The Effect of the Child Care Tax Credit on Maternal Labor Supply

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November 13, 2019

Job Market Paper.
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Abstract

Childbearing is the main factor that affects the labor supply of women. Many studies show that the cost of child care services has a significant impact on the labor supply of women with young children. The Child Care Tax credit (CCTC) is a child care subsidy program that allows working parents to claim a tax credit for their child care expenses. In the study, I document a comprehensive legislative history of the CCTC enactments, amendments, and repeals at both federal and state levels. Using the CCTC variation generated by exogenous law changes and focusing on mothers between the ages of 20 to 55 in the Panel Study of Income Dynamics, I estimate the effect of the CCTC on maternal labor supply. Using differences-in-differences estimation and policy shocks measured at the state level, I found that a $1000 increase in the CCTC increases the maternal labor force participation rate by three percentage points. To incorporate the policy variation within a state, I construct an individual CCTC treatment variable for each woman using observable individual characteristics and state specific regulation. I use the state-level CCTC treatment variable as the instrumental variable for the individual CCTC treatment variable and find that a $1000 increase in CCTC increases the maternal labor force participation rate by six percentage points. The effects are more pronounced in married mothers than single mothers.

JEL Classification: J10, J22, H24

Key words: The Child Care Tax Credit, Maternal Labor Force Participation, Differences-in-differences, Instrumental Variables

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†I am deeply grateful to my advisor Patrick Warren. I thank Curtis Simon, Jorge Luis Garcia, William Dougan for their comments and suggestions. I received helpful feedback from labor and public workshops of Clemson University. All errors are mine.

1 Introduction

The Child Care Tax Credit (CCTC) is a child care subsidy program enacted in 1976.[1] It allows parents to claim a tax credit for their child care expenses while they are working.[2] It was estimated that there were 6.25 million families who claimed $3.47 billion in federal CCTC in 2017 (Ackerman et al., 2016). Previous research uses coarse and incomplete measurements of the policy to estimate the effect of the CCTC on maternal labor supply (Michalopoulos et al., 1992; Leibowitz et al., 1992; Averett et al., 1997). In this paper, I collect detailed CCTC legislative history and construct precise policy treatment variables to analyze how the CCTC affects the labor supply of women with young children, and which demographic groups are most responsive to the policy.

The labor force participation rate of working age women in the United States rose from 50% in the 1960s to the highest level of 75% at the end of the 1990s. This increase was mainly driven by married mothers (Juhn and Potter, 2006). However, since the year 2000 the female labor force participation rate in the United States has been decreasing and is now lower than the rate in many other industrial countries (F. Blau and Kahn, 2013). It appears that giving birth to children significantly affects the labor supply of women. Figure 1 shows the female labor force participation rate before and after giving birth to the first child. Before the birth of the first child, women of all cohorts have a labor force participation rate of about 90%. After giving birth to the first child, the female labor force participation rate drops significantly.[3] Women tend to reenter the labor market when their children are older, and alternative child care is cheaper, suggesting that the cost of market-provided child care services are essential factors that affect the labor supply of women with young

[1] CCTC is also referred to as the "child and dependent care tax credit" or the "dependent care tax credit".

[2] In contrast to tax deductions, which reduce the income used to calculate personal income tax, CCTC is a tax credit and directly reduces tax liability, dollar for dollar.

[3] The patterns shown in Figure 1 are consistent with existing research on this topic (e.g., Goldin and Mitchell (2017)).

children (Heckman, 1974; D. Blau and Robins, 1988; Connelly, 1992; Ribar, 1992; D. Blau and Robins, 1998).

The legislative objective of the CCTC is to increase the labor force attachment of parents with young children, especially mothers. Therefore, the CCTC is designed as an employment-related subsidy policy rather than a pure welfare program. For married couples, both parents have to be employed to be eligible for the tax credit. A single parent has to work to qualify for the credit. For a divorced couple, the primary care provider is required to work to be eligible. Parents must also pay for child care expenses in the market to claim the credit (typical eligible expenses include the cost of daycare centers, after-school care facilities, or summer camps). Thus, the CCTC encourages the use of formal care rather than informal care (e.g., child care provided by older children in the family).

Since the enactment of the federal CCTC, many states have enacted their own versions. The state-level CCTC legislation varies in the timing of enactments and amendments, as well as in its generosity, phase-out rate, and many other aspects. The state-level CCTC variation provides an identification opportunity to estimate the responsiveness of the maternal labor supply to child care costs and subsidies.

There are not many studies that examine the effectiveness of the CCTC on labor supply, and even fewer make use of the multi-dimensional variation of the policy. Michalopoulos et al. (1992) use the 1984 wave of Survey of Income and Program Participation to estimate the effect of child care subsidies on child care expenses. They simulate child care expenses and mothers' labor supply under various counterfactual federal CCTC policy settings, finding that the CCTC increases both the demand for market-provided child care services and maternal labor supply. Leibowitz et al. (1992) use the National Longitudinal Survey of Youth 1979 to study the responsiveness of mothers' labor supply to changes in the availability and cost of non-maternal child care after intervals of three months and two years since the birth of the first child. Their findings show that mothers who are eligible for a large amount of the

CCTC within three months after giving birth to their first child are more likely to return to the labor market.

These studies use cross-sectional data and cross-sectional variation of state CCTC documented by D. Blau (1991), without using the variation generated by specific state CCTC regulation on eligibility and phasing-out rates. The CCTC variation used in these studies is measured only at the specified maximum level. The estimates obtained from using cross-sectional variation suffer from the confounding effects of many other co-existing state-level policies, the results depend heavily on the year chosen to perform the studies. In addition, these papers do not focus on the CCTC policy itself. As a result, it is difficult to observe clearly the causal relationship between the CCTC and maternal labor supply.

Averett et al. (1997) use the 1986 wave of the National Longitudinal Survey of Youth 1979 to estimate the kinked budget constraint generated by the federal CCTC. They simulate the labor supply response under different counterfactual federal CCTC policy settings and find that the federal CCTC significantly affects maternal labor supply. However, since a few states have very generous state-level CCTC some years, not incorporating the state-level CCTC leads to biased estimates. Guner et al. (2017) use a macroeconomic structural model and simulate the effects of expanding the federal CCTC coverage. They find that expanding the coverage of the CCTC increases the female labor force participation, an effect that is significant mainly for lower-skilled women.

