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ABSTRACT

Recent policy proposals call for significant new investments in early care and education (ECE). These policies are designed to reduce the burden of child care costs, support parental employment, and foster child development by increasing access to high-quality care, especially for children in lower-income families. In this paper, we propose and calibrate a model of supply and demand for different ECE service and teacher types to estimate equilibrium family expenditures, participation in ECE, maternal labor supply, teacher wages, market ECE prices, and program costs under different policy regimes. Under a policy of broadly expanded subsidies that limits family payments for ECE to no more than 7% of income among those up to 250% of national median income, we estimate that mothers' employment would increase by six percentage points while full-time employment would increase by nearly 10 percentage points, with substantially larger increases among lower-income families. The policy would also induce a shift from informal care and parent-only care to center- and home-based providers, which are higher-quality on average, with larger shifts for lower-income families. Despite the increased use of formal care, family expenditures on ECE services would decrease throughout most of the income distribution. For example, families in the bottom three income quintiles would experience expenditure reductions of 76%, 68%, and 55%, respectively. Finally, teacher wages and market prices would increase to attract workers with higher levels of education. We also estimate the impact of a narrower subsidy expansion for families with an income up to 85% of national median income.

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1 Introduction

Over the past several decades, the U.S. witnessed phenomenal growth in the labor market attachment of mothers with young children (Figure A.1), leading to a concomitant rise in families' reliance on non-parental early care and education (ECE) services. Approximately 13 million preschool-age children regularly attend a form of ECE—equivalent to 60% of children ages 0 to 5—with the average enrolled child spending 32 hours per week in these settings (Cui and Natzke, 2021; Herbst, 2013). At the same time, ECE costs are highly regressive, such that low-income families pay a significantly larger share of income for such services than their high-income counterparts (Hotz and Wiswall, 2019). There is also mounting evidence that access to ECE, particularly when it is high-quality and especially for disadvantaged children, can have positive short-run effects on school readiness as well as long-run effects on educational attainment and labor market success (Auger et al., 2014; Chaparro et al., 2020; Herbst, 2017; Cascio, Forthcoming).

The dual role of ECE policy—supporting parental employment and promoting better life chances for children, especially disadvantaged children—has led some policymakers to call for substantial public investment in these services. Economic rationales for publicly-supported ECE rest on four foundations.[1] First, low-income parents in particular face binding credit constraints that prevent them from investing optimally in high-quality ECE experiences, which may have implications for child development and school readiness (Heckman, 2000; Caucutt et al., 2005; Caucutt and Lochner, 2020; Cunha, 2013).[2] Second, high-quality ECE may generate external benefits for society at large beyond the private benefits to parents. If parents do not recognize the full benefits of ECE, making them pay the entire cost of these services would lead to an equilibrium with too little consumption of high-quality ECE. For example, access to higher-quality ECE may increase adult educational attainment, raise tax revenues from higher adult earnings while reducing public benefit use, and increase the productivity of adult co-workers and neighbors through productivity spillovers (Bartik, 2011; Council of Economic Advisers, 2015). Third, parents may possess imperfect information about the quality of care received by children because they lack the resources to assess provider quality or are unable to efficiently monitor caregivers. This can lead to a form of adverse selection in which high-skilled caregivers leave the ECE industry for better wages elsewhere, thereby lowering average ECE quality (Mocan, 2007). A final justification focuses on economic self-sufficiency considerations. By reducing ECE costs for families, subsidies encourage employment and other human capital investments in parents and children, which in turn increases the likelihood of long-term economic security and reduce use of other social assistance benefits, especially among families with less earning power (Blau, 2001).[3]

Despite the economic rationale for publicly-supported ECE, current funding levels and eligibility requirements are such that these services are available to only a small fraction of families. Across all major programs, the public invests about $1,500 per child per year in ECE during the first five years of

[1] There are compelling moral arguments as well, including equity and distributional considerations. High-quality ECE may be viewed as a merit good in which all families should have equal access to such services regardless of their ability to pay. This argument may be salient if the private ECE market is unable to close income-based early learning gaps or makes such gaps worse (Council of Economic Advisers, 2016; Flood et al., 2022).

[2] Chaparro et al. (2020) estimate that the impact on child cognitive skill from offering families access to free, high-quality ECE services were five times larger per dollar than giving cash, which can be directed to many uses beyond high-quality experiences for young children.

[3] Further, because care responsibilities traditionally fall disproportionately on women, ECE investments may advance gender equity in the labor market and home production.

life (Davis and Sojourner, 2021). In contrast, the public invests about nine times more per child per year through the K-12 system during the subsequent 13 years. Even for programs focusing on children from disadvantaged families, funding is too low to serve all eligible children. The latest pre-pandemic estimates suggest that only 15% of eligible children receive subsidies from the Child Care and Development Block Grant (CCDBG) (Chien, 2021), Early Head Start serves approximately 11% of eligibles, and Head Start covers 36% of eligibles. Furthermore, not all states have pre-K programs, and those that do may serve only a subset of eligible three- and four-year-olds.

Given the fragmented and insufficient public funding for ECE, a number of proposals to reform or expand the system have been developed over the years (e.g., Blau, 2001; Chaudry et al., 2021; Davis and Sojourner, 2021). In addition, Congress is now considering proposals that would constitute a major expansion of federal investment ECE in policy. In late 2021, for example, the U.S. House of Representatives passed H.R. 5376, also called the Build Back Better Act (BBBA), which would create an entitlement-based child care subsidy system for eligible children ages 0 to 5 and universal free pre-K for three- and four-year-olds. In addition, there is a pair of proposals to revise the current CCDBG now under consideration in the U.S. Senate. The recently introduced CCDBG Reauthorization Act of 2022, co-sponsored by Senators Tim Scott (R-SC) and Richard Burr (R-NC), expands eligibility for child care subsidies to more families but retains the CCDBG's capped funding structure and does not propose any increase in resources to expand ECE access. The second proposal, co-sponsored by Senators Patty Murray (D-WA) and Tim Kaine (D-VA), would triple the discretionary funding for the CCDBG, provide grants to states to increase supply and quality, and allocate more resources for states' pre-K programs. Although the Murray-Kaine proposal would not establish new eligibility and co-payment requirements (unlike BBBA), the increased funding is intended to increase the share of CCDBG-eligible families who can access subsidized ECE services.

In this paper, we develop an equilibrium model of ECE subsidy policy, and we use this model to estimate the impact of three alternative systems. One system—a narrower expansion of subsidies—is based on the CCDBG's current eligibility and co-payment structure, and we analyze the impact of a fully funded version of the policy (i.e., one that serves all eligible children). The most relevant policy proposal to this system is the one by Murray-Kaine. The other two modeled policies involve a broader expansion of subsidies, reflecting the child care benefit structure proposed in the BBBA. One version of this broad policy excludes the BBBA's teacher compensation requirements (i.e., Wage Floors) and the other includes them. We assess each policy in relation to a wide range of outcomes, including families' ECE expenditures, the demand for ECE services (including formal and informal caregivers), mothers' labor supply, the compensation of ECE workers, and market prices. While the paper models equilibrium in the labor market for ECE teachers, it does not model equilibrium in the broader labor market, nor does it examine GDP effects or the impact of these policies on children's development.[4]

All models of ECE subsidy policy—including the three studied here—must take into consideration at least four characteristics of households and providers for the purposes of determining eligibility and subsidy amounts. First, subsidy eligibility depends on a child's age, which varies considerably across the policies. For example, the current CCDBG is targeted at children ages 0 to 12, while BBBA's child care

[4] In addition, we do not attempt to model pre-K expansions, child care start-up grants, or quality- and facility-improvement resources available to providers, although some of these elements are included in recent proposals.

reform would serve those ages 0 to 5. Second, eligibility and benefit levels are often conditioned on family income. Progressive subsidies fall as income rises, with families above a certain income level becoming ineligible for assistance. The current CCDBG and the proposed subsidy under the BBBA have such a means-tested design, although they vary substantially on the income eligibility limit and the degree of progressivity in the subsidy. Third, parents may have to comply with an activity requirement, such that all parents must be employed, in school, or participating in job training or job search. These types of requirements are embedded in the current CCDBG and in the proposed BBBA. The final criterion relates to the types of ECE services at which eligible families can use a subsidy. For example, the current CCDBG allows children to be cared for by a wide variety of ECE providers, while the BBBA limits the pool of eligible providers to home- and center-based services that are licensed, regulated, and meet specific quality criteria.

Our equilibrium model incorporates these design elements into the analysis of all three subsidy policies. The policy based on fully funding a version of the current CCDBG—which we refer to as the "narrow" subsidy policy—offers child care assistance to all eligible households with children before kindergarten age, such that those with an income below 30% of national median income (NMI) would have no payments at qualifying providers, those with an income between 30% and 85% of NMI would have payments capped at 7% of income, and those above 85% of NMI would not be eligible for a subsidy.[5] The other policies we model are based on the BBBA proposal—referred to as a "broad" subsidy policy—which similarly offers assistance to all eligible households, but expands eligibility and caps child care expenses at a lower amount (for many household) relative to the narrow policy. Specifically, those with an income up to 75% of NMI would have no ECE payments, those with an income between 75% and 125% of NMI would have payments capped at 2% or 4%, those with an income between 125% and 250% of NMI would have ECE expenditures capped at 7% of income, and those above 250% of NMI would not be eligible for a subsidy. As previously mentioned, we analyze two versions of this policy: one that includes a teacher compensation requirement and one that does not include such a requirement.[6] All three proposals we model include a parental work activity requirement.

Our analysis proceeds in two steps. We begin by studying the static effect of the child care subsidy policies on families' ECE cost burden, disregarding any potential behavioral responses by families or providers. Here we define "cost burden" as the share of net-of-taxes family income allocated to purchasing ECE services. We conduct this analysis over the distribution of income as well as separately for single- and two-parent households and across different ECE provider-types (e.g., center- and home-based services). Results from this analysis suggest that the broad subsidy expansion would substantially lower households' ECE cost burden. Among households currently paying for ECE, the median fraction of income spent on such services is 7.1%. Among these households, the median fraction of income spent on child care would fall to 4.6% if the broad child care subsidy were enacted. For households in the bottom income quintile, we estimate median ECE costs among those paying for care is currently 11.9% of income, and, for these households, expenses would fall to 5.6% under the broad subsidy policy. These estimates assume

[5]NMI is $90,657 for a family of four. Table B.1 provides more detail. A key difference between the Murray-Kaine proposal and the "narrow" policy simulated here is that the narrow policy assumes the program is always fully funded. In contrast, Murray-Kaine would substantially increase funding for CCDBG through an appropriation but would not create an entitlement.

[6]The policy with the requirement pays ECE teachers without a bachelor's degree at least $15 per hour and pays those with a bachelor's a salary comparable to K-12 teachers.

no behavioral responses to the legislation. In reality, such policies are likely to alter household labor supply decisions and encourage a shift toward subsidy-eligible care types, leading to a further reduction in household ECE expenses in levels and as a share of income. Thus, it is important to account for behavioral responses in the analysis.

In the second step, we develop and estimate an equilibrium model of differentiated ECE markets to examine the impact of narrow and broad subsidy expansions on parents' ECE decisions and labor supply, allowing for behavioral responses. Specifically, the model examines parents' demand for ECE services jointly with their labor supply, accounting for a variety of ECE provider types, including center-based, home-based, and informal providers. We also model ECE providers' ability to produce services at different quality and cost levels. We combine the demand and supply models into a unified framework and define an equilibrium as a set of sector-level prices and quantities such that all ECE service and labor markets simultaneously clear. Subsidies to one type of provider can raise their own costs (due to upward-sloping labor supply curves) and can increase costs for other service types that must compete with them for labor. Using this structure, we designate a set of provider types as eligible for subsidies and model how the subsidy schedules affect family budget constraints, parents' optimal labor supply, and the demand for ECE services (i.e., types and quantities) conditional on prices. This yields predictions for equilibrium impacts on ECE service use, parental labor supply, teacher compensation, and family and public expenditures on ECE services. Once again, we allow for different predictions across family and ECE service types.

To calibrate the ECE demand model, we divide households by the number of parents present. The 2019 American Community Survey (ACS) and the 2019 National Survey of Early Care and Education (NSECE) provide data on this as well as parental labor supply, hourly wages, non-labor income, and the type and quantity of ECE services used. To calibrate the ECE supply model, we use a model of competition between provider types. We focus on modeling the way in which costs rise with child care demand in both low- and high-quality centers and home-based settings due to competition in the labor market for ECE workers with varying levels of education (i.e., those with and without a bachelor's degree). Elasticities of parental employment with respect to wages for single- and dual-parent mothers are the key parameters on the demand-side. Elasticities of labor supply to the ECE sector for workers with and without a bachelor's degree and sector-specific shares of production expenses allocated to labor (versus other inputs) are the key parameters on the supply-side. We thoroughly review the academic literature to develop credible elasticity estimates for calibration. To calibrate input shares, we use information from the 2012 NSECE on center-based and home-based child care workers' education levels, wages, and child-to-teacher ratios.We assume inputs other than labor are provided elastically and assume inputs are used in fixed proportions, which is conservative in that it will tend to overstate future care costs by not allowing for substitution between relatively more and less expensive inputs (although it also assumes away possible changes in costs beyond labor). We assume that unlicensed informal care is elastically supplied.

The equilibrium model yields several important insights regarding the predicted effects of ECE investment on households. First, under the broad subsidy expansion policy, household ECE expenditures fall substantially in dollar terms and in share-of-income terms throughout most of income distribution, but especially among lower-income families. For example, the model predicts that under the broad subsidy policy average expenditures among those using full-time care would fall by 76% (relative to baseline) for households in the poorest income quintile, by 55% for those in the third quintile (middle fifth of households), and by 7% for those in the richest quintile. Under the narrow subsidy policy, average full-time expenditures would fall by 30% and 10% in the first and third quintiles, respectively, and increase by 4% in the richest quintile. Second, the model estimates that the subsidy policies would generate substantial increases in the share of mothers with children ages 0 to 4 who are employed full-time, by 9.7 percentage points (pp) under the broad policy and 4.6 pp under the narrow policy. Again, these effects are driven by the large labor supply response among mothers in low-income families. Indeed, full-time employment among mothers in the bottom income quintile is predicted to increase by 18.2 pp under the broad subsidy policy. Third, the model predicts a significant shift in children's time from parental and informal care to center-based and home-based care. Importantly, the largest increase occurs for high-price center-based care, which may be associated with the highest level quality in the non-parental care choice set (Bassok et al., 2016). Specifically, the model estimates a 5.1 pp decline in the use of parental care (only) under the narrow policy and a 7.9 pp decline in the use of informal family, friends, and neighbor care. These are offset by a 2.0 pp increase in the probability of using a home-based provider and a 11.0 pp increase in center-based care use. For the broad policy, the effects are larger in magnitude, resulting in 7.6 pp and 18.3 pp increase in the use of home- and center-based services, respectively. These shifts are much larger for families in the lowest income quintile.

The increased demand for formal ECE services is assumed to require wage increases to draw more care labor into the sector. The model estimates hourly wages would increase by 9.5% (to $12.99) for teachers without a bachelor's degree under the narrow policy and by 14% (to $13.51) under the broad policy. Wages for teachers with a bachelor's degree would rise by 19% (to $22.46) under the narrow policy and 29% (to $24.44) under the broad policy. The broad subsidies are predicted to induce larger demand increases that drive wages up near the mandated wage floor. Therefore, adding the wage floor policy is not predicted to affect outcomes much beyond the impact of the subsidies alone.[7]

Given the changes in ECE service use and workers' compensation, these policies would increase the marginal cost of producing ECE services. These increased costs come from shifting the mix of care workers towards those with better labor market opportunities outside the ECE sector and raising compensation of all types of care workers as demand expands. The model also provides estimates on how much the policies would increase market price of high-price centers, low-price centers, and paid home-based care. Under the narrow policy, market prices are predicted to rise by 4.1%, 12.6%, and 9.4%, respectively, while the broad policy would increase prices by 6.3%, 19.2%, and 14.2%, respectively. Not surprisingly, adding the wage floor policy to the broad subsidy would generate larger price increases. It is important to note that most families would be insulated from these market price increases given the subsidy expansions. However, the increased prices are relevant to households that are income-ineligible for the subsidy and for those in which the parents do not meet the activity requirement.

Our research is heavily informed by and contributes to a body of child care literature that estimates elasticities of parental employment and child care choices with respect to prices and elasticities of child care labor supply. This work is summarized by Blau (2001) and Morrissey (2017), and we provide a

[7] If the prediction is correct, the costs and effects of a wage floor are small. If the subsidies do not raise wages as much as predicted, then the wage floor policy would have larger effects.

detailed discussion of the literature in Appendix Section A.1. A growing number of studies simulate the impact of a variety of child-related policies. For example, the recent temporary expansion of the Child Tax Credit (CTC), which expanded eligibility to all low- and medium-income families and increased benefit levels, has catalyzed an active line of research on the program's anti-poverty and fiscal effects (Corinth et al., 2021; Goldin et al., 2021; Acs and Werner, 2021; Collyer et al., 2021; Marr et al., 2021). While most of this work simulates the static effects of the expanded CTC—ignoring any behavioral responses—a few studies do incorporate predicted labor supply adjustments into their estimation of poverty and fiscal impacts (e.g., Corinth et al., 2021; Goldin et al., 2021). The most recent generation of estimated models of maternal labor supply and ECE demand also show that subsidies have strong positive effects on mother's labor supply and paid ECE use (Chaparro et al., 2020; Guner et al., 2020; Griffen, 2019). Only one other paper we are aware of models both ECE demand and supply in an equilibrium model, as we do here (Berlinski et al., 2022).[8] They also find substantial positive effects of a generic subsidy program on maternal labor supply and the use of higher priced paid ECE services.

The remainder of the paper proceeds as follows. Section 2 describes and compares the structure of the current CCDBG as well as the recent federal subsidy proposals. We then introduce the equilibrium model and data sources in Sections 3 and 4, respectively, followed by a discussion of the results in Section 5. Section 6 concludes.

2 Current ECE Policy Landscape and Reform Proposals

This section describes the key ECE policy levers under current law and in recent federal reform proposals, focusing on the eligibility criteria and co-payments for families, how benefits are structured, and the eligibility and payments for providers. Understanding these policy levers is fundamental to the assumptions in the supply-and-demand model described in the following section.

The impact of expanded federal investment in ECE will depend on policy decisions that affect the number of children who are eligible, the amount of the subsidy, and the cost of providing care services. The BBBA differed from current law in that it would have created a new "child care and early learning entitlement" through which all age and income eligible children would have access to free or subsidized child care and early learning services. The new policy would have guaranteed financial assistance to all eligible families as opposed to rationing appropriated funds among such families, as is the case under the current CCDBG. In contrast, the policies we model are assumed to be fully funded, rather than as rationed by budget limits. Thus, we model the numbers of families who would choose to use a subsidy under an entitlement.

The BBBA proposed two vehicles for subsidizing ECE services for preschool-age children. One is a subsidy that could be used for children of any such age, commonly called the "child care" program. It funded full-day, full-year care and with maximum family payments for qualifying ECE services capped as a share of income in a way that subsidies phase-out with family income. It also had a parent activity requirement. The other vehicle, commonly called "pre-K," offered fully-subsidized, formal group instruction for children who are 3 and 4 years old. The program did not have a parental activity requirement,

[8] We discuss how their child care supply model differs from ours below, in addition to a number of other important differences between their analysis and ours.

and the available hours were limited, roughly following the K-12 part-day and part-year schedule. This paper only focuses on the child care subsidy applied to children too young for kindergarten. It does not simulate changes to pre-K policy.

To be eligible for a child care subsidy, families have to meet three criteria. The first focuses on the ages of children eligible to be served. Under the current CCDBG, children ages 0 to 12 can qualify for subsidized care. Although the proposed CCDBG Reauthorization Act retains this age range, the BBBA specifies that a child must be age 0 to 5 and not yet in kindergarten. Second, the current and the proposed child care subsidy programs are means-tested, meaning that a family must meet the income eligibility requirements. Under the current CCDBG and under the narrow-expansion policy we simulate, the federal guideline is that eligibility require family income below 85% of a state's median income (SMI) for their family size. However, states can chose to set eligibility thresholds less or greater than the federal recommendation. The BBBA's child care reform would raise the income-eligibility threshold to 250% of SMI.[9] Finally, parents have to comply with an activity requirement. Under the current CCDBG, states have the authority to establish the set of acceptable work activities, leading to significant cross-state variation, but the activities typically include formal employment (i.e., part- or full-time work), job training or search, and enrollment in education. The BBBA specified a list of work activities with which all states would have to allow.[10]

Under the current CCDBG, states set the payment rates to providers based on either a study of market prices or a cost estimation model. Federal guidelines recommend that payment rates be set at the 75th percentile of market prices, however in most states payment rates are well below that level. The most recent proposals have included a stronger push to base provider payment rates on the full cost of providing services, as established by a cost estimation model or a cost study. In the BBBA, for example, payment rates were expected to take into account the cost of meeting the requirements of each tier in the state's quality measurement system and be sufficient to "ensure adequate wages for staff providing...child care services." "Adequate wages" were defined as a minimum of a living wage and equivalent to wages for elementary school educators with similar work experience and credentials. States would have to certify that they established a wage ladder for staff of eligible child care providers and that the wage scale is adjusted annually for cost-of-living changes.

Under current law and both proposals studied here, financial assistance to help families cover the cost of ECE would be provided on a sliding scale basis. Currently, states under the CCDBG have the authority to set family co-payment levels, whereas both proposals set upper limits at the federal level for families' expenses. Under BBBA's child care proposal, the family's co-payment—expressed as a percent of family income—depends on income relative to state median income. Please refer to Table 3 for a description of the co-payment rates and income eligibility limits included in the BBBA's subsidy reform as well as the narrow expansion policy we model.

Provider eligibility was more restrictive under the BBBA than under current CCDBG regulations. Under the CCDBG, many provider-types, even those that are unregulated, are eligible to serve subsidized

[9] Under the BBBA, income eligibility would have gradually expanded over a period of several years, starting with families whose income does not exceed 75% of SMI in 2022 and increasing annually to 125%, 150%, and finally 250% in 2025.

[10] The BBBA also allowed participation in mental health treatment and other activities to prevent child abuse and neglect or that meet the activity requirements for other programs, including the Supplemental Nutrition Assistance Program (SNAP) or Temporary Assistance for Needy Families (TANF).

children. In contrast, the BBBA stipulated that eligible providers include center-based services and home-based caregivers (i.e., "family child care providers"), including those that are faith-based. In addition, all providers must meet the following requirements: they must be licensed under state law, must participate in the state's tiered quality measurement system (i.e., QRIS), and must meet the applicable state and local requirements under the CCDBG Act of 1990. Provider participation in QRIS is a critical difference with the current and proposed CCDBG, given that the highest quality tier uses at a minimum Head Start's performance standards. Such standards cover a range of activities, including program governance and structure (e.g., classroom ratios and group sizes), teaching practices and staff qualifications, health services and family engagement. In addition, providers must be provided with financial resources and technical assistance to help them progress toward higher tiers. Thus, the BBBA had a comparatively strong focus on provider quality.

In this paper, we focus only on reforms to the child care subsidy system. We base the construction and estimation of our equilibrium model on several of the most important policy levers proposed by BBBA as well as a fully funded version of the current CCDBG. While we cannot capture every aspect of any particular legislative proposal, we attempt to model the features that have the largest influence on families' ECE choices and expenses, parents' work incentives, and ECE providers' labor costs.

3 Model

We begin with a model of household choices over labor supply and ECE service use in a way that connects household budget constraints to the status quo and alternative policies. Families choose among differentiated ECE service options, only some of which are eligible for a subsidy. Next, we describe the model of ECE service supply. Finally, we describe the equilibrium.

3.1 Demand

Our model of household demand for child care reflects three important considerations: (i) child care arrangements and mothers' labor supply are jointly determined, (ii) household composition, in particular numbers and ages of young children but also the presence and earnings of any spouse/partner, are important sources of heterogeneity, and (iii) there are variety of child care and work arrangements we observe, even for seemingly similar households.

