

Notes: Table A.12 reports the externally estimated parameter in $\vec{\pi}_P$.

A.2.7 Childhood skill investment technology

The parameters of the dynamic technology are takend directly from Moschini (2023). 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 parental time and p_n the price of non-parental childcare time faced by the family.

$$\min_{q,n} \left[w_q q + p_n n\right] \qquad s.t.\ I\left(q,n\right) \geq I$$

where $n+q, n, q \in [0,1]$ and the investment technology affects the constraint, as given in equation (5) of the main text. From the first-order conditions of this problem we obtain:

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

Most datasets do not allow the econometrician to control for $\frac{\theta_q}{\theta_n}$ at the household level. If one assumes that for the average household using childcare in the population the parent and childcare productivity are the same, then for the average household the term $(1-\nu)\ln\left(\frac{\theta_q}{\theta_n}\right)$ is equal to 0 and the following equation holds:

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

One can then express γ in terms of ν and average quantities and prices:

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

Because in Moschini (2023) the elasticity parameter ν is not statistically different across family structures, we assign ν as the population-weighted average of their estimates, 0.56. 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 given ν and observed averages for prices and quantities, which is 0.32. This parameterization approach allows us to capture the qualitative takeaways of Moschini (2023) in our current framework, which abstracts from heterogeneity in family structure.

A.2.8 Adulthood life cycle skill accumulation technology

We assume that wages grow over the life cycle in the model so that $\tilde{\theta}(j, \theta_a) = (1 + growth(j))\,\theta_a$, where

$$growth(j) = \beta_1^{age}(j-1) + \beta_2^{age}(j-1)^2 + \beta_3^{age}(j-1)^3$$

We calibrate β_1^{age}, β_2^{age} and β_3^{age} so that wage growth at age $j = 2$, $j = 5$, and $j = 8$ relative to age $j = 1$ matches the experience-wage profiles for rich countries estimated at 5-year intervals and reported in Panel B of Table 3 of Lagakos, Moll, Porzio, Qian, and Schoellman (2018). We chose Panel B because it is an intermediate case with respect to the cited Table's assumptions, and we chose the experience-wage profiles for rich countries because we want growth rates suitable for the United States.

B Model

B.1 The joint distribution over ages and types

This section constructs the joint distribution over ages and adult types. To begin we introduce some useful notation. The type of a consumer, z_j, varies by age and is defined as:

$$z_j \equiv \begin{cases} \{\theta_a, \xi, \delta, \theta_k, R\} & \text{if } j = 1 \\ \{\theta_a\} & \text{otherwise} \end{cases}$$

Define $\pi_\xi(\xi)$ as the probability of drawing ξ, $\pi_k(\theta_k \mid \theta_a)$ as the conditional probability of drawing θ_k given θ_a, and $\pi_N(R)$ as the probability of drawing R, which can be either 0 or 1. The joint distribution over ages j and types z_j is:

$$\Omega(j, z_j) \equiv \begin{cases} \frac{1}{11} \times \mu(\theta_a)\,\pi_\xi(\xi)\,\pi_k(\theta_k \mid \theta_a)\,\pi_N(R)\,\mathbb{I}_{\delta^*(\theta_a,\xi)=\delta} & \text{if } j = 1 \\ \frac{1}{11} \times \mu(\theta_a) & \text{otherwise} \end{cases} \tag{20}$$

The distribution across types conditional on a given age can be constructed from the distribution across types and ages:

$$\Omega_j(j, z_j) = 11 \times \Omega(j, z_j)$$

The subscript on Ω indicates the age on which we condition the distribution, so that $\int_{z_j} \Omega_j(j, z_j)\, dz_j = 1, \forall j$ and $\sum_{j=1}^{11} \int_{z_j} \Omega(j, z_j)\, dz_j = 1$.

B.2 The government's budget constraint

The government's budget constraint is balanced by λ_y^* which solves:

$$\begin{aligned}\lambda_y^* \sum_{j=1}^{11} \int_{z_j} \left(y^*(j, z_j)^{1-\tau_p}\right) \Omega(j, z_j)\, dz_j \quad &= \quad (1-\Theta_G) \sum_{j=1}^{11} \int_{z_j} (y^*(j, z_j))\, \Omega(j, z_j)\, dz_j \\ &+ \quad \sum_{j=1}^{11} \int_{z_j} (\tau_c c^*(j, z_j))\, \Omega(z_j)\, dz_j \\ &- \quad \sum_{X=\{C,E,T,P,N\}} \sum_{j=1}^{11} \int_{z_j} (g_X^*(j, z_j))\, \Omega(j, z_j)\, dz_j\end{aligned} \tag{21}$$

The components of this budget constraint are, on the left-hand size, after-tax income, and on the right-hand side the share of output available after government consumption is financed, plus consumption-tax revenue, net of spending on transfer programs. Spending on transfer programs for each type at each age in equilibrium is denoted by $g_X^*(j, z_j \mid \vec{\pi}_G)$, which is the pretax amount of transfers received from policy X by type z_j and age j of adulthood in equilibrium.

B.3 Definition of a stationary steady state equilibrium

Given a conditional distribution of initial skill endowments for each adult skill, a distribution of fixed costs for CCDF application, a goods production technology, a childcare pricing rule, and a government policy vector $\vec{\pi}_G$, a stationary steady state equilibrium is defined as:

1. agent choices and objective functions (consumers, goods producer, and childcare provider)
2. consumer expectations about $V_k^a(\theta_k^a)$
3. a distribution over the skills of new adults $\mu(\theta_a)$
4. an average income tax rate λ_y

such that

1. agents optimize taking prices as given
2. consumer expectations are rational
3. the distribution over family types is stationary

4. the government balances its budget constraint

Given environmental primitives and distribution of skill for new adults, $\mu(\theta_a)$, the distribution over family types, $\Omega(j, z_j)$, is constructed using equation (20) of Appendix B.1. When all of the equilibrium conditions hold, the goods market clears by construction. Assumptions about the childcare provider's pricing rule imply 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 at that price.

B.4 Decomposition of welfare changes behind the veil of ignorance

In the main text, we present results from a decomposition exercise which extends the flexible methodology of Guvenen et al. (2023) to allow for a fourth component, changes in consumption age profiles. The four components are:

(i) Changes in share of total consumption going to each age group (holds fixed aggregate consumption at its Φ value)

(ii) Changes in the average level of child skill outcomes (holds fixed aggregate consumption at its Φ value)

(iii) Changes in the average level of consumption and non-leisure time (implies the Φ' level of aggregate consumption)

(iv) Changes in the expected return to skill for lifetime utility, the distribution of quantities across individuals, and the endogenous distribution of types (implies the Φ' level of aggregate consumption)

To implement this decomposition, we begin by constructing a set of value functions that gradually incorporate the total change in the economy moving from one steady state to the other. Next, we convert these value functions into expected values by taking expectations using the distribution of adult skill in the relevant equilibrium (specified below). Gradually moving across these intermediate value functions, we then compute the consumption-equivalent welfare change that makes a consumer indifferent between the previous value function and the current one. That welfare change is the marginal contribution of the change that the current value function represents. In the main text, we decompose the welfare changes behind the veil of ignorance at age $j = 1$ (at the start of adulthood). Here, we describe a more general methodology that implements the decomposition for any age j.

B.4.1 Constructing auxiliary objects

To perform this decomposition, we begin by defining some notation that is useful for this exercise. As in the main text, let Φ be the policy regime that indexes a steady state equilibrium; moving from the baseline policy to the expanded policy regime is indicated by going from Φ to Φ'. Accordingly, policy functions that are chosen by consumers aged j with type z_j under policy Φ are referred to generically as $g^*(j, z_j, \Phi)$, where g is equal to c for consumption, h for labor supply ,and so on. Next, define the following objects:

$$\begin{aligned} C(\Phi) &= \sum_j \int_{z_j} c^*(j, z_j, \Phi)\, \Omega(j, z_j, \Phi)\, dz_j; \\ H(\Phi) &= \sum_j \int_{z_j} \ell^*(j, z_j, \Phi)\, \Omega(j, z_j, \Phi)\, dz_j; \\ Q(\Phi) &= \sum_j \int_{z_j} q^*(j, z_j, \Phi)\, \Omega(j, z_j, \Phi)\, dz_j; \end{aligned}$$

The first line is aggregate consumption under policy Φ , the second line aggregate labor, and the third aggregate quality time from parents. Here, $\Omega(j, z_j, \Phi)$is the joint distribution over types z_j and age j under policy Φ that arises in equilibrium and is such that $\sum_j \int_{z_j} \Omega(j, z_j, \Phi)\, dz_j = 1$. Next, construct the average child expected lifetime utility:

$$\overline{V}_k^a(\Phi', \Phi) = \int_{z_j} V_k^{a*}\left(\theta_k^{a*}(j, z_j, \Phi'), \Phi\right) \Omega_{j=1}(j = 1, z_j, \Phi)\, dz_j.$$

Here, we use the equilibrium expected value function, $V_k^{a*}(\cdot, \Phi)$, computed under policy regime Φ, evaluated at $\theta_k^{a*}(j, z_j, \Phi')$, which is the equilibrium skill outcome of a child (mnemonic: "k" for kid) at adulthood (mnemonic: "a" for adult) chosen by family z_j at $j = 1$ under a policy regime Φ' which may be different from the policy regime Φ under which the expected value function is computed. This skill outcome is found by evaluating the skill production technology using the parents' type and their choice of investment inputs; we express the family's investment decision in the space of skill outcomes for the purpose of this exercise. We integrate using the conditional distribution over types for age $j = 1$ under policy Φ. Next, define the aggregate quantity of consumption for age j:

$$C_j(\Phi) = \int_{z_j} c^*(j, z_j, \Phi)\, \Omega(j, z_j, \Phi)\, dz_j.$$

Using this quantity, we can build the share of aggregate consumption going to each age j in equilibrium Φ:

$$S_C(j, \Phi) = \frac{C_j(\Phi)}{C(\Phi)}$$

Next, we construct value functions that marginally introduce changes to the environment, moving from the baseline equilibrium under policy Φ to the new equilibrium under policy Φ'. To begin, define the modified set of policy functions:

$$c_J\left(j, z_j, \Phi, \Phi'\right) = c^*\left(j, z_j, \Phi\right) \frac{S_C\left(j, \Phi'\right)}{S_C\left(j, \Phi\right)}.$$

Here, the only change relative to the baseline is that we adjust consumption to reflect the redistribution across ages that occurs when moving to the new policy. This adjustment maintains aggregate consumption at its value in the baseline equilibrium, $C\left(\Phi\right)$.

B.4.2 Constructing value functions

As we proceed, $u\left(\cdot\right)$ denotes the utility function of the main text, evaluated at a given set policy functions.

(i) First marginal change: change in share of total consumption going to each age group We now construct the present discount lifetime utility value function $V_J\left(j, \theta_a, \Phi, \Phi'\right)$ for each age $j = x$ and type θ_a:

$$V_J\left(x, \theta_a, \Phi, \Phi'\right) = \begin{cases} \mathbb{E}_{\theta_k, \xi, R}\left(\sum_{j=x}^{J} \beta^{j-x}\left[u\left(c_J\left(j, z_j, \Phi, \Phi'\right), \ell^*\left(j, z_j, \Phi\right), q^*\left(j, z_j, \Phi\right)\right) + bV_k^a\left(\theta_k^{a*}\left(j, z_j, \Phi\right), \Phi\right)\right] \mid \Phi\right) & \text{if } j = 1 \\ \sum_{j=x}^{J} \beta^{j-x}\left[u\left(c_J\left(j, z_j, \Phi, \Phi'\right), \ell^*\left(j, z_j, \Phi\right), q^*\left(j, z_j, \Phi\right)\right)\right] & \text{otherwise.} \end{cases}$$

Notice that, except for consumption, all the other policy functions remain at their baseline values. Also note that we use the start of stage 1 of period $j = 1$ value function for the age 1 consumers; we take expectations using the distribution over types in the economy indexed by Φ, so that the value function on the left-hand side is indexed by θ_a at each age.