Some studies examine the effect of child care subsidy programs in the context of other industrial countries. For example, Blundell, Costa Dias, et al. (2016) estimate female labor supply under child-related tax credit and welfare programs in Britain and find that mothers (especially single mothers) are very responsive to subsidy programs. Bick (2016) analyzes the relationship between child care programs and the labor supply of women in West Germany and finds that the child care subsidy policies positively affect maternal labor supply. Olivetti and Petrongolo (2017) survey and summarize the child care programs and their impact on

maternal labor supply in many industrial countries, showing positive effects of subsidized child care on female employment. Nonetheless, no research uses the United States CCTC variation over time, across states and individuals, to perform a reduced-form analysis of the causal relationship between the CCTC and maternal labor supply.

The CCTC legislative history is not documented in a rigorous and organized manner. The National Women's Law Center published reports "Making Care Less Taxing," which collected detailed information about the state CCTC but only for a few years (for example, Campbell et al. (2011)). Using the TAXSIM program of the National Bureau of Economic Research, one can calculate the approximated federal and state-level CCTC (Feenberg and Coutts, 1993). However, TAXSIM does not provide the details of the regulation used to calculate the tax credit. Also, TAXSIM does not incorporate information on the eligible age of the children, so the calculation is not accurate enough.

Therefore, I document the legislative history of the federal and state-level CCTC and construct a comprehensive panel data set of the policy variation from 1976 to 2015. Focusing on women from the Panel Study of Income Dynamics (PSID), I use the exogenous policy shocks especially at the state level to estimate the effect of the CCTC on maternal labor supply. The challenge here is that the CCTC changes the entire budget constraint faced by a woman, a woman then maximizes her utility by choosing the optimal point along the new budget line.[4] Therefore the actual CCTC a woman claims is endogenous. To tackle this issue I first use the maximum state-level CCTC as a proxy for the generosity of the state in providing its CCTC, and perform the differences-in-differences analysis with treatment intensity. In doing so, I compare women living in a state or year having different CCTC generosities.

The pooled ordinary least squares (OLS) estimation shows that, on average, a $1000 increase in the CCTC increases the female labor force participation rate by three percentage

[4] I describe the details of the policy in the next section

points. Comparing the effect of the CCTC by subgroups generated by the age of the youngest child, I find that the effect of the CCTC on labor force participation is more pronounced in women with older eligible children. Also, among subgroups of married women generated by the husband income quantile, women whose husbands are in the top income quantile are relatively more responsive to the CCTC by joining the labor market. After controlling for individual fixed effects to deal with unobserved heterogeneity, I find that a $1000 increase in the CCTC increases maternal labor force participation rate by approximately two percentage points.

To incorporate the multi-dimensional policy variation generated by the state CCTC legislation, I construct an individual CCTC treatment variable using the husband's income (which is zero for single women) and the number of CCTC eligible children in the household as individual characteristics. I use the maximum CCTC each woman can claim from a state as a proxy for the policy faced by each woman. The OLS estimation using differences-in-differences method and policy treatment measured at the individual level shows that a $1000 increase in the CCTC increases the labor force participation rate by three percentage points. Incorporating individual fixed effects reduces the magnitude of the treatment effect to close to two percentage points.

However, the individual CCTC treatment variable involves individual information, which introduces endogeneity. In addition, the measurement of the individual CCTC treatment variable is based on the maximum level for each woman, which suffers from measurement error. Moreover, there could be other time-varying factors that are omitted from the estimation. To deal with these issues, I use the state-level CCTC treatment variable as the instrumental variable for the individual CCTC treatment variable. The results from using the instrumental variables (IV) estimation show that a $1000 increase in the CCTC increases maternal labor force participation rate by six percentage points. The effects are more pronounced in married mothers than in single mothers. Conditional on being in the

labor market, a $1000 increase in the CCTC increases annual work hours by 104 hours. The effects are also mainly pronounced in married mothers.

In the literature, there is a large variation in the estimated labor supply responsiveness of women. Hausman (1985) and Blundell and MaCurdy (1999) summarize the wide-ranged empirical results of the responsiveness of female labor supply in their survey papers. In the United States context, Hausman and Ruud (1984) use the 1976 wave of the PSID to estimate a joint labor supply responding to federal and state tax schedules and find an elasticity of wives' labor supply to be 0.76. Triest (1990) uses the 1983 wave of PSID to estimate an elasticit of wives' labor supply to be 0.97. Rosen (1976) uses data from the 1967 National Longitudinal Survey of Mature and Young Women to examine the labor supply decisions of married women. He estimates the elasticity of annual work hours to be 2.3. In the British context, Arrufat and Zabalza (1986) uses British General Household Survey 1974 and estimate an elasticity of labor supply for married women to be 2.03. And Blundell, Costa Dias, et al. (2016) use British Household Panel Survey to estimate an elasticity of female labor supply to be 0.67. In this study, the basic difference-in-differences estimation results can be transferred into a back-of-the-envelope calculation of an elasticity of female labor supply that is close to 0.6. And the estimation results using IV estimation can be transferred to an elasticity of labor supply that is 1.1 for all mothers with CCTC eligible children and 1.6 for married mothers, which are close to the upper bound of the estimates in the literature.

One major policy that may affect the identification is the Earned Income Tax Credit (EITC). To address the possible confounding effect of the EITC, I use the legislative history of the EITC to construct a state-level EITC treatment variable and an individual EITC treatment variable in the similar way as I construct the CCTC treatment variables. I control for the EITC in all the estimations, and find that including the EITC does not influence the effects of the CCTC on maternal labor supply, though the EITC does have an independent

impact on the labor supply of women with young children. However, in contrast to CCTC, the effect of EITC is more pronounced in single mothers rather than married mothers. The results for the effect of the EITC are consistent with Scholz (1996), Hotz et al. (2003), and Bastian and Michelmore (2018).

The main contribution of this paper is that I explore the causal effects of the CCTC on maternal labor supply. This study also contributes to the literature by providing new empirical evidence for the relationship between child care cost and maternal labor supply. Researchers may find the CCTC legislative information documented in this study to be useful in studying child care related topics. This paper is also the first to evaluate the CCTC and the EITC within the same framework.

2 Institutional Background

In 1976, the United States federal government added a subsection to the Internal Revenue Code — "Expenses for household and dependent care services necessary for gainful employment (Title 26 U.S.C.§ 21)." It replaced a tax deduction for child care expenses with a tax credit. According to the law, parents can claim a tax credit against their federal income tax liabilities to go toward the child care expenses necessary for them to work. The CCTC uses the existing tax system without adding extra services or establishing new institutions, as do many subsidy or welfare programs. The CCTC merely involves extra administrative costs during the tax season and is relatively easy for the potential benefit recipients to comprehend. To participate in the program, a taxpayer only needs to provide the necessary tax forms and payment proof.