Given mothers are the vast majority of primary caregivers and whose labor supply is most affected by the presence of children, the model focus is mothers, who may or may not have a partner or spouse. Each household i chooses a combination of mother's labor supply and child care type. A model period represents a year, though prices and hours are often discussed in weekly terms. Maternal labor supply is endogenous, and partner's labor supply is exogenous and provides non-labor income from the perspective of the mother. We also assume the number and ages of children are exogenous and the presence of a partner is as well. We do not model marriage or fertility or their potential responses to policy.

We discretize the choice space so that there are $j = 1, \dots, J$ discrete options. Each option represents a combination of maternal labor supply hours, care type (parent-only, relatives, center-based, and so on), and care hours, if any. One choice is, for example, a mother works full-time and uses a home-based provider full-time at a given provider-type price.

Households choose the option with the highest latent utility, with latent utility given by

$$V_{ijk} = \alpha_{jk} + \beta_k \ln I_{ijk} + \epsilon_{ijk} \tag{1}$$

where k indexes household type (based on number of adults). α_{jk} is an option-by-household-type specific intercept, I_{ijk} is net household income (after-tax household income net of after-subsidy care expenditures),[11] β_k is a free parameter representing how utility associated with different choices varies with net income and can differ by household type.[12] ϵ_{ijk} is a mean-zero idiosyncratic option-specific term.

I_{ijk} is constructed from household income, care expenditures (if any), and tax and subsidy policy. Household income is the sum of mother's labor income if she works and all other income (primarily labor income from a spouse or partner if any). Care expenditures depend on the care-type and hours chosen, with the prices for each care-type determined in equilibrium as described below. Finally, net-income depends on the appropriate tax and subsidy policy.

Accurately modeling the household budget constraint and how it changes with various tax and subsidy policies is a key component of our model. Here we provide a brief overview, with much greater detail in Appendix B.

Our budget model takes into account federal taxes, credits, and deductions, including the Child Tax Credit (CTC), Earned Income Tax Credit (EITC), and the Child and Dependent Care Tax Credit (CDCTC). We set the budget model to the appropriate period when calibrating demand-side parameters, and to counterfactual values when evaluating proposed policies. We also include an approximation of state tax policy as well, although the model is calibrated to match nationally-representative data ignoring state residence.

Taxes depend on maternal wage income, other income, number of household members (i.e., number of adults, number of children ages 0 to 5, and total number of children), and child care expenses. We assume that two-parent households file their taxes as "married, filing jointly" and one-parent households file as "head of household." For two-parent households, any income other than the mother's wage income is treated as spouse's wage income, for tax purposes. For one-parent households, any income other than the mother's wage income is treated like child support.

The α_{jk} terms represent all other elements of utility, including mean differences across households in preferences for care-types or preferences for leisure. They also can reflect differences in quality perceived across different care-types (e.g. high-price centers are perceived to be of higher quality than lower-price centers) and the preferences households have for care quality. Still another possibility is they reflect differences across households in the availability of types of care (e.g. presence of grandparents or the distance to center-based care) or the availability of employment. With our data, we cannot distinguish between these and other various sources of heterogeneity. Instead, as we describe in the next section, we

[11] Net household income would be equivalent to household consumption with no borrowing or saving. We ignore these dynamic issues in the current version of the model. However note that household types, in particular marital state, are related to levels of wealth and access to credit markets.

[12] At least two aspects of our assumed functional form may be important. First, the log functional form assumes a particular curvature of utility with respect to income, with greater elasticity for lower-income families. Future work could generalize this form, and possibly calibrate additional parameters. Second, we do not explicitly use an equivalence scale, adjusting net income for household size and composition. We do however estimate separate β_k parameters by household-types which reflect these characteristics, therefore implying a potentially different price and transfer elasticity across households.

calibrate our model to match wage elasticities by household type estimated in the current literature, and use these estimates to quantify the relative importance of the pecuniary considerations embedded in the net income term I_{ijk} versus the non-pecuniary considerations embedded in the α_{jk} terms. The magnitude of the β_k versus α_{jk} parameters then provides the relative weighting on pecuniary versus non-pecuniary considerations.

Importantly, we assume that the α_{jk} terms are policy invariant and child care related tax and subsidy policy operates only through equilibrium care prices and household net income. This rules out for example that large-scale subsidies cause many more care providers to enter the market, reducing the distance to providers, one of the factors the α_{jk} terms likely reflects. We discuss these issues and other caveats in the Conclusion.

Finally, assuming ϵ_{ijk} follows an i.i.d. Extreme Value distribution, the probability of each choice for each household type is

$$q_{jk} = \int \frac{\exp(\alpha_{jk} + \beta \ln I_{ijk})}{\sum_{j'} \exp(\alpha_{j'k} + \beta \ln I_{ij'k})} dF_{jk} \tag{2}$$

where F_{jk} is the distribution of household level residual income corresponding to each choice j and household type k. Even within household types k, households differ in wage offers, non-labor income, and numbers and ages of children, and labor income varies endogenously with labor supply choices included in j. The Data Section describes the specific choice options and household types used.

3.2 Supply

We aggregate child care providers into $s = 1, 2, \ldots, S$ sectors differentiated by provider type. We first describe our model as if each sector charged positive prices, and then describe how we adapt the model to include unpaid child care providers as well.

Each sector provides hours of care services using two main inputs: low formal education labor lacking a bachelors degree (l_s) and high formal education labor with at least a bachelors degree (h_s). Our focus is the labor inputs required to provide child care as we view caregiving/teaching labor as the limiting factor in care supply. In addition to labor, each sector also uses additional inputs (e.g. building space and materials), which we include for completeness.

We assume each sector s produces care according to a fixed-proportions (Leontief) production technology:

$$y_s = \min\{a_{ls} l_s, a_{hs} h_s, a_{xs} x_s\} \tag{3}$$

where y_S is care hours produced in sector s, l_s and h_s are input hours of low- and high-education labor, a_{ls} and a_{hs} are the associated productivity parameters, which vary across sectors, and x_s represents the remaining inputs (e.g. building space and materials) with associated productivity a_{xs}. Given the fixed proportions technologies for each sector, input demand for each sector is given by $b_s = y_s/a_{bs}$ for inputs $b = l, h, x$. The ratio of high- to low-education labor for each sector is fixed at $h_s/l_s = a_{ls}/a_{hs}$. This formulation allows the education mix of the caregivers in each sector to differ, a key characteristic of different child care provider types (home-based versus centers) and of higher and lower quality providers.

The fixed proportions technology restricts each sector's education mix of workers to remain constant as demand for child care changes.

Given some education-specific wages w_l and w_h, we assume that aggregate low-educated and high-educated labor are supplied according to constant-elasticity input supply functions:

$$L = L^0 \left(\frac{w_l}{w_l^0}\right)^{\eta_l}$$
$$H = H^0 \left(\frac{w_h}{w_h^0}\right)^{\eta_h}$$

where $L = \sum_{s=1}^{S} l_s$ and $H = \sum_{s=1}^{S} h_s$ are aggregate labor hours across all child care sectors, and w_l^0, w_h^0 are baseline (current equilibrium) wages. The constants L_0, H_0 are set such that they equal current aggregate labor supply at current wage levels $w_l = w_l^0$ and $w_h = w_h^0$. The η_l and η_h parameters are caregiver labor supply elasticities, with $\eta_l = 0, \eta_h = 0$ indicating perfectly inelastic labor supply at the baseline labor quantities L_0 and H_0. As described below, we calibrate (η_l, η_h) to match estimates in the literature. We assume that other inputs x_s are perfectly elastically supplied and, therefore, play only a placeholder role in the model.

These upward-sloping input supply curves for low- and high-educated labor imply that child care providers face increasing marginal cost curves. Re-arranging the input supply functions for low- and high-educated labor determines how the input prices (wages) would satisfy aggregate input requirements (L, H):

$$w_l = w_l^0 \left(\frac{L}{L^0}\right)^{1/\eta_l}$$
$$w_h = w_h^0 \left(\frac{H}{H^0}\right)^{1/\eta_h}$$

Given a sector-specific hourly price p_s, total revenue for each sector is $p_s y_s$. Total labor costs are $w_l l_s + w_h h_s$. The difference between revenues and labor costs is residual revenue, $\Delta_s = p_s y_s - (w_l l_s + w_h h_s)$. This reflects the cost of other inputs and any profits. For example, under the assumption that each sector earns 0 profits, the difference in revenues and labor costs is equal to the cost of the x_s inputs. Given we do not observe profits (and the child care sector consists of a mix of for-profit and non-profit providers) nor the other x_s inputs in our data, we take no stand on the source of the residual revenue Δ_s. One interpretation of our model is that the x_s inputs represent the fixed costs of providing child care (e.g. building space); under this interpretation Δ_s is then variable profits.

We assume that all child care providers are price-takers. And, we assume that the equilibrium child care prices for each sector must maintain the observed revenue net labor cost per care hour we observe in baseline for each sector.[13] Our model is then equivalent to one assuming a 0 profit condition holds in each

[13] Baseline revenue net of labor costs for each sector is given by $\Delta_s^0 = p_s^0 y_s^0 - (w_l^0 l_s^0 + w_h^0 h_s^0)$, where each variable is the baseline level. Substituting the input demand functions, baseline residual revenue per care hour $\Delta_s^0 / y_s^0 = p_S^0 - (w_l^0 / a_{ls} + w_h^0 / a_{hs})$.

sector. But it is also equivalent to models allowing for positive (variable) profits, under the assumption that the level of residual revenue per care hour remains constant.

Given these assumptions the price setting in this model takes a simple form. As demand for care increases, caregiver wages increase to meet the fixed labor inputs required to produce that care. Care prices then increase to maintain the baseline residual revenue level. Although the mix of high- to low-educated labor remains fixed in each sector as demand rises, the aggregate (across all child care sectors) mix of labor used responds to demand changes. For example, if a change in the policy environment causes households to demand more care from sectors that use more educated caregivers (e.g. high quality and higher price sectors), the model translates this change in demand to changes in demand for labor by type, which in turn will affect labor and care costs. In this case, all sectors care prices will rise in general, and the mix of care labor will shift toward more highly educated teachers.

For the unpaid child care sectors, we assume the labor they use comes from the same pool of care workers as the paid sectors. Therefore as policy makes the unpaid sector more attractive to households, these sectors compete for labor with the paid sector. Because the prices they charge are 0, we do not need to make any further assumption about price setting for these free-to-parents sectors, nor solve for their equilibrium prices, although their market share and labor use affects the prices of the paid sectors.

3.3 Equilibrium

An equilibrium in this market consists of a vector of prices for each child care sector $p_1, p_2, \ldots, p_S$, and wages for each type of worker (w_l, w_h), such that (i) aggregate market demand for child care of each sector is equal to the aggregate market supply of that type, (ii) aggregate demand for each type of worker is equal to the supply of that type of worker, and (iii) the price for each child care sector is equal to its labor costs plus the residual revenue level (cost of additional inputs and profits) for that sector. Appendix Section C.1 contains details on the computation of the equilibrium.

4 Data and Calibration

In this Section we describe our data sources and model calibration. Our main data sources on household child care usage and child care providers come from the National Survey of Early Care and Education (NSECE), conducted in 2012 and 2019. We supplement these data with information from the 2019 American Community Survey (ACS) and other sources.

4.1 Household Data

To understand how households with children ages 0 to 4 make ECE and labor supply choices, we rely primarily on the 2019 NSECE, a nationally representative sample of households with young children conducted in the first half of 2019. The 2019 NSECE has arguably the most detailed and up-to-date information on families' ECE choices, including weekly hours of use and payments. In addition, it includes information on parental employment—including hours of work—labor earnings, and household earnings. We use the ACS data, constructing a larger sample of households with young children, to supplement and re-weight the NSECE data as needed to ensure the NSECE sample represents the U.S. population of households with young children.

Our sample consists of households with children under age five and with a biological parent or step-parent to at least one of the children. We also require the analysis sample to have observed values on the number of household members, the household sample weight (one observation does not), and the gender of the household's respondent adult (who is knowledgeable about children's care arrangements). We start with about 4,800 households meeting the eligibility requirements above, and then exclude about 7% of households without a resident parent or step-parent (e.g., that have only grandparents, for instance, rather than parents). We further exclude all households that report paying for child care but have missing information on child care expenditures (about 6% of remaining households), as well as households with missing information on mother's labor supply (about 7% of remaining households). This leaves a sample of about 4,000 households. A key aim of our analysis is to conduct separate simulations according to whether a given household contains one or two parents (or step-parents), allowing α and β to differ between these two household types. The sample size for one-parent households is 867 unique households, while that for two-parents is 3,090 unique households. [14]

4.1.1 Child Care

The 2019 NSECE household data provides detailed information on the child care used by all children in the household. It also provides information on the hours of child care use as well as the fees paid to each regular provider. Free care is defined as zero fees paid, while paid care is defined as positive fees paid. Using only the providers to which the household reports paying positive fees, we compute an average hourly expenditure for each household and child as the ratio of the total fees paid and total hours of paid care.[15]

For those with any positive non-parental care hours, we categorize non-parental care types into seven mutually exclusive categories. For each child care arrangement, we categorize the provider based on whether the care occurs in a center, in the child's home, or elsewhere (e.g. provider's home); whether the caregiver had a prior relationship with the child; and how much the household pays per hour for the care. The resulting categories of non-parental providers are as follows:

1. **Unpaid Center-Based**: center-based care that was free to the parent, e.g., Early Head Start, Head Start, or school-based pre-k, or in a private center with no cost to household,

[14] For each household, we keep the household weight from the original sample, which will not cause bias in our means or estimation under the assumption that information is missing at random. However, we are more likely to drop households reporting that they pay for child care since these are the only households missing relevant expenditure data. This will bias downward our baseline fraction of individuals paying for child care. Similarly, if the number of hours a mother works is missing, that observation is only dropped if the mother is reported to be employed, which may bias down the fraction of mothers employed in baseline.

[15] Because our focus in demand modeling is household expenses, our measure of out-of-pocket fees excludes any subsidies paid directly to a child care provider. Therefore, free care includes care such as fully-subsidized pre-K or Head Start. We do not explicitly model or measure the current rationing of subsidies via the CCDBG, Head Start, or pre-k, which could distort results by at least two countervailing channels. First, our demand model interprets everyone not choosing free center-based care as due to "preferences" (the α terms), rather than the option not being available due to rationing. This may lead it to underestimate the role of income in shaping behavior and bias the model towards predicting smaller changes. Second, the counterfactuals introduce subsidies into a modeled environment without existing subsidies. Many low-income households currently use subsidies, and so the counterfactual might impact them less than the model assumes. This might be expected to bias the predictions toward larger changes.

2. **Low-Priced Center-Based**: center-based care for which the hourly expenditure is below \$4.75 per hour.[16]

3. **High-Priced Center-Based**: center-based care for which the hourly expenditure is above \$4.75 per hour,

4. **Unpaid Home-Based**: care provided outside the child's own home by someone with no prior relationship to the child and at zero cost,

5. **Paid Home-Based**: care provided outside the child's own home by someone with no prior relationship to the child and at a non-zero cost,

6. **Other Unpaid Care**: zero-price care provided inside the child's home or by someone with a prior relationship to the child (e.g., sibling or relative).

7. **Other Paid Care**: positive-price care provided either inside the child's home (e.g., nanny) or by someone with a prior relationship to the child.

We also classify non-parental care choices according to the intensity of use. In particular, child care quantity choices are divided into three categories based on the total number of hours the child spends in non-parental care in the week prior to the survey: none (0), part-time (positive to 20 hours), or full-time (20 or more hours). Hours of non-parental care include the amount of time the child spends at "regular" providers, defined as those that regularly provide at least five hours of care per week to the child. When households report hours in multiple categories, we privilege paid care over unpaid care so as to better capture household expenditures on child care. For example, we classify a child with 15 hours of paid center-based care and 25 hours of unpaid relative care as receiving part-time center-based care.[17] We use these categories in estimating the model because they embody meaningful distinctions in terms of household budgets, production and competition, policy eligibility, measurement, and household preferences. However, to simplify reporting, we will coarsen them up to center-based, home-based, and other (informal).

Based on insights from previous studies (Bassok et al., 2016; Flood et al., 2022) as well as our own analysis of the (limited) quality measures available in the NSECE provider surveys, we consider unpaid center-based care to be the highest-quality mode of non-parental care, on average, followed by high-price center-based care, low-price center-based care, and home-based providers (paid or unpaid), with other care (paid or unpaid) to be the lowest-quality non-parental care type. Indeed, our analysis of the NSECE reveals large differences between unpaid center-based care, other center-based care, and home-based care according to whether a curriculum is used, whether teachers have mentors, and teacher education levels. Measured differences between high-price and low-price center-based care are more modest, though high-price centers are more likely to be accredited by the National Association for the Education of Young Children (NAEYC) and to have a dedicated center director. See the Appendix for the full set of results comparing quality level across the various provider types.

[16] This is the median expenditure on the youngest child.

[17] We further privilege high-price center-based care over low-price center-based care, and paid center-based over paid home-based and other care. An alternative definition would be to assign the child the care type equal to the type where they spent the most hours.

Table 1: Summary Statistics by Household Type

Household Type = Number of (step-)parents:	One	Two
Panel A: Choices		
Child care type		
Parent only	27.8	37.9
Unpaid informal	26.1	17.5
Unpaid formal	0.2	0.0
Unpaid center	15.5	7.1
Paid informal	6.3	7.5
Paid home-based	5.4	4.7
Paid low-price center	15.3	11.8
Paid high-price center	3.4	13.5
Total	100.0	100.0
Child care hours		
None	27.8	37.9
Part Time	10.8	16.3
Full Time	61.4	45.9
Total	100.0	100.0
Maternal earning hours		
None	23.2	30.5
Part Time	24.8	20.7
Full Time	52.0	48.8
Total	100.0	100.0
Panel B: Heterogeneity		
HH income, not maternal earnings (1,000s)	20.95	95.90
	(35.71)	(90.91)
Maternal wage offer	18.70	26.10
	(15.70)	(21.25)
Number of 0-4 year olds	1.226	1.303
	(0.471)	(0.521)
Number of all children	2.117	2.268
	(1.269)	(1.206)

Notes: Cells display column shares in Panel A and means and (standard deviations) in Panel B by household type. Number of NSECE observations: 3,953. Re-weighted to match the 2019 American Community Survey's household counts by household type. Maternal wage offer is observed if earning and predicted if not.

We divide households into two types. By sample construction, all have a resident (step-)mother. The types are divided based on whether the mother is the only parent present or whether another (step-)parent is as well. Among one-parent households, 27.8% use only parental care; among two-parent households, the share is 37.9% (Table 1). Single-parent households are also more likely to use full-time non-parental care and less likely to have no maternal earning hours than two-parent households.

4.1.2 Labor Supply and Income

The NSECE records the total number of hours that parents are engaged in "work-related activities (work, school, training, commuting)," and we use this as our measure of labor supply for mothers. Given that for some households this does not reflect only paid work hours, we use our equivalent ACS sample to adjust our sample distribution of mothers' labor supply to match the ACS, as described below. Mothers' labor supply choices are distributed into one of three categories: none (0), part-time (positive to 29 hours), or full-time (30 or more hours).

Mothers' reported labor earnings are computed on an hourly basis. For mothers who report missing earnings (either due to zero hours of work or non-reported earnings), we impute their wage offers using the sample of mothers who report earnings. We predict wage offers based on observable characteristics and a no-selection assumption for those not employed.[18] We compute non-labor income (from the mother's perspective) by subtracting mothers' realized labor income from reported household income.

To leverage the ACS's larger sample, we re-weight the 2019 NSECE sample to match the 2019 ACS's population shares in household types defined by the combination of: (1) whether it is a one- or two-parent household, (2) whether there is exactly one child below age five or more than one child, and (3) whether the mother's labor supply choice is no work, part-time work, or full-time work. We further adjust mothers' wage (both realized and predicted) and non-labor income to match the average level observed in the ACS.

In the weighted sample, average income excluding maternal earnings averages \$20,950 for one-parent households and \$95,900 for two-parent households.[19] Maternal wage offers (observed or predicted) average \$18.70 per hour and \$26.10 in the respective household types.

4.2 Demand-Side Calibration

We calibrate the demand-side model of household choices in a multiple-step procedure. In the first step, we create a grid of β_k values (separately for households defined by number of adults), and for each value of the β_k parameters we compute the α_{jk} parameters to fit the share of households choosing each alternative in the NSECE 2019 household sample described above.[20] In the second step, given a particular set of β_k values and associated α_{jk} values, we compute model predicted average elasticities.[21]

In our main specification, we calibrate the model to employment elasticities: any employment (part- or full-time) with respect to the wage rate. Using the procedure outlined above, we find the two β_k values such that the calibrated model produces an average elasticity of employment with respect to the

[18] To obtain the predicted wage for mothers without observed wages, we estimate a linear regression of log hourly wages among working mothers on the number of adults in the household, mother's marital status, number of children under age five, number of children ages five to 17, mother's race, father's log hourly wage if observed, and a binary indicator for missing data on father's wage. Then, for mothers without an observed wage, we predict their hourly wage based on this model and observable characteristics.

[19] Median earnings excluding mother's earnings are \$8,286 and \$73,431, respectively.

[20] We do so using Maximum Likelihood Estimation (MLE), including choice specific intercepts and constraining the term on log residual income for each alternative to take the pre-specified value. The MLE procedure produces α_{jk} values such that the model predicts exactly the sample fractions choosing each alternative.

[21] Given the general tax and subsidy function we use, the many multiple choices allowed for, and the heterogeneity across households within a non-linear choice model, analytic derivatives and elasticities are not possible to compute. Instead we compute elasticities numerically using finite differences for each household, and then averaging those household-specific elasticities using sample weights to be population representative (as described above).

wage offer of 0.35 for one-adult households (single mothers) and 0.65 for two-adult households (married mothers). We choose these values because they are approximately at the mid-point of those reported in the prior literature, identified using a range of sources and methods, most commonly government policy changes or market-level variation (see the Appendix Section A.1 for an overview of the prior literature). In robustness exercises, we consider alternative target elasticities, and show the sensitivity of policy results to these alternative calibrations.[22]

Our calibration procedure is a generalization of recent methods using prior-literature labor supply elasticities to evaluate the changes in the Child Tax Credit (e.g., Corinth et al., 2021; Goldin et al., 2021). In that evaluation literature, labor supply elasticities are applied directly to implied changes in the "return to work" from the CTC change to produce predicted changes in labor supply and household income.[23] In our context, the child-care policies we evaluate are more complex, and depend not only household labor supply but jointly-determined child care choices as well. Our demand-side calibration procedure then accomplishes two aims: one we link our model primitive parameters to prior literature values of elasticities, as in the previous CTC evaluations, and second we match the baseline joint distribution of maternal labor supply and child-care choices.

4.3 Provider Data and Calibration of the Production Functions

To calibrate the production technologies, we use the nationally representative NSECE's (2012) surveys of center- and home-based programs.[24] We measure the child-to-staff ratio and the average hourly wage for workers with and without at least a bachelor's degree for each child-age group and then aggregate across ages. For providers operating out of their own homes, we use the survey of home-based providers and restrict the sample to "listed" providers, meaning those that are licensed or otherwise have a formal regulatory status, thereby making them eligible for the subsidy under the BBBA. The Appendix describes in detail how we estimate the labor inputs.

Table 2 shows the input ratios used to calibrate the production function. The rows represent different provider types. Each entry represents the number of units of the input required to provide one year of full-time care for one child by a provider of a given type.