(ii) Second marginal change: change in average child skill outcomes Next, we define

$$V_A^{kid}\left(z_j, \Phi, \Phi'\right) = V_k^a\left(\theta_k^{a*}\left(j, z_j, \Phi\right), \Phi\right) \frac{\overline{V}_k^a\left(\Phi, \Phi'\right)}{\overline{V}_k^a\left(\Phi, \Phi\right).}$$

This scales the altruism term by the ratio of average realized values across the two equilibria, incorporating only changes in child skill outcomes and not the changes in the endogenous value function that maps from skill outcomes to expected lifetime utilities. We can now define our next value function, $V_A\left(j, \theta_a, \Phi, \Phi'\right)$, which adjusts V_J by incorporating the change in average child outcomes. For age $j = x$ and type θ_a this function is:

$$V_A\left(x, \theta_a, \Phi, \Phi'\right) = \begin{cases} \mathbb{E}_{\theta_k, \xi, R}\left(\sum_{j=x}^{J} \beta^{j-x}\left[u\left(c_J\left(j, z_j, \Phi, \Phi'\right), \ell^*\left(j, z_j, \Phi\right), q^*\left(j, z_j, \Phi\right)\right) + V_A^{kid}\left(z_j, \Phi, \Phi'\right)\right] \mid \Phi\right) & \text{if } j = 1 \\ \sum_{j=x}^{J} \beta^{j-x}\left[u\left(c_J\left(j, z_j, \Phi, \Phi'\right), \ell^*\left(j, z_j, \Phi\right), q^*\left(j, z_j, \Phi\right)\right)\right] & \text{otherwise.} \end{cases}$$

(iii) Third marginal change: change in average levels of consumption and non-leisure quantities In the third marginal change, we first define:

$$\begin{aligned} c_L\left(j, z_j, \Phi, \Phi'\right) &= c_J\left(j, z_j, \Phi, \Phi'\right) \frac{C\left(\Phi'\right)}{C\left(\Phi\right)}; \\ \ell_L\left(j, z_j, \Phi, \Phi'\right) &= \ell^*\left(j, z_j, \Phi\right) \frac{H\left(\Phi'\right)}{H\left(\Phi\right)}; \\ q_L\left(j, z_j, \Phi, \Phi'\right) &= \begin{cases} q^*\left(j, z_j, \Phi\right) \frac{Q(\Phi')}{Q(\Phi)} & \text{if } j = 1 \\ 0 & \text{otherwise.} \end{cases} \end{aligned}$$

This set of objects scales policy functions and the altruism term in the baseline by the proportional change in aggregate levels for the respective quantity, except for consumption, which scales the age-profile adjusted policy c_J.

We now construct the present discount lifetime utility value function $V_L\left(j, \theta_a, \Phi, \Phi'\right)$, which for a given age $j = x$ and type θ_a is:

$$V_L\left(x, \theta_a, \Phi, \Phi'\right) = \begin{cases} \mathbb{E}_{\theta_k, \xi, R}\left(\sum_{j=x}^{J} \beta^{j-x}\left[u\left(c_L\left(j, z_j, \Phi, \Phi'\right), \ell_L\left(j, z_j, \Phi, \Phi'\right), q_L\left(j, z_j, \Phi, \Phi'\right)\right) + bV_A^{kid}\left(z_j, \Phi, \Phi'\right)\right] \mid \Phi\right) & \text{if } j = 1 \\ \sum_{j=x}^{J} \beta^{j-x}\left[u\left(c_L\left(j, z_j, \Phi, \Phi'\right), \ell_L\left(j, z_j, \Phi, \Phi'\right), q_L\left(j, z_j, \Phi, \Phi'\right)\right)\right] & \text{otherwise.} \end{cases}$$

(iv) Fourth marginal change: distributional and other adjustments The remaining component is the marginal effect of incoporating changes in the expected lifetime utility for a given child skill outcome, changes in the distribution of quantities across stypes, and changes in the distribution of types in the economy. To compute this we construct the realized value function in equilibrium Φ is $V\left(j, \theta_a, \Phi\right)$, and is given for age $j = x$ and type θ_a by:

$$V\left(x, \theta_a, \Phi\right) = \begin{cases} \mathbb{E}_{\theta_k, \xi, R}\left(\sum_{j=x}^{J} \beta^{j-x}\left[u\left(c^*\left(j, z_j \Psi\right), \ell^*\left(j, z_j, \Phi\right), q^*\left(j, z_j, \Phi\right)\right) + bV_k^a\left(z_j, \Phi\right)\right] \mid \Phi\right) & \text{if } j = 1 \\ \sum_{j=x}^{J} \beta^{j-x}\left[u\left(c^*\left(j, z_j \Psi\right), \ell^*\left(j, z_j, \Phi\right), q^*\left(j, z_j, \Phi\right)\right)\right] & \text{otherwise.} \end{cases}$$

When evaluated at Φ, this is the initial equilibrium full value function. When evaluated at Φ', it is the final equilibrium full value function. Note that $V\left(x, \theta_a, \Phi'\right)$ is where we incorporate changes in ϕ_N, which is embedded in the expectation taken when $j = 1$ that conditions on the policy environment Φ'.

B.4.3 Constructing marginal contributions from each component as share of total

From the value functions defined above, construct the expected utility of a consumer born into age $j = x$ and taking expectations over their possible adult skill θ_a:

$$\begin{aligned}
\mathbb{E}_{\theta_a}\left[V_J\left(x,\theta_a,\Phi,\Phi'\right) \mid j\right] &= \int_{\theta_a} V_J\left(x,\theta_a,\Phi,\Phi'\right)\mu\left(\theta_a \mid \Phi\right)d\theta_a; \\
\mathbb{E}_{\theta_a}\left[V_A\left(x,\theta_a,\Phi,\Phi'\right) \mid j\right] &= \int_{\theta_a} V_A\left(x,\theta_a,\Phi,\Phi'\right)\mu\left(\theta_a \mid \Phi\right)d\theta_a; \\
\mathbb{E}_{\theta_a}\left[V_L\left(x,\theta_a,\Phi,\Phi'\right) \mid j\right] &= \int_{\theta_a} V_L\left(x,\theta_a,\Phi,\Phi'\right)\mu\left(\theta_a \mid \Phi\right)d\theta_a; \\
\mathbb{E}_{\theta_a}\left[V\left(x,\theta_a,\Phi\right) \mid j\right] &= \int_{\theta_a} V\left(x,\theta_a,\Phi\right)\mu\left(\theta_a \mid \Phi\right)d\theta_a.
\end{aligned}$$

Note that the last line is the full expected lifetime utility at age x in equilibrium Φ; in the new equilibrium both the left- and right-hand side are evaluated at Φ', so that the integration uses $\mu\left(\theta_a \mid \Phi'\right)$.

The next step is to compute the consumption-equivalent welfare change using these expected values. These are the consumption-equivalent changes that need to be given to each θ_a aged $j = x$ to make them indifferent as we hypotheticall move from the baseline economy to each marginal transformation of their allocation described above. In computing these welfare changes we impose the utility functional form used in the main text, which is reflected in the expressions below.

$$\begin{aligned}
1+\kappa_J\left(x,\Phi,\Phi'\right) &= \exp\left(\frac{\mathbb{E}_{\theta_a}\left[V_J\left(x,\theta_a,\Phi,\Phi'\right) \mid x\right]-\mathbb{E}_{\theta_a}\left[V\left(x,\theta_a,\Phi\right) \mid x\right]}{\sum_{j=x}^{J}\beta^{j-x}}\right); \\
1+\kappa_A\left(x,\Phi,\Phi'\right) &= \exp\left(\frac{\mathbb{E}_{\theta_a}\left[V_A\left(x,\theta_a,\Phi,\Phi'\right) \mid x\right]-\mathbb{E}_{\theta_a}\left[V_J\left(x,\theta_a,\Phi,\Phi'\right) \mid x\right]}{\sum_{j=x}^{J}\beta^{j-x}}\right); \\
1+\kappa_L\left(x,\Phi,\Phi'\right) &= \exp\left(\frac{\mathbb{E}_{\theta_a}\left[V_L\left(x,\theta_a,\Phi,\Phi'\right) \mid x\right]-\mathbb{E}_{\theta_a}\left[V_A\left(x,\theta_a,\Phi,\Phi'\right) \mid x\right]}{\sum_{j=x}^{J}\beta^{j-x}}\right); \\
1+\kappa_D\left(x,\Phi,\Phi'\right) &= \exp\left(\frac{\mathbb{E}_{\theta_a}\left[V\left(x,\theta_a,\Phi'\right) \mid x\right]-\mathbb{E}_{\theta_a}\left[V_L\left(x,\theta_a,\Phi,\Phi'\right) \mid x\right]}{\sum_{j=x}^{J}\beta^{j-x}}\right).
\end{aligned}$$

In particular, $\kappa_J\left(x,\Phi,\Phi'\right)$ is the marginal welfare change at age x after incorporating changes in the age profile of consumption to the initial baseline equilibrium, holding fixed aggregate consumption. Next is the marginal contribution of average changes in the level of child skill outcomes, κ_A, and the marginal contribution from changes in average levels of other quantities, κ_L for a given age and type in the same way. The last term here, κ_D, is the consumption-equivalent change of moving from $\mathbb{E}_{\theta_a}\left[V_L\right]$ to the value function of that type in the new equilibrium. This incorporates the fact that the return to child skill outcomes in the altruism term may have changed, that types do not all see the same proportional change in their utility-input quantities, and that the distribution of types over which expectations are taken may have changed. Note that only the final expected value function is aggregated using the distribution of adult skill in the new equilibrium. Also note that this decomposition is log-additive in the sense that it aggregates to the total welfare change for age $j = x$ as follows:

$$\begin{aligned}
1+\kappa_{tot} &= (1+\kappa_J)(1+\kappa_A)(1+\kappa_L)(1+\kappa_D) \\
&= \exp\left(\frac{\mathbb{E}_{\theta_a}\left[V_J(x,\theta_a,\Phi,\Phi') \mid x\right] - \mathbb{E}_{\theta_a}\left[V(x,\theta_a,\Phi) \mid x\right]}{\sum_{j=x}^{J}\beta^{j-x}}\right) \\
&\quad \times \exp\left(\frac{\mathbb{E}_{\theta_a}\left[V_A(x,\theta_a,\Phi,\Phi') \mid x\right] - \mathbb{E}_{\theta_a}\left[V_J(x,\theta_a,\Phi,\Phi') \mid x\right]}{\sum_{j=x}^{J}\beta^{j-x}}\right) \\
&\quad \times \exp\left(\frac{\mathbb{E}_{\theta_a}\left[V_L(x,\theta_a,\Phi,\Phi') \mid x\right] - \mathbb{E}_{\theta_a}\left[V_A(x,\theta_a,\Phi,\Phi') \mid x\right]}{\sum_{j=x}^{J}\beta^{j-x}}\right) \\
&\quad \times \exp\left(\frac{\mathbb{E}_{\theta_a}\left[V(x,\theta_a,\Phi') \mid x\right] - \mathbb{E}_{\theta_a}\left[V_L(x,\theta_a,\Phi,\Phi') \mid x\right]}{\sum_{j=x}^{J}\beta^{j-x}}\right) \\
&= \exp\left(\frac{\mathbb{E}_{\theta_a}\left[V(x,\theta_a,\Phi') \mid x\right] - \mathbb{E}_{\theta_a}\left[V(j=x,\theta_a,\Phi) \mid j\right]}{\sum_{j=x}^{J}\beta^{j-x}}\right).
\end{aligned}$$

Using the property of the log function that $\log(1+w) \approx w$ for small values of w,we can also say that the contribution of a given component w for an individual to the total can be approximately represented by $s_w = \frac{\kappa_w}{\kappa_{tot}}$. We report these shares in the main text; one can verify that the approximation is adequate by confirming that they sum to 1.