Compared to many subsidy or welfare programs that mainly aim at low-income or single-parent families, the CCTC covers a broad population. At the federal level, the CCTC does not phase out entirely as family income increases. However, the federal CCTC is limited to

the tax liability, i.e., it is non-refundable. If a taxpayer only has a small level of tax liability, she cannot get many benefits even if she incurs a large amount of child care expenses. As a result, low-income or single-parent families do not receive as many benefits as middle-income or high-income families (Ackerman et al., 2016). Though the CCTC is not refundable at the federal level, some states do allow refunds. In this case, when the state CCTC is higher than the state tax liability, the taxpayers can get a refund.[5]

It is essential to clarify the details of the CCTC calculation. I do so by first describing the details of the current federal CCTC calculation. As of 2015, families with children under thirteen are potentially eligible for the federal CCTC.[6] The actual tax credit is the product of the following two elements: child care expenses used to calculate the tax credit and an applicable rate decreasing with family adjusted gross income (AGI). The equation used to calculate the federal CCTC is

$$CCTC_{federal} = \textit{Child care expenses} \times \textit{applicable rate}. \tag{1}$$

As of 2015, the highest applicable rate is 35% for a family with AGI less than $15,000. The rate reduces by one percentage point per $2000 of extra AGI, from the highest rates at 35% for a family with AGI under $15,000 to the lowest rates of 20% for a family with AGI higher than $43,000.

The measure of the expenses used to calculate the credit is complicated. First, the expenses are bound by an upper limit of $3000 for families with one eligible child or $6000 for families with two or more eligible children. Second, the expenses are subject to the actual child care expenses paid by the parents for the eligible children in a tax year. Third, the

[5] Among the twenty-five states with the CCTC, Alaska, California, Colorado, Hawaii, Iowa, Louisiana, Maine, Minnesota, Nebraska, New Mexico, New York, and Vermont have allowed a refundable CCTC at least for one year.

[6] Except for young children, eligible individuals include dependent(s) physically or mentally incapable of caring for him or herself. Most states follow the definition of eligible individuals in the federal CCTC.

expenses are no more than the earned income of the parent if single, or the smaller of the earned income of the parents if married. The smallest among the three items is the reference for the child care expenses. Table 1 shows the applicable rate and the maximum allowable federal CCTC for families with different AGIs and number of eligible children.

Figure 2 illustrates the legislative history of the federal CCTC. At first, the 1976 legislation allowed families to claim 20% of the child care expenses up to $2000 for one child or $4000 for two or more children regardless of the family income. The 1982 legislation increased the upper bound of expenses to $2400 for one or $4800 for two or more eligible children and made the applicable rate a sliding scheme reducing from 30% to 20%. The 1989 legislation lowered the eligible age from under fifteen years old to under thirteen years old. The 2003 legislation increased the upper bound of the expenses to current $3000 for one or $6000 for two or more eligible children and increased the highest applicable rate to the current 35%.

Following the federal government, many states adopted similar policies allowing taxpayers to claim a tax credit against their state income tax for the same child care expenses. As of 2015, twenty-four states and D.C. offered a CCTC.[7] Another four states offered a tax deductions for child care expenses.[8] Figure 3 exhibits the states with the CCTC and child care tax deductions. Although child care tax deductions also provide some incentive for mothers to join the labor market, their effects are not as direct as a tax credit. In this study, I put these four states that provide only a tax deduction in the control group rather than the treatment group.

There are two sources of variation in the state-level CCTC. First, each of the twenty-five states has its own CCTC legislative history. Second, most states link their state CCTC to the federal CCTC. When the federal government makes adjustments to the policy, the

[7]Among these 25 states, Kansas repealed its CCTC in 2013; North Carolina repealed its CCTC in 2014; Alaska does not have a state income tax, but it provides a refundable "tax credit" to eligible families.

[8]Idaho, Massachusetts, Montana, and Virginia are all states with a child care tax deduction policy.

state-level CCTC changes accordingly. States usually set a match-up rate as a proportion of the federal CCTC. The linkage with the federal CCTC makes the screening and calculation easier. In most states, the equation used to calculate the state CCTC is

$$CCTC_{state} = CCTC_{federal} \times state\ match\text{-}up\ rate. \tag{2}$$

Some states set a uniform match-up rate regardless of the family income, for example, Georgia allows all eligible taxpayers to claim a state CCTC equal to 30% of the federal CCTC.[9] Some other states however, specify different match-up rates according to the family income. There are also cases that states link their state CCTC with the child care expenses used to calculate the federal CCTC. There are also some other states that do not link their state CCTC to the federal CCTC. I describe the details of the CCTC calculation in each state in Appendix C. The state CCTC provides an extra subsidy in addition to the federal CCTC.

One contribution of this paper is that I collect and organize the legislative history of the federal and state CCTC from 1976 to 2015. I look up the federal and state statutes and in some cases, use references from various sources.[10] I document the enactments, amendments (in some cases repeals), and the specific regulation of eligibility, phasing-out rate, and other aspects of the legislation. This detailed data set allows me to estimate the effect of the CCTC on maternal labor supply thoroughly and rigorously. In Appendix A I describe the details of the federal CCTC; in Appendices B and C I describe the details of the state CCTC.

The Earned Income Tax Credit (EITC) is another subsidy policy that mainly assistants low-income families. In order to deal with the potential confounding effect of EITC, I collect the legislative history of the federal EITC and adopt the state EITC history documented by

[9]For example, a two-child family in Georgia with AGI \$14,000 can claim \$630 ($\$2,100 \times 30\% = \$630$) of the state CCTC if the earning of any parent is higher than \$6000.

[10]In Appendix C I describe the details of the sources of this information.

Shapiro (2019) from the National Bureau of Economic Research. I discuss the details of the information used to calculate the EITC in Appendix D.

3 Theoretical Framework for the Effect of the CCTC on the Budget Constraint

CCTC changes the budget constraint faced by women with young children. To illustrate the effect of the CCTC (and the EITC) on a woman's budget constraint, I create the following scenario. Imagine a married woman has two children under thirteen years old. Her husband works full-time and has an annual income of $30,000.[11] The income and time allocation of the husband are exogenous. The woman has 2000 hours that she can allocate between labor supply and home production (or child care).[12] If she works, she earns $15 per hour. At the same time, once she starts to work, she pays a fixed number of $6000 per year for the child care expenses of her two children. In Figure 4, the horizontal axis represents the hours allocated on home production, the opposite of which is then the hours of labor supply; the vertical axis is the family income under different tax calculations. The tax rate used here is reflective of the federal income tax code in the 2018 tax year.