Table 2: Calibrated Production Function Parameters: Inputs Required to Produce a Year of Full-Time Care by Provider Type

Type	Residual Input	Labor: BA+	Labor: No BA
Unpaid Center-Based	–	0.0586	0.0702
Low-price Center-Based	98	0.0422	0.1135
High-price Center-Based	13,156	0.0538	0.1070
Paid Home-Based	1,759	0.0380	0.2015

[22] We also consider a calibration to the "internal" values of β_k estimated using the 2019 NSECE data alone. These are akin to "naive" OLS estimates, not exploiting exogenous variation in labor-market wages used in the prior literature.

[23] The CTC evaluation literature also considers income effects from the CTC on labor supply. In our model of the household we incorporate both substitution and income effects in one unified utility function.

[24] We use the 2012 rather than the 2019 NSECE data because price variables are not available in the 2019 data at this time.

Input ratios for labor are based on worker-to-enrollment ratios, and labor units are number of full-time equivalent (FTE) workers. We can interpret the parameters as indicating for example that at unpaid centers it requires 0.586 hours of college-educated caregiver labor and 0.702 hours of non-college educated caregiver labor, for a total of 1.288 hours, to produce 10 hours of caregiving for one child, or 1 hour of caregiving for 10 children.[25]

Using the median expenditure for each type of child care from the demand data, the price of one year of full-time care was computed by multiplying the hourly expenditure by 2000. Labor costs for one year of full-time care were computed by taking the average wage of workers in each provider type, inflating to 2019 dollars using the Consumer Price Index (CPI), and multiplying by the labor input shares. The "Residual Input" is estimated as the difference between the price and the labor costs.[26]

4.4 Calibration of the Caregiver Labor Elasticity Parameters

The elasticity of ECE labor supply with respect to wages is critical for determining how much market prices will increase with increased ECE service demand following the enactment of the expanded subsidy reforms. If ECE labor supply is very elastic—meaning that it's easy to attract new workers to the sector with small wage increases—ECE service costs will not increase much. However, if supply is inelastic, then expanding the supply of services will require larger increases in ECE workers' wages, and, as a result, ECE service costs are predicted to rise accordingly.

Furthermore, to capture heterogeneity in child care quality, the model distinguishes between two types of labor: those with less than a bachelor's degree and those with at least this level of education. Estimation of the model therefore requires an elasticity at both worker-quality levels. The literature produces a few relevant elasticities, which we describe at some length in Appendix Section A.3, although there is no direct evidence on exactly these elasticities. Nevertheless, we assume baseline elasticity values on the low end of the range supported by the literature's evidence: an elasticity of $\eta_l = 4$ for child care workers without a bachelor's degree and an elasticity of $\eta_h = 2$ for those with such a degree.

5 Results

The four policy scenarios considered are:

1. *Baseline*: Current tax policy environment in the absence of ECE subsidy expansions and without the Child Tax Credit (CTC) and Child and Dependent Care Tax Credit (CDCTC) expansions.[27]

[25]Note that for the unpaid providers, the residual input is undefined given 0 prices. For the remaining provider types not listed in the table (unpaid home-based, other paid care–e.g. nanny, and other unpaid care–e.g. relative provided care), we assume they are perfectly elastically supplied and do not compete for labor with center-based and paid home-based providers. In addition, we do not model any direct interaction between maternal labor supply and the non-maternal supply of child care, as in the case where mothers with young children also work as care-givers in a home-based or center-based provider.

[26]It is important to note that several aspects of the calibration process could be improved. For example, the ad-hoc procedure for calibrating non-care labor input generates some unsatisfactory results, especially for high-price centers, for whom the procedure yields a residual share of expenditures of approximately 65%, which may be implausibly high. Therefore, alternative strategies for calibrating this input will be considered. The labor shares for home-based providers are also high, and this may reflect that this care is provided with little additional cost beyond labor (care provided in the provider's home, rather than in a separate building).

[27]The baseline budget constraint calculation includes the standard deduction, FICA taxes, federal income tax, 2019

2. *Narrow Child Care Subsidy*: Baseline tax policy environment plus narrowly expanded child care subsidies, which cap total family spending on child care to varying fractions of household income depending on the relationship between household income and national median income (NMI). Care costs for households with an income up to 30% of NMI would not be required to spend on child care (Table 3). Those with income between 30% and 85% of NMI would pay up to 7% of their income toward ECE services and public subsidies would cover the remaining price. Households with income above 85% of NMI would not be subsidized and have no cap on care expenditures. The maximum co-payment rate applied to a given family did not vary depending on the number of children receiving ECE services. See the Appendix for additional implementation details.[28]

3. *Broad Child Care Subsidies*: Baseline tax policy environment plus broadly expanded subsidies. Compared with the Narrow Subsidy policy, the only changes are those listed in Table 3, which is a subsidy schedule with broader income eligibility and a more gradual phase in of higher family payment rates. Age eligibility, parental activity requirements, qualifying providers, and other policy elements are the same as in the narrow policy.[29]

4. *Broad Child Care Subsidy + Wage Floors*: Baseline tax policy environment, broad child care subsidies, and a wage floor of K-5 equivalent wage for ECE teachers with at least a bachelor's degree and $15/hour for all others.[30]

Table 3: Definition of Modeled Subsidy Policies: Assumed Household Payment as a Percent of Income by Household Income Range by Policy

	ECE cost as % of income	
Household	Subsidy Policy	
Income as % of NMI	Narrow	Broad
0-30%	0%	0%
30-75%	7%	0%
75-85%	7%	2%
85-100%	no cap	2%
100-125%	no cap	4%
125-150%	no cap	7%
150-250%	no cap	7%
Above 250%	no cap	no cap

Notes: Table displays assumed co-payments by household income relative to national median income (NMI) for the narrow and broad subsidy policies modeled here. Appendix Table B.1 gives detail about NMI levels by households structure.

version of the CTC, EITC, and state income taxes. The calculation of net child care expenses takes into account the 2019 version of the CDCTC. See the Appendix for additional details of what is included in the budget constraint calculation.

[28] This policy very roughly corresponds to fully-funding CCDBG for any kids before kindergarten whose parents meet income and activity requirements. However, it abstracts from state-level variation in CCDBG's actual rules and requirements.

[29] This policy very roughly corresponds to the BBBA child care subsidy program without its proposed pre-k program nor many other elements.

[30] The K-5 equivalent hourly wage of $24.11 was calculated using data from the National Center for Education Statistics (NCES). We took the average base pay for elementary and secondary school teachers with a bachelor's degree (https://nces.ed.gov/programs/digest/d17/tables/dt17_211.20.asp) and divided by average statutory working hours (https://nces.ed.gov/programs/digest/d17/tables/dt17_601.60.asp). Note that this is an upper bound because it is based on the experience profile of K-12 teachers, who on average have more years of experience than child care teachers.

In the narrow and broad policies, subsidy qualification requires labor market work by any parent(s) is required. Also subsidies can be spent on centers and providers offering care in their own home, but not nannies, sitters, or informal friends, family, or neighbor care.

We begin with an analysis of effects on families' child care expenditures. This is static analysis; subsidies and families' expenses can change but families' or providers' choices cannot. Then we move to equilibrium analysis and simulation results for six outcomes related to household choices, child care supply, and required government expenditures. First, we present results on the effect on household out-of-pocket expenditures on child care. Then, we discuss model predictions on the effect of child care subsidies on child care use by sector, followed by the effect on maternal employment. Turning to child care supply, we present results on the effect of ECE policy expansions on child care teacher wages and market prices of child care.[31] Finally, we estimate the total government expenditures required for each policy scenario.

5.1 Static Simulation of Effects on Household ECE Expenditures

In order to demonstrate how the policies work, we first present results with no behavioral responses by households or providers, which we refer to as the static simulation. In this model, labor supply, choices of child care types and hours, and prices remain unchanged, and we estimate family child care expenses and net income under 3 different policy environments: baseline, narrow, and broad.[32]

Figure 1 displays hypothetical net child care costs and Figure 2 displays net costs as a fraction of net income for a single-parent family with a 4 year old under current (baseline) policy and with the narrow and broad child care subsidies with copays capped based on family income as outlined in Table 3.

We assume that the family uses only one type of provider, and we calculate costs to the family of full-time, full-year care for that provider type. Subfigure (a) shows results if the family uses a home-based provider, subfigure (b) if a low-cost center-based provider, and subfigure (c) if a high-cost center-based provider. All providers in these provider types are assumed to be eligible for child care subsidies.

In the baseline scenario, a single parent making \$10/hour (about \$20,000 annually) would have to spend \$9,795 per year, or 42% of their after-tax income, for full-time child care at a home-based provider, \$5,562 (or 24% of after-tax income) for a low-price center, and \$19,516 (or 84% of after-tax income) for a high-price center in order to care for one child of preschool age. Under the broad child care subsidy program, this family would have no out-of-pocket costs for full-time care at these provider types, while under the narrow subsidy policy, full-time care at any of these providers would cost \$1,280 per year, or 5.5% of after-tax income. The narrow subsidy brings their child care payment to 7% of gross income, the CDCTC reduces it further, and this family's after-tax income is higher than their before-tax income due to EITC.

In the baseline scenario, a single parent making \$100,000 annually would have to spend \$9,315 (12% of their after-tax income) for full-time child care at a home-based provider, \$5,082 (6%) for low-price center-based care, and \$19,036 (24%) for high-price center-based care. The reason their costs are lower than the lower-income family is because their tax liability is higher, so they can claim more of the non-refundable CDCTC. This family's income is too high to qualify for the narrow child care subsidy program, so in the static simulation where prices do not change, their costs remain unchanged. Under the broad child

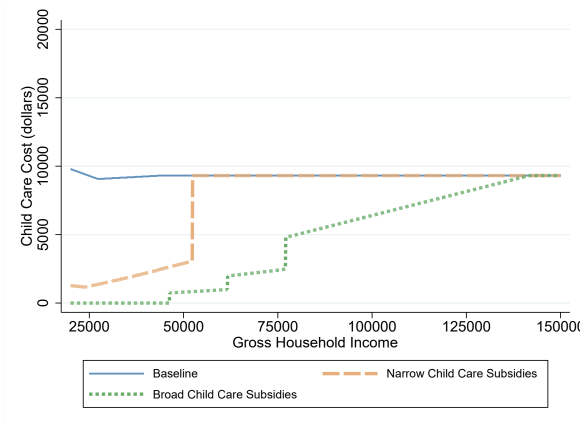
[31] Market prices are the "sticker prices," referring to unsubsidized provider costs.

[32] The static analysis does not allow providers to change their prices so does not consider a policy with wage floors.

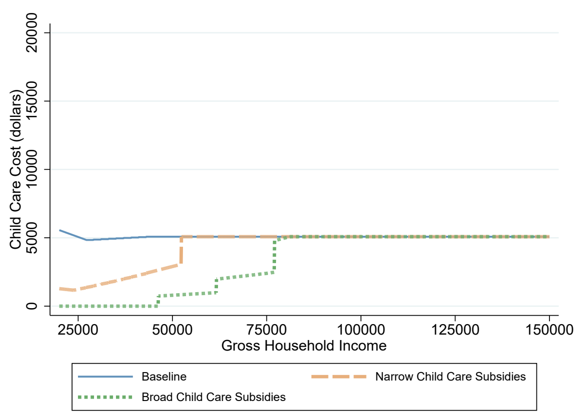
care subsidy program, this family's child care expenditures at these care types are capped at 7% of gross income, a cap that is binding for home-based care and high-price center-based care but not for low-price center-based care.[33]

Figure 1: Annual Net Child Care Costs For Single Parent with a 4-year-old

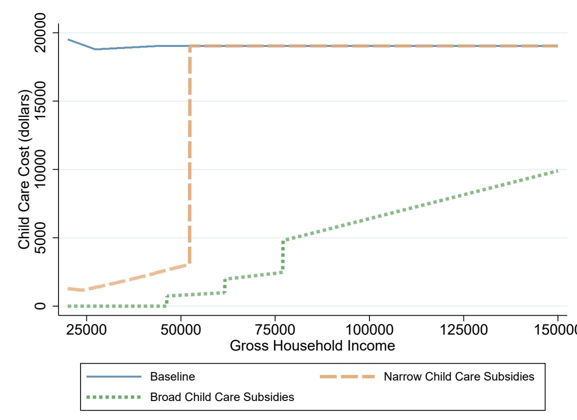
(a) Home-based Provider



(b) Low-Price Center-Based Provider



(c) High-Price Center-Based Provider

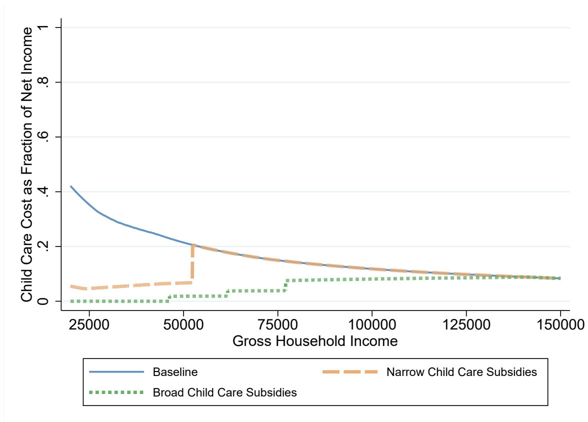


Notes: Figures display hypothetical full-time annual net child care costs by provider type and policy for a single-parent household with one child who is four years old. Gross income is on the x-axis, and the budget model is used to calculate net child care costs. Net child care costs are calculated as gross child care costs minus any CDCTC amounts and subsidies that depend on the policy environment. Child care costs are set to the median hourly prices paid by households by care type in the 2019 NSECE.

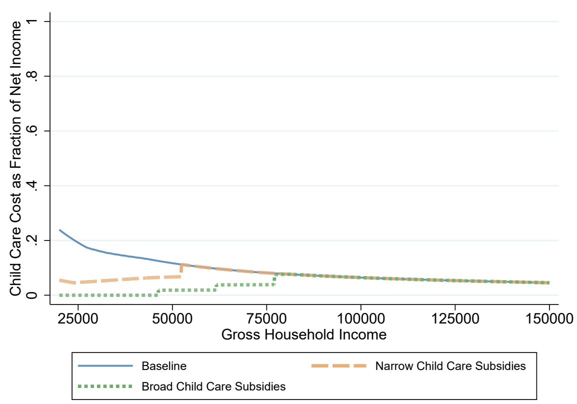
[33] The figures display child care costs as a fraction of net income, while the subsidy program caps costs to a fraction of gross income. For this family, 7% of gross income is equivalent to 8% of net after-tax income.

Figure 2: Child Care Costs as Fraction of Net Income For Single Parent with a 4-year-old

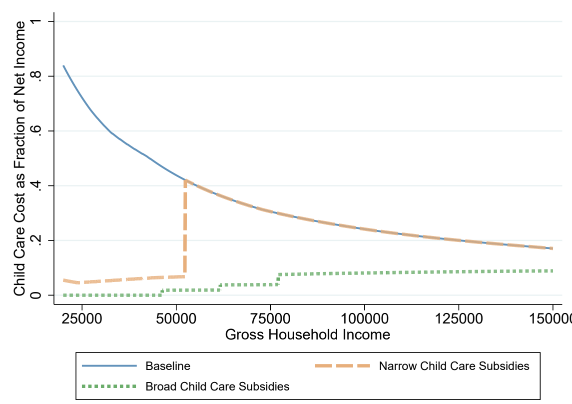
(a) Home-based Provider



(b) Low-Price Center-Based Provider



(c) High-Price Center-Based Provider



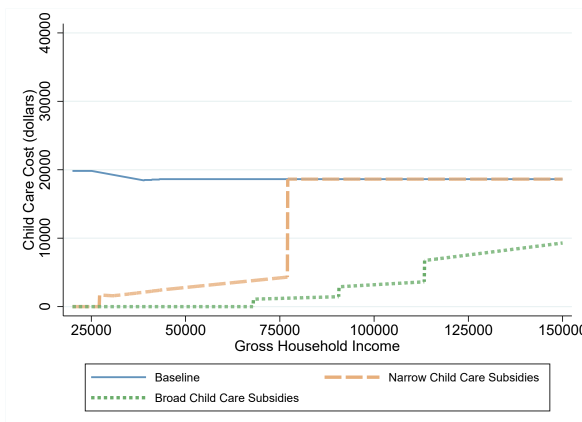
Notes: Figures display hypothetical full-time net child care costs by provider type and policy as a fraction of net income for a single-parent household with one child who is four years old. Gross income is on the x-axis, and the budget model is used to calculate net after-tax income. Child care costs are set to the median hourly prices paid by households by care type in the 2019 NSECE. Net income and net child care expenses are calculated assuming the CTC and CDCTC remain at their 2020 levels and are not expanded.

Figure 3 displays hypothetical net child care costs and Figure 4 displays net costs as a fraction of net income for full-time, full-year care for a two-parent family with a 4 year old and a 2 year old under the same policy scenarios. Families are assumed to put both children in the same type of care. Subfigure (a) shows child care costs as a fraction of net income if the family uses a home-based provider, subfigure (b) if a low-cost center-based provider, and subfigure (c) if a high-cost center-based provider.

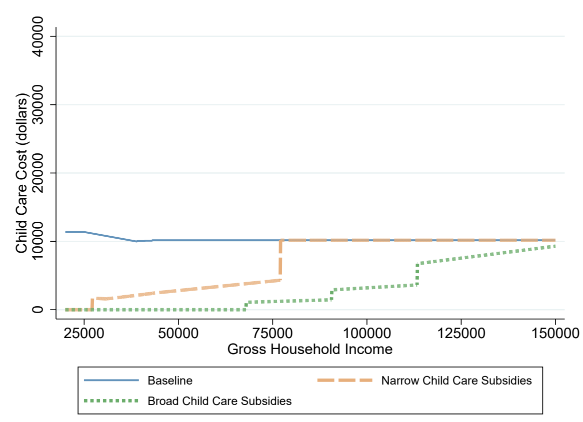
In baseline, a two-adult family with two children making $35,000 per year would have to spend over 100% of their after-tax income on child care in order to send both children to high-price center-based care. They would spend over $10,000 per year, or 27.5% of their after-tax income, for low-price center-based care and over $18,000 (50% of after-tax income) for home-based care. The Department of Health and Human Services defines child care as affordable if it costs less than 7% of family income (U.S. Department of Health and Human Services Administration for Children and Families, 2016). Even for a family making $150,000 annually, the maximum shown on the graph, high-price center-based care and home-based care for two children exceeds this threshold in baseline. Low-price center-based care would be 5.8% of after-tax household income for a family making $150,000 annually. With the broad child care subsidy policy, expenditures are capped at 7% of gross household income (at the most) for all income levels included in the figures. Under the narrow subsidy policy, expenditures are capped to at most 7% of gross household income up to $77,058 for this family of four. Families with income above this threshold pay full price.

Figure 3: Annual Net Child Care Costs For Married Couple with a 2-year-old and 4-year-old

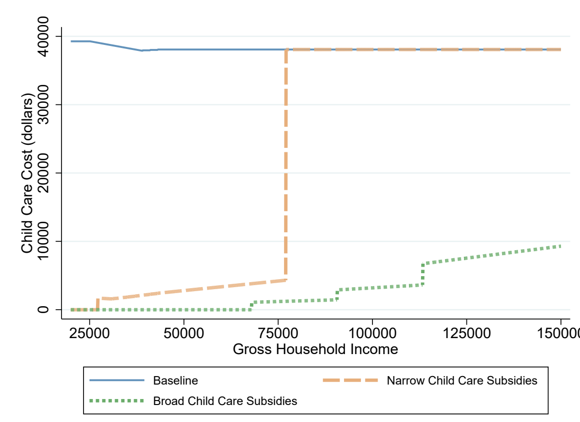
(a) Home-based Provider



(b) Low-Price Center-Based Provider



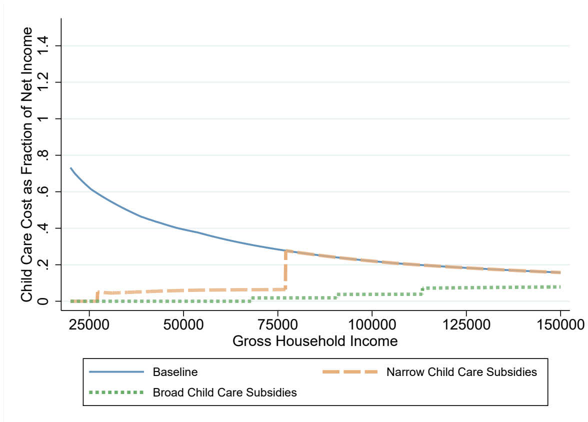
(c) High-Price Center-Based Provider



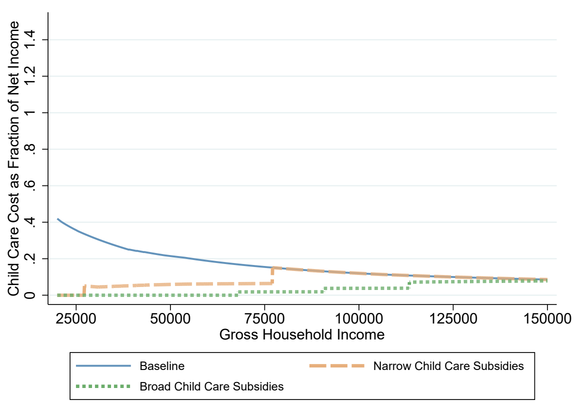
Notes: Figures display hypothetical full-time annual net child care costs by provider type and policy for a single-parent household with one child who is four years old. Gross income is on the x-axis, and the budget model is used to calculate net child care costs. Net child care costs are calculated as gross child care costs minus any CDCTC amounts and subsidies that depend on the policy environment. Child care costs are set to the median hourly prices paid by households by care type in the 2019 NSECE.

Figure 4: Child Care Costs as Fraction of Net Income For Married Couple with a 2-year-old and 4-year-old

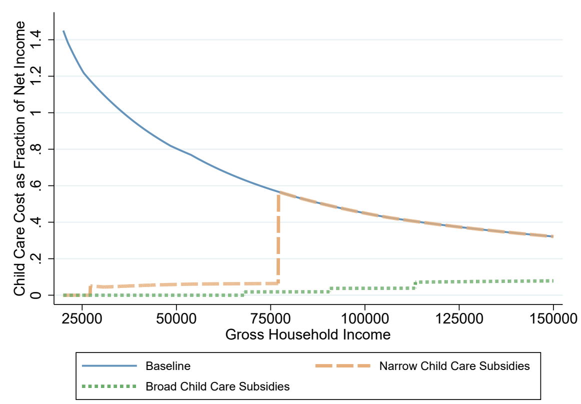
(a) Home-based Provider



(b) Low-Price Center-Based Provider



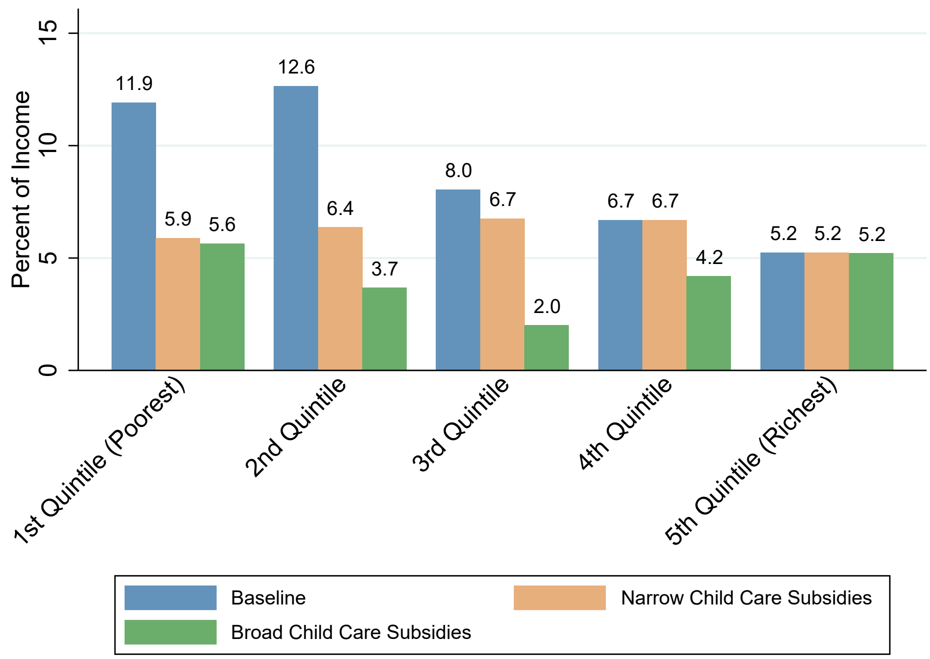
(c) High-Price Center-Based Provider



Notes: Figures display hypothetical full-time net child care costs by provider type and policy as a fraction of net income for a two-parent household with two children, one four-year-old and one two-year-old. Gross income is on the x-axis, and the budget model is used to calculate net after-tax income. Earned income is assumed to be evenly split between the two adults in the household. Child care costs are set to the median hourly prices by care type in the 2019 NSECE. Net income and net child care expenses are calculated assuming the CTC and CDCTC remain at their 2020 levels and are not expanded.