C Results

C.1 Calibration

Our model has seven parameters whose value we assign inside of the model (internally calibrate). To identify these parameters, we select seven moments that are related to at least one of the calibrated parameters and which reflect aspects of reality that we want the model to match. We provide intuition for why we think those aspects of reality are relevant for our purposes in the main text. We choose a set of target moments that reflect those attributes of reality, but there may be more than one set of target moments that does so. For example, there could be alternative estimates in the literature of the correlation of initial child skill endowment with adult skill (we perform robustness on this calibration target moment in Appendix C.5.1). In another example, intergenerational mobility could be measured with the correlation of child skill outcomes and parent income, as in the main text, or using the correlation of the income distribution rank across generations, as measured with the rank-rank correlation coefficient of Chetty et al. (2014) (we perform robustness on this calibration target moment in Appendix C.5.2).

When we present our calibration results of the main text, we emphasize that all calibrated parameters affect the set of calibration targets. Operationally, we calibrate parameters jointly to target all moments at the same time; as we iterate towards a solution in this process we update each parameter using the difference between one of the moments and its target value. The moment used to update a given parameter is what we refer to as its "target moment"; of course, another parameter's value can affect a parameter's target moment. The result of the calibration is a set of seven parameter values that are consistent with the set of seven moments that we target. As parsimonious evidence of each parameter affecting the moment that we use to update it, Figure C.1 illustrates how each parameter's target moment changes as a percent change from the moment's baseline value (y-axis) when the parameter is increased or decreased by 20 percent of its baseline equilibrium value (x-axis).

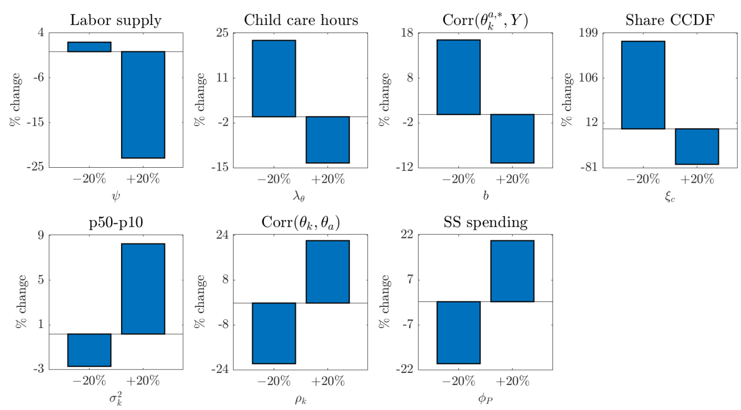


Figure C.1: Percent change in target moment as calibrated parameter changes

Notes: Figure C.1 reports the percent change in the calibration target moment from its baseline value when each calibrated parameter is decreased/increased by 20 percent. The y-axis of each figure is the percent change in the target moment from its baseline value; the x-axis is the percent change of the parameter from its initial value, assigned using calibrated value from the baseline equilibrium of the main text.

C.2 Baseline equilibrium: additional properties

C.2.1 Skill outcome: percentage difference from population average

Figure C.2 breaks down averages by parent adult skill quartile (θ_a) and initial child skill endowment quartile (θ_k). Specifically, Figure C.2a illustrates patterns in the level of investment in child skill and Figure C.2b illustrates patterns in the adult skill outcome. Each panel in a subfigure is a different θ_a quartile. Each x-axis category is a different θ_k quartile. The y-axis of each panel is the percentage-point difference between the (θ_a, θ_k) average value and the across-θ_k, within θ_a average value.

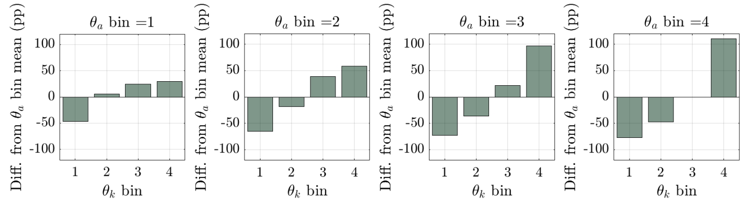
Within each panel of Figure C.2a, increasing the child's initial skill endowment implies a higher level of investment in the child's skill. Moving to the right across panels in the figure, as the parent adult skill quartile increases the gradient of the level of investment in the child's skill with respect to initial child skill endowment becomes steeper. The higher the level of investment the more worthwhile it is to distort labor supply downward in order to qualify for the CCDF.

Within each panel of Figure C.2al, increasing the child's initial skill endowment implies a higher average adult skill outcome. Moving to the right across panels in the figure, as the parent adult skill quartile increases the gradient of the child's skill outcome with respect to initial child skill endowment becomes steeper. This means that, for families with low-θ_a, there is room to achieve higher skill outcomes for children with higher skill endowments in a pattern similar to higher θ_a bins.

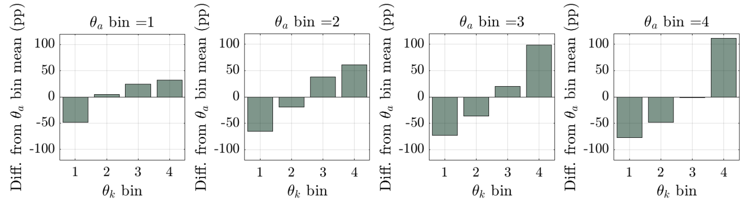
C.2.2 Attributes of CCDF recipients

In Table C.13, we compare CCDF recipient attributes in the model baseline with observable moments computed using CCDF administrative data for the 2016 FY. In what follows, for the average earnings of the population of parents with children under 5 we use earnings at the tax unit level measured in CPS ASEC.

We focus on three statistics: the realized pretax income of recipients compared to all families with children in the same age range; the realized average subsidy rate among CCDF recipients; and, the annual dollar amount per child received from the CCDF by recipients. In the baseline equilibrium, the relative income of CCDF recipients is comparable to its empirical counterpart: CCDF recipients are poorer than the average household with similar-age children to a degree similar to what we observe in the data. The model's conditional average subsidy rate is close to the data, although slightly higher: this average rate arises endogeneously in the model baseline equilibrium due to CCDF application and receipt combined with the CCDF subsidy rate. Finally, the annual dollar amount per child received from the CCDF in the model is slightly higher than its empirical



(a) Investment



(b) Adult skill outcome

Figure C.2: Average investment level and adult skill outcome of children, by θ_a and θ_k quartile: difference from θ_a- quartile mean

Notes: Figure C.2 breaks down averages by parent adult skill quartile (θ_a) and initial child skill endowment quartile (θ_k). Specifically, Figure C.2a illustrates patterns in the level of investment in child skill and Figure C.2b illustrates patterns in the adult skill outcome. Each panel in a subfigure is a different θ_a quartile. Each x-axis category is a different θ_k quartile. The y-axis of each panel is the percentage-point difference between the (θ_a, θ_k) average value and the across-θ_k, within θ_a average value.

counterpart: this is partly due to the higher subsidy rate among recipients in the baseline, although it is also due to our model's childcare market in which all childcare has the same price. In reality, families who are eligible for the CCDF are likely to face lower pre-subsidy prices for childcare than their higher-income peers (Moschini, 2023).

Table C.13: Attributes of CCDF recipients: model versus data

Variable description	**Data**	**Model**
Average income as a share of pop. average	0.29	0.32
Average subsidy rate	0.84	0.88
Average transfer (1000s USD, per year per child)	7.39	9.65

Notes: Table C.13 reports three statistics in both the model baseline equilibrium and the data. First, the average income of CCDF recipients as a fraction of average income for parents with children under 5. Second, the average CCDF subsidy rate among recipients. Third, the conditional annual dollar amount of transfers received from the CCDF for recipients, converted to 2016 USD using US median household income.

Although we do not have a comparable estimate to compare it with in the data, we can compute the dollar value of the average application cost paid by CCDF applicants in the baseline, scaling into 2016 USD using median household income. This average application cost is \$4,345.

C.2.3 Share of adults receiving of CTC and EITC transfers

Table C.14 compares the share of adults that receive transfers from the CTC and EITC in the model baseline to the share of tax filers that receive these transfers in the data. We do not report the mass of recipients for the CCDF because it is targeted in our calibration. We do not report the mass of recipients for the component of TANF that we model because our empirical estimate of that mass is closely linked to aggregate spending (which we compare in the main text) so doing so would be redundant. Empirical moments are computed in the data as described in Appendix A.1.

Model values in Table C.14 have a good fit to their empirical counterparts, although the model slightly underestimates the share of recipients for the CTC (the EITC's difference with the data is very small). This may be partly due to the fact that, when parameterizing the CTC, we rounded the eligibility threshold for the child's age downward from 17 to 15; rounding the age eligibility cutoff for the model representation is necessary because in our model each period lasts five years.

Table C.14: Share of adults receiving transfers in the model baseline and US data

Policy	**Data**	**Model**
Child Tax Credit (CTC)	0.15	0.12
Earned Income Tax Credit (EITC)	0.18	0.17

Notes: Table C.14 reports the share of the relevant population that receive transfers from each family policy in the baseline economy and in US data during the period 2015-2017, as well as the definition of the population of interest for the transfer. For the empirical source of data moments see Appendix A.1.

C.2.4 Spending distribution of the EITC

In Figure C.3, we compare distributions of total spending and transfer recipients in model baseline with the data. Empirical values are constructed as described in Appendix A.1.

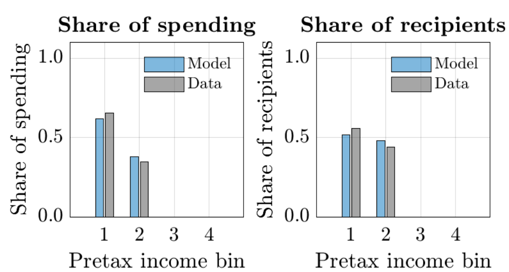


Figure C.3: EITC share of spending and recipients by income quartile

Notes: Figure C.3 reports, for households with children aged under 5, the share of transfer spending going to each income quartile (left panel) and share of recipients (right panel) for the EITC in the model baseline and the data. The y-axis of each graph is the share of total spending or total recipients; the x-axis is the income quartile assigned using the distribution of income for households with children under 5.