The family is potentially eligible for the CCTC (if the woman starts to work and has an earned income) and the EITC. Since the EITC is refundable while the CCTC is not, the EITC comes in the budget constraint first, even when the woman is not working. If this woman does not work, she does not pay for child care. The height of the dot on the 2000-home-production-hour line represents the family income when the wife does not work. This income includes a refund from the EITC.

[11] I choose $30,000 because if the wife works at least part-time, the family's income reaches the median family income in the United States.

[12] I choose 2000 hours because it is the typical annual work hours for a full-time worker. So a woman is most likely to choose annual work hours between 0 to 2000.

Once she starts to work, she needs to pay $6000 a year for child care services. The solid line shows the relationship between the total family income after paying for child care services and after federal income taxes according to the time allocation of the woman. The dashed line in Figure 4 represents the family income after paying for child care services and after federal income taxes and EITC. The distance between the solid line and the dashed line decreases as the mother supplies more work hours and the family has a higher income. The EITC totally phases out gradually.

CCTC is not refundable. It comes in the budget constraint when the family incurs a tax liability. With the presence of the EITC, the CCTC kicks in only when the tax liability exceeds the EITC. The dotted line in Figure 4 represents the family income after paying for child care services and after federal taxes, the EITC, and the CCTC according to the time allocation of the woman. When the CCTC comes in the budget constraint, it is first bound by the actual tax liability. When the tax liability is low, the difference between the dotted line and the dashed line is small. The benefit of CCTC increases when the family has more tax liability. When the mother's work hours are low and her income is lower than $6000 a year, the CCTC calculation is limited to the mother's earned income. When the mother works more hours and earns more than $6000, the calculation of CCTC is bound by the upper limit of $6000. At the same time, the applicable rate decreases as family income increases, and the distance between the dotted and dashed lines decreases but stays constant when the applicable rate reaches its lowest 20%.

For households living in states with state income taxes and a state-level CCTC, the state income taxes move the dotted budget line downward and the state-level CCTC moves the budget line upward again. A woman maximizes her utility by choosing whether to work and how many hours to work.[13] Without the CCTC, it is possible that the woman finds

[13] There could exist additional fixed costs for her to join the labor market (Cogan, 1980). The fixed costs of joining the labor market can reflect the skill or the preference of the woman, or both. These costs will further move the budget constraint downward.

it is optimal for her to stay out of the labor market. However, She is more likely to work when her choice set is expended by the existence of the CCTC. Her optimal time allocation can jump from the corner solution of not working to a tangent point or a kinked point with certain amount of work hours. That said, if conditional on being in the labor market, the effects of the CCTC and the EITC on work hours are ambiguous.

4 Empirical Strategies Used to Estimate the Effect of the CCTC on Maternal Labor Supply

The CCTC changes the incentive faced by women with young children. In Appendix E, I describe a simple model for the utility maximization problem faced by a mother. The labor supply of a mother is a function of the child care cost and other factors. In this section, I propose to estimate a reduced form model denoted by

$$Y_{ist} = \alpha_0 + \alpha_1 CCTC_{ist} + \alpha_2 A_{ist} + \kappa_s + \rho_t + \omega_i + \nu_{ist}, \tag{3}$$

where Y_{ist} is the dependent variable representing the labor supply of a woman. The independent variable $CCTC_{ist}$ denotes the CCTC received by mother i in the state s and year t. The covariate A_{ist} includes individual characteristics: age, age squared, marital status, education, husband's income (for married women), number of children, and age of the youngest child. Other variables on the right hand side are κ_s, ρ_t, and ω_i, which represent state, year, and individual fixed effects, respectively, and ν_{ist} is the disturbance term.

The federal CCTC is more generous compared to most state-level CCTCs. However, conditional on husband's income, number of children and a woman's potential earning, families receive the same treatment from the federal CCTC in a given year. As a result, the effect of the federal CCTC is absorbed by the year fixed effects. However, the state-level CCTC

variation generates a treatment group and a control group; they are the primary sources of identification.

As specified above, the actual CCTC is endogenous. First, it is a joint decision to work more hours and to purchase more child care services.[14] Second, the mother's income and purchased child care affect the expenses used to calculate the credit. Moreover, the mother's labor supply affects family income, and family income further determines the applicable rate used to calculate the federal and some state-level CCTCs. I deal with this endogeneity issue by proposing the following empirical strategies. I first use the variation of the state CCTC adoption and adjustment in generosity to construct a state-level CCTC treatment variable and perform a differences-in-differences analysis with treatment intensity. I then further exploit the federal and state CCTC regulations on individual eligibility and generosity to construct an individual CCTC treatment variable and perform a differences-in-differences with the individual-specific CCTC treatment intensity. Finally, I use the state-level CCTC treatment variable as an instrument for the individual CCTC treatment variable. By applying these strategies, I explore the causal relationship between the CCTC and maternal labor supply.

4.1 State-level CCTC Variation

First, the state CCTC varies in time of enactments. The earliest group of states enacted the state CCTC between 1976 and 1977 almost immediately after the enactment of the federal CCTC.[15] Georgia is the most recent state to adopt the policy, creating its own CCTC in 2006 (restricting the cases to before 2016). This variation in the timing of the CCTC enactment provides the first opportunity for identification. The implementation of a state

[14] In reality, families can use child care from other family members or friends, but unpaid informal care does not count in claiming the CCTC.

[15] These states include Arkansas, California, Hawaii, Iowa, Kansas, Minnesota, New York, Oklahoma, Oregon, Vermont, and Washington D.C.

CCTC provides additional incentives for women to enter the labor force. All other things equal, women with CCTC eligible children living in states that provide CCTC are more likely to participate in the labor market compared to women living in states that do not provide CCTC.

Among states offering a CCTC, some states are more generous than others. A more generous state CCTC has a different impact when compared to a less generous state CCTC. It is difficult to capture the effect of the CCTC by indicating only the existence of a state CCTC. The variation in state CCTC generosity can be reflected by the match-up rate to the federal CCTC. For example, New York matches the federal CCTC to levels as high as 110% in some years. It means that if a New York family claims $1000 of the federal CCTC, the family could claim up to $1100 of the state CCTC if the family's income falls in a certain income bracket. On the other hand, Iowa matched the federal CCTC by as low as 5% when it first adopted its state CCTC.

In addition to cross-sectional variation across states, the CCTC vary differently over time. Some states seldom change their CCTC regulations, while others adjust their CCTC regulations frequently. The variation in the generosity of the policy across states and over time provides another opportunity for identification. A more generous state CCTC provides more incentive for women to join the labor market. All other things equal, women with CCTC eligible children living in a state or time period offering a more generous CCTC are more likely to join the labor market when compared with women living in a state or time period offering a less generous CCTC.