The previous analysis demonstrated how the ECE cost burden would change for specific types of families making particular decisions under different policies. Another question is how families overall would be affected based on the child care choices they are currently making. That is, how would we expect the ECE cost burden to change under different policy scenarios *if families were to continue to make the same choices that they make now and nothing changes in terms of market prices*? Figure 5 displays the median fraction of net income currently being spent on ECE for families currently using paid care, split by household income quintile. In the first (poorest) quintile, among households using any paid care, the median household spends 11.9% of their net income on child care. Households in this income quintile are eligible for both the broad and narrow subsidies, so the median fraction of income spent on care falls by half.[34] The median fraction of income spent on care for families in the fifth (richest) quintile is not affected by the subsidy policies in the static simulation. About 40% of the families in the fifth quintile who have ECE expenses earn too much to be eligible for the broad subsidy. Nearly all remaining families have a required copay of 7%, and over 70% of the remaining families already have expenses below this threshold. Some of the remaining families do see lower expenses under the broad subsidy (if their children are in eligible care types and parents meet the activity requirements), but it does not affect the median, which is already below 7%.

Figure 5: Static Simulation: Median Fraction of Income Spent on ECE, Conditional on Using Paid ECE in Baseline



Notes: Figure displays median fraction of net household income spent on child care for households using paid care in the 2019 NSECE under different policy regimes assuming no behavioral responses to the policies. No behavioral responses means that households continue to make the same work and child care decisions and child care prices do not change. "Baseline" is current spending in the data. Values for the broad and narrow child care subsidies are calculated using the appropriate copay-by-income schedule and the parental activity requirement. Households are split by baseline household income quintile in the 2019 NSECE.

5.2 Equilibrium Model

While the static model took parent and provider choices as fixed and simply applied changes in subsidy rules to those choices, the equilibrium model allows families and providers to re-optimize and solves for the new equilibrium where the market for each type of provider clears. Unlike the static simulations' focus on specific family types, these equilibrium estimates use nationally-representative data.

[34]Note that informal care is not covered by the subsidy regimes, so ECE costs for families using informal arrangements like family, friends, or nannies remain the same regardless of the policy regime.

We consider three policy scenarios: the baseline scenario, an expanded child care subsidy policy, and the expanded child care subsidy with the additional impact of wage floors for child care workers. We also explicitly describe relevant tax policies in each scenario. In the equilibrium model, families can adjust choices, so modeling the baseline policy environment becomes important.

In this framework, we simulate household and provider equilibrium choices under each policy environment and summarize the results below.

Effects on Household's ECE Expenditures: At baseline, we estimate that the average household using full time ECE services spends $8,133 annually on them. This includes household spending on all types of non-parental care. With narrow subsidy policy in place, mean annual ECE expenditures across all households with a young child that use full-time ECE fall by 6% to $7,657 (Table 4). As a share of household income, mean ECE expenditures conditional on using full time care fall from 17.8% of income to 12.0%. This reduction occurs both because the expanded subsidies narrowly focused among the lowest-income families lowers their out-of-pocket costs and because their maternal earning hours and incomes tend to rise, as we discuss in more detail below. Countervailing this, there are some expected increases in costs experienced by households that do not meet the narrow income-eligibility criteria or the parental activity requirement. Under the broadly-expanded subsidy policy, mean ECE expenditures for those using any non-parental ECE services full time fall by 38% to $5,022. Further, expenditure as a share of income falls from 17.8% to 6.2%.

Adding the policy of wage floors is predicted to raise mean expenditures only slightly. We find that the broad subsidy policy alone raises demand for ECE services and care labor enough that ECE teachers' wages are estimated to rise close to the wage floor anyway, so that it is close to non-binding.

Table 4: Household ECE Expenditures by Policy, Conditional on Using Full-Time ECE

Policy Environment:	Mean Expenditures	Expenditures as Fraction of Net Household Income
Baseline	$8,133	17.8%
Narrow Child Care Subsidies	$7,657	12.0%
Broad Child Care Subsidies	$5,022	6.2%
Broad + Wage Floors	$5,078	6.4%

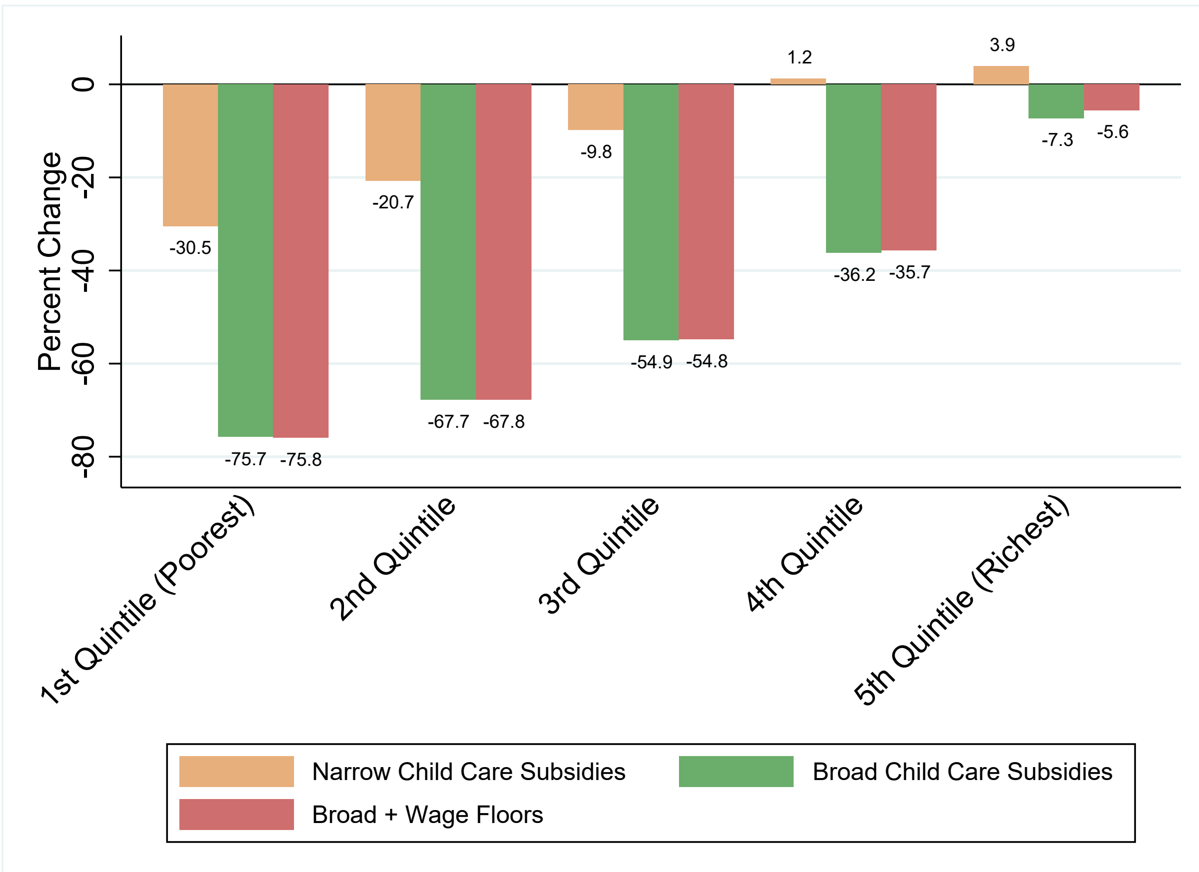
Notes: Table displays measures of household child care expenditures for households that use full-time, non-parental care of any kind (paid and unpaid; center based, provider-home based, nanny, relative and other informal care; licensed and unlicensed) under different policy scenarios. "Mean expenditures" are mean household-level child care expenditures after CDCTC and subsidies, if applicable. "Expenditures as a fraction of net household income" is the mean of a variable calculated at the household level as net child care expenses divided by after-tax income.

The policy impacts on ECE expenditures for full-time care users differ between households with lower- and higher-income at baseline. Large differences across the income quintiles in full-time care costs at baseline reflect large differences in the types of care used.[35] However, both policies have sizable effects on ECE expenses over most of the income distribution. In the middle-income fifth (3rd quintile) of households, mean ECE expenditures fall by 10% under the narrowly-expanded subsidy policy, by 55% under the broadly-expanded policy without wage floors, and by essentially the same amount when adding

[35] Gaps between the expenditure data and the model's baseline predictions warrant caution in interpreting the results and merit further investigation.

wage floors (Figure 6). For the poorest fifth of households, mean expenditures fall by 31% under the narrow policy and by 76% under either broad policy. The subsidy schedule under the broad policy keeps co-pays low much further up the income distribution (Table 3). Looking at the richest fifth of households, expenditures by full-time care users rises by 4%. Under the broad policies, they fall by 6-7%. Again, the wage floors are predicted to have little impact over and above the broad subsidy.

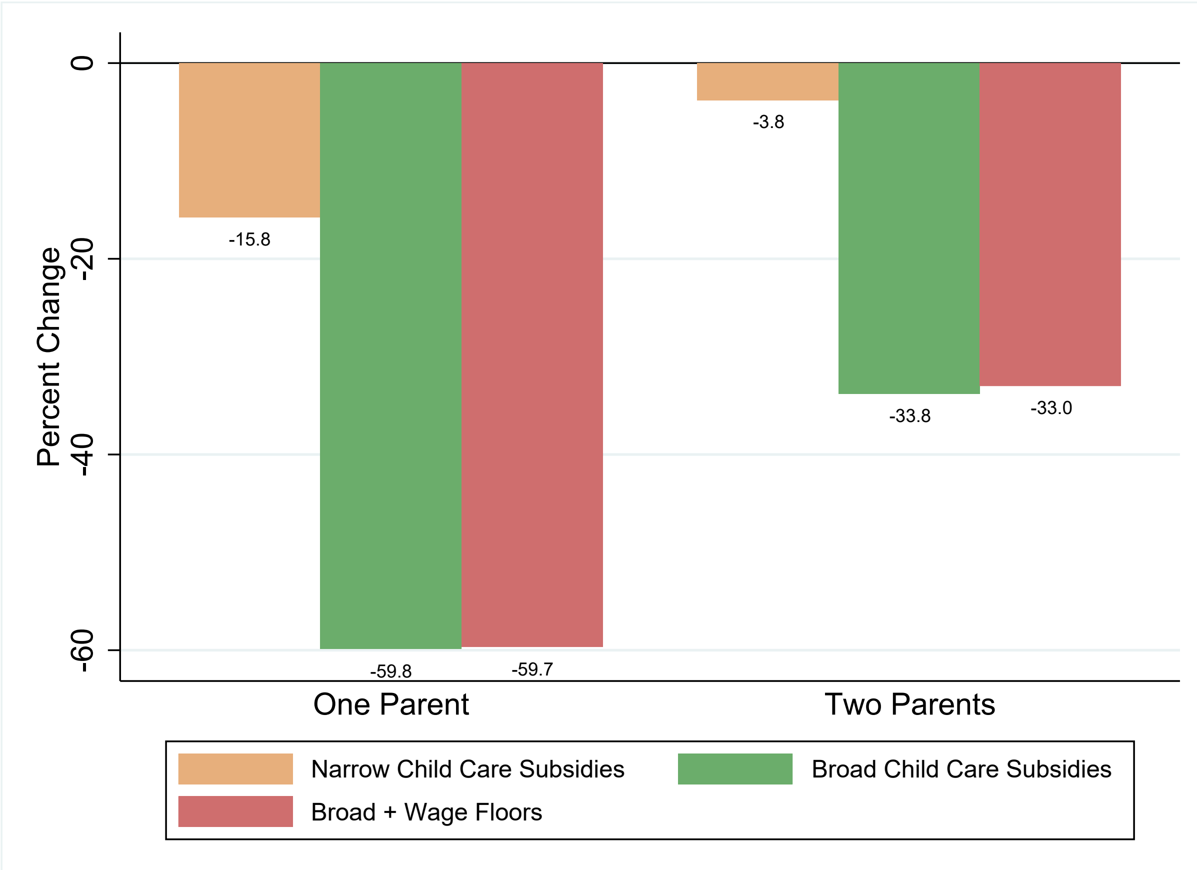
Figure 6: Percent Change in Household ECE Expenditures by Policy and by Income Quintile, Conditional on Using Full-Time ECE



Notes: Figures display predicted percent change in average annual household expenditure on child care. This only includes households using full-time non-parental care. Households are split by baseline household income quintile in the 2019 NSECE.

Conditional on using full time care, the narrow policy reduces full-time care expenses by 16% among single-parent households and 4% among two-parent households (Figure 7). The broad policies reduce expenses by about 60% among single-parent households and by 33-34% among two-parent ones.

Figure 7: Percent Change in Household ECE Expenditures by Number of Parents and by Policy, Conditional on Using Full-Time ECE



Notes: Figures display the predicted percent change in average annual household expenditure on ECE for households using full-time non-parental care. Households are split by whether there is one adult or two adults in the home in the NSECE 2019.

Effects on ECE Utilization: Expanded child care subsidies cause substantial shifts toward formal child care, particularly center-based care (Table 5).[36] Under the narrow subsidy policy, the share of households using center-based care increases by 11.0 percentage points (pp), from 34.1% at baseline to 45.1%, which is a 45.1% increase over baseline. Use of ECE based in the provider's home increases from 5.0% to 7.0%, a much smaller increase. Households shift most substantially away from informal care, whose usage is predicted to fall by 7.9 pp from 26.9% to 19.1%,. The share of households using parental care only, which is 34.0% at baseline, falls 5.1 pp to 28.8%. The model predicts that broad subsidy policies raise center-based care use by about 18 pp to about 52%. Use of care in the provider's home rises by almost 3 pp to 7.6%, while these are offset by a large decrease in the use of informal care (-11.5 pp) and a slightly smaller decrease in parents-only care (-9.5 pp).

[36] For simplicity, we report on coarsened care types here. The modeling takes place with a richer set of care types, as described in the Data section above. We pool together full-time and part-time use here as well.

Table 5: Changes in ECE Use by Sector

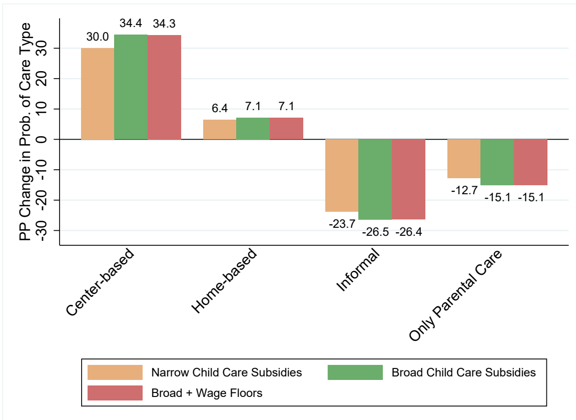
Policy Environment:	Center-based	Home-based	Informal	Only Parental
Baseline	34.1%	5.0%	26.9%	34.0%
Narrow Child Care Subsidies	45.1%	7.0%	19.1%	28.8%
	[11.0pp]	[2.0pp]	[-7.9pp]	[-5.1pp]
Broad Child Care Subsidies	52.4%	7.6%	15.5%	24.5%
	[18.3pp]	[2.7pp]	[-11.5pp]	[-9.5pp]
Broad + Wage Floors	52.3%	7.6%	15.6%	24.5%
	[18.2pp]	[2.6pp]	[-11.4pp]	[-9.4pp]

Notes: Table displays predicted shares from the equilibrium model of households using center-based, home-based, informal, and only parental care under different policy scenarios. Percentage point changes from baseline are in brackets. Due to rounding, rows may not add up to 100% and means minus changes may not exactly match baseline.

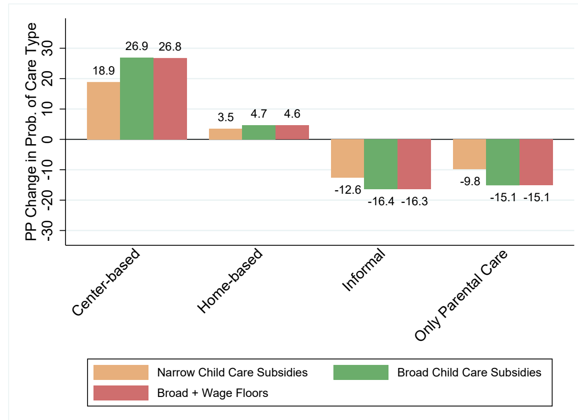
Figure 8 provides additional detail on the changes in the use of ECE by type of care split by household income quintile (based on actual household income reported in the 2019 NSECE). Changes in use are shown as percentage point changes in use of a given type of care in a given policy scenario versus baseline. The model predicts larger changes in ECE usage among poorer households. In the poorest fifth of households, the narrow policy is predicted to increase center-based care use by 30.0 pp and home-based care by 6.4 pp offset by a 23.7 pp fall in informal care use and a 12.7 pp fall in parent-only care. For these households, the broad policies produce slightly larger but similar effects because both narrow and broad policies put resources here. Higher up the income scale, the difference between narrow and broad policies become larger as do the differences in their effects. For instance, for the middle-income fifth of households (3rd quintile), the narrow policy is predicted to raise center use by 6.5 pp but broad policies to raise it by 18 pp.

Figure 8: Change in ECE Use by Sector by Baseline Household Income Quintile

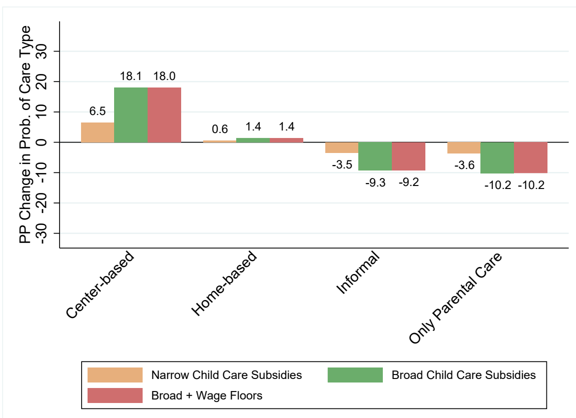
(a) First Income Quintile (Poorest)



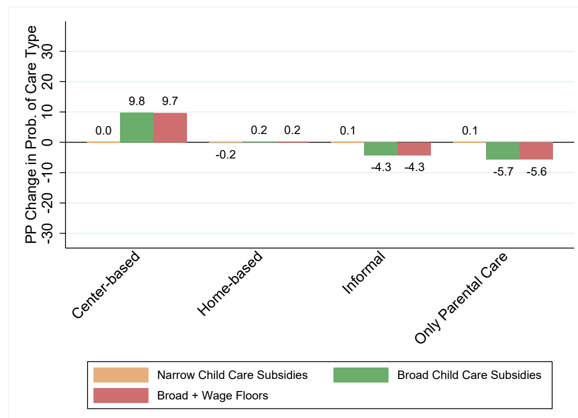
(b) Second Income Quintile



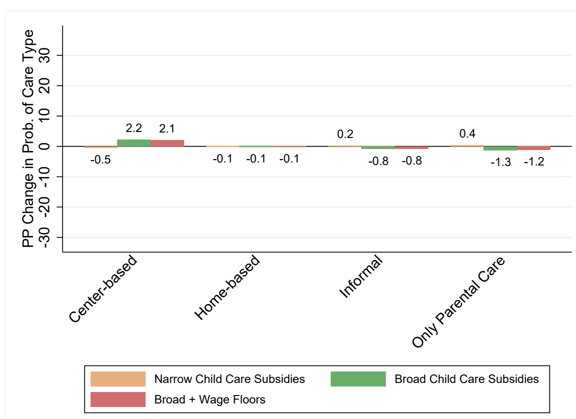
(c) Third Income Quintile



(d) Fourth Income Quintile



(e) Fifth Income Quintile (Richest)

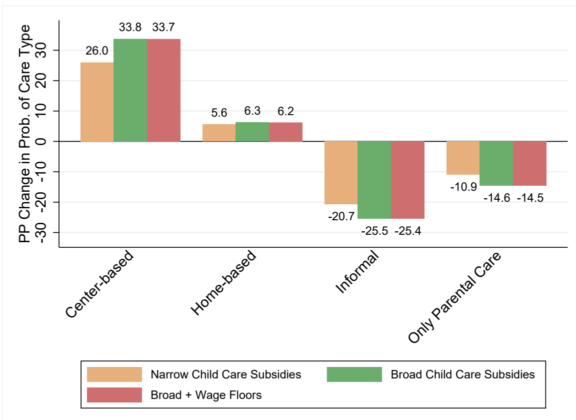


Notes: Figures displays percentage point changes using a given type of child care for households by observed income quintile at baseline. "No CC" indicates that the family uses only parental care and no regular non-parental care arrangements. Households are split by baseline household income quintile in the 2019 NSECE.

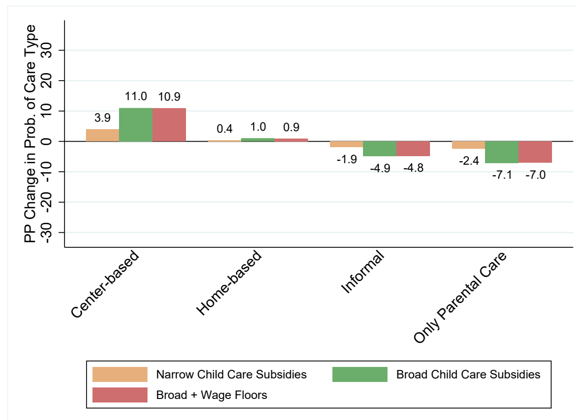
Figure 9 shows that children in households with one parent would experience far more change in their care arrangements than children in households with two parents, partially reflecting the fact that single-parent households tend to be lower income and, therefore, would be the most impacted by these policy changes. Under these policies, single parents become able to afford center-based care. Children in these households shift away from the informal care and parental care they tend to heavily use now. The narrow policy is predicted to have small effects on the experiences of children in two-parent households. The broad policies do drive a substantial shift though.

Figure 9: Change in ECE Use by Sector by Number of Parents in Household

(a) One Parent



(b) Two Parents



Notes: Figures displays percentage point changes in the probability of using a given type of child care for households by whether the household has one parent (or zero) or two parents. "No CC" indicates that the family uses only parental care and no regular non-parental care arrangements.

Effects on Maternal Employment: The model estimates that expanded child care subsidies will lead to substantial decreases in the share of mothers with young children who are not employed and the shares employed part time. Under the narrow subsidy policy, the share who are not employed decreases from 28.2% to 25.9%, a decline of 2.3 pp (Table 6). Under the broad subsidy policies, the share who are not employed falls by 6 pp (21%). Mothers would also shift away from part-time to full-time work. Together, these shifts produce a 4.6 pp (9%) increase in the share of mothers employed full-time under the narrow policy and an increase of almost 10 pp (19%) under the broad policies.