C.3 Main experiments: additional findings

C.3.1 Inflows into CCDF application and receipt after the CCDF expansion

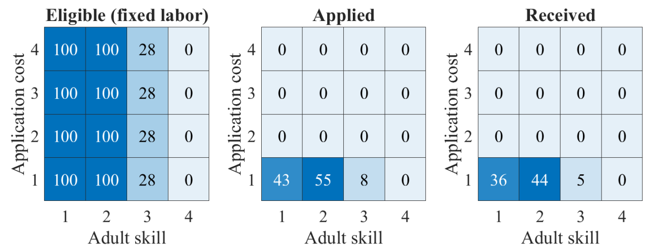
Here, we demonstrate how the composition of CCDF applicants and recipients changes after the CCDF policy expansion of the main text in general equilibrium. We report results broken down by adult skill and application cost bins in Figure C.4 and by adult skill and initial child skill endowment in Figure C.5. As a reminder about timing within the model of the main text, recall that the CCDF application decision is made taking as given the application cost draw and adult skill level of the family, as well as the intergenerational correlation of skill in the environment, but without knowing the specific skill draw of the child. After application, receipt and the initial skill draw are realized, after which labor supply is chosen. For a given breakdown, we report the baseline CCDF application and receipt patterns with their counterparts after the CCDF expansion of the main text.

Specifically, we report the within-cell percentage who are eligible for the CCDF at a fixed level of labor supply (16 hours per week), as well as the percentage who apply for and receive CCDF aid in separate graphs. Here, as in the main text; in that sense, we are using *potential* eligibility following the method of Guzman (2019). We chose this level of labor supply as a reasonably low number of hours that illustrates our point. If the share of a cell who apply or receive the CCDF exceeds the share who are eligible, it means that some adults worked less than 16 hours a week in order to qualify for the CCDF. We point this out before proceeding because drawing takeaways about sorting by adult skill into application and receipt from this figure (and comparing these patterns with the literature) is aided by representing eligibility established according to some measure, but constructing this set requires us to make some choices which could lead to interpretive confusions if not directly addressed. This is the case in Figure C.4 because there are cells for which no one is flagged as eligible but application rates are above zero.

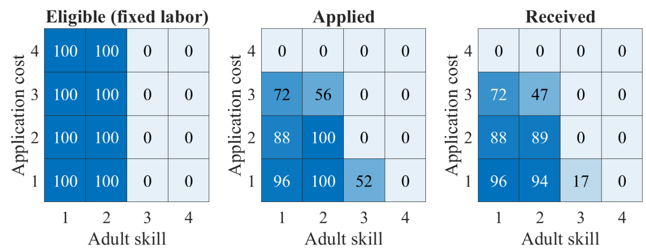
Comparing across Figure C.4a and Figure C.4b, eliminating rationing and subsidizing CCDF application costs means that, at a fixed level of labor supply, some types are no longer eligible (left panel). This is due to the drop in labor supply among young adults, evident in Table 4, which lowers the value of the eligibility threshold for the CCDF (computed as the 27th percentile of income among adults with children under 10). This drop in the eligibility threshold occurs despite the increase in average adult skill.

As for the composition of CCDF recipients, the CCDF expansion generates inflows into CCDF application and receipt that occur from relatively higher application cost bins than the baseline equilibrium counterparts. Figure C.5 is more clear in regards to inflows by θ_a: comparing Figures C.5a and C.5b shows that application inflows arrive from both adults in the first, second, and third skill quartiles, although inflows are largest for the first two adult skill bins.

The far right panel of Figure C.5b illustrates that there is sorting into receipt by child initial skill endowment which is already present in the baseline but becomes more noticeable after the CCDF expansion. This effect becomes stronger once the application cost subsidy is introduced because it becomes less costly to apply for the CCDF, so those who are more likely to refuse an offer of CCDF aid once θ_k is realized are now more likely to apply.



(a) Baseline equilibrium



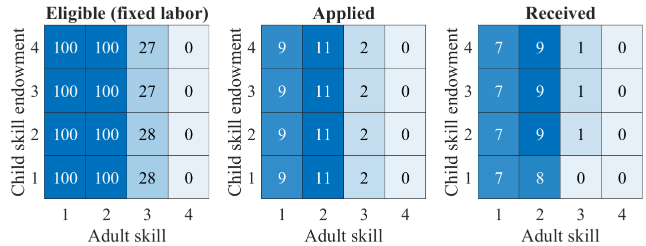
(b) CCDF expansion of the main text

Figure C.4: Selection into CCDF application and receipt by adult skill θ_a and application cost ξ

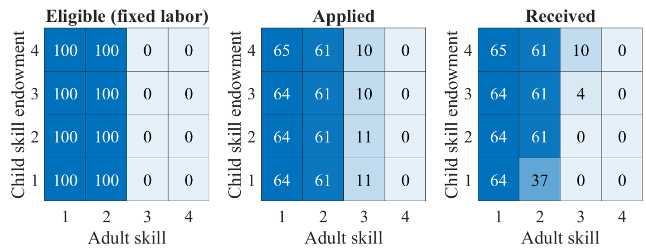
Notes: Figure C.4 shows conditional rates of CCDF eligibility, application, and receipt among parents with children under 5 in the baseline (Figure C.4a), and after the CCDF expansion of the main text (Figure C.5b). Conditional rates are in percentages and are broken down by adult skill and the CCDF application cost draw. This exercise is in general equilibrium; quartiles are assigned in using unconditional distributions of each variable in the baseline equilibrium.

C.3.2 Breakdowns of policy margins

Table C.15 reports changes in aggregate quantities and welfare after the 2017 TCJA expansion of the CTC (column 1). Then, in columns (2) to (4), we shut off one CTC policy margin change at a time by setting it to its baseline value, and allow consumers to re-optimize while holding fixed aggregate quantities and distributions at their values in the new steady-state. Specifically, in column (2) we shut off the increase in the maximum credit level for the nonrefundable and refundable components; in column (3), we shut off the decrease in the lower-bound on income eligibility; in column (4), we shut off the increase in the upper-bound for income eligibility. Note that the change in the tax rate and average adult skill in each of these decomposition exercises are the same as in column (2), because these exercises are in partial equilibrium after the economy has



(a) Baseline equilibrium



(b) CCDF expansion of the main text

Figure C.5: Selection into CCDF application and receipt by adult skill θ_a and initial child skill endowment θ_k quartile

Notes: Figure C.5 shows conditional rates of CCDF eligibility, application and receipt among parents with children under 5 in the baseline (Figure C.5a), and after the CCDF expansion of the main text (Figure C.5b). Conditional rates are in percentages and are broken down by adult skill and initial child skill endowment. This exercise is in general equilibrium; quartiles are assigned in using unconditional distributions of each variable in the baseline equilibrium.

reached its new steady state.

Welfare changes drop the most from their general-equilibrium values when we shut off the policy margin changes in columns (2) and (4). These results indicate that the welfare gains from the CTC expansion are driven by the rise in the phaseout threshold (column 4) and the rise in the maximum credit levels (column 2). Although our focus is not on labor supply of parents, the CTC decomposition indicates that, without the increase in the phaseout threshold, the CCDF expansion lowers labor supply on net because a sufficient mass of consumers distort their labor choice downward in order to qualify for the increased credit. This distortion dominates inflows from non-working parents seeking the increased credit. Expanding the range of eligible incomes without raising the maximum credit level has a slightly positive effect on labor supply as it reduces the set of parents affected by the incentive to distort labor downward to qualify for the credit. Changing both the credit level and expanding the range of eligible incomes allows the rise in the credit level to pull non-working parents into the labor force and reduces the incentive to distort labor downward for adults with higher incomes, so that on average labor supply slightly increases.

In Table C.16, we perform a similar exercise for the CCDF expansion of the main text. Here, the two marginal changes that we shut off one at a time are the rationing rate (which is set to 1 in the

Table C.15: Breakdown of policy changes in the 2017 TCJA CTC expansion

Variable category	Variable description	Baseline	(1) CTC	(2) $\overline{\kappa}$	(3) $\underline{y}$	(4) $\overline{y}$
Panel A: Government	Government expenditures	22.62	0.54	0.12	0.54	0.36
Δ units: percentage point change	Average tax rate (at y_{ave} baseline SS)	17.68	0.53	0.53	0.53	0.53
Panel B: Aggregate quantities	Average adult skill	0.94	0.51	0.51	0.51	0.51
Δ units: percent change	Labor supply	0.31	0.14	0.01	0.15	-0.64
	Output	0.43	0.52	0.52	0.52	-0.17
	Consumption	0.35	0.49	0.02	0.49	-0.40
Panel C: Welfare change in levels	Behind the veil of ignorance	0.00	2.45	0.64	2.43	1.99
Δ units: percent of lifetime consumption	New adults	0.00	1.87	0.06	1.85	1.42
	All adults	0.00	-0.18	-0.49	-0.19	-0.28
Panel D: Share who gain	New adults	0.00	1.00	0.50	1.00	0.77
Δ units: share of group	All adults	0.00	0.22	0.06	0.22	0.16

Notes: Table C.15 reports changes in aggregates after the CTC expansion of the main text in general equilibrium (column 1), and changes after setting one changed policy margin at a time to its baseline value in partial equilibrium. Specifically, column (2) sets the maximum credit levels (maximum refundable and nonrefundable) to their baseline values, column (3) sets the phase-in income threshold to its baseline value, and column (4) sets the phaseout threshold to its baseline value.

full policy change and toggled to its baseline value in column 2) and the application cost subsidy κ_N, which is set to its baseline value of zero in column (3). As in Table C.15, the tax rate and change in average adult skill are set to the final steady-state value in columns (2) and (3). The results indicate that the application cost subsidy (column 3) makes the largest contribution to total welfare changes from the CCDF expansion, although both ingredients are important; the effect on labor supply for each margin is similar for each component of the policy reform.

Table C.16: Breakdown of policy changes in the CCDF expansion

Variable category	Variable description	Baseline	(1) CCDF	(2) ϕ_N	(3) κ_N
Panel A: Government	Government expenditures	22.62	0.54	0.39	0.08
Δ units: percentage point change	Average tax rate (at y_{ave} baseline SS)	17.68	0.23	0.23	0.23
Panel B: Aggregate quantities	Average adult skill	0.94	6.85	6.85	6.85
Δ units: percent change	Labor supply	0.31	-0.61	-0.46	-0.37
	Output	0.43	6.61	6.66	6.71
	Consumption	0.35	6.02	6.05	6.08
Panel C: Welfare change in levels	Behind the veil of ignorance	0.00	8.28	7.78	7.00
Δ units: percent of lifetime consumption	New adults	0.00	2.11	1.63	0.89
	All adults	0.00	0.00	-0.05	-0.11
Panel D: Share who gain	New adults	0.00	0.66	0.66	0.59
Δ units: share of group	All adults	0.00	0.15	0.15	0.14

Notes: Table C.16 reports changes in aggregates after the CCDF expansion of the main text in general equilibrium (column 1), and changes after setting one changed policy margin at a time to its baseline value in partial equilibrium. Specifically, column (2) sets the rationing rate to its baseline value and column (3) sets the application cost subsidy to zero, its value in the baseline economy.

C.3.3 Motivation for choice of CCDF policy margins

In our main experiments, we expand the CCDF by shutting off rationing and subsidizing the application cost of applying for aid. We follow this procedure to focus on the benefits of reducing frictions in access to subsidized childcare, similar to adjusting the implementation method of the policy while holding its other attributes fixed. Although they would be less fitting for that goal, we could alternatively adjust the application cost subsidy while also adjusting other policy margins that affect the means-tested nature of the policy. In Table C.17 we demonstrate that, compared to eliminating rationing (column 1), multiple alternative expansions of the CCDF that generate the same increase in government expenditures yield lower welfare gains. The alternatives we consider are increasing the maximum subsidy value (column 2), decreasing the rate of change of the subsidy as income increases (column 3), or eliminating the income cutoff for eligibility (column 4).