As specified above, the CCTC regulation is a function of a woman's own labor supply and some other individual characteristics. To disentangle the endogeneity issue, I construct a state-level CCTC treatment variable using the maximum level of the state CCTC. It is the product of the maximum federal CCTC in a given year and the highest match-up rate of a state in the same year. Therefore, I construct a panel dataset for the state-level CCTC

treatment variable by assigning the same treatment to all women in a state-year cell. The assumption used here is that states with a higher value of the state-level CCTC measured at the maximum level are more generous in offering the CCTC.

Using the state-level CCTC treatment variation, I explore the effect of the CCTC on labor supply by using a differences-in-differences method. The empirical model is

$$Y_{ist} = \beta_0 + \beta_1 maxCCTC_{st} + \beta_2 X_{ist} + \beta_3 maxEITC_{st} + \lambda_s + \delta_t + \xi_i + \epsilon_{ist}, \tag{4}$$

where Y_{ist} is the dependent variable representing the labor supply of a woman. It can represent whether a woman i in state s and year t is in the labor market; or it can represent her annual work hours. The independent variable $maxCCTC_{st}$ denotes the maximum state-level CCTC allowed in the state s and year t. The independent variable X_{ist} includes individual characteristics: age, age squared, marital status, education, husband's income (for married women), number of children, and age of the youngest child. The covariate $maxEITC_{st}$ denotes the maximum state-level EITC in state s and year t. Other variables on the right hand side are λ_s, δ_t, and ξ_i, which represent state, year, and individual fixed effects, respectively; and ϵ_{ist} is the disturbance term.

The state and year fixed effects absorb the common factors that affect the labor supply of every woman in a year or a state; the individual fixed effects can absorb the unobserved heterogeneity in productivity or preference towards work, or both. With the other controls, β_1 is the main coefficient of interest that reflect the effect of the state-level CCTC treatment variable on maternal labor supply. However, the baseline differences-in-differences strategy suffers from the common challenge of the differences-in-differences method. There could exist some factors that affect the time of the CCTC adoption or adjustment in generosity, and therefore affect the maternal labor supply at the same time. The local economy or social stigma towards working women are a couple of examples. Moreover, the basic differences-in-

differences strategy requires that the female labor supply in different states follows a common trend before the introduction of the state CCTC.

Adding another source of variation within a state-year cell to perform a triple-differences estimation is a solution to this issue (Angrist and Pischke, 2008; Goodman-Bacon, 2018). Though the state-level CCTC treatment is the same for all the individuals in a state-year cell, it has a different impact on different demographic groups. If the enactment and adjustment in the generosity of the state CCTC affect the female labor supply, it only does so for women with CCTC eligible children. Women without children and women whose children are beyond the age of eligibility provide placebo tests and a common trend. If the state-level CCTC treatment variable only affects the labor supply of women with eligible children but has no effect on women without eligible children, it is evident that the effects of the CCTC on female labor supply are not a reflection of a common trend. The emplirical model for the triple-differences analysis is

$$\begin{aligned} Y_{ist} = {} & \pi_0 + \pi_1\ maxCCTC_{st} + \pi_2\ eligible_{ist} + \pi_3\ maxCCTC_{st} \cdot eligible_{ist} \\ & + \pi_4\ X_{ist} + \pi_5\ X_{ist} \cdot eligible_{ist} + +\pi_6\ EITC_{st} + \pi_7\ EITC_{st} \cdot eligible_{ist} \\ & + \lambda_s + \pi_8\ \lambda_s \cdot eligible_{ist} + \delta_t + \pi_9\ \delta_t \cdot eligible_{ist} + \xi_i + \epsilon_{ist}, \end{aligned} \tag{5}$$

where $eligible_{ist}$ is a dummy variable indicating that individual i has at least one CCTC eligible child in state s and year t. Such a triple-differences strategy assuages some doubts on the baseline differences-in-differences method.

4.2 Individual CCTC Variation

The state-level CCTC treatment variable is a coarse proxy for the CCTC treatment. It does not incorporate the multi-dimensional variation of the CCTC regulations in some states. Many states have precise regulations on the eligibility of the state CCTC and specify such

eligibility by setting a phase-out scheme according to family income (or in some cases, an income cap), and such regulations frequently change over time. As a result, the maximum state-level CCTC is not relevant to most of the families living in the states where the CCTC eligibility and generosity vary significantly with income. It is appropriate to construct a treatment variable that is relevant to each woman according to her observable characteristics. Except for the income of the woman, which is endogenous, the number of eligible children and the husband's income (for married women) are the most critical factors that decide the state CCTC treatment for a particular woman. I construct an "individual CCTC" treatment variable to reflect the policy faced by each woman. I propose to use the maximum CCTC a woman can claim from a state to represent the treatment intensity of a state CCTC.

The empirical model using the individual CCTC treatment variation is

$$Y_{ist} = \gamma_0 + \gamma_1 \; maxCCTC_{ist} + \gamma_2 \; Z_{ist} + \gamma_3 \; maxEITC_{ist} + \zeta_s + \eta_t + \theta_i + \mu_{ist}. \qquad (6)$$

The main difference from the empirical model in the last subsection is that $maxCCTC_{ist}$ denotes the maximum CCTC for a woman i in the state s and year t. Here, Z_{ist} controls for the same individual characteristics and includes the number of eligible children because it is an element that both decides the treatment intensity as well as the labor supply. The covariate $maxEITC_{ist}$ represents the maximum individual ETIC that is applicable to woman i in state s and year t. Other variables on the right hand side are ζ_s, η_t, and θ_i, which represent state, year, and individual fixed effects, respectively; and μ_{ist} is the disturbance term.

Incorporating individual information related to the CCTC eligibility provides more sources of identification. Apart from comparing the differences in the labor supply caused by the resident state or time with the different state CCTC policy intensity, I can compare the effects of the CCTC on labor supply for groups that are generated by the cut-off limit of husband's income and the number of CCTC eligible children. The coefficient γ_1 is the

main coefficent of interest reflecting the effect of the individual CCTC treatment variable on maternal labor supply.

The calculation of the individual CCTC treatment variable follows the function

$$maxCCTC_{ist} = f_{st}(E_i, N_i), \tag{7}$$

where E_i and N_i represent the husband's income and number of CCTC eligible children, respectively. The function $f_{st}(\cdot, \cdot)$ represents the state CCTC regulation used to calculate the credit in state s and year t. The construction of the individual CCTC treatment variable starts from the individual federal CCTC. A woman realizes the maximum federal CCTC when she earns a certain amount of annual income and spends enough on child care services to hit the upper bound of the expenses. The break-even point of the woman's earnings, child care expenses, and the upper bound of \$3000 or \$6000 guarantees the woman with the maximum federal CCTC. I first use the break-even point to calculate the maximum federal CCTC for each woman. Using this individual federal CCTC, I then calculate the individual maximum state CCTC by multiplying individual federal CCTC with the match-up rate specified by a state (according to husband's income).