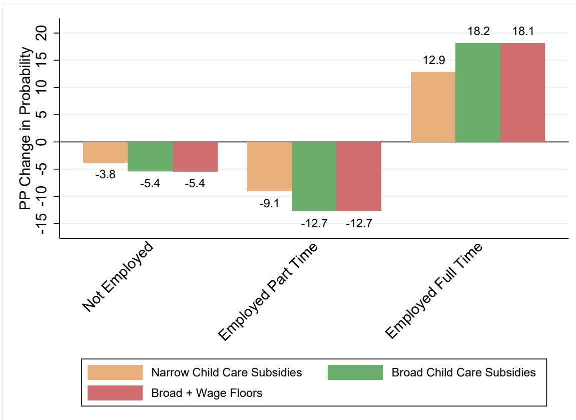
Table 6: Maternal Employment by Policy

Policy Environment:	Not Employed	Employed Part Time	Employed Full Time
Baseline	28.2%	22.0%	49.8%
Narrow Child Care Subsidies	25.9%	19.7%	54.4%
	[-2.3pp]	[-2.3pp]	[4.6pp]
Broad Child Care Subsidies	22.3%	18.3%	59.5%
	[-6.0pp]	[-3.7pp]	[9.7pp]
Broad + Wage Floors	22.3%	18.3%	59.4%
	[-5.9pp]	[-3.7pp]	[9.6pp]

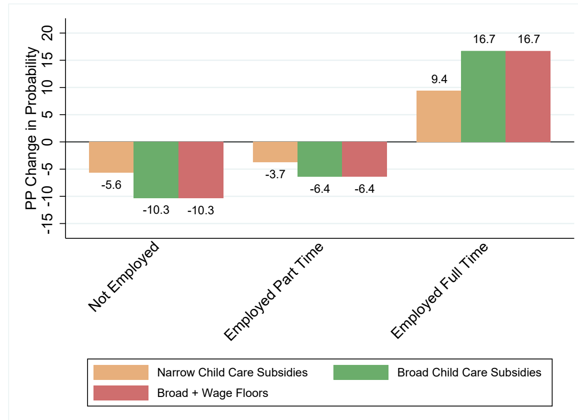
Notes: Table displays predicted shares from the equilibrium model of mothers not working, working part-time, and working full-time under different policy scenarios. Percentage point changes from baseline are in brackets. Rows may not add up to 100% due to rounding.

Figure 10: Change in Maternal Employment by Policy and By Baseline Household Income Quintile

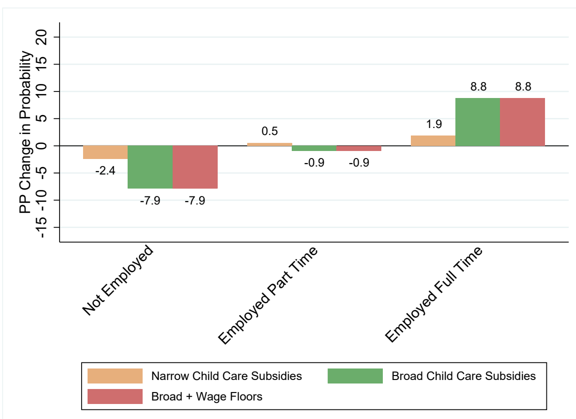
(a) First Income Quintile (Poorest)



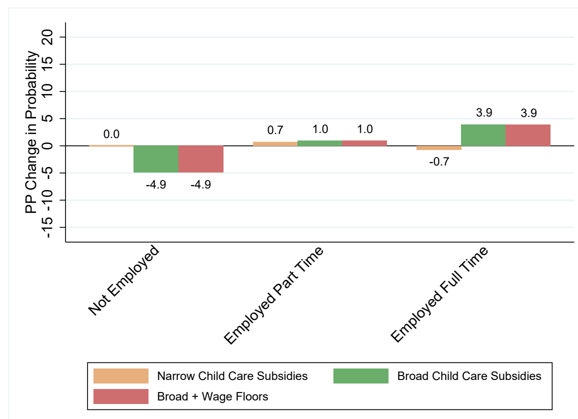
(b) Second Income Quintile



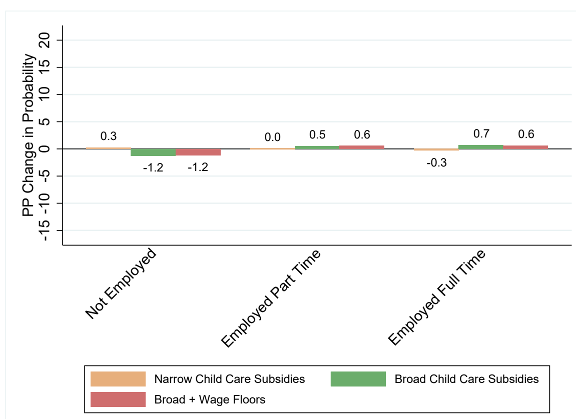
(c) Third Income Quintile



(d) Fourth Income Quintile



(e) Fifth Income Quintile (Richest)

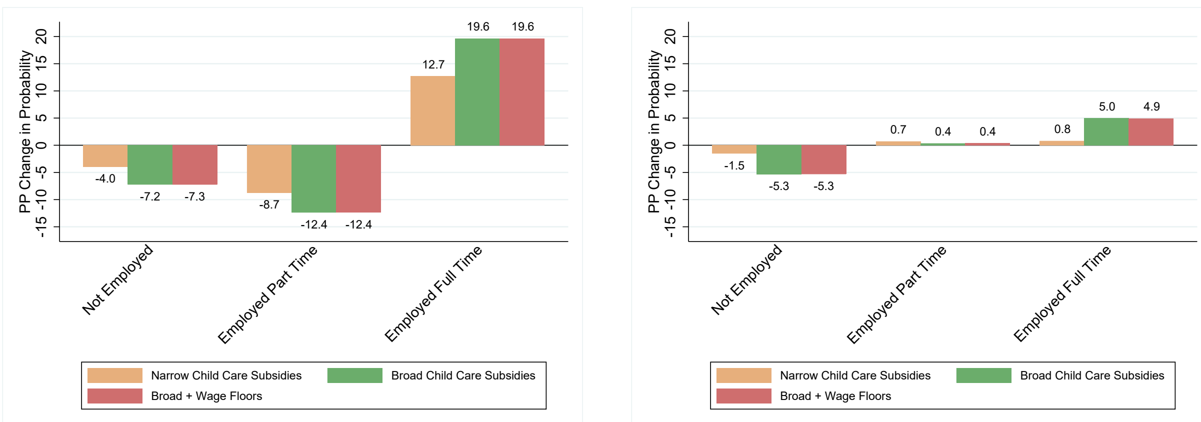


Notes: Figures display percentage point changes in the probability of mothers not working, working full time, and working part time by observed income quintile at baseline. Households are split by baseline household income quintile in the 2019 NSECE.

This overall shift is driven largely by shifts among lower-income households (Figure 10). For households in the first quintile, the percentage working full-time under the narrow child care subsidy policy increases by 12.9 pp. In the richest quintile, under the narrow policy, there is just a 0.3 pp shift away from full-time employment to non-employment, with this very small change driven by the increased cost of care and the lack of offsetting subsidies. Though the model captures this mechanism, the effect is predicted to be very small. Under the broad subsidy policies, there are shifts away from non-employment and towards full-time employment in every quintile, with much larger effects among lower-income households.

Figure 11: Change in Maternal Employment by Policy and by Number of Parents in Household

(a) One Parent (b) Two Parents



Notes: Figures displays percentage point changes in the probability of mothers not working, working full time, and working part time for households by whether the household has one parent (or zero) or two parents.

Single mothers are predicted to shift away from non-employment (-4.0 pp) and part time employment (-8.7 pp) and towards full-time employment (+12.7 pp) under the narrow subsidy policy (Figure 11). Under the broad subsidy policies, the shifts are similar but larger. For two-parent households, effects are smaller and there's not much predicted change in part time employment share but non-employment falls by 5 pp and full time employment rises by 5 pp.

Effects on ECE Teacher Wages: The model predicts how much expanded subsidies will translate into higher ECE teachers' wages in order to meet the expanded demand for child care teachers as families shift the amount and types of ECE services they demand. These predictions account for families' choices across all the detailed types of care, the production process for each type of care (mix of bachelors and no-bachelors teacher labor), non-wage compensation costs, and the need for care providers to compete with each other and with options outside the ECE sector for talent.

Table 7 presents estimated ECE teacher hourly wages under the different policy scenarios. In the baseline, ECE teachers without a bachelors degree make \$11.86 per hour and teachers with a bachelors degree make \$18.95 per hour. The model estimates that the narrow subsidy policy would increase wages of no-bachelors teachers by 9.5% to \$12.99 and of bachelors teachers by 18.5% to \$22.46. The broad policy without wage floors is predicted to raise no-bachelors wages to \$13.51 and wages of those with a bachelors to \$24.44. Beyond the broad subsidies, the Wage Floor policy is predicted to have negligible effects because, given the demand and labor supply elasticities as calibrated, the model predicts that movement up the teacher labor supply curve increases wages to levels similar to those required by the Wage Floor policy. The wage floor of $15/hour for no-bachelors teachers binds a bit, but the floor for teachers with a bachelors is not binding. Increased compensation for teachers and ECE workers would plausibly reduce ECE's high turnover rates, increase the stability of child-caregiver relationships, and improve the quality of children's ECE experiences.

Table 7: ECE Teacher Hourly Wages under ECE Subsidy Scenarios by Teacher Education Level

Scenario:	No Bachelors	Bachelors+
Baseline	$11.86	$18.95
Narrow Child Care Subsidies	$12.99	$22.46
	[9.5%]	[18.5%]
Broad Child Care Subsidies	$13.51	$24.44
	[13.9%]	[29.0%]
Broad + Wage Floors	$15.00	$24.42
	[26.5%]	[28.9%]

Notes: Table displays predicted ECE worker hourly wages from the equilibrium model under different policy scenarios. Bachelors+ workers are workers with at least a bachelor's degree. No Bachelors workers are workers without a bachelor's degree. Percent change from baseline is in brackets.

Effects on Market Prices for ECE: In this model, prices rise only due to a need to raise wages to draw more teachers into the sector to meet expanded demand. Here, we detail predicted effects on the market prices (unsubsidized prices) for high-price center-based care, low-price center-based care, and home-based care. Table 9 displays the estimated annual market prices for full-time care at baseline and under each policy. The combination of family expenditures and subsidies will total this market price.

The model predicts that narrow subsidy policy would increase ECE market prices of high-priced centers by 4.1% from $22,347 at baseline to $23,263, of low-price centers by 12.6%, and of paid home-based care by 9.4%. Broad subsidy policy would increase prices more and adding wage floors raises prices a bit more. Across all policy scenarios, the market price increases are the smallest for high-price centers and largest for low-price centers, with home-based providers falling in between. Market price increases occur because the increased demand for ECE teachers requires raising wages to attract workers to the ECE sector. Both the overall labor share and the relative labor shares of the more elastic no-bachelor's market and less elastic bachelors market are relevant for understanding these results. Calibrated labor shares for high-price centers are significantly lower than those for low-price centers and home-based care, which is why high-price centers experienced the smallest market price increases. Although the labor share is larger for paid home-based providers than for low-price centers, the predicted market price increases are smaller for home-based providers than for low-price centers. Home-based providers are primarily staffed by no-bachelors teachers, who experience more modest wage increases because their labor supply is more elastic than teachers with a bachelor's degree.

Table 8: Annual Market Price of Care under ECE Policy Scenarios

Policy Environment:	High-price center	Low-price center	Paid home-based
Baseline	$22,347	$6,466	$11,284
Narrow Child Care Subsidies	$23,263	$7,282	$12,349
	[4.1%]	[12.6%]	[9.4%]
Broad Child Care Subsidies	$23,744	$7,706	$12,883
	[6.3%]	[19.2%]	[14.2%]
Broad + Wage Floors	$24,213	$8,203	$13,770
	[8.3%]	[26.9%]	[22.0%]

Notes: Table displays predicted ECE market prices for one year of full-time care by care type from the equilibrium model under different policy scenarios. Percent change from baseline is in brackets.

Estimated Net Public Cost of ECE Provisions: We estimate the net cost of the subsidies by calculating the total cost of subsidies and adding any reduction in CDCTC costs to the public and increases in income tax revenue due to an increase in mothers' labor force participation. We assume that the government reimbursement rate in a given policy scenario will be equal to the equilibrium price of care in that scenario minus any required household expenditures.

In the baseline, households with a young child average $215 in CDCTC payments from the public and pay $18,280 in income tax. With the narrow subsidy policy in place, the average household gets $5,336 in new ECE subsidies, CDCTC payments rise by $69, and income tax revenues increase by $186 due to increased maternal earnings (Table 9). The net change in public cost is $5,299 per household through these channels. Aggregating to the population level and assuming that all states participate, this implies an additional $66 billion in net public expenditures annually, which would be divided between state and federal governments. We do not model that split. The table provides analogous statistics for the broad policies. These new public costs cover a combination of expanding the size of the ECE care workforce, raising their hourly compensation, and shifting care towards ECE sectors that more intensively use workers with more formal education and, hence, higher hourly compensation.

Table 9: Changes in Annual Government Expenditures and Tax Receipts under ECE Policies Scenarios

	Per Household with Children ages 0-4				Aggregate	
Policy Environment:	New subsidies	CDCTC	Taxes on Income	Net Cost	New subsidies	Net Cost
Narrow Child Care Subsidies	$5,336	$69	$106	$5,299	$67 billion	$66 billion
Broad Child Care Subsidies	$9,803	-$22	$473	$9,309	$122 billion	$116 billion
Broad + Wage Floors	$10,106	-$22	$466	$9,619	$126 billion	$120 billion

Notes: Table displays estimated subsidy program costs and change in CDCTC and tax revenue from baseline under different policy regimes. The first four columns are average values per household. The final two columns estimate the total cost across all households by multiplying the per household costs by the 12,487,080 households in the 2019 ACS with a mother and any children under the age of 5 years old.

Additional revenue offsets are likely though we are not well-equipped to model them. For instance, the fiscal impact of ECE workers will shift dramatically as their incomes change. Given their low wages at baseline, they are estimated to use about $3 billion in a year in public benefits (Kashen et al., 2016; Palladino and Mabud, 2021). As ECE workers' wages rise, most would become ineligible for these benefits, creating public savings. Furthermore, ECE workers would pay additional income tax on their new earnings. Increased ECE worker wages account for most of the new public expenditure and such workers are likely to pay income tax of 15-25%. On the other hand, we have not modeled the costs of any distortions that might arise from raising the public funds for this program.

Robustness: We assess how key predictions differ when the model is changed in two dimensions: the labor supply elasticity of child care workers and how the β_k parameters in the utility function are estimated. We do this first for the narrow policy and second for the broad policy. In each case, the main model discussed above uses values of two and four for the sectoral labor supply elasticities of child care workers with and without a bachelor's degree, respectively. The results of this model, discussed at length above, are summarized in column (1) of Table 10 for easy reference. We first increase the care labor supply elasticities by a factor of two as indicated in the bottom rows of the table, which makes it less expensive to attract workers into the sector (Column 2). Estimated effects on most outcomes are similar to the main model (Column 1), but teacher wages rise by about half as much and public costs fall by 3%. In Column 3, the care labor supply elasticities from the main model are decreased by a factor of two, making it more expensive to attract workers to teacher jobs in the sector. Again, most of the estimated effects are similar though wages rise more than in main model, up 18.8% to \$14.09 per hour (about \$29,000 annually) for no-bachelors teachers and up 38.7% to \$26.28 per hour (about \$56,000 annually) for teachers with a bachelors. This raises the public cost by 7% above the main model.

Next, we go back to the main model's care labor elasticities but instead change the β_k parameters. In our main model, we choose the β_k parameters for single- and two-parent households as those implied to match calibrated values for maternal extensive margin labor supply elasticities with respect to wages from the literature, 0.65 for single mothers and 0.35 for married mothers. Here, instead, we choose β_k calibrated to lower levels, 0.33 for single mothers and 0.25 for married mothers. This version of the model predicts smaller changes in maternal employment and a smaller shift toward center-based care (Column 4). This leads to smaller increases in ECE workers wages and 44% less predicted new public cost, \$37 billion instead of \$66 billion.

Finally, we change the β_k values to match those estimated in our household demand model directly using maximum likelihood (using only the 2019 NSECE data and no external estimates of elasticities, akin to a "naive" OLS estimate). This estimation process implies lower maternal labor supply elasticities than the literature finds and than we use in the main model and, therefore, using these values implies lower effects of policy changes on maternal employment and ECE use.

Table 10: Key Outcomes for Narrow Child Care Subsidy Policy Under Different Modeling Assumptions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Mean Household Expenditure,	$7,657	$7,556	$7,846	$7,633	$7,421	$7,537	$7,613
Conditional on using FT care	[-5.9%]	[-7.1%]	[-3.5%]	[-9.8%]	[-2.7%]	[-13.7%%]	[-12.8%]
Fraction of Net Household Income Spent,	12.0%	11.7%	12.5%	12.5%	11.3%	13.3%	13.4%
Conditional on using FT care	[-5.8pp]	[-6.0pp]	[-5.3pp]	[-6.2pp]	[-5.4pp]	[-6.6pp]	[-6.5pp]
Non-Parental Care Fraction	71.2%	71.4%	70.8%	69.2%	73.2%	67.5%	67.4%
	[+5.1pp]	[+5.3pp]	[+4.8pp]	[+3.1pp]	[+7.1pp]	[+1.4pp]	[+1.4pp]
Center-Based Care Fraction	45.1%	45.4%	44.6%	39.8%	50.3%	36.4%	36.3%
	[+11.0pp]	[+11.2pp]	[+10.5pp]	[+5.6pp]	[+16.2pp]	[+2.2pp]	[+2.2pp]
Mother LFP	74.1%	74.2%	73.9%	73.4%	75.1%	72.8%	72.7%
	[+2.3pp]	[+2.4pp]	[+2.1pp]	[+1.6pp]	[+3.3pp]	[+1.0pp]	[+0.9pp]
Mothers working full-time	54.4%	54.6%	54.1%	52.2%	55.8%	50.8%	50.8%
	[+4.6pp]	[+4.8pp]	[+4.3pp]	[+2.4pp]	[+6.0pp]	[+1.0pp]	[+1.0pp]
Mothers working part-time	19.7%	19.6%	19.8%	21.1%	19.3%	21.9%	21.9%
	[-2.3pp]	[-2.4pp]	[-2.2pp]	[-0.9pp]	[-2.7pp]	[-0.1pp]	[-0.1pp]
Low-education worker wages	$12.99	$12.42	$14.09	$12.60	$13.17	$12.17	$12.47
	[+9.5%]	[+4.7%]	[+18.8%]	[+6.2%]	[+11.0%]	[+2.6%]	[+5.1%]
High-education worker wages	$22.46	$20.66	$26.28	$20.91	$23.63	$19.73	$20.52
	[+18.5%]	[+9.0%]	[+38.7%]	[+10.4%]	[+24.7%]	[+4.1%]	[+8.3%]
High-price center market price	$23,263	$22,798	$24,223	$22,894	$23,506	$22,569	$22,790
	[+4.1%]	[+2.0%]	[+8.4%]	[+2.4%]	[+5.2%]	[+1.0%]	[+2.0%]
Low-price center market price	$7,282	$6,869	$8,132	$6,959	$7,489	$6,667	$6,866
	[+12.6%]	[+6.2%]	[+25.8%]	[+7.6%]	[+15.8%]	[+3.1%]	[+6.2%]
Home-based market price	$12,349	$11,812	$13,440	$11,945	$12,589	$11,555	$11,823
	[+9.4%]	[+4.7%]	[+19.1%]	[+5.9%]	[+11.6%]	[+2.4%]	[+4.8%]
Net program cost (billions)	$66	$64	$71	$37	$91	$20	$21
Modeling Assumptions:							
Beta estimation method	Calibrated	Calibrated	Calibrated	Calibrated	Calibrated	MLE	MLE
Single Mother ϵ	0.65	0.65	0.65	0.33	1.20	N/A	N/A
Married Mother ϵ	0.35	0.35	0.35	0.25	0.55	N/A	N/A
ECE teacher labor supply elasticities w.r.t. wage							
Teachers without a bachelors degree	4	8	2	4	4	4	2
Teachers with a bachelors degree	2	4	1	2	2	2	1

Notes: Table displays key results under the child care subsidy policy under different modeling assumptions. The preferred specification presented in the previous section is in column (1). Percent or percentage point (as indicated) changes from baseline are in brackets. Because some measures have slightly different estimates at baseline under the different assumptions, the implied baseline values calculated using the counterfactual level and change may be different across specifications. The bottom section of the table gives information about each specification. A beta estimation of method of "Calibrated" means that the betas in the utility function are calibrated to match mother's extensive margin labor supply elasticity with respect to wage. The matched elasticities are below this line. A beta estimation method of "MLE" means that the beta parameters were estimated using maximum likelihood internally using only the 2019 NSECE data.

The results of the same exercises for the broad subsidy policy without wage floors yields similar results (Table 11). Changing the care labor supply elasticities in this range has relatively small effects. Changing the β_k parameters that govern household sensitivity to changes in disposable income have a much bigger impact on costs.

Table 11: Key Outcomes for Broad Child Care Subsidy Policy Under Different Modeling Assumptions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Mean Household Expenditure,	$5,022	$4,944	$5,175	$4,985	$5,067	$4,921	$4,977
Conditional on using FT care	[-38.3%]	[-39.2%]	[-36.4%]	[-41.1%]	[-33.6%]	[-43.6%]	[-43.0%]
Fraction of Net Household Income Spent,	6.2%	6.1%	6.6%	6.7%	5.9%	7.7%	7.8%
Conditional on using FT care	[-11.6pp]	[-11.7pp]	[-11.2pp]	[-12.0pp]	[-10.8pp]	[-12.2pp]	[-12.1pp]
Non-Parental Care Fraction	75.5%	75.6%	75.3%	71.9%	79.8%	68.7%	68.7%
	[+9.5pp]	[+9.6pp]	[+9.3pp]	[+5.9pp]	[+13.8pp]	[+2.6pp]	[+2.6pp]
Center-Based Care Fraction	52.4%	52.6%	52.1%	44.0%	62.3%	38.1%	38.1%
	[+18.3pp]	[+18.4pp]	[+17.9pp]	[+9.9pp]	[+28.1p]	[+4.0pp]	[+4.0pp]
Mother LFP	77.8%	77.8%	77.7%	75.6%	80.7%	73.8%	73.8%
	[+6.0pp]	[+6.0pp]	[+5.9pp]	[+3.8pp]	[+8.9pp]	[+2.0pp]	[+2.0pp]
Mothers working full-time	59.5%	59.5%	59.4%	55.3%	63.3%	52.1%	52.1%
	[+9.7pp]	[+9.7pp]	[+9.6pp]	[+5.5pp]	[+13.5pp]	[+2.3pp]	[+2.3pp]
Mothers working part-time	18.3%	18.3%	18.3%	20.4%	17.4%	21.7%	21.7%
	[-3.7pp]	[-3.7pp]	[-3.7pp]	[-1.6pp]	[-4.5pp]	[-0.3pp]	[-0.3pp]
Low-education worker wages	$13.51	$12.66	$15.33	$12.99	$13.86	$12.35	$12.86
	[+13.9%]	[+6.8%]	[+29.2%]	[+9.5%]	[+16.9%]	[+4.1%]	[+8.4%]
High-education worker wages	$24.44	$21.54	$31.36	$22.20	$26.57	$20.30	$21.73
	[+29.0%]	[+13.7%]	[+65.5%]	[+17.2%]	[+40.2%]	[+7.1%]	[+14.7%]
High-price center market price	$23,744	$23,013	$25,421	$23,223	$24,194	$22,718	$23,104
	[+6.3%]	[+3.0%]	[+13.8%]	[+3.9%]	[+8.3%]	[+1.7%]	[+3.4%]
Low-price center market price	$7,706	$7,059	$9,180	$7,252	$8,089	$6,800	$7,147
	[+19.2%]	[+9.2%]	[+42.0%]	[+12.2%]	[+25.1%]	[+5.2%]	[+10.5%]
Home-based market price	$12,883	$12,053	$14,745	$12,323	$13,333	$11,729	$12,189
	[+14.2%]	[+6.8%]	[+30.7%]	[+9.2%]	[+18.2%]	[+3.9%]	[+8.0%]
Net program cost (billions)	$116	$111	$128	$73	$159	$44	$46
Modeling Assumptions:							
Beta estimation method	Calibrated	Calibrated	Calibrated	Calibrated	Calibrated	MLE	MLE
Single Mother ϵ	0.65	0.65	0.65	0.33	1.20	N/A	N/A
Married Mother ϵ	0.35	0.35	0.35	0.25	0.55	N/A	N/A
ECE teacher labor supply elasticities w.r.t. wage							
Teachers without a bachelors degree	4	8	2	4	4	4	2
Teachers with a bachelors degree	2	4	1	2	2	2	1

Notes: Table displays key results under the child care subsidy policy under different modeling assumptions. The preferred specification presented in the previous section is in column (1). Percent or percentage point (as indicated) changes from baseline are in brackets. Because some measures have slightly different estimates at baseline under the different assumptions, the implied baseline values calculated using the counterfactual level and change may be different across specifications. The bottom section of the table gives information about each specification. A beta estimation of method of "Calibrated" means that the betas in the utility function are calibrated to match mother's extensive margin labor supply elasticity with respect to wage. The matched elasticities are below this line. A beta estimation method of "MLE" means that the beta parameters were estimated using maximum likelihood internally using only the 2019 NSECE data.