Table C.17: Motivating choice of margins for the CCDF expansion in the main text

Variable category	Variable description	Baseline	(1) ϕ_N	(2) $\beta_{N,0}$	(3) $\beta_{N,1}$	(4) No $\overline{y}_N$
Panel A: Government	Govt. expenditures	22.62	0.05	0.05	0.05	0.05
Δ units: percentage point change	Ave. tax rate (at y_{ave} baseline SS)	17.68	-0.01	0.02	0.02	0.03
Panel B: Agg. quantities	Ave. adult skill	0.94	1.12	0.52	0.52	0.44
Δ units: percent change	Labor supply	0.31	-0.02	0.00	-0.01	0.04
	Output	0.43	1.12	0.51	0.51	0.46
	Consumption	0.35	1.05	0.44	0.44	0.37
Panel C: Δ W in levels	Behind the veil of ignorance	0.00	1.00	0.41	0.41	0.24
Δ units: percent of lifetime consumption	New adults	0.00	0.08	0.03	0.03	-0.01
	All adults	0.00	0.02	-0.02	-0.02	-0.03
Panel D: Share who gain	New adults	0.00	0.57	0.51	0.51	0.34
Δ units: share of group	All adults	0.00	0.96	0.05	0.05	0.03

Notes: Table C.17 reports changes in aggregate quantities after alternative spending-equivalent expansions of the CCDF. Column (1) eliminates rationing; column (2) and (3) calibrate the indicated parameter to match spending in column (1); column (4) eliminates the upper bound on income for CCDF eligibility.

C.3.4 Sources of skill gains

Figure C.6 shows changes in adult skill outcomes for children born into an initial child skill endowment, or θ_k, quartile and adult skill, or θ_a, quartile. The first and second row reports changes after the CTC and CCDF expansions of Table 4 in Section 6 of the main text, respectively. For each expansion, skill changes are reported in partial equilibrium (darker shade) and general equilibrium (lighter shade). A general takeaway of this figure is that increases in child skill outcomes after either expansion are driven by families with low-skill adults and children with high initial skill endowments.

Starting with the CTC expansion, in the lowest θ_a quartile, changes in child skill outcomes are increasing in θ_k in partial equilibrium, and in general equilibrium are slightly lower for the fourth

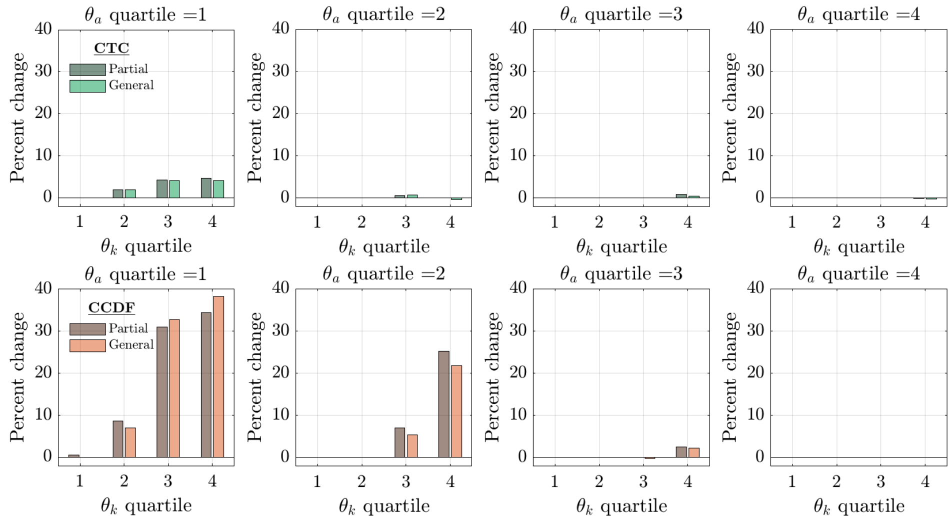


Figure C.6: Changes in skill outcomes from baseline in general equilibrium, by θ_k and θ_a

Notes: Figure C.6 shows percent changes in skill outcomes by quartile of initial skill endowment, θ_k, and adult skill, θ_a, after the CTC (first row) and CCDF expansion (second row) in Section 6 of the main text. Each column is a different adult skill quartile; for each adult skill quartile, each figure shows changes by initial skill endowment quartile. Changes after each expansion are shown in two equilibrium types: partial equilibrium and in general equilibrium. Bins are assigned using the baseline equilibrium's distribution. The legend of each row indicates the color of the equilibrium type.

θ_k quartile compared to the third quartile. At higher levels of parent skill, changes in child skill outcomes are much smaller, and any non-negligible negative changes are introduced by general equilibrium adjustments.

For the CCDF expansion, changes in child skill outcomes are increasing in child skill for each adult skill quartile in partial equilibrium. These changes shift slightly upward once general-equilibrium adjustments are taken into account.

Changes in adult skill outcomes for children are decreasing in the skill of their parent because lower-skill adults are those for whom the largest adjustment in child skill outcomes compared to the baseline is possible, especially for parents with high-skill children (recall that child skill outcomes are correlated with family income as a consequence of our calibration, and income and skill and strongly related in this model).

The changes in skill outcomes differ when moving from partial equilibrium to general equilibrium. The reasons for this include: first, changes in expected lifetime utility in the altruism term of the parent's objective function which affect their incentives to achieve a given child skill outcome (due to changes in tax rates and transfers that affect different adult skill levels differently); and, second, adjustments in other transfer programs as the economy grows, which provide additional aid to some parenting adults (i.e., "scaling" of these policies). In the case of the CTC, the first adjustment dominates: as the tax rate adjusts, being very high-skilled offers fewer rewards and this outcome is no longer worth financing for altruistic parents. In the case of the CCDF, the second adjustment dominates among the poor (first θ_a quartile) and increases in child skill outcome increase relative to partial equilibrium. For θ_a's in the second quartile, however, the first effect dominates, and the skill gains of children decrease in general equilibrium relative to partial equilibrium.

In Figure C.7, we perform a new comparison of changes in skill outcomes. We report changes in general equilibrium after the CCDF expansion of the main text and after a second CCDF expansion which implements all of the changes of the main-text CCDF expansion and additionally sets $\beta_{N,1} = 0$ and eliminates the income eligibility cutoff, so that income does not affect the CCDF transfer. This maintains the CCDF work requirement, however. The two policies are not-spending equivalent, but the point of this comparison is to show that skill gains remain concentrated among high-θ_k, low-θ_a types after a CCDF expansion even without the means-testing of the baseline CCDF.

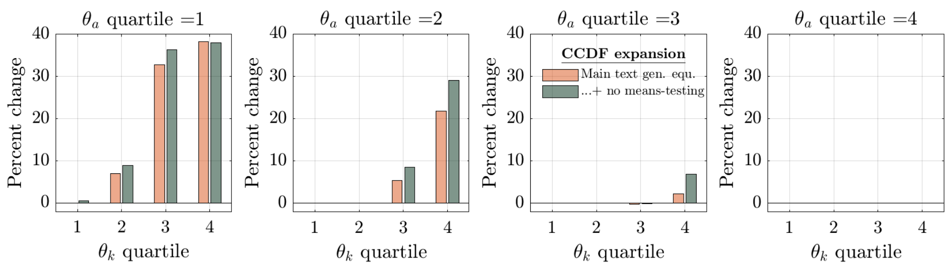


Figure C.7: CCDF expansion of main text vs. additionally eliminating means-testing: changes in skill outcomes from baseline in general equilibrium, by θ_k and θ_a

Notes: shows percent changes in skill outcomes by quartile of initial skill endowment, θ_k, and adult skill, θ_a, after the CCDF expansion of in Section 6 of the main text and the an expansion in which means-testing is additionally eliminated. Each column is a different adult skill quartile; for each adult skill quartile, each figure shows changes by child initial skill endowment quartile. Bins are assigned using the baseline equilibrium's distribution. The two policies are not-spending equivalent, but the point of this comparison is to show that skill gains remain concentrated among high-θ_k, low-θ_a types even without the means-testing of the baseline CCDF.

C.3.5 The role of general equilibrium adjustments

In column (1) of Table C.18 we present welfare changes behind the veil of ignorance and on average for new adults (age $j = 1$) and all adults after the two policy expansions in general equilibrium, drawn from Panel C of Table 4. Beginning with column (2), each column of Table C.18 holds fixed general-equilibrium object(s) at their baseline value while feeding in all of the other general-equilibrium objects at their values in the final steady-state. These exercises allow for household decisions to adjust to the same policy change when facing a different aggregate environment; the goal of these exercises is to identify the extent to which welfare changes are affected by adjustments in various aggregate endogenous objects. Specifically, each column holds fixed the following:

(2) full partial equilibrium where only household choices adjust and aggregate objects stay at their baseline values

(3) the distribution of adult skill

(4) the return to skill for expected lifetime utility, V_k^a

(5) average income tax λ_y

(6) childcare price p

(7) family transfer scaling to income distribution

(8) pensions

In full partial equilibrium, the CTC gains are larger than the CCDF gains for all three welfare measures (column 2). The general equilibrium gains for the CTC in Panel A are most affected by the adjustments held fixed in columns (5), (3), and (4). The high tax burden of this expansion holds down welfare gains both behind the veil of ignorance and on average for adults (column 5), while the increase in expected adult skill raises well-being behind the veil of ignorance (column 3). As for column (4), holding this fixed lowers welfare gains by about a half a percentage point both behind the veil of ignorance and on average for new adults; internalizing that one's children can expect more aid compounds the welfare gains from this policy. The general equilibrium gains from the CCDF expansion in Panel B are most affected by adjustments held fixed in columns (3), (7), and (5) although to differing extents depending on the welfare measure. Behind the veil of ignorance, most gains arise from higher expected adult skill levels (column 3), while for new adults the scaling of family transfers boosts average gains (column 7). This is also reflected in the average across consumer ages. As for column (5), adjustments in the income tax act to lower welfare gains, especially for all adults on average.

C.3.6 Welfare changes over the transition

From a political economy standpoint, the short-run effects of a policy change are likely to play a significant role in determining its viability as a possible reform. Table C.19 reports welfare changes over the transition to the two steady states analyzed in Table 4. In period zero, the economy is at the initial steady state; in period 1 of the transition, the policy parameters are changed to their values in the final equilibrium and the economy is allowed to gradually converge to its stationary steady state. Here, altruistic parents whose children are past early childhood do not internalize changes

Table C.18: Partial equilibrium decomposition of welfare changes across steady states

Panel A: CTC	**(1) GE**	**(2) PE**	**(3) $\mu(\theta_a)$**	**(4) V_k^a**	**(5) λ_y**	**(6) p**	**(7) Scaling**	**(8) Pension**
Behind the veil of ignorance	2.45	2.01	1.87	1.94	3.08	2.48	2.45	2.45
New adults	1.87	2.02	1.87	1.36	2.49	1.90	1.87	1.87
All adults	-0.18	0.35	-0.19	-0.23	0.42	-0.18	-0.18	-0.21
Panel B: CCDF	**(1) GE**	**(2) PE**	**(3) $\mu(\theta_a)$**	**(4) V_k^a**	**(5) λ_y**	**(6) p**	**(7) Scaling**	**(8) Pension**
Behind the veil of ignorance	8.28	1.43	2.17	7.68	8.58	8.61	7.43	8.29
New adults	2.11	1.44	2.20	1.55	2.39	2.43	1.30	2.12
All adults	0.00	0.13	0.00	-0.05	0.26	0.03	-0.17	0.05

Notes: Table C.18 reports welfare changes after expanding the CTC (Panel A) and CCDF (Panel B), in General Equilibrium (GE), Partial Equilibrium (PE), and holding fixed one general equilibrium object at at time as indicated in the header of each column. The column "Scaling" refers to family policies eligibility thresholds and transfer levels being held fixed at their baseline values.

in their child's expected lifetime utility that occur after the policy is implemented in period 1. In Panel A, we report welfare changes after the CTC expansion for new adults behind the veil of ignorance, new adults, and all adults at 5 (first completed period of the transition), 25, and 45 years into the transition, as well as at the new steady state. Panel B reports the same statistics for the CCDF expansion.