In reality, a woman makes her labor supply decision without considering the maximization of the CCTC. However, in this complicated situation, the maximum individual CCTC treatment variable makes it convenient to compare the treatment intensity across individuals. Some assumptions are necessary for the break-even point to land on the budget constraint. When child care expenses impose a fixed cost for a woman to join the labor market and if the fixed cost of child care is close to the upper bound of \$3000 or \$6000, the break-even point is on the budget constraint. Otherwise, this break-even point may not be a feasible choice under other child care payment schemes.

The individual CCTC treatment variable may not be a good policy proxy for women

who are more likely to supply a high level of hours and with a high potential labor income, because the total family income with or without the wife's income would be quite different. In this case, the optimal time allocation point is far away from the point on the budget constraint used to construct the treatment variable. In addition, if the state CCTC phases out significantly with family income, the treatment variable is not accurate for them. That said, in terms of measuring the extensive margin,i.e., whether work or not, it is not a problem. Women who have a high earning ability are also more likely to be in the labor market regardless of the existence of the CCTC. Therefore, they do not contribute to the identification. Instead, the marginal women who are indifferent between working or staying at home contribute to the identification the most. When these women begin to join the labor market, it is plausible that they are less likely to participate in the labor market intensively. As a result, the optimal time allocation is not too distant from the break-even point on the budget constraint used to construct the individual CCTC treatment variable. A woman on the margin can receive the maximum CCTC by working part-time and paying for child care. Therefore, it is acceptable to define the individual CCTC treatment variable based on these assumptions and coding criteria.

Introducing detailed individual characteristics makes the treatment more relevant for each woman, but it also brings in endogeneity. There is also the assumption that the husband's income are exogenous for married women. Under this assumption, a woman first finds her best-matched husband in the marriage market, then the characteristics of the husband (e.g., earning ability and time arrangement in the family) are exogenous. Taking the husband's income as exogenous is an assumption adopted by Michalopoulos et al. (1992), Van der Klaauw (1996), and Francesconi (2002). Mroz (1987) also provides some evidence for this argument.

The number of children or number of CCTC eligible children may be endogenous, too. However, a more generous state CCTC has little effect on the fertility decisions. Most states

follow the federal CCTC regulation and only make the distinction for the number of eligible children between one and two (two includes more than two CCTC eligible children). As a result, an additional child cannot contribute to more tax credit if the family already has two eligible children. The other doubt would be that a family can extend the time of childbearing to take advantage of a longer eligibility period, but the chance that it could be a concern is also small.[16]

There could be other issues involved in the individual CCTC treatment variable. Even controlling for husband's income, number of children, and the individual fixed effects, there could be other time-varying factors that are omitted. For example, women with the same number of eligible children but with different age structure of the children may face quite different time constraints. Or for example, a woman may prefer more children after she had her first one. In this case, she will be less likely to join the labor market and at the same time receive higher individual CCTC treatment. As a result, the treatment effect is attenuated. The influence from the original family may also affect a woman's fertility and labor supply decision. Some women's fertility decisions and timing may be related to the availability of the help they expect to receive from their families. And this information is relatively hard to control for. Also, since the individual CCTC treatment variable is defined at the maximum level, it is a proxy of the policy rather than the exact state CCTC amount one can receive. As a result, there is a measurement error problem as well. My proposal for dealing with these issues is to use the state-level CCTC treatment variable as the instrumental variable for the individual CCTC treatment variable.

The state-level CCTC treatment variable reflects the generosity of a state in providing CCTC in general. It is the maximum CCTC a state allows. To claim the exact amount of the maximum CCTC, a family must have two or more CCTC eligible children, fall in the lowest income bracket (if the state specifies its match-up rate for different income brackets),

[16] I estimate the effect of the state CCTC on the number of children and number of eligible children; none of them are associated with the treatment of the CCTC.

and also pay for child care expenses to the upper bound at the same time. Families with only one eligible child never get the maximum state CCTC. The state-level CCTC is not relevant for families that fall into higher income brackets either. As a result, it is only applicable to a small portion of the population. For the majority of the population, it meets the exclusion restriction for a valid IV.

The state-level CCTC treatment variable has an impact on the labor supply only through its association with the individual CCTC treatment variable. In general, the state-level CCTC treatment variable is positively associated with the individual CCTC treatment variable. In some cases, a state adjust the match-up rates making no distinction across income levels; in these cases, the individual CCTC treatment variable always moves in the same direction as the state-level CCTC treatment variable. However, in some cases, when the CCTC policy is adjusted, a state may make it more generous to some income groups (usually the low-income families) but less generous or even unavailable for some other groups (usually the high-income families). In these cases, the state-level CCTC and the individual CCTC may move in opposite directions for high-income families. Such regulations create "defiers" in the population. The existence of the defiers invalidate the IV method. However, the defiers only consist of a small fraction of the population, and they are more likely to be women whose husband has a high annual income. To deal with the problem caused by the existence of the defiers, I restrict my sample used to perform the IV analysis by dropping married women whose husband earns more than \$50,000 every year.[17] With the sample restriction, the state-level CCTC treatment variable meets both the relevance requirement and the monotonicity requirement. Based on the above argument, the state-level CCTC treatment variable is a valid IV for the individual CCTC treatment variable.

[17] This income is inflation-adjusted and \$50,000 is approximately the median income for husbands in my sample

5 Data Used to Construct the Variables

The samples used in this paper are from the Panel Study of Income Dynamics (PSID). The PSID consists of 4802 households and 18,233 individuals in the first wave of the survey in 1968. The sample households and the extended households were followed up annually from 1968 to 1997, and biennially from 1997 to the present.[18]

The PSID survey collects information at the household level. Relatively abundant economic and demographic information about the household head and the spouse (if there is one) is collected. If other family members do not form a new family unit, their information is not as abundant. I restrict my sample to women aged 20 to 55 who are either the wife of the household head or the head of a household during the survey years of 1968-2015. Although women with at least one child under the eligible age of the CCTC are the main focus, I include women with no children and women with children above the eligible age to perform placebo tests.

The PSID dataset is suitable for this research because it covers a time range that provides pre-treatment and post-treatment periods to carry out the differences-in-differences method. The information about the labor market and family structure is useful for examining the effect of the CCTC on labor supply decisions. I include woman with CCTC eligible children from all 50 U.S. states and D.C. I also use the PSID Childbirth and Adoption History to calculate the number of CCTC eligible children in a household in a given year. The restriction of the birth history data is that it is only available for up to five children. Therefore, I restrict my sample to women who have less than six children in their life time. Applying the sample selection criteria, I construct an individual-level panel data set.