6 Discussion

We find that child care subsidies would substantially decrease the cost burden of ECE for covered families, particularly for low-income families, and induce a significant shift from subsidy-ineligible informal care to subsidy-eligible care. Reductions in the household expenditures necessary to obtain ECE facilitates the entry of more mothers into the labor force, including a significant shift to full-time employment over part-time employment. The increased demand for ECE services raises ECE teacher wages, leading to some market price increases which are borne by government programs for program-eligible households and households for ineligible households.

In this section, we discuss some potential implications of our findings, grounded in results from the previous literature, as well as how our model relates to other models in the literature.

6.1 Implications for Families

Our analysis predicts that the broad subsidy policy would substantially lower families' ECE cost burden. As a result of the decrease in ECE expenditures combined with a rise in income caused by increased employment, the fraction of family income spent on ECE (i.e., the cost burden) would decline. Moreover, the reduction in child care costs would be significantly greater among lower-income families than higher-income families. Specifically, those in the bottom income quintile experience a 76% reduction in ECE expenditures, while those in the top quintile see their ECE spending fall by 4%. In addition, under the broad subsidy regime, the fraction of income spent on ECE would decrease from 24.4% to 4.4% for households in the poorest quintile and from 10.1% to 8.6% for those in the richest quintile.

While the subsidies would significantly reduce the cost burden for subsidized families, the impact on market prices facing unsubsidized families (e.g., those above the income eligibility threshold) is predicted to be modest. Results from the equilibrium analysis indicate that market prices would increase by 19.2% for low-price (and presumably low-quality) center-based care and by 6.3% for high-price (and presumably higher-quality) center care.[37] One potential explanation for the disparity in price increases between the two care types is that the labor share of operating expenses is significantly higher for low-quality centers. In addition, the model predicts a price increase of 14.2% for home-based care. It is important to note that these prices would not be binding for the vast majority families because ECE expenses are capped at 7% percent of income for families at or below 250% of SMI. Overall, our findings do not support the argument expressed by some that an expansive subsidy policy like the one proposed under the BBBA would substantially increase the market price of child care (Mulligan, 2021)[38].

With respect to the behavioral responses of parents, two noteworthy results stem from our analysis. First, the reduced cost of ECE is predicted to increase the share of mothers working full-time. The rise in full-time employment is driven primarily by a decrease in the fraction of mothers not working, and to a lesser extent by a shift from part-time to full-time employment. Specifically, under the broad subsidy policy, the proportion of mothers employed full-time would increase by 9.7 pp, while the share of mothers employed part-time would decrease by 3.7 pp, resulting in a 6 pp net rise in the proportion of mothers who are employed. The overall rise in employment is driven by shifts among lower-income mothers, whose employment rate is predicted to increase by 18.2 pp.

The second noteworthy result is that the broad subsidy reform would lead to an increase in the use of formal modes of care—center- and home-based services—and a decrease in the use of informal and parental care. Once again, the substitution toward the formal sector is comparatively large among low-income families. An implication of this result is that families would move from unlicensed care, which is ineligible for subsidies, to licensed care, which on average is of higher quality. This would narrow the large gap in exposure to high-quality ECE experienced by disadvantaged children (Flood et al., 2022).

[37]The Appendix provides evidence from the NSECE on the relationship between care quality and ECE type.

[38]Specifically, Mulligan (2021) predicts that child care market prices would increase between 102% and 122% under the BBBA.

These findings also ease the concern that an increase in the quantity of formal ECE services would come at the expense of quality.

This analysis shows that increasing equity in access to high-quality ECE will require expanding supply and raising its quality, which could raise the market price of care for others. To the extent that this is true, richer families currently benefit from poor and middle-class families not being able to afford ECE services. Status quo policy provides very limited subsidies, meaning that children in families with little ability-to-pay end up with systematically worse care experiences and developmental trajectories (Flood et al., 2022). It also means that wealthier families can pay lower ECE prices, while also creating developmental advantages for their children relative to other children. Expanding subsidies limited to the bottom of the income distribution, as contemplated by proposals to make CCDBG subsidies available to all eligible children, advances equity and limits new demand. However, it raises implicit marginal tax rates on the phase-out. On the other hand, innovations that improve productivity in ECE provision could expand access and quality with less impact on costs Davis and Sojourner (2021).

6.2 Implications for the Child Care Workforce

Consistent with the increased demand for formal care services, our analysis indicates that the broad and narrow subsidy policies would generate sizable increases in teacher wages. The wage gains would be especially strong among teachers with a bachelors degree, who would see their wages increase by 29% under the broad policy. Wages of teachers without a bachelors would increase less. If the wage floor component of the BBBA was enacted on top of the broad subsidies, teacher compensation would increase even more among teachers without a bachelors, while no additional gains are predicted for the wages of teachers with a bachelors as the wage floor is predicted not to bind for this group.

6.3 Implications for Child Development

A primary policy motivation for investing in ECE is to improve children's developmental trajectories and reduce inequality in access, opportunity, and ultimately outcomes. We do not explicitly model the impact of subsidies on child development in the short term or children's life chances and well-being in the long run, although this is a high priority for future work. The effect of subsidies on the quality of care experienced by children and, thus, on their later development is a critically important but challenging area. Impacts will depend on the context and the policy's proposed quality assurance structure.

A large body of work demonstrates that high-quality ECE experiences *can* meaningfully improve children's short- and long-term outcomes. These studies also collectively demonstrate that policy and program effects rest on both the quality of the care in the focal setting and also in the setting from which families and children are moving. In broad terms, shifting children's time from parental to non-parental care has different impacts depending on the contrast in care quality between these two settings, and the impact of moving care from lower- to higher-quality non-parental care follows a similar logic (Bernal and Keane, 2010, 2011; Kline and Walters, 2016; Cascio, 2015; Chaparro et al., 2020). The shifts to and expansions of participation in licensed care, and particularly center-based care, could move meaningfully the quality of the settings and inputs that children experience in the critical early childhood years.

Increasing compensation for ECE teachers has been found to significantly reduce teacher turnover (Bassok et al., 2021), which is very high. One recent study found an annual turnover rate of about 40% in the child care sector in Louisiana (Bellows et al., 2021). Reducing turnover leads to more stable environments for children in care, improving child development outcomes (Markowitz, 2019). Because child-caregiver relationships are a critical component of quality in ECE, improving continuity in the ECE workforce could have substantial positive effects on children. Higher compensation could also improve care quality by allowing the sector to attract more productive workers into the sector.

6.4 Modeling Decisions and Robustness

Our analysis imposes a number of assumptions, and readers should interpret the results within the context of these assumptions. First, we assume that all states participate in the subsidy system making no attempt to model states' participation decisions. Second, we do not model individual providers' decision to participate in the subsidy system. Third, we assume that the public can fund ECE services provided at cost. Achieving something like this would require careful attention to provider incentives in policy and program design.[39] Third, our sample and population analysis is limited to households with a resident mother, including step- or foster-. Finally, we assume that there are no additional costs of raising public funds. The reader is welcome to apply their preferred cost to the public expenditure estimate.[40]

The key issue in the equilibrium analysis of child care policy is how subsidy policy would affect child care prices. In our model, the labor market for caregivers plays the central role. The elasticities of caregiver labor supply determine the extent to which child care prices rise as demand increases. We calibrate the caregiver elasticities to the best, albeit limited, evidence we have.[41]

In contrast, the only other equilibrium analysis of child care policy, Berlinski et al. (2022)'s recent working paper, takes a different modeling approach, and estimates that generic ECE subsidy policies would *reduce* child care prices, not increase them. In Berlinski et al. (2022)'s model, as demand increase for ECE, high-quality providers enter the market and existing high-quality providers expand, reducing market prices for child care. In their model, child care providers face a fixed cost of operating, and variable costs are constant regardless of scale. In contrast, we model increases in cost due to the limited supply of potential child care workers, which we believe to be more reasonable when modeling large-scale subsidy increases that could affect the wages of ECE workers. Furthermore, Berlinski et al. (2022) assume that each provider's variable costs are exogenously determined (although heterogeneous by provider quality and type). In contrast, we model variable costs as arising from equilibrium in the markets for ECE workers, reflecting the interdependence of provider types in the ECE industry, such that expansion of one type may lift wages for workers at other types. We therefore argue that our assumptions are conservative, and represent an upper bound to the possible price increase that may result from expanded subsidies.[42]

[39] Davis and Sojourner (2021) proposes some mechanisms to achieve increased public funding for ECE.

[40] One could consider robustness along several other dimensions as well. First, our model imputes wage offers to non-earning mothers based on observed wages among similar earning mothers. Given that non-earners' wage offers are likely lower that earners' wages, one could impute offered wages for non-earning mothers below predicted wages. Second, our model assumes that each sector's residual revenue (revenue less care labor costs) per care hour stays fixed. One could assess how prices as well as public and private costs change if residual revenue is assumed to increase or decrease. Third, one could use a higher ratio between high- and low-educated labor than currently calibrated in the production function.

[41] See also Rodgers (2018) for evidence on market power in the ECE industry.

[42] There are a number of other differences between our analysis and Berlinski et al. (2022). Berlinski et al. (2022) directly

There are several other models and analysis of child care subsidies in the recent literature (Chaparro et al., 2020; Guner et al., 2020; Griffen, 2019), but none models the equilibrium in the ECE market (they assume child care prices are fixed) and therefore cannot be used to address this issue. For example, an important paper is by Guner et al. (2020), who study the impact of tax-financed ECE subsidies in a labor market equilibrium framework, focusing on parents' labor supply choices and a public budget constraint. It elegantly focuses on labor supply, economy-wide output, and the political economy of support for subsidies. However, it assumes an undifferentiated ECE market with constant, exogenous prices, corresponding to perfectly elastic supply and ruling out any increase in ECE costs from expanding demand.

Our ability to make accurate predictions hinges on the validity of elasticity estimates identified in the child care literature. There are two key areas where the elasticities strongly determine the model's predictions, but the evidence on the most appropriate parameter values is thin. First, the literature contains little direct evidence on the ECE service production process and the industry's competitive structure. Second, the elasticity of ECE sectoral labor supply with respect to compensation governs the impact of subsidies on the ECE market prices as well as the private and public budget impacts. The field would benefit from better evidence in these domains.

7 Conclusion

The importance of ECE in promoting the development of children and the economic security of parents animates active debates and legislative efforts about ECE policy. Further, the pandemic made clear the critical role of accessible and affordable child care, especially as the economy continues its recovery, further fueling the impetus for significant public investments in ECE. Indeed, there is a bipartisan belief that child care should be more accessible and affordable for families and that its quality, along with ECE teachers' pay, needs to improve. Accordingly, there are multiple reform proposals percolating in the U.S. Congress to achieve these goals. The House-passed BBBA would have fundamentally altered the ECE policy landscape by creating an entitlement-based child care subsidy system——capable of serving all children in eligible families——and authorizing sufficient funding to cover the full cost of pre-K services for all 3- and 4-year-olds.

This paper represents the first attempt at conducting a thorough ex ante analysis of the impact of child care subsidy reforms of the scale being debated. Although there was considerable coverage of the BBBA in the popular press as well as cursory analysis of its likely effects, careful, relevant, ex ante studies of recent policy proposals have not been conducted to provide guidance to policymakers and the public. The analyses to date have not integrated the behavioral responses of parents and service providers into the empirical framework, nor have they explored the differential effects of reform efforts across family and ECE provider types. Our model provides flexibility to simulate effects for a variety of alternative policy counterfactuals. Therefore, the methods developed here have potential to inform the design and evaluation of many ECE reforms beyond those recently under consideration.

models child development and ECE quality, although this requires using data on households collected in 2003 rather than 2019. In addition, it examines a broader set of generic policies, such as cash transfers and regulations, which provides important insights, but is not immediately applicable to the very recent policy proposals. Another potentially important distinction is that Berlinski et al. (2022) restrict their analysis to households with one 2 year old child.

How might one assess the magnitude of the impact of the broad expansion policy (motivated by BBBA's child care policies) on parental employment, child care utilization, and other outcomes? One rough option is to compare these outcomes in the U.S. and other OECD countries with and without the enactment of the BBBA. According to the OECD's Family Database, in 2019, 61% of U.S. mothers with children ages 0-2 were employed, while 68% with children ages 3-5 were employed. Such employment rates rank 21st and 32nd, respectively, out of 40 OECD countries with employment data available (the OECD averages are 59% and 72%, respectively). Our estimates of the broad expansion policy imply that the ages 0-2 employment rate would increase to 71% and that the ages 3-5 employment rate would increase to 78%, thereby increasing the U.S. ranking in the OECD to 12 and 9, respectively. Regarding ECE participation, 66% of U.S. children ages 3-5 are enrolled in some form of non-parental early education or care setting. This participation rate ranks 42nd out of 48 OECD countries reporting such information (the OECD average is 87%). Our estimates imply that the ECE participation rate would increase to 84%, thereby increasing the U.S. ranking to 29th in the OECD.[43]

Ultimately, the model estimates suggest that expansion of child care subsidies would mitigate family-income gaps in access to licensed care facilities, moving families from unlicensed care to center-based care in particular. These shifts also facilitate meaningful increases in maternal employment and imply improvements in the quality of care experienced by children. These improvements are driven in part through shifts in types of care and in part through improvements in the ECE teacher workforce. Increases in ECE teacher wages likely bolster quality improvement by stabilizing the ECE workforce which is currently characterized by high turnover. Improved workforce stability would be expected to support stronger child-caregiver relationships, a critical component of ECE quality.

Importantly, a trade-off inherent in child care subsidy design is that a robust program necessarily generates demand for ECE teachers, raising their wages and increasing overall provider-side costs. In contrast, a smaller program does not generate the sizable shifts in ECE participation and maternal employment, so the benefits are likely smaller. These considerations are paramount as the policy discourse on public investments in ECE subsidies moves forward.

[43]OECD Family Database information can be found here: https://www.oecd.org/els/family/database.htm.

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Appendix A: Literature Review

A.1 Elasticity of Employment with Respect to the Price of Child Care

There is a large literature estimating the elasticity of parental employment with respect to the price of child care. Despite the large number of studies, there is still uncertainty about the size of this elasticity. Blau (2001); Morrissey (2017); Tekin (2007); Herbst (2010) each provide a broad review of the literature and summarize the range of estimates. Blau and Currie (2006) report the range of estimates as between 0.04 and -1.26. In a relatively recent summary of the literature, Morrissey (2017) finds that the estimates span from -0.025 to -1.1, with most appearing in the range -0.05 to -0.25.[44]

The most common methodological approach to estimating price effects includes a discrete choice employment equation with selection-corrected predicted hourly child care expenditures and wages as the key right-hand-side variables. This basic structural approach has been used over the past few decades using data from inside and outside of the U.S., with samples comprised of both single and married women with different levels of education and with children of varying ages.

The most commonly used data source in the literature is the Survey of Income and Program Participation (SIPP). In one of the earliest SIPP studies, Ribar (1992) analyzed the 1984 survey to find an elasticity of employment with respect to child care prices of -0.74 in a sample of married mothers with at least one child under age 15. Leveraging data from the 1987 and 1988 SIPP, Kimmel (1995) reports an employment elasticity of -0.35 for a sample of (married and single) mothers below the poverty line. Anderson and Levine (1999) use four waves of the SIPP between 1990 and 1993, and estimate separate elasticities for married and single mothers by education level and with children of varying ages. For married women with children under age six, they find elasticities ranging from -0.94 for mothers with less than a high school degree to -0.30 for those with more than a high school degree. A similar pattern emerges for single mothers, with elasticity of -0.73 among those with less than a high school degree and an elasticity of -0.21 among those with more than a high school degree.[45] Finally, focusing on single mothers with children ages 0 to 12, Herbst (2010) combines data from eight SIPP survey waves (from 1990 to 2001) and 15 Current Population Survey (CPS) samples (from 1990 to 2004) to estimate an employment elasticity of -0.05.

Studies leveraging other data sources show a similarly large range of estimates. Blau and Robins (1988) analyze the Employment Opportunity Pilot Project to find an employment elasticity of -0.38 in a sample of married women with at least one child under age 14. Blau and Robins (1991) report an elasticity of 0.04 in a sample of all mothers using the National Longitudinal Survey of Youth (NLSY), while Averett et al. (1997) use the NLSY to examine labor supply (hours worked) for married mothers, finding an elasticity of -0.78. Using CPS data from 1991 to 1994, Han and Waldfogel (2001) estimate elasticities in the range -0.30 to -0.40 for married mothers and -0.50 to -0.73 for single mothers with at least one child under age six. Finally, Blau and Hagy (1998) use the National Child Care Survey and

[44] Much of the literature focuses on employment elasticity but there are also studies that consider hours worked. For the purposes of this summary, "employment elasticity" refers to labor force participation unless noted otherwise.

[45] In another study using the 1992 and 1993 SIPP surveys, Connelly and Kimmel (2003) examine married and single mothers and make a distinction between full- and part-time employment. They find employment elasticities of -0.45 for married mothers and -0.98 for single mothers. They also find part-time elasticities of -0.09 and -0.40 for married and single mothers, respectively, and full-time elasticities of -0.75 and -1.29 for married and single women, respectively.

the Profile of Child Care Settings to examine maternal employment, the decision to pay for care, mode choice, and the demand for quality. They report an employment elasticity of -0.20 for mothers in which the youngest child is under age seven.[46] [47]

Another strand of research in the U.S. (and Canada) uses quasi-experimental methods to estimate the impact of child care prices (or subsidies) on parental employment. Berger and Black (1992) compare the employment probability for single mothers who received subsidized child care with those on a wait list. They estimate that subsidy receipt increases employment by 12 percentage points, corresponding to elasticities between 0.09 and 0.35. Gelbach (2002) uses children's quarter-of-birth as an instrumental variable for enrollment in public kindergarten, which would constitute a 100% child care subsidy. He reports employment elasticities between -0.13 and -0.36. Finally, Baker et al. (n.d.) use a difference-in-differences strategy to examine the employment response to the introduction of universal child care in Quebec, Canada. Results from this study imply a price elasticity of 0.24.

A.2 Elasticity of Child Care Choices with Respect to the Price of Child Care

Studies estimating the impact of child care prices on parents' child care choices is substantially smaller than that for parental employment. Papers in this literature typically make a distinction between broad forms of formal and informal arrangements or paid and unpaid arrangements. Still other studies examine the effect of prices on specific child care arrangements, such as center- and home-based child care as well as relative care.

In an early study, Blau and Robins (1988) examine a sample of married women under with at least one child under age 14, finding an elasticity of market-based (i.e., paid) child care with respect to prices of -0.34. This is identical to the estimate reported by Blau and Hagy (1998), who examine a sample of mothers for whom the youngest child is under age seven. The authors also estimate arrangement-specific elasticities of -0.24 for center-based care, -0.34 for family-based care, and -0.12 for other forms of non-parental care. These estimates are quite different from those in **?**, who study married and single women with children under age six. The authors find much larger elasticities (-2.3 and -4.0, respectively, for center-based care and -1.1 and -4.4, respectively, for home-based care). Larger elasticities are also reported Michalopoulos and Robins (2000), who find an elasticity of -1.0 for center-based care but no effect for other child care arrangements in a sample of married parents with children under age five. Finally, in a related line of work, Tekin (2007) generates an elasticity of paying for child care of -0.47 for single mothers with at least one child under age 13.

Three studies from Canada also shed light on the impact of prices on child care choices. First, Powell (2002) finds an elasticity of -1.4 for center-based care and -0.80 for relative care in a sample of married mothers with children under age 6. Second, a study by Cleveland et al. (1996) reports an elasticity for market-based care of -1.1. Finally, Baker et al. (n.d.) study of universal child care in Quebec generates

[46] A number of other data sources have been used in this literature. Tekin (2007) uses the National Survey of America's Families to examine single mothers with children under age 13, allowing for differences across full- and part-time work. He finds employment elasticities of -0.15 for full-time work and -0.07 for part-time work. More recently, Chaparro et al. (2020) use data from the Infant Health and Development Program and find an overall hours worked elasticity of -0.39.

[47] An important strand of the structural literature are studies estimating multinomial choice models. Generally speaking, these studies report employment elasticities at the lower end of the range of estimates in the literature. They include -0.34 from Blau and Robins (1988), -0.09 from Ribar (1995), and -0.16 from Michalopoulos and Robins (2000)

an elasticity of any-use of child care with respect to the subsidy rate of 0.58.

A.3 Elasticity of Child Care Labor Supply with Respect to Wages

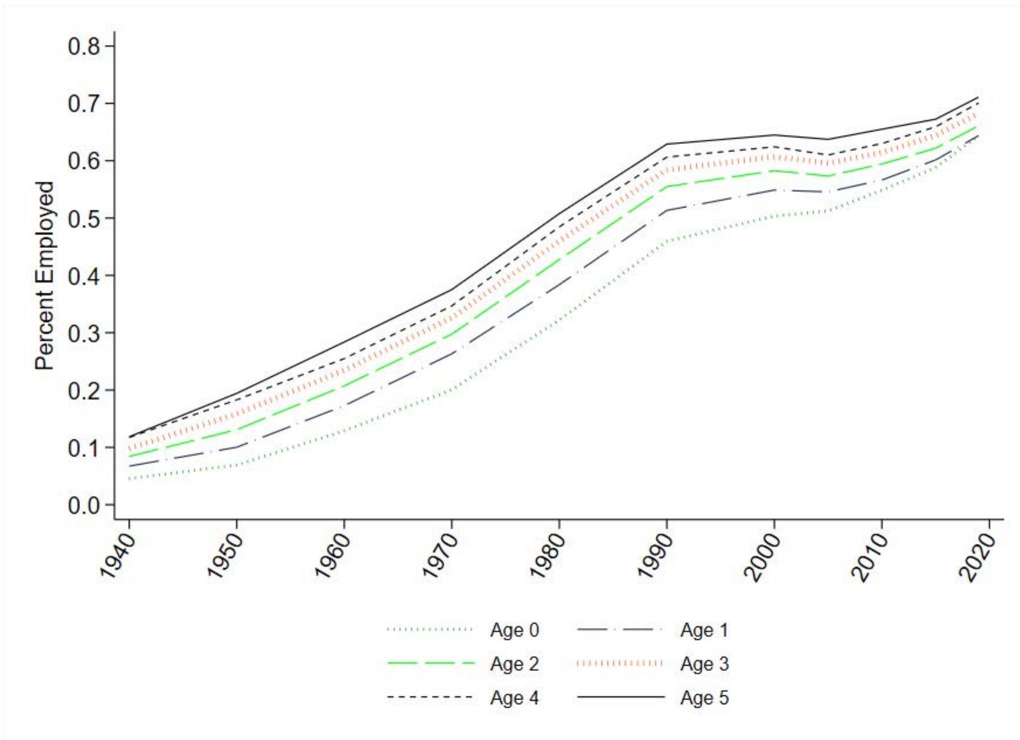
The final literature critical to our simulation exercise relates to the supply-side of the market, estimating the sensitivity of ECE employment to changes in ECE wages. This is the primary determinants of how any increased demand that would follow from increased subsidies would translate into changes in ECE costs. High elasticity of labor supply to the ECE sector implies that costs of care will not rise much because large changes in quantity can be induced by small changes in wage. A lower elasticity of ECE labor supply with respect to ECE wage means that ECE costs rise more with any demand increase.