Beginning with the CTC in Panel A, welfare gains behind the veil of ignorance are initially lower than their long-run value and rise over time as average adult skill rises. Average welfare gains for new adults and all adults, however, are closer to their long run values early on in the transition, because these changes are driven by redistribution across ages and types, rather than by changes in average adult skill. The average welfare gain for new adults declines slightly over time as the price of childcare rises with average adult skill, and the share who gain is always equal to 1; the welfare losses of all adults are slightly mitigated over time as tax rates decline due to long-run expansions in the stock of adult skill (and therefore taxable income), and the share who gain slightly increases over time.

As for the CCDF in Panel B, welfare gains behind the veil of ignorance are initially low and take a generation to accrue most of their long-run value, because it takes that long for the first treated cohort of children to join the workforce and start parenting, earning money, and paying taxes. At the same time, as these higher-skilled cohorts of adults start to work, a larger tax base allows the average income tax to decrease, lowering the burden on older adults who do not receive transfers from family policies. Over time, this acts to raise average welfare gains for new adults and adults; the share who gain in each group also increases from the initial periods of the transition to the new steady state.

To summarize, early in the transition the CTC is preferred because its sources of welfare gains are faster-moving than those of the CCDF.

Table C.19: Welfare changes at various points in the transition to the new steady state

Panel A: CTC	**5**	**25**	**45**	**Final**
Behind the veil of ignorance	1.88	2.19	2.42	2.45
New adults	1.88	1.87	1.87	1.87
- Share who gain	1.00	1.00	1.00	1.00
All adults	-0.22	-0.22	-0.19	-0.18
- Share who gain	0.21	0.21	0.22	0.22
Panel B: CCDF	**5**	**25**	**45**	**Final**
Behind the veil of ignorance	1.00	6.14	7.49	8.28
New adults	0.95	1.12	2.00	2.11
- Share who gain	0.43	0.44	0.66	0.66
All adults	-0.40	-0.29	-0.05	0.00
- Share who gain	0.04	0.04	0.14	0.15

Notes: Table C.19 reports welfare changes after expanding the CTC (Panel A) and CCDF (Panel B), at various points in the transition to the new stationary steady state.

C.4 Additional experiments using the benchmark model

C.4.1 Gradual expansions of CTC and CCDF

In the main text, we compare two spending-equivalent expansions of the CTC and CCDF, where the magnitude of the expansion is dictated by the parameters of the CTC expansion passed into law by the 2017 Tax Cuts and Jobs Act. Here, we demonstrate that the qualitative patterns of welfare gains from each expansion are not unique to the specific change in government spending that we consider in the main text, but rather hold true over a wide range of changes in government spending levels.

In Figure C.8, we report changes in well-being in consumption equivalent units for paired gradual expansions of the CTC and CCDF in general equilibrium. We expand the CTC by setting the income eligibility thresholds to their TCJA values and gradually raising the maximum credit level; we expand the CCDF by eliminating rationing and gradually subsidizing application costs. These expansions use the margins we varied in our main experiments. In the figure, the color of each line denotes the policy being expanded. The three panels of the figure each report a different measure of welfare changes: behind the veil of ignorance (left panel), averaged across new adults (middle), and averaged across all adults (right); changes in government spending on all transfer policies and government consumption on the x-axis relative to the baseline equilibrium. The legend in the middle panel explains the line symbolism.

The variation in government spending is bounded by construction in the following way: we set κ_N such that it pays for all of the application costs in the economy and eliminate rationing. This determines the upper bound on the change in government spending, 1.84 percentage points, that we impose on both expansions. Next, we calibrate the maximum credit level value (same for refundable and nonrefundable components) of the CTC expansion so that its maximum government spending is the same as the upper bound established with the CCDF. Each line of Figure C.8 ends with a round, solid dot to emphasize that the upper bound on government spending in the graph represents a natural bound on the change in government spending. Of course, the CTC could be expanded further than the CCDF, but the point of the exercise is to compare these policies.

Moving across panels, welfare changes behind the veil of ignorance are higher for the CCDF at every spending level; they are slightly higher for the CCDF when examining welfare changes for adults who know their own skill type at age $j = 1$ (middle panel) or averaging across adults overall (right panel).

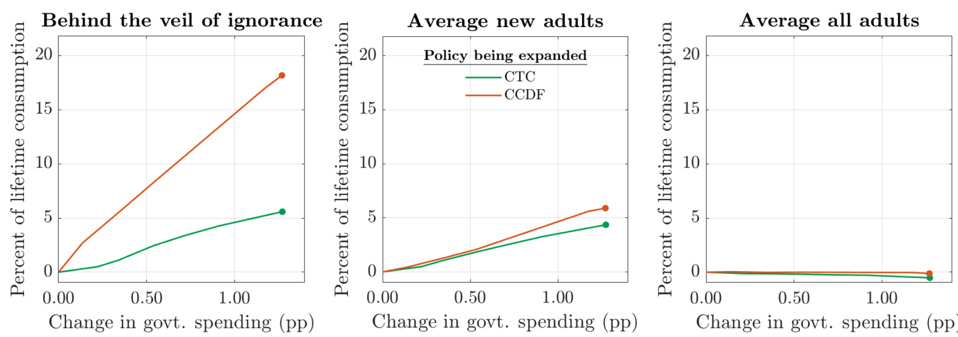


Figure C.8: Welfare changes after gradual expansions of CTC or CCDF

Notes: Figure C.8 reports changes in well-being in consumption equivalent units using three different measures: behind the veil of ignorance (left panel), averaged across new adults (middle), and averaged across all adults (right). Lines end with round dots to highlight that the expansion has reached a natural limit in government spending, described in the text.

C.4.2 Alternative spending-equivalent expansions of CCDF

In our main experiments, we expand the CCDF by reducing access frictions. Specifically, we eliminate rationing and subsidize the CCDF application cost until government spending increases by the same amount as under the CTC expansion. Table C.20 reports the effects of two alternative spending-equivalent expansions of the CCDF, reported in columns (3) and (4), which we compare with the main-text results reported in columns (1) and (2). Specifically, column (3) reports changes after expanding the CCDF using only the application cost subsidy. Column (4) reports changes after a "traditional" expansion, where the income eligibility cutoff is eliminated, $\beta_{N,0}$ is set to zero, and $\beta_{N,1}$ is calibrated to 0.935 in order to match the change in government spending of column (1). This traditional expansion maintains the CCDF work requirement.

Table C.20: Alternative CCDF expansions compared to main experiment

Variable category	Variable description	Baseline	(1) CTC	(2) CCDF	(3) κ_N	(4) Trad.
Panel A: Government	Govt. expenditures	22.62	0.54	0.54	0.54	0.54
Δ units: percentage point change	Ave. tax rate (at y_{ave} baseline SS)	17.68	0.53	0.23	0.29	0.51
Panel B: Agg. quantities	Ave. adult skill	0.94	0.51	6.85	5.63	1.03
Δ units: percent change	Labor supply	0.31	0.14	-0.61	-0.63	0.14
	Output	0.43	0.52	6.61	5.37	1.07
	Consumption	0.35	0.49	6.02	4.80	0.32
Panel C: Δ W in levels	Behind the veil of ignorance	0.00	2.45	8.28	7.07	0.29
Δ units: percent of lifetime consumption	New adults	0.00	1.87	2.11	2.00	-0.38
	All adults	0.00	-0.18	0.00	-0.11	-0.56
Panel D: Share who gain	New adults	0.00	1.00	0.66	0.67	0.00
Δ units: share of group	All adults	0.00	0.22	0.15	0.14	0.00

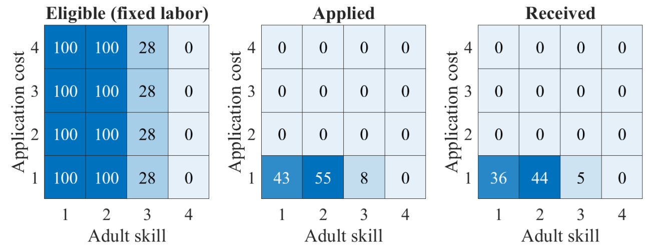
Notes: Table C.20 reports changes in aggregate quantities after the 2017 TCJA expansion of the CTC in column (1) and alternative spending-equivalent expansions of the CCDF: the baseline expansion in column (2), only subsidizing application costs in column (4), and a traditional expansion where the income eligibility cutoff is eliminated, $\beta_{N,0}$ is set to zero, and $\beta_{N,0}$ is calibrated to 0.935 to match government spending.

The CCDF expansion of column (3) is a less beneficial than the main-text CCDF expansion of column (2) but compares in a similar way to the CTC expansion of column (1). The traditional expansion of column (4), however, is strikingly worse than the other family policy expansions considered in this table. To investigate why this is the case, in Figures C.9 and C.10, we examine the effect of the traditional CCDF expansion in column (4) on selection into CCDF application and receipt. Increases in CCDF receipt after the traditional expansion stem from inflows from high-skill adults with low application costs. Meanwhile, taxes go up in equilibrium after this policy change, making low-skill adults with high skill children are even worse off than before. This stands in contrast to the effects of reducing barriers to accessing the CCDF leaving its means-tested attributes unchanged, as in our expansion of the main text: when application costs are reduced, inflows come from lower-θ_a adults. The inflows into CCDF application and receipt after the main-text CCDF expansion are presented and discussed further in Appendix C.3.1.

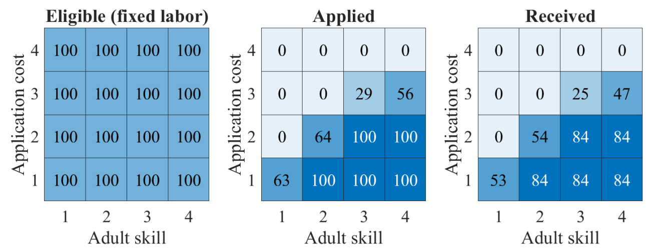
C.5 Robustness exercises

C.5.1 Targeting higher correlation of initial child skill endowment and parent skill

Context for this exercise In our benchmark calibration we target a correlation between child initial skill endowments and parent adult skill levels of 0.06 from Cunha et al. (2010). Previous macroeconomic studies who discipline a similar model object have assumed zero correlation as in Zhou (2022), target a low correlation as in Daruich (2023)—which also draws its target from Cunha et al. (2010)—or abstract from child skill accumulation entirely, as in Guner et al. (2020). Because this correlation coefficient is measured early in life and may be affected by measurement error, in



(a) Baseline equilibrium



(b) Traditional CCDF expansion

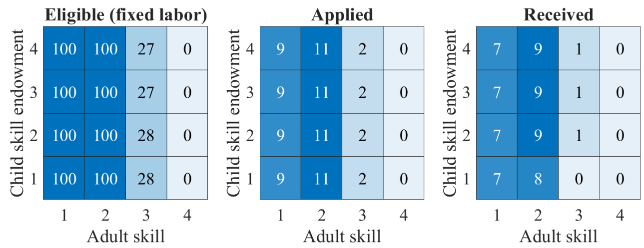
Figure C.9: Traditional expansion: selection into CCDF application and receipt by θ_a and ξ

Notes: Figure C.9 shows conditional rates of CCDF eligibility, application, and receipt among parents with children under 5 in the baseline (Figure C.9), and after the traditional CCDF expansion (Figure C.9b), broken down by adult skill quartile and application cost quartile. This exercise is in general equilibrium; quartiles are assigned in using unconditional distributions of each variable in the baseline equilibrium.