Table 2 reports the summary statistics for the sample by marital status. LFP is a

[18] Among the 4,802 original households, 2,930 households are from a nationally representative sample (Survey Research Center at University of Michigan or SRC sample), and the other 1,872 are from a low-income household sample (Survey of Economic Opportunity or SEO sample).

dummy variable denoting whether a woman is or is not in the labor market.[19] The LFP for the married women is 65%, and the LFP for the single women is 78.9%. On average the married women work 1042 hours every year and the single women work 1113.7 hours. Conditional on being in the labor market, the number of annual work hours is 1420.6 and 1528.0 for married and single women respectively. On average the married women are 31.8 years old, while the single women are 30.6 years old. The married women have 12.5 years of education, which is half a year more than the single mothers. For married women, the average husband's annual income (in 2015 dollars) is $52,636 (conditional on the husband having income). The average number of children is around 2.1 for both groups. The racial composition is quite different. The single women are more likely to be black compared with married mothers.

Figure 5 shows the bin-scatter plot of the labor force participation rates and ages of the youngest child by states or years with or without the state-level CCTC. The vertical dashed line represents the cut-off age of the CCTC eligibility since 1989, and the samples are restricted to between 1989 to 2015. For women whose youngest child is 8 to 12 years old, the labor force participation rate in the states or years that provide state CCTC is on average higher than that of the states or years that do not provide state CCTC. Right after the cut-off age, the labor force participation rates of the two groups converge together. Figure 6 shows the distribution of the state-level CCTC treatment variable, and Figure 7 shows the distribution of the individual CCTC treatment variable. Figure 8 shows the correlation between the state-level CCTC treatment variable and the individual CCTC treatment variable. Appendix F also shows the summary statistics for samples used to perform IV estimation.

[19]The PSID individual data set provides information about employment status since the survey year of 1979. I code people as in the labor market if they reported working, looking for jobs, or being laid off temporarily. They are treated as not in the labor market if they report other activities as retired, permanently disabled, housekeeping, student, or other. For survey years before 1979, I use the survey question about the source of their income. If they report receiving labor income or a combination of labor income and other income, I code them as being in the labor market. For a robustness check, I also define being in the labor market if a person reported positive working hours in a given year.

They are similar to the main samples except for having lower husbands' incomes.

6 Estimation Results

I apply the empirical strategies described in section 4, and I look at the effects of the CCTC on the labor force participation rate and the annual work hours (conditional on being in the labor market). This section reports the estimation results.

6.1 Estimation Results Using the State-level CCTC Treatment Variable

Using the state-level CCTC treatment variable described above, I run differences-in-differences estimations with treatment intensity. I first apply the method to the labor force participation rates, and Table 3 shows the results. The main independent variable of interest is the state-level CCTC. All specifications control for the state-level EITC. The covariates are years of education, age, age squared, marital status (except for column 3 and column 4), husband's annual income (except for column 4), number of children (except for column 6), age of the youngest child (except for column 6), and state and year fixed effects. Column 1 shows results for all the samples using pooled ordinary least squares (OLS) estimation. The coefficient of the state-level CCTC treatment variable is 3.28, which means that on average, a $1000 increase in state-level CCTC, measured at the maximum level, increases the maternal labor force participation rate by 3.28 percentage points. [20]

Column 2 shows the results from panel regression controlling for individual fixed effects. The coefficient of the state-level CCTC variable is smaller compared to the pooled OLS result

[20] The treatment unit of the CCTC (and EITC) is normalized to $1000 because the magnitude of $1000 is the mean value of state-level CCTC treatment variable. This magnitude is about 1.5 standard deviation of the state-level CCTC treatment variable. The individual CCTC treatment variable has a smaller mean value, but I still use the same unit of $1000 to be consistent with state-level treatment variable.

in column 1 but still statistically significant. Column 3 demonstrates the results for the sub-sample of married women while column 4 shows the results for single women. Comparing the two, the effect of CCTC is more pronounced in married women. Column 5 and column 6 provide placebo tests by applying the policy treatment on groups of women without CCTC eligible children. Column 5 shows that the state-level CCTC treatment variable does not affect the labor force participation of women whose children are too old to be eligible for the CCTC, and column 6 shows that the state-level CCTC treatment does not affect the labor supply of women who have no children. The placebo tests provide convincing evidence that the effect of the CCTC is not merely a reflection of a common trend. In column 7 I pool all the sample together and run a triple-differences estimation as specified in equation (5). Column 7 reports the estimation result for the coefficient π_3 in equation (5), which represents the treatment effect of the state-level CCTC on women with at least one CCTC eligible child. It means that a $1000 increase in CCTC increases the labor force participation rate by 1.97 percentage points.

At the same time, the state-level EITC significantly affects the labor force participation rates of women with young children. However, the EITC only affects labor force participation of single women, not married women. The results provide evidence that the CCTC and the EITC work through different channels.

I then apply the same method to estimate the effect of the state-level CCTC on annual work hours conditional on already being in the labor market, the results of which are reported in Table 4.[21] With the same controls as in Table 3, column 1 shows that a $1000 increase in CCTC increases annual work hours by 34. Column 2 adds control for individual fixed effects, and the effect of the CCTC is smaller and not significantly different from zero. Column 3 and column 4 shows the sub-groups by marital status. Column 5 and column 6 show the results for women who have no eligible children. Column 7 shows the result using triple-

[21] I restrict the work hours between 0 and 3000. In the sample, 3000 hours per year is at the 99th percentile among positive hours.

differences method. The EITC has no significant effects on work hours in all specifications. After controlling for individual fixed effects, the coefficients for the state-level CCTC are not statistically different from zero.

6.2 Estimation Results Using the Individual CCTC Treatment Variable

This subsection reports the estimation results using the individual CCTC treatment variable. I first apply the method to examine the effect on labor force participation rates, and Table 5 shows the results. The controls are the same with those in the last subsection except that the control for the EITC is at the individual level. Additionally, I include a control for the number of the CCTC eligible children because it is a factor used to calculate the individual CCTC treatment variable. Column 1 shows the results for the basic pooled OLS estimation. The coefficient of the CCTC means that a $1000 increase in the state CCTC, measured at the individual maximum level, increases labor force participation rate by 2.79 percentage points. Column 2 controls for individual fixed effects and uses the panel regression method. With individual fixed effects, the coefficient of the CCTC treatment is relatively smaller, reflecting that the individual fixed effects absorb too much variation.