The goal of such studies in the literature has been to estimate the elasticity of child care supply but in practice reports child care labor elasticities, given that data on supply is unavailable. In addition, this literature is quite thin and dated, with only two previous studies, to our knowledge, producing such elasticities. First, Blau (1993) uses data from the 1977 to 1987 CPS and a sample of female child care workers ages 18 to 64 to obtain an elasticity of the supply of child care labor with respect to wages of 1.9. In follow-up work, Blau (2001) extends the observation period to 1998, and reports elasticities along the extensive and intensive margins of labor supply. Specifically, it reports an elasticity of 0.73 for child care sectoral choices and an elasticity of 0.42 for hours of child care work, corresponding to an overall labor supply elasticity of 1.15. A credible, recent estimate of firm-specific child care labor supply elasticity comes from research on policy changes in Japan. Akai and Jibiki (2021) estimate an elasticity of 2.7, though there are challenges in judging relevance to the U.S. context.

Looking beyond ECE, there is evidence from K-12 schooling, from firm-specific labor supply, and on heterogeneous elasticities by worker education, which suggests relevant elasticities of an order of magnitude from 1 to 10, and with lower-skill occupations and better-identified studies showing higher elasticities. Rothstein (2015) calibrates a model of K12 teacher labor supply and assumes elasticity of 1 at the occupation-level, also considers 0.5 and 1.5. Ransom and Sims (2010) found school districts have firm labor supply elasticities of about 1.8. Webber (2016) estimates an average firm labor supply elasticity of 0.9 for women to employers in the educational services industry. The meta-analysis of Sokolova and Sorensen (2021) finds lower firm-specific elasticites for women than men, also for nurses and for teachers. They recommend a best-practice firm-specific labor supply elasticity estimate of 6.0 for women with a 95% confidence interval [1.1,10.9], though their best-practice estimate for women based only on studies using a well-identified identification strategy is 10.7 with CI [-1.7,23.0]. Across the whole labor market, Azar et al. (2019) find, "the implied market-level labor supply elasticity is about 0.6" and that "...low skill occupations have higher market-level elasticities than high skill occupations."

A.4 Supplementary Tables and Figures

Figure A.1: Maternal Employment Rates, by Age of Youngest Child, 1940-2019



Source.—Authors' analysis of the 1940-2000 U.S. Decennial Census and the 2005, 2010, 2015, and 2019 American Community Survey (ACS).

Appendix B: Budget Model

Modeling the budget constraint and how it changes with various policies requires care. Here we describe the assumptions that apply broadly. We also discuss the assumptions for specific tax and subsidy provisions within those sections.

Tax depends on mother's wage income, other income, number of household members (i.e., number of adults, number of children ages 0 to 5, and total number of children), and child care expenses. We assume that two-parent households file their taxes as "married, filing jointly" and one-parent households file as "head of household." For two-parent households, any income other than the mother's wage income is treated as spouse's wage income. For one-parent households, any income other than the mother's wage income is treated like child support for tax purposes.

The budget constraint model takes into account the following taxes, credits, deductions, and programs: FICA taxes (Social Security and Medicare), Standard Deduction, Federal Income Tax, 2020 version of Child Tax Credit (CTC), Earned Income Tax Credit, State Income Tax, the 2020 version of Child and Dependent Care Tax Credit (CDCTC), and, as relevant, child care subsidies.

B.1 Child and Dependent Care Tax Credit (CDCTC) and Child Tax Credit (CTC)

Both the CTC and CDCTC were expanded significantly for tax year 2021, but they have since have reverted to their previous levels. Thus, we use the original unexpanded CTC and CDCTC provisions.

Child care expenses eligible for the CDCTC are capped at $3,000 for one child and $6,000 for two or more children. Eligible expenses are also limited to the earnings of the lower-earning spouse (or to the earnings of the single parent if filing head of household). The CDCTC is a nonrefundable tax credit worth between 20% (for families with household income of $43,000 or more) and 35% (for lower-income families) of eligible expenses. Paid care from all types of care is eligible. We do not model child care expenses for school-age children, so these are not included in our CDCTC calculation in the model.

The CTC is a tax credit that is worth $2,000 per child in the household. All children in the household are included in this calculation. The CTC is partially refundable, with up to $1,400 refundable and the remaining $600 non-refundable.

Tax depends on the following inputs:

- w: gross wage income
- Y: other income (for two-adult households, assumed to be wage income from the other parent; for one-adult households, treated like child support)
- N_a: number of adults, 1 or 2
- N_k: number of children
- N_{yk}: number of children under the age of 6 (at the end of the tax year)
- CCy: child care expenses for children under the age of 5
- CCy_type: type of child care arrangement (used to determine whether child care expenses will be eligible for subsidies)

Taxes for the household are calculated using the following assumptions:

- No self-employed income, which would be subject to both the employee and employer FICA taxes (doubling the FICA tax obligation)
- No capital gains
- For one-adult households, treat Y as if it is child support. Therefore, it is not subject to income taxes, but it would factor into the income test and copays for the child care subsidy policies
- For two-adult households, treat Y as wage income from the other adult in the household.
- Therefore, for two-adult households, the total income I subject to income taxes is $I = w + y$, while for one-adult households, it is $I = w$
- Assume two-adult households have filing status "married, filing jointly" and one-adult households have filing status "head of household"
- Ignores married filing separately: probably most common for couples who are legally married but living apart and cannot agree to file a joint return; note that if legally married but living apart for at least the last six months of the calendar year, then the parent who contributes more to the children's expenses can file head of household
- Ignores qualifying widow(er): individuals with dependents whose spouse died in either of the previous two calendar years prior to the current tax year and they have not remarried (in the tax year of death, they would file a joint return)

Tax calculations use the following formulas.

B.2 FICA taxes

FICA taxes are calculated on the entire gross income before taking deductions. Assuming here that there is no self-employed income. If self-employed, would need to double FICA tax.

- Social Security tax is calculated as $SStax = 0.062 * (min(w, SScap) + min(Y, SScap))$ for two-adult households and as $SStax = 0.062 * min(w, SScap)$ for one-adult households.
  - Tax rate is 6.2% up to an individual income cap ($SScap$) of $142,000 in 2021 or $147,000 for 2022
- Medicare tax is $MedTax = 0.0145 * I$ (tax rate of 1.45%; no income cap)

B.2.1 Deductions

Assume everyone uses the standard deduction D. Note that this value is adjusted for inflation each year.[48] For the 2021 values:

- Married filing jointly ($N_a = 2$): $D =$\$25,100
- Head of household ($N_a = 1$): $D =$\$18,800

Assuming no other deductions, in particular:

- No itemizing
- Ignoring $300 deduction allowed for charitable contributions (this deduction is allowed for taxpayers who take the standard deduction)
- Ignoring pre-tax benefit contributions, like 401k (which is still subject to FICA) or medical/dental insurance, etc.
- Ignoring possible employer-sponsored Dependent Care Flexible Spending Accounts (the NSECE data has no information about which households have these accounts)

B.2.2 Federal Income Tax

Federal tax is calculated on the total income minus the deductions. Then the credits are calculated that may offset some of this calculated amount.

Federal tax brackets are adjusted for inflation each year. The 2021 brackets are in the table below. Taxable income up to B_1 is taxed at 10%, taxable income between B_1 and B_2 is taxed at 12%, etc.

[48] (https://www.irs.gov/newsroom/irs-provides-tax-inflation-adjustments-for-tax-year-2021)

Variable	Married Bracket Cap	HOH Bracket Cap	Tax Rate
B_1	\$19,900	\$14,200	10%
B_2	\$81,050	\$54,200	12%
B_3	\$172,750	\$86,350	22%
B_4	\$329,850	\$164,900	24%
B_5	\$418,850	\$209,400	32%
B_6	\$628,308	\$523,600	35%
B_7	no cap	no cap	37%

For example, a married taxpayer with \$100,000 in taxable income (after the deduction) would be calculated as: $0.22 * (100,000 - 81,050) + 0.12 * (81050 - 19900) + 0.1 * 19,900 = 13,947$

B.2.3 Child Tax Credit (CTC)

The Child Tax Credit (CTC) was modified for 2021 only. The credit amount was increased from \$2000 for children ages 0-16 to \$3000 for children age 6-17 and \$3600 for children age 0-5 (subject to income caps). It was also made fully refundable (instead of partially refundable). The future of the CTC is currently under debate. We assume that the CTC is not extended and use the 2020 version in our budget calculations.

To calculate the 2020 CTC, start with the intermediate calculations of the nonrefundable and refundable portions. $CTCNRF_{2020}$ is the non-refundable portion of the CTC, $CTCRF_{2020}$ is the refundable portion of the CTC, N_k is the number of children in the household, D is the standard deduction for the household, and $CTCcap1$ is the income level where the CTC begins to phase out, which is \$200,000 for head of household filers and \$400,000 for joint filers:

$CTCNRF_{2020} = max(0, 600 * N_k - 0.05 * max(0, I - D - CTCcap1))$

$CTCRF_{2020} = max(0, 1400 * N_k - 0.05 * max(0, I - D - CTCcap1))$

If $IncomeTax > CTCNRF_{2020} + CTC_RF_{2020}$ (income tax amount calculated from the tax table above is greater than the sum of the refundable and nonrefundable parts of the CTC), then the taxpayer receives the entire CTC:

$CTC_{2020} = CTCNRF_{2020} + CTCRF_{2020}$

If $CTCNRF_{2020} < IncomeTax < CTCNRF_{2020} + CTCRF_{2020}$ (income tax amount is greater than the nonrefundable portion but less than the total CTC amount), then the taxpayer receives the CTC up to the taxes owed plus (potentially) some or all of the remaining amount:

$CTC_{2020} = IncomeTax + min(CTCNRF_{2020} + CTCRF_{2020} - IncomeTax, 0.15 * max(0, 0.15 * (I - 2500))$

If $IncomeTax < CTCNRF_{2020}$ (income tax owed is less than the nonrefundable portion), then the CTC amount is equal to income taxes owed plus (potentially) some or all of the refundable portion:

$CTC_{2020} = IncomeTax + min(CTCRF_{2020}, 0.15 * max(0, 0.15 * (I - 2500))$

The 2020 CTC:

- The 2020 CTC is $2,000 per child ages 0-16 for families whose adjusted gross income (AGI) is under the caps
- The CTC phases out at a 5% rate for joint returns with AGI over $400,000 and head of household returns over $200,000
- The 2020 CTC is partially refundable: $600 per child is not refundable and up to $1,400 per child is refundable, with the amount refunded based on earned income I (without subtracting the standard deduction)
- In order to receive the refundable portion, earned income must be at least $2,500. The refundable amount is capped at 0.15*(I-2500), up to the $1,400 per child.
- Currently ignoring some additional refundability for taxpayers with three or more children

B.2.4 Earned Income Tax Credit (EITC)

The EITC is fully refundable. It has phase in and phase out rates that vary by number of children. The thresholds where phase in ends and where phase out begins are adjusted for inflation each year. The 2021 values are:

Parameter	One Child	Two Children	Three+ Children
Phase-in Percent ($EITCin$)	34%	40%	45%
Phase-out Percent ($EITCout$)	15.98%	21.06%	21.06%
Maximum Credit ($EITCmax$)	$3,618	$5,980	$6,728
Income when phase-out begins (Joint) ($EITCcap$)	$25,470	$25,470	$25,470
Income when phase-out begins (HOH) ($EITCcap$)	$19,520	$19,520	$19,520

EITC credit can be calculated as:

$$EITC = \begin{cases} min(EITCmax, I * EITCin), \text{if } I \leq EITCcap \\ max(0, EITCmax - EITCout\text{*(I-}EITCcap\text{)}), \text{if } I > EITCcap \end{cases} \quad \text{(B.1)}$$

B.2.5 State Income Taxes

To estimate state income taxes, we used TAXSIM to estimate the state tax burden and marginal state income tax for all states and D.C. at the federal median income for a family of four ($90,657). The resulting population-weighted state tax burden was $2,599, and the population-weighted marginal state tax rate was 4.15%. A flat tax of 4.15% would produce a very similar tax burden to the observed tax burden, so I suggest using a flat tax for simplicity. This is similar to Michigan, which has a flat tax of 4.25% or Colorado, which has a flat tax of 4.55%. Estimate state income taxes as a 4.15% flat tax on income higher than the federal standard deductible: $StateTax = 0.0415 * max(0, I - D)$.

B.3 Modeling Child Care Subsidies

The child care subsidies cap total child care expenses for children under the age of 6 and not yet eligible for Kindergarten to a percent of income that varies by family income relative to state median income and is phased out at 85% of state median income for the narrow policy and for families with income greater than 250% of state median income for the broad policy. These remaining child care expenses would be eligible for the CDCTC.

To be eligible for child care subsidies, parents must meet a work activity requirement. In the budget constraint model, we assume one-adult families are eligible if they have nonzero wage income, and two-adult families are eligible if both wage income and other income (assumed to be wages of the other adult) are nonzero.

The child care provisions cap child care expenses in eligible providers for children under the age of 6 (and not in kindergarten) to a percent of income, where the percent is based on income relative to state median income (SMI). Because the NSECE data does not contain information on state, we use the national median income (NMI) for these calculations.

Table 3 in the main text gives the copay schedules for the narrow and broad child care subsidy programs. These copays are expressed as a percent of income $w + Y$. Note that for one-adult households, Y did not factor into the tax calculations, but it is included for child care subsidy copay and eligibility decisions. The copay limits the total cost of child care at eligible providers for children under the age of 6 (and not eligible for kindergarten) to a fraction of NMI. For both the broad and narrow child care subsidy policies, we consider center-based and home-based care to be eligible but informal care not eligible. Informal care is care in the child's own home (i.e., nannies, babysitters, relatives) or care by someone with whom the family has a previous relationship. We have defined it this way in an attempt to identify potentially licensed and potentially unlicensed care. Licensed care is eligible for subsidies while unlicensed care is not.

National median income is $90,657 for a family of four, and we apply the LIHEAP (Low-Income Housing and Energy Assistance Program) ratios to calculate median income for other household sizes: 68% for family of 2, 84% for family of 3, 116% for family of 5, 132% for family of 6, and add 3 percentage points for each additional family member after that.[49]

This results in the following estimated national median income levels by family size:

Table B.1: National Median Income by Household Size

Household Size	National Median Income
2	$61,647
3	$76,152
4	$90,657
5	$105,162
6	$119,667
Add'l members	Add $2720

Notes: This table shows the National Median Income (NMI) values used in the model.

[49] https://www.acf.hhs.gov/sites/default/files/documents/ocs/comm_liheap_im2002smiattachment_fy2021.pdf.

B.4 Child and Dependent Care Tax Credit

While the CDCTC was expanded significantly under the American Rescue Plan Act (ARPA), the expansion was for only one year. It reverted to the previous version when it was not extended by Congress. We base our model assumptions on the 2020 version of the CDCTC (i.e., without the expansion).

For calculating the CDCTC, we assume that the number of children with eligible child care expenses is equal to N_{yk} (number of children under 6 years). Child care expenses eligible for the CDCTC are capped at the earned income of the lower-earning parent (or of the single parent in the case of one-adult families), with some allowances for other non-work labor market activities such as education. Only child care expenses incurred to further these activities are eligible for the tax credit. In the model, we only consider wage income and not other activities. Letting $CCexp$ be the total child care expenses incurred after any subsidies, eligible child care expenses for children in two-adult families are then: $CC_elig = min(CCExp, w, Y)$ and for one-adult families are: $CC_elig = min(CCExp, w)$.[50]

Before the expansion, eligible child care expenses were capped at \$3,000 for one child or \$6,000 for two. Let this value be called $MaxCC$. For individuals with gross income greater than \$15,000, the 2020 CDCTC is calculated as: $CDCTC = min(IncomeTax - CTC, min(MaxCC, CC_elig) * max(0.2, 0.35 - 0.01 * CEILING((I - 15000)/2000)))$. For individuals with income under \$15,000, it is calculated as: $CDCTC = min(IncomeTax - CTC, min(MaxCC, CC_elig) * 0.35)$

The CDCTC takes its 2020 form as follows:

- Maximum credit is equal to a percent that varies by income times eligible child care expenses.
- For families with income of \$15,000 or less, that percent is 35%. (But because the credit is nonrefundable, these families generally cannot claim the credit.)
- The percent is reduced by 1 percentage point for every \$2,000 of income over \$15,000 (or fraction thereof), until it reaches 20% for families with income greater than \$43,000.
- Credit is also capped by the earned income of the spouse with lower earnings (with an adjustment allowed for full-time students). In calculating the CDCTC, we assume that this condition is satisfied.
- Credit is nonrefundable, so it is limited to the federal tax liability minus other credits.
- There is no maximum income for claiming the credit.

[50] Child care expenses for older children are not modeled and are therefore not included in this calculation.

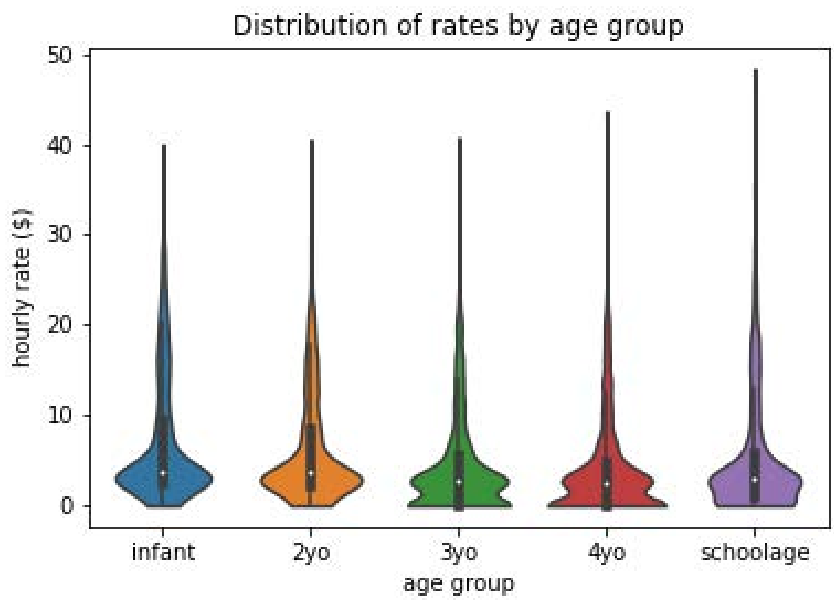
Appendix C: Supply Side and Equilibrium Computation

C.1 Estimation of Input Shares

Using the nationally-representative NSECE's survey of centers and their workforces, we measure the child:staff ratio and the average hourly wage for workers with and without at least a bachelors degree for each child-age group and then aggregate across ages.

C.1.1 Centers

We use the 2012 NSECE Public Use data file for Center-Based Providers and the linked Center-Based Workforce file.We aggregate the hourly price a center charges families for full-time care for each child age group it serves into the age-group categories infant (age 0-1), 2-year-old, 3-year-old, 4-year-old, school-age. The distribution of non-missing rates by age group, after applying sample weights, is illustrated in the figure below. The figure shows that there are many zero values, especially for the 3- and 4-year-old age groups, and that all of the distributions are right-tailed.[51]

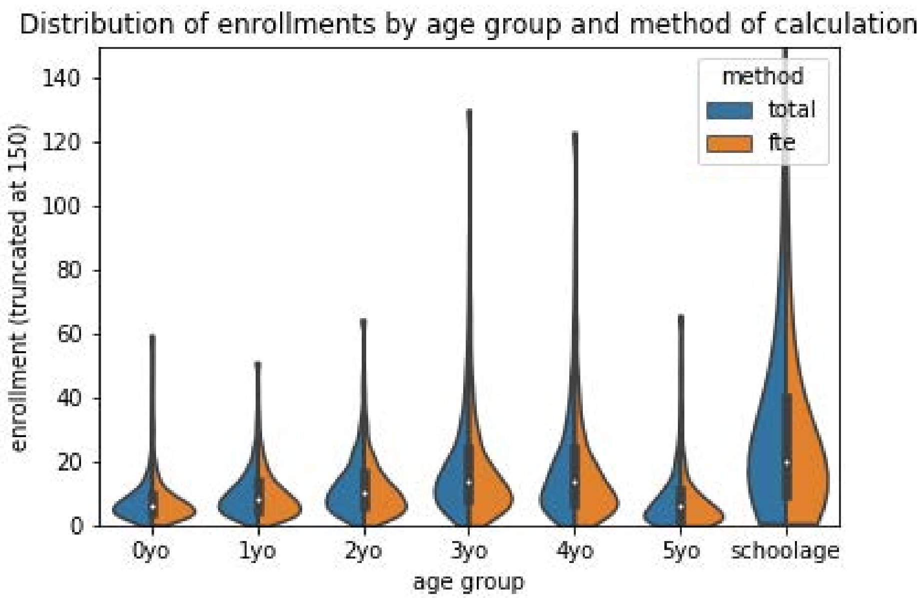


[51]A large number of rates are missing or zero. Care must be taken in interpreting these, as in principle there are a number of different reasons why a rate could be missing: the provider may not serve that age group, care for that age group may be free, or the respondent may simply have not answered the survey questions regarding the rate. In order to investigate the pattern of missing variables, We used two additional variables. First, a variable that asks whether care is free versus at least some families pay for care. Second, a set of variables that ask whether the provider serves each age group. Table C.1 shows, for the 4-year-old age category, the (unweighted) count of respondents by the paid care indicator and whether the rate is missing, nonzero, or zero, after restricting the sample to providers who indicate that they serve that age category. There are a large number of missing rates even among providers indicating that they serve the age group and who provide paid care. However there are relatively few zero rates among these providers.

Table C.1: Missing and zero rates for the 4-year-old age category

Paid Care	Rate Missing	Nonzero Rate	Zero Rate
Indicator missing	57	0	0
Paid care	1008	4072	22
Unpaid care	0	0	1732

Secondly, we measure each center's full-time equivalent enrollment by age group.[52] The figure below shows the distribution of enrollments by age group, after applying the sample weights, comparing the total enrollment and FTE-enrollment.