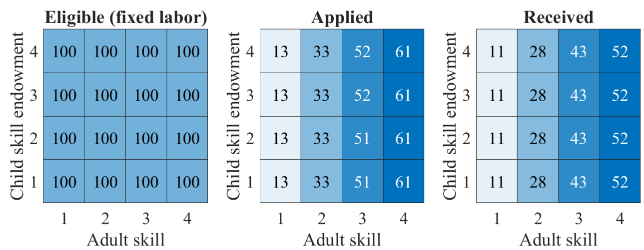
this appendix we recalibrate the model to target a correlation target of 0.18, taken from Table C.10 of the online appendix to Attanasio, Cattan, Fitzsimons, Meghir, and Rubio-Codina (2020); in that study, which uses data from Colombia, the authors report the correlation of maternal cognitive skill and child cognitive skill measured for a sample in which children were on average 18 months old. The study is an experiment, so correlations are computed separately for the treated (correlation of 0.18) and control (0.35) group. We use the value for the treated group here as an illustrative example of the effects of a higher correlation target.

Neither the main text nor this appendix take a stand on the extent of measurement error present in these correlation estimates, nor does our study resolve disagreements within the literature regarding the role of genes in determining later outcomes (see the literature overview in Houmark et al. (2024) and the handbook chapter of Duncan, Kalil, Mogstad, and Rege (2023) for helpful summaries). That being said, one should be wary of interpreting "heritability" estimates in the literature (economic or otherwise) as corresponding directly to the correlation of child's initial skill endowment with the skill of their parent (the model object we consider here). As Duncan, Kalil, Mogstad, and Rege (2023) note:

> *... the policy implications of the heritability estimates are the subject of much controversy. Part of this controversy may be due to confusion about what these estimates*



(a) Baseline equilibrium



(b) Traditional CCDF expansion

Figure C.10: Traditional expansion: selection CCDF application and receipt by θ_a and θ_k

Notes: Figure C.10 shows conditional rates of CCDF eligibility, application, and receipt among parents with children under 5 in the baseline (Figure C.10), and after the traditional CCDF expansion (Figure C.10b), broken down by adult skill quartile and child skill endowment quartile. This exercise is in general equilibrium; quartiles are assigned in using unconditional distributions of each variable in the baseline equilibrium.

do and do not capture. A heritability estimate measures the fraction of the population variation in individual outcomes that can be explained by genetic variation in the population. However, the degree of heritability of an outcome cannot tell us how important genes are for shaping the outcome, nor how easy it is to change that outcome.

Recalibration results Table C.21 reports the parameter estimates of the recalibration, in which we target a correlation of initial child skill endowments and parent skill of 0.18 instead of our benchmark target of 0.06. All other targets are unchanged. Targeting a higher correlation of initial child skill and parent skill leads the value ρ_k to increase, which is a direct effect of targeting a higher value with that parameter. This recalibration also leads to a higher value of b relative to the calibration results presented in Table 2 of the main text. The value of λ_θ also rises. Other parameters are similar to their benchmark calibration values.

Results of counterfactual experiments Using the recalibrated framework, Table C.22 reports changes in aggregate quantities and welfare after two policy expansions: column (1) reports changes after expanding the CTC using the 2017 TCJA changes; column (2) implements a spending-equivalent expansion of the CCDF in which $\kappa_N = 0.376 \times \mu_\xi$ and $\phi_N = 1$; column (3) implements a spending-equivalent traditional expansion that eliminates means-testing by shutting off the in-

Table C.21: Targeting higher intergenerational persistence of initial skill: calibration resultsl

Category	**Sym.**	**Parameter description**	**Value**	**Moment description**	**Data**	**Model**
Panel A: Jointly calibrated	ψ	Marginal disutility labor	6.77	Age 25-55 ave. hours labor h	0.31	0.31
	λ_θ	Skill scaling factor	4.96	Age 20 ave. hours childcare n	0.31	0.31
	b	Altruism coefficient (share β)	0.72	Age 20 Corr(θ_k^{a*}, y^*)	0.32	0.32
	μ_ξ	Ave. app. cost (share $\overline{y}_{pop}$)	0.15	Age 20 share receiving CCDF	0.04	0.05
	σ_k^2	Var. of log (θ_k)	1.04	Age 25-34 log (y) p50-p10	1.39	1.39
	ρ_k	Intergen. persistence of skill	0.19	Age 20 Corr(θ_k, θ_a)	0.18	0.18
	ϕ_P	SS replacement rate	0.20	SS spending (share output)	0.05	0.05
Panel B: Set proportionally	θ_n	Child care productivity	0.85	Age 20 workers ave. log prod. ratio	0.00	0.00
	ϕ	Pre-policy price for n	0.07	Age 20 workers price ratio	0.18	0.18

Notes: Table C.21 reports calibration results for a recalibration of the model baseline that targets the correlation of initial child skill with parent skill reported in Attanasio et al. (2020) with its model counterpart, using the benchmark model framework.

come eligibility cutoff, setting $\beta_{N,1} = 0$ (while maintaining the CCDF work requirement), and sets $\beta_{N,0} = 0.952$ to match government spending in columns (1) and (2).

Adult skill gains after the CCDF expansion of column (2) exceed those of column (1), although the recalibration leads the adult skill gains of the CCDF and CTC expansions to be closer together (which means that the tax increase necessary to finance each expansion is also more similar). The main takeaways of the benchmark model remain in the recalibrated model: the CCDF is preferred behind the veil of ignorance, on average new adults and all adults are more ambivalent between the two programs, and incorporating a larger share of adults see their welfare increase after the CTC expansion. As for magnitudes, the CCDF has a smaller advantage in terms of welfare gains behind the veil of ignorance, relative to the main text. This is due to more similar skill gains across the two expansions. The higher magnitude of welfare gains for new adults compared ot the main text reflects the higher altruism coefficient in the recalibration considered here.

In column (3) of Table C.22, we examine the consequences of a traditional expansion of the CCDF in this recalibrated environment. Comparing columns (2) and (3) indicates that reducing access frictions remains the more appealing method for expanding the CCDF: parents who flow into CCDF receipt after such a traditional expansion are expensive for the subsidy program and put a tax burden on lower-income parents who cannot afford to pay their CCDF application cost (which remains unchanged in such a traditional expansion). This lowers adult skill on average and reduces welfare. The takeaway here is the same as in Appendix C.4.2 where we performed a traditional expansion in our benchmark calibration.

Table C.22: Targeting higher intergenerational persistence of initial skill: changes in aggregates and welfare across steady states

Variable category	Variable description	Baseline	(1) CTC	(2) CCDF	(3) Traditional
Panel A: Government	Government expenditures	22.58	0.50	0.50	0.49
Δ units: percentage point change	Average tax rate (at y_{ave} baseline SS)	17.36	0.50	0.45	0.53
Panel B: Aggregate quantities	Average adult skill	1.24	0.19	1.56	-0.00
Δ units: percent change	Labor supply	0.31	-0.02	-0.56	0.02
	Output	0.56	0.15	1.37	-0.05
	Consumption	0.46	0.13	0.86	-0.69
Panel C: Welfare change in levels	Behind the veil of ignorance	0.00	3.73	5.44	-0.61
Δ units: percent of lifetime consumption	New adults	0.00	3.58	4.05	-0.66
	All adults	0.00	-0.01	-0.12	-0.60
Panel D: Share who gain	New adults	0.00	1.00	1.00	0.00
Δ units: share of group	All adults	0.00	0.22	0.12	0.00

Notes: Table C.22 reports changes in aggregate quantities and welfare after the 2017 TCJA expansion of the CTC (column 1) and a spending-equivalent expansion of the CCDF that reduces income (column 2), or a traditional expansion (column 3). The baseline equilibrium in this exercise was recalibrated to target a higher correlation coefficient for initial child skill endowments and parent skill. Column (1) policy changes are as described in the main text; in column (2) $\kappa_N = 0.376 \times \mu_\xi$ and $\phi_N = 1$; in column (3), the flat subsidy rate is calibrated to $\beta_{N,0} = 0.952$. Further descriptions are in the text.

C.5.2 Targeting the intergenerational rank-rank correlation of income

Context for this exercise In our benchmark model of the main text, we target the correlation of child skill outcomes at age 5 and parent income measured in Moschini (2023). This is the measure of intergenerational mobility that we think is best suited to our model environment. Because we do not have earnings risk in our environment, when compared to the data this approach yields a slightly high value for another popular measure of intergenerational mobility, the correlation of family income rank across generations. For the core sample in Table 1 of Chetty, Hendren, Kline, and Saez (2014) the estimate of this correlation is 0.34; the analogously computed value for our benchmark calibration is 0.41. Here, we recalibrate the model to target the rank-rank correlation statistic.

Recalibration results Table C.23 reports the recalibration results. Compared with the benchmark calibration results (reported in Table 2 of the main text), the recalibration exhibits a higher b but similar parameter values otherwise.

Results of counterfactual experiments Table C.24 reports changes in aggregate quantities and welfare after two expansions: in column (1), the 2017 TCJA expansion of the CTC; in column (2) and a spending-equivalent expansion of the CCDF, achieved by setting $\kappa_N = 0.504 \times \mu_\xi$ and $\phi_N = 1$. Relative to the main text, the alternative calibration approach considered here yields lower skill gains for the CCDF expansion of column (2). However, the differences across the CTC and

Table C.23: Targeting intergenerational rank-rank correlation of income: calibration results

Category	Sym.	Parameter description	Value	Moment description	Data	Model
Panel A: Jointly calibrated	ψ	Marginal disutility labor	6.72	Age 25-55 ave. hours labor h	0.31	0.31
	λ_θ	Skill scaling factor	4.87	Age 20 ave. hours childcare n	0.31	0.31
	b	Altruism coefficient (share β)	0.44	rank-rank corr Chetty 2014	0.34	0.34
	μ_ξ	Ave. app. cost (share $\overline{y}_{pop}$)	0.14	Age 20 share receiving CCDF	0.04	0.04
	σ_k^2	Var. of log (θ_k)	1.02	Age 25-34 log (y) p50-p10	1.39	1.42
	ρ_k	Intergen. persistence of skill	0.08	Age 20 Corr(θ_k, θ_a)	0.06	0.06
	ϕ_P	SS replacement rate	0.20	SS spending (share output)	0.05	0.05
Panel B: Set proportionally	θ_n	Child care productivity	0.76	Age 20 workers ave. log prod. ratio	0.00	0.00
	ϕ	Pre-policy price for n	0.06	Age 20 workers price ratio	0.18	0.18

Notes: Table C.23 reports calibration results for a recalibration of the model baseline that targets the rank-rank correlation of Chetty et al. (2014) with its model counterpart, using the benchmark model framework.

CCDF expansion highlighted in the main text remain after the recalibration. We therefore conclude that our main takeaways are qualitatively robust to this alternative calibration approach.