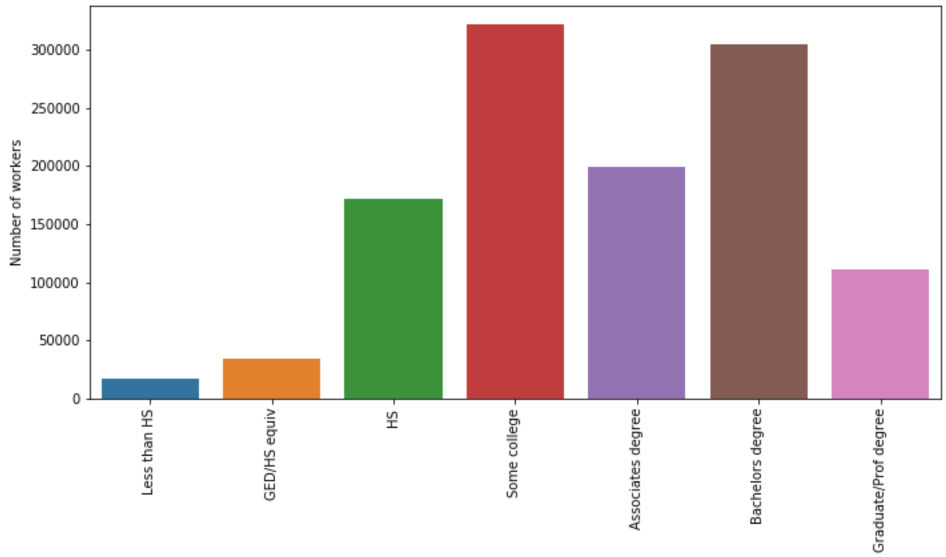


The first set of variables used from the Workforce data measure worker educational attainment. The figure below shows the estimated worker counts by education category. We classify workers based on whether they have at least a 4-year college degree.[53]

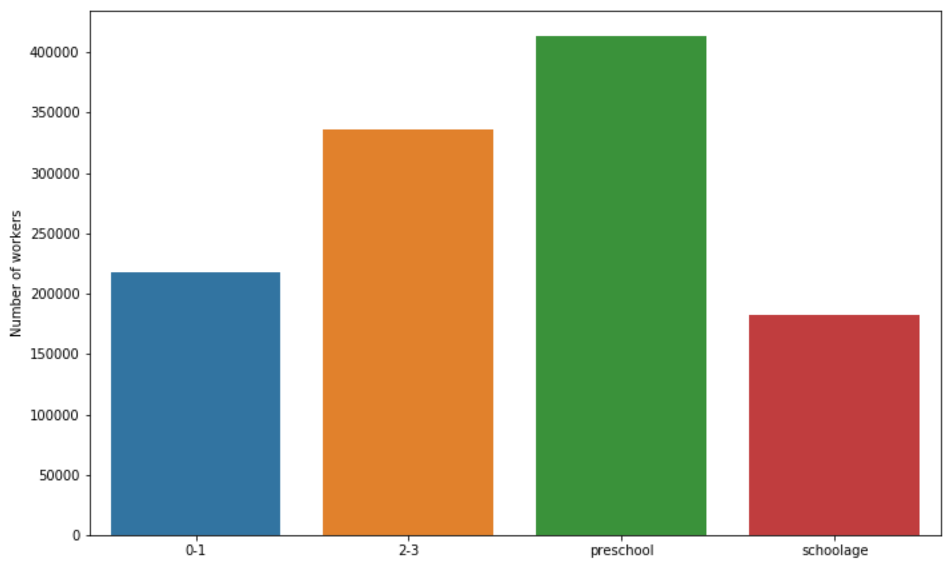
[52]The categories for enrollments are: 0-year-old, 1-year-old, 2-year-old, 3-year-old, 4-year-old, 5-year-old (but not in kindergarten), and school-age. Data is available on total enrollments, and on the percentage of enrollment that is full-time. Following assumptions used in the demand model, We calculate a full-time-equivalent enrollment (FTE-enrollment) based on the assumption that part-time enrollment is half-time. The FTE-enrollment is defined as follows:

$$\text{fte-enrollment} = \text{total-enrollment} \cdot \%\text{ft} + \tfrac{1}{2}\text{total-enrollment} \cdot (1 - \%\text{ft})$$

[53]This abstracts from provider experience in the classification of workers. Due to the expansion of college education, older child care workers may be less likely to have 4-year degrees but, but they may nonetheless be highly skilled and knowledgeable.

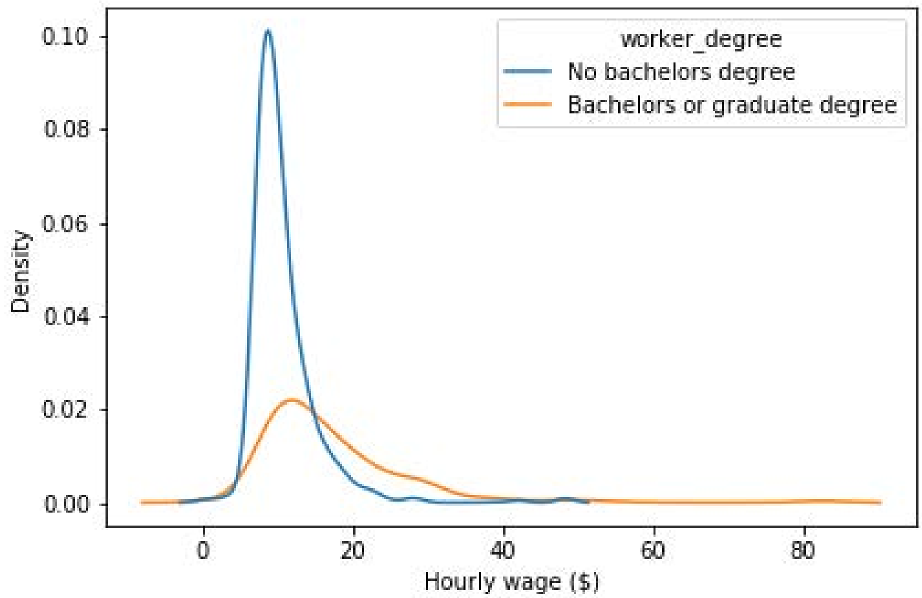


The second set of Workforce variables measure the child age group each worker serves.[54] The figure below shows the number of workers associated with each age category served.



The third set of variables used from the Workforce data are those describing worker wage. The figure shows a kernel density plot of the distribution of hourly wages by whether or not the worker has at least a bachelors degree.

[54] Workers in the NSECE workforce sample are randomly chosen from the sampled centers using a two-stage process. A classroom at the sampled center is randomly chosen. Then, a worker associated with that classroom is randomly chosen from a staff roster. The age of the youngest and oldest child in the each focal classroom, as well as whether a classroom is designated as school-age, is recorded. We construct an age-category-served variable as follows. If the classroom was designated as school-age, the child age category is school-age. If not, we compute the average age of the youngest and oldest child and assign the classroom to a child age category based on this average with categories for 0-1, 2-3, and 4-5 (labeled as preschool) years.

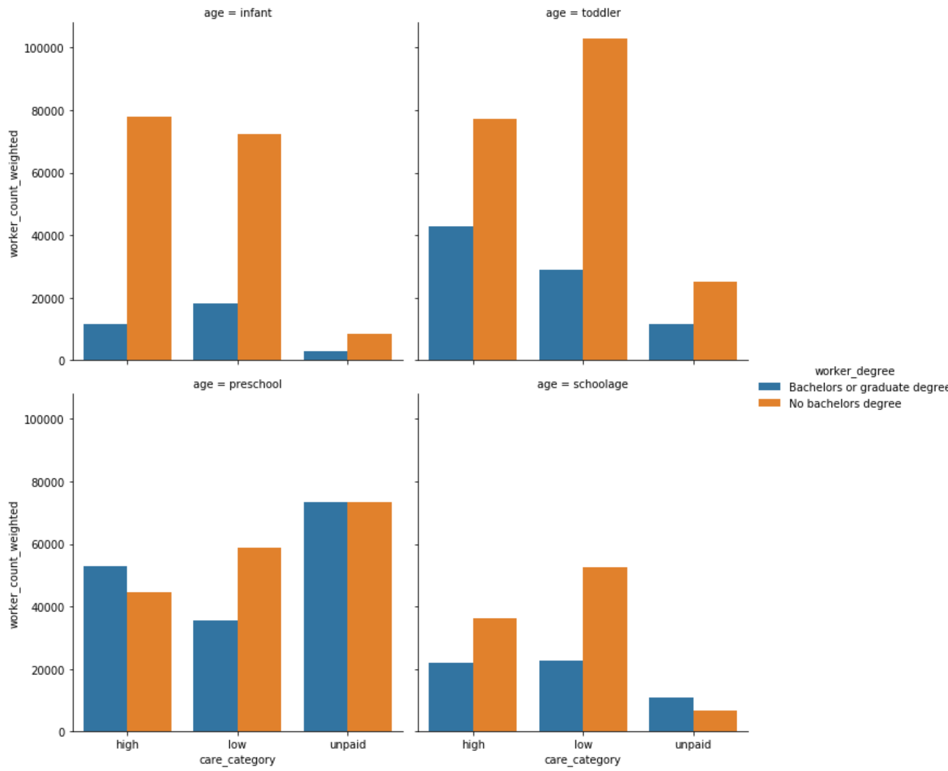


Finally, we compute full-time equivalents of staff using an indicator of whether each worker is full-time or part-time and an assumption that part-time is 0.5 full-time.

Within each child age group, we classify centers into three groups based on price: unpaid, low-price, and high-price. We use the following age groups formed by combining the more granular age categories in the data: infant, toddler (2-3 years-old), preschool (4-5 years-old but not in school), and school-age.[55] For harmonizing with decisions made in the demand model, we split paid providers into low- and high-price using the (unweighted) median hourly rate charged by paid providers in that age group. We classify providers as unpaid if they report that they do not have paid care. We exclude providers for whom the paid care variable is missing.

Combining this information, the figure shows the estimated count of workers by age category, care type (high-price, low-price, and unpaid), and worker education. Older child age groups are more likely to be served by college-educated workers, and high-priced and unpaid care have a higher proportion of college-educated workers than low-priced care. Interestingly, in the infant age category, high-priced care has a lower proportion of college-educated workers than low-priced.

[55] We restrict the sample to providers that indicate that they have paid care and that they serve at least one of the underlying age categories for the composite age group, and to providers that report at least one non-missing rate for one of these age categories. We assume that the rate reported for 4-year-olds also applies to 5-year olds who are not in school. If a center reports different rates for 2- and 3-year-old groups, we compute the toddler rate as the mean of the 2- and 3-year old rate.



Next, we calculate child:staff ratios by child age group and center type and Tables C.2, C.3, and C.4, and C.5 present them.[56] Within table, rows differentiate by center type. Average child:staff ratio for staff with at least a bachelors degree is in the first column, for staff without a bachelors in the second, and for all staff in the third.

	Bachelors+	No bachelors	All
Infant			
high	31.70	4.32	3.80
low	23.15	5.45	4.41
unpaid	23.00	8.01	5.94

Table C.2: Child:Staff Ratios for Infant Care, by staff education

[56] The sample is restricted to worker-center pairs where the center category variable could be derived. Within this sample, we estimate the total FTE-enrollment in each category (applying the center weights) and the total employment of workers with and without a college degree (applying the worker weights), and divide to find the ratio of FTE child enrollment per FTE worker.

Toddler	Bachelors+	No bachelors	All
high	22.45	11.97	7.81
low	31.50	9.13	7.08
unpaid	52.76	24.59	16.77

Table C.3: Child:Staff Ratios for Toddler Care, by staff education

Preschool	Bachelors+	No bachelors	All
high	11.84	14.25	6.47
low	19.61	12.74	7.72
unpaid	10.97	11.25	5.55

Table C.4: Child:Staff Ratios for Preschool Care, by staff education

Schoolage	Bachelors+	No bachelors	All
high	29.17	20.43	12.02
low	45.32	21.71	14.68
unpaid	91.73	217.69	64.54

Table C.5: Child:Staff Ratios for School-age Care, by staff education

The demand model does not differentiate between age groups, so to aggregate across age groups within center type, we sum enrollment and worker totals for infant, toddler, and preschool age groups (but not school-age) within center type, and calculate child:staff ratio by center type. Table C.6 presents the results.

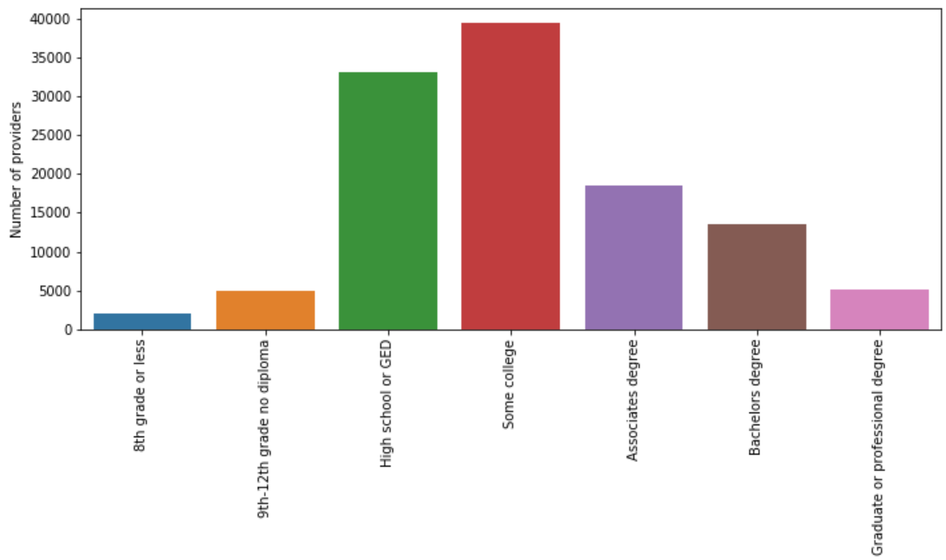
	Bachelors+	No bachelors	All
high	18.02	9.40	6.18
low	24.64	8.77	6.47
unpaid	17.07	14.24	7.76

Table C.6: Child:Staff Ratios aggregated across Infant, Toddler, and Preschool Care, by center type

C.1.2 Home-based providers

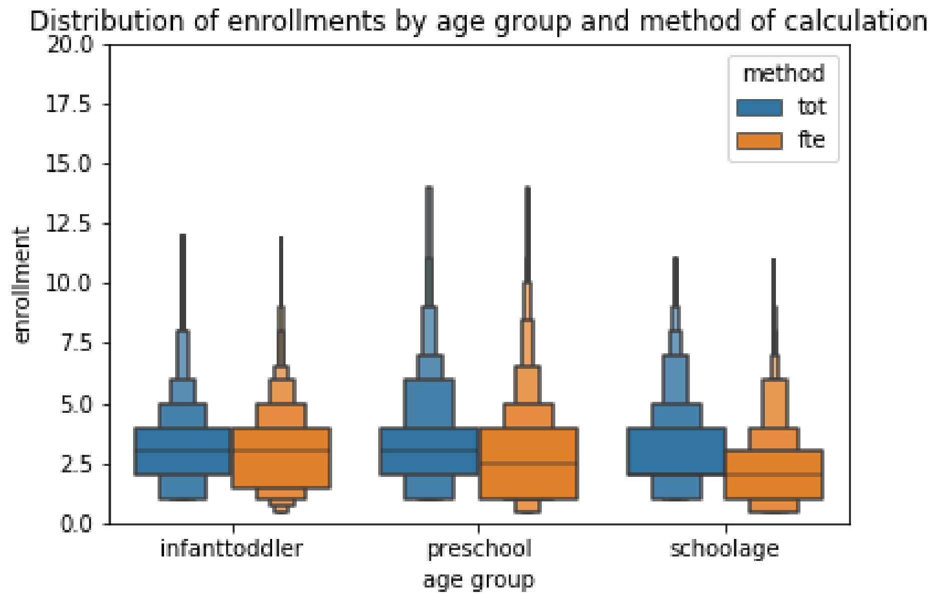
For home-based providers, we also use the 2012 data. Specifically, this is called the Family provider Public Use file. We restrict the sample to ”listed” providers meaning those that are licensed or otherwise have a formal regulatory status because these are the providers who would be eligible for subsidies under BBBA and, consequently, see increases in demand.

The first set of variables used from this data are those pertaining to provider education. The figure below shows the number of workers by education category after applying sample weights.



The second set of variables used concerns the number of workers associated with a home-based provider. Unfortunately, only limited detail is available, in the form of a categorical variable that describes whether the provider has assistants, whether the assistant is from inside or outside the home, and whether the assistant is paid. After applying sample weights, and assuming that missing values imply no assistant, 60% of the providers reported an assistant of some kind. We assume that when an assistant was present the number of workers was 2, and otherwise the number of workers was 1.

The third set of variables used are enrollments in various age group categories. Compared to the center data, fewer age categories are available. The data is reported in three categories, age 0-3 (infant-toddler), age 4-5 but not in kindergarten (preschool), and school-age. Although more detailed schedule data is available, for simplicity, we calculate FTE-enrollments using the same formula as for centers, weighting enrollments as half if they are not full time. If the variable indicating the number of enrollments that are full time is missing but the total enrollment variable is present, we assume all enrollments are part time. The figure below shows the distribution of enrollments by age category.



C.1.3 Home-Based Provider Input Ratios

Home-based providers differ from centers, in that they are not divided into classrooms serving different age groups. Instead of associating each worker with an age group, we calculate an overall worker-to-enrollment ratio by summing the FTE-enrollments for all age groups. Although school-age children are not currently used in the demand estimation, we include school-age enrollment because omitting them would lead to overestimating the ratio of workers to children. In calculating the ratios, we omit workers associated with providers whose enrollment variables were all missing. The worker/child ratios computed in this way for home-based providers are higher than the aggregate-age-group ratios for any of the categories of centers.

	Bachelors+	No bachelors	All
Children per worker	26.329	4.962	4.175

Table C.7: Ratios for Home-based Providers

C.2 Analysis of Provider Quality

Using the NSECE provider data, we compare quality across child care sectors. We are able to consider measures of quality across four different sectors: unpaid centers, high-price centers, low-price centers, and home-based child care (paid and unpaid combined). The remaining two care type categories in the paper, paid and unpaid other informal child care, do not have any available quality metrics in the NSECE. Among the sectors we do consider, we are somewhat limited by the available variables. Therefore, we also rely on previous literature when thinking about care quality across non-parental care types.

Table C.8 presents the means of the available quality variables across sectors. NSECE weights are used for all analyses. Child care types are ordered from expected highest quality on the left to expected lowest quality on the right. Stars indicate whether the mean for a given type is statistically different from the mean immediately to the left, which is expected to be the next step up in quality. Across nearly all measures, unpaid centers appear to be the highest quality and home-based facilities the lowest quality.

On the household side, paid center-based care is split into high-price and low-price care based on whether the price paid for care is greater than or less than \$4.75/hour. Because of this classification, in the center-based survey, some centers may be split into different categories for different age groups depending on how prices vary across age. In the center-based NSECE survey, some variables are measured for a randomly-selected classroom within the facility. For these variables, the sector classification is based on the classification for the age group in the selected classroom. Other variables are measured at the facility level. For these variables, observations are transformed to be at the age group-facility level, where the age groups are infant (0-12 months), toddler (1-2 years), and preschool (3-4 years). Each facility has a row for each age category it serves, and weights are split evenly across served age groups. The sector for each row is classified based on the sector classification of that age group in the facility.[57]

Table C.8 shows that 90.4% of selected classrooms in unpaid centers have a curriculum, compared to 74.3% in high-price centers and 72.2% in low-price centers. Only 26.0% of home-based facilities use a curriculum. Providing mentors to child care teachers may help them to improve teaching skills. In 76.6% of unpaid centers, respondents indicate that teachers are provided mentors, coaches or consultants to work with, compared to 44.8% in high-price centers and 48.4% in low-price centers. Only 7.0% of providers in home-based facilities indicate that they have a mentor. Finally, care quality may be higher when it is provided by more educated teachers. Nearly all primary teachers (92.1%) in unpaid centers have at least an associate's degree, compared to 59.4% in high-price centers, 56.3% in low-price centers, and only 31.2% in home-based facilities.[58] Approximately two-thirds of the primary teachers in unpaid centers have a four-year college degree, compared to 37.8% in high-price centers, 34.3% in low-price centers, and 19.4% in home-based facilities. Across all of these measures, the means of unpaid centers are higher than those for high-price centers at the 1% level, means for high-price and low-price centers are not statistically different at the 10% level, and home-based means are lower than low-price center-based means at the 1% level.

Turning to facility-level variables, the fraction of unpaid centers and high-price centers that are accredited by NAEYC is very similar, at about 11-12%. Low-price centers are slightly less likely to be accredited by NAEYC, with 8.7% accredited. High-price centers are also more likely to have a dedicated director than low-price centers (58.2% vs. 49.7%). Whether providers are at capacity may be indicative of the desirability of their services to parents, which may take quality into account. Unpaid centers were the most likely to have turned away children in the past year due to space constraints (80.7%), and about 60% of the paid center-based facilities had to turn children away within the past year, compared to 40.0% of home-based providers.

Therefore, the somewhat limited available quality measures in the NSECE clearly point to unpaid

[57] For the number of observations in the facility-level variables, a fraction of a center is assigned for each age group in a given category. For example, if a center serves toddlers and preschoolers and the toddler care is categorized as high-price center and the preschooler care is categorized as low-price center, then that would count as 0.5 centers in the high-price care category and 0.5 centers in the low-price care category.

[58] For the center-based teachers, education levels are based on the first teacher listed as working in the selected classroom. Usually this teacher is categorized as a lead teacher.

centers being the highest-quality form of non-parental care on average and home-based care being of lower quality than center-based care on average.

Table C.8: Measures of Quality by Child Care Type

	(1) Unpaid Centers	(2) High-price Centers	(3) Low-price Centers	(4) Home-based
Classroom-Level Variables:				
Use Curriculum	0.904	0.743***	0.722	0.260***
Teachers Have Mentors	0.766	0.448***	0.484	0.070***
Teacher Has at Least an Associate's Degree	0.921	0.594***	0.563	0.312***
Teacher Has at Least a Bachelor's Degree	0.667	0.378***	0.343	0.194***
Observations	1,699	1,954	2,109	
Facility-Level Variables:				
Accredited by NAEYC	0.111	0.117	0.087*	N/A
Have Dedicated Director	0.289	0.582***	0.497***	N/A
Turned Away Children in last 12 months Due to Lack of Space	0.807	0.604***	0.626	0.400***
Observations	2,001	2,083	2,265	5,986

Notes: This table presents means of the listed variables by child care sector from the sample of center-based and home-based child care facilities in the NSECE 2012. Stars indicate whether the mean is statistically different from the one in the previous column immediately to the left. That is, means for high-price centers are tested against unpaid centers, low-price center means are tested against high-price centers, and home-based care is tested against low-price centers. All statistics are calculated using the population weights provided by the NSECE.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

C.3 Computation

We compute the equilibrium using the following algorithm:

1. Given a vector of candidate prices labeled r, $p_1^r, \ldots, p_S^r$, compute the quantity of childcare hours demanded from each sector using the demand model, $y_1^r, \ldots, y_S^r$. This includes hours in all sectors, paid and unpaid.

2. Using the sector-specific production functions, compute input (labor) requirements for producing the quantity demanded, $l_1^r, \ldots, l_S^r$ and $h_1^r, \ldots, h_S^r$. With fixed-proportions production, the input requirements depend only on the production functions: $l_s^r = 1/a_{ls}y_s^r$ and $h_s^r = 1/a_{hs}y_s^r$ for all $s = 1, \ldots, S$. Aggregate labor demand is then $L^r = \sum_{s=1}^S 1/a_{ls}y_s^r$ and $H^r = \sum_{s=1}^S 1/a_{hs}y_s^r$.

3. Using the input supply functions for low and high educated labor, determine the input prices (wages) that would satisfy the aggregate input requirements:

$$w_l^r = w_l^0 \left(\frac{L^r}{L^0}\right)^{1/\eta_l}$$
$$w_h^r = w_h^0 \left(\frac{H^r}{H^0}\right)^{1/\eta_h}$$

4. Given these input prices and the input requirements determined above, compute residual revenue per care hour for each paid sector: $p_s^r - (w_l^r/a_{ls} + w_h^r/a_{hs})$. If residual revenue per care hour under these new candidate prices is equal to the baseline level, then this vector of candidate prices satisfies the equilibrium conditions (given that the previous steps in the algorithm already guarantee that at these prices quantity demanded and supplied are equal for each sector). If residual revenue per hour differs from the baseline, then we repeat the algorithm at a new candidate vector of prices.

To compute this fixed point we used an off-the-shelf optimizer to minimize the Euclidean norm $\|\vec{p} - T(\vec{p})\|$, and then verify that, at the optimizing prices, $\vec{p} = T(\vec{p})$ within a small tolerance. With the equilibrium prices in hand, we compute the equilibrium output quantity from the demand curve, and the equilibrium input requirements and input prices following the steps above.