Table C.24: Targeting intergenerational rank-rank correlation of income: changes in aggregates and welfare across steady states

Variable category	Variable description	Baseline	(1) CTC	(2) CCDF
Panel A: Government Δ units: percentage point change	Government expenditures	22.67	0.55	0.56
	Average tax rate (at y_{ave} baseline SS)	17.65	0.56	0.34
Panel B: Aggregate quantities Δ units: percent change	Average adult skill	1.07	0.19	4.94
	Labor supply	0.31	0.07	-0.43
	Output	0.48	0.18	4.81
	Consumption	0.39	0.15	4.14
Panel C: Welfare change in levels Δ units: percent of lifetime consumption	Behind the veil of ignorance	0.00	2.43	6.46
	New adults	0.00	2.23	2.44
	All adults	0.00	-0.20	-0.12
Panel D: Share who gain Δ units: share of group	New adults	0.00	1.00	1.00
	All adults	0.00	0.22	0.09

Notes: Table C.24 reports changes in aggregate quantities and welfare after the 2017 TCJA expansion of the CTC (column 1) and a spending-equivalent expansion of the CCDF (column 2) in which $\kappa_N = 0.504 \times \mu_\xi$ and $\phi_N = 1$.

C.5.3 A model with CCDF application costs in utils (stigma costs)

Context for this exercise An alternative to our benchmark framework of the main text would be to use a utility application cost that appears in the objective function and penalizes utility when the childcare subsidy is applied for; such a utility cost is sometimes referred to as a "stigma cost". For example, consider a modified model where the consumer problem in $j = 1$ is:

$$\begin{aligned} V\left(j,\theta_a,\xi_u,\delta,R,\theta_k\right) &= \max_{c,\ell,n,q\geq 0} u\left(c,\ell,q\right) - \delta \max\left\{\xi_u - \kappa_{N,u},0\right\} + bV_k\left(\theta_k^a\right) + \beta V\left(j+1,\theta_a\right) \\ s.t. & \qquad (22) \\ \left(1+\tau_c\right)c + pn &\leq y_d\left(y \mid j,\theta_a,\vec{\pi}_G\right) + \delta CCDF_u\left(y,n \mid j,R,p,\vec{\pi}_N\right) \\ y &= \theta_a \ell \\ \theta_k^a &= f_s\left(n,q \mid \theta_a,\theta_k\right) \end{aligned}$$

where the utility function $u\left(\cdot\right)$ is the same as in the main text. There are two changes in (22) relative to analogous problem (3) of the main text. First, the application cost in the budget constraint, ξ, has been replaced by a stigma cost in the objective function, ξ_u. This utility cost shock is also drawn from a log-normal distribution whose mean we calibrate to match CCDF receipt rates in equilibrium. Second, parameters of the CCDF policy $CCDF_u$ now affect both the budget constraint term $CCDF_u\left(y,n \mid j,R,p,\vec{\pi}_N\right)$ (which no longer takes the application cost ξ as an argument) and the objective function via a policy instrument $\kappa_{N,u}$ that offsets application costs and which is normalized to zero in the baseline equilibrium. Raising $\kappa_{N,u}$ above zero represents making it less embarrassing to get help from the program or by implementing destigmatization campaigns or intervention with social norms which do not cost the government anything.

Recalibration results We recalibrate the modified framework with application costs in utils by choosing μ_{ξ_u} to match the share of the population receiving the CCDF in the baseline equilibrium. Table C.25 reports the calibration results. Compared with the benchmark calibration results (Table 2 of the main text) the marginal disutility of labor supply is higher in this specification, and of course the magnitude of the application costs is different. Other calibrated parameter values are similar to the main text.

Table C.25: Utility cost: calibration results

Category	Sym.	Parameter description	Value	Moment description	Data	Model
Panel A: Jointly calibrated	ψ	Marginal disutility labor	6.89	Age 25-55 ave. hours labor h	0.31	0.31
	λ_θ	Skill scaling factor	4.91	Age 20 ave. hours childcare n	0.31	0.31
	b	Altruism coefficient (share β)	0.32	Age 20 Corr(θ_k^{a*}, y^*)	0.32	0.32
	$\mu_{\xi,u}$	Ave. app. cost in utils	0.75	Age 20 share receiving CCDF	0.04	0.04
	σ_k^2	Var. of log (θ_k)	1.03	Age 25-34 log (y) p50-p10	1.39	1.39
	ρ_k	Intergen. persistence of skill	0.09	Age 20 Corr(θ_k, θ_a)	0.06	0.06
	ϕ_P	SS replacement rate	0.20	SS spending (share output)	0.05	0.05
Panel B: Set proportionally	θ_n	Child care productivity	0.71	Age 20 workers ave. log prod. ratio	0.00	0.00
	ϕ	Pre-policy price for n	0.00	Age 20 workers price ratio	0.18	0.18

Notes: Table C.25 reports calibration results for a recalibration of a modified model framework with stochastic stigma costs for CCDF application.

Results of counterfactual experiments Table C.26 changes in aggregate quantities and welfare after two policy expansions: in column (1), the CTC is expanded according to the 2017 TCJA changes; column (2) reports a spending-equivalent expansion of the CCDF implemented by setting $\phi_N = 1$ to eliminate rationing and setting $\kappa_{N,u} = 0.529 \times \mu_{\xi,u}$.

Table C.26: Utility cost: changes in aggregates and welfare across steady states

Variable category	Variable description	Baseline	(1) CTC	(2) CCDF
Panel A: Government	Government expenditures	22.61	0.54	0.54
Δ units: percentage point change	Average tax rate (at y_{ave} baseline SS)	17.68	0.55	0.14
Panel B: Aggregate quantities	Average adult skill	0.96	0.04	8.76
Δ units: percent change	Labor supply	0.31	0.08	-0.75
	Output	0.44	0.03	8.47
	Consumption	0.36	0.02	8.08
Panel C: Welfare change in levels	Behind the veil of ignorance	0.00	1.98	11.67
Δ units: percent of lifetime consumption	New adults	0.00	1.81	3.49
	All adults	0.00	-0.21	0.28
Panel D: Share who gain	New adults	0.00	1.00	1.00
Δ units: share of group	All adults	0.00	0.22	0.20

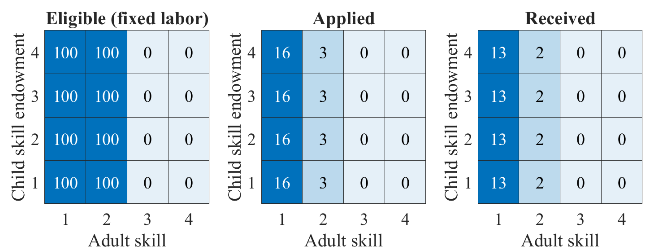
Notes: Table C.26 reports changes in aggregate quantities and welfare after the 2017 TCJA expansion of the CTC (column 1) and a spending-equivalent expansion the CCDF instead (column 2). In column (1) changes are as described in the main text, and in column (2) $\kappa_{N,u} = 0.529 \times \mu_{\xi,u}$ and $\phi_N = 1$.

In Table C.26 welfare gains are higher after the CCDF expansion in column (2) compared to the results of the main text specification presented in Table 4 (CTC gains are similar across the two specifications). Higher gains from the CCDF expansion in the framework with stigma costs occurs for two main reasons: first, because reducing a stigma cost is free (due to the lack of evidence for disciplining the cost function); and, second, because skill gains are higher. The first reason reduces the tax burden necessary to finance the CCDF expansion, while the second reason further mitigates the tax increase and raises expected adult skill outcomes behind the veil of ignorance. The remainder of this section argues that, compared to the alternative framework with a CCDF application cost in utils that we consider here, the benchmark model specification of the main text offers: first, a better match to findings on sorting into CCDF receipt from previous studies; and, second, lower skill gains after the CCDF expansion that reduces access frictions.

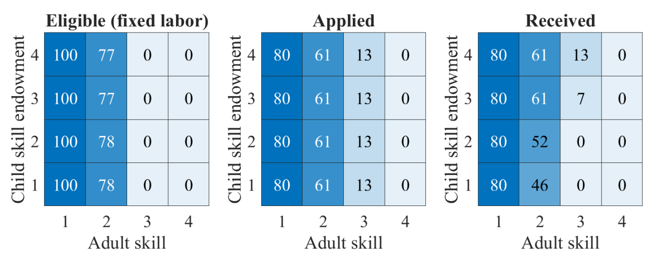
In the model with stigma costs, for both the baseline equilibrium and the equilibrium after the CCDF is expanded, Figure C.11 illustrates CCDF eligibility (using fixed labor supply), application, and receipt rates broken down by adult skill and initial child skill endowment quartiles using the distributions of the baseline equilibrium; we do not report a selection figure by θ_a and application cost ξ_u because it is not necessary for our point.

In the baseline equilibrium, CCDF applicants and recipients are more heavily weighted towards lower-skilled adults (shown in Figure C.11a) when compared to the benchmark framework of the main text (shown in Figure C.5a). In terms of selection by educational attainment (θ_a in the model), the utility-cost alternative specification is less consistent with the findings of Guzman (2019) than the benchmark model. Another presentation of this selection pattern is the spending and recipient distributions in Figure C.12. When CCDF application costs are modeled as stigma costs, both distributions are counterfactually concentrated in the first income quartile.

After the CCDF application costs are reduced, inflows into CCDF application and receipt are more heavily weighted towards low-skilled adults than after the CCDF expansion in the benchmark model. To see this, one can compare the receipt-probability gradient in Figure C.11b with the gradient of the analogous figure for the benchmark model, Figure C.5b: moving from left to right across adult skill bins, the gradient is steeper in a utility cost specification compared to the consumption cost specification of the main text. At the same time, selection by θ_k into CCDF receipt is similar to the benchmark specification. Low θ_a, high θ_k families see the largest skill gains after the CCDF expansion, so more inflows from low θ_a parents yields larger average adult skill gains from the CCDF expansion relative to the benchmark model.



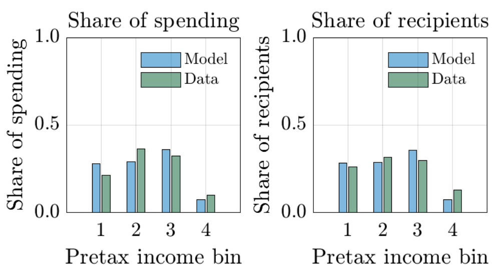
(a) Baseline equilibrium



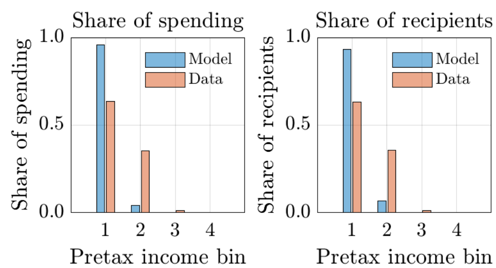
(b) CCDF expansion

Figure C.11: Utility cost: selection into CCDF receipt by θ_a and θ_k

Notes: Figure C.11 shows conditional rates of CCDF eligibility, application, and receipt among parents with children under 5 in the baseline (Figure C.11a), and when the CCDF is expanded (Figure C.11b), broken down by adult skill quartile and child skill endowment quartile. This exercise is in general equilibrium; quartiles are assigned in using unconditional distributions of each variable in the baseline equilibrium.



(a) Child Tax Credit



(b) Child Care and Development Fund

Figure C.12: Utility cost: CTC and CCDF share of spending and recipients by income quartile

Notes: Figure C.12 reports the share of program spending going to each income quartile (left panel) and share of recipients in each income quartile (right panel) for the Child Tax Credit (Figure 7a) and the Child Care and Development Fund (Figure 7b) in the model's baseline equilibrium.