As discussed in the last section, the individual CCTC treatment variable is more relevant to the condition of each woman, but it also introduces endogeneity. The state-level CCTC and the state-level EITC treatment variables are exogenous and can work as the instrumental variables for the individual CCTC and the individual EITC treatment variables. Column 3 of Table 5 reports results for instrumental variable estimation, it shows that the CCTC significantly increases the labor force participation of mothers. A $1000 increase in CCTC increases the labor force participation rate by 6.35 percentage points. The coefficient of the IV estimation is larger than the coefficients from using OLS and panel regression, which reflects the OLS estimates using individual CCTC variation are attenuated. Column 4 and

column 5 show the results according to marital status. The disparity of the effects across marital status is consistent with results derived by using the state-level CCTC treatment. The EITC has a small effect on the labor force participation of the mothers, and it affects single mothers only.

Table 6 reports the first stage estimates of the IV regression. It shows that the state-level CCTC is a good predictor of the individual CCTC, and the state-level EITC treatment variable is a good predictor of the individual EITC treatment variables. However, the state-level CCTC does not account for the variation of the individual EITC; neither does the state-level EITC account for the variation of the individual CCTC. Overall, the state-level CCTC and EITC pass weak instrument tests.

I then apply the same method on the annual work hours (conditional on already being in the labor market). The results in column 1 and column 2 in Table 7 show that the individual CCTC treatment has little effect under OLS estimations. However, the IV estimation results in column 3 show that CCTC significantly increases annual work hours. A $1000 increase in CCTC increases the annual working hours by 103.8 hours. Such an increase equals to two and a half weeks of full-time work. Further examining the effects by marital status, I find that the effects are particularly large for married mothers. For most specifications in Table 7, the EITC does not significantly affect the work hours.

7 Discussion

The CCTC significantly increases the labor supply of women with CCTC eligible children, but different demographic groups may have different responses given the different constraints faced by different women. In this section, I first interpret the heterogeneity of the estimation results and discuss the mechanisms behind them as well as the potential confounding policies.

7.1 Heterogeneity

In the literature, there is a large range of estimates as to the responsiveness of female labor force participation. Blundell and MaCurdy (1999) summarize the wide-ranged empirical results of the responsiveness of female labor supply in their surveys. For the United States context, the estimated elasticities of labor force participation for married women range from 0.76 (Hausman and Ruud, 1984) to 0.97 (Triest, 1990). Other research such as Rosen (1976), estimates the elasticity of annual work hours for married women to be 2.3. The estimated elasticities for married women under British context varies from 0.67 (Blundell, Costa Dias, et al., 2016) to 2.03 (Arrufat and Zabalza, 1986). The results from this study can be transferred into a back-of-the-envelope calculation of the labor supply elasticity to be 1.1 for all women and 1.6 for married women. These results are close to the upper bound in the literature.

The labor force participation responsiveness to CCTC for single mothers are smaller than that of the married mothers. Also, the results derived from using instrumental variables show that for single mothers the responsiveness to CCTC is very close to that of EITC. In the literature, the range of estimation of labor supply responsiveness for single women is relatively narrow. The magnitude of the labor force participation responsiveness of single mothers in this study is comparable to the results of Eissa and Liebman (1996), who find that the participation elasticity for single mothers with lower level of education is approximately 0.6.

Children of different ages impose different time constraints on mothers. I divide the CCTC eligible mothers into groups according to the age of the youngest child. I run the pooled OLS estimation on the labor force participation rates for each group, and the results are shown in Figure 9. The horizontal axis represents the age of the youngest child in these groups. The vertical axis is the labor force participation rate. The height of the black dots represents the values of the regression coefficients for the state-level CCTC treatment

variable, and the segments that go through the dots are the 95% confidence intervals. Figure 9 shows that women whose youngest child is between 10-12 years old are most responsive to the CCTC treatment, while women whose youngest child is between 4-6 years old are the least responsive to the policy.

Similarly, Figure 10 shows the results of annual work hours according to the age group of the youngest child. If the women are already in the labor market, the effects are only significantly different from zero for the women whose youngest child is under three years old.

Women whose youngest child is older are more responsive to the CCTC in terms of participation but less responsive to CCTC in terms of work hours. The explanation is that women with older children have less intense time constraints. At the same time, women with older children are more likely to be in the labor market in the first place, with or without the CCTC. Once being in the market, they are more likely to participate in the labor market intensively. Therefore, when they are exposed to the policy, they are more likely to move from not working at all to working full-time. As a result, if the women are already in the labor market, the effect of the CCTC on work hours is diminished for women with older children. While women with younger children face a higher cost of child care services and a more restricted time constraint, and they are less likely to be incentivized to join the labor force. If they work, they are more likely to work part-time. As a result, they are more responsive to the policy by working different hours.

Women with different non-labor incomes also face different constraints, therefore responding differently to the same policy. I divide the sample of married mothers with the CCTC eligible children according to the income quantiles of the husband and run the pooled OLS estimation on different groups. Figure 11 shows the results of the CCTC treatment on the labor force participation rate. Women whose husbands are in both the lowest and highest income quantiles are the most responsive to the CCTC; with a more generous state-level CCTC, these two groups are more likely to join the labor market. Even though women

from the two ends have a similar response, the mechanisms are not the same. Women with higher non-labor income have lower labor force participation rates because they do not face tight budget constraints, while women with lower non-labor income have lower labor force participation because they are more likely to be low-skill workers and may find it is not worth it to work and pay for child care services at the same time.

Figure 12 shows that women whose husbands are in the lowest income quantile are more likely to work more hours under a more generous state-level CCTC policy. While the responsiveness of the women with higher non-labor income is not very significant. This is because women whose husbands have high incomes have higher potential earning ability themselves. When these women participate in the labor market, they tend to do so intensively. As a result, there is not much room force them to make adjustment for work hours. Women with a lower non-labor income however, are only loosely attached to the labor market. There are more rooms for them to make adjustment on work hours.

7.2 The Earned Income Tax Credit

Some other government policies are implemented at the same time as the CCTC. These policies include the Earned Income Tax Credit (EITC), universal public school, Head Start, and others. It is possible that they might confound with the effect of the CCTC. This section deals with these doubts, mostly concerning the EITC.

The EITC is a benefit for working people with low to moderate incomes. The EITC phases out entirely as the family income reaches a certain level. Most importantly, the EITC does not require a secondary earner in a family, which makes it less effective in motivating the labor force participation for married women. As long as the family has earned income, and the earned income is below a certain threshold, they are eligible for the EITC. The EITC, by design, is to assist low-income families (Crandall-Hollick and Hughes, 2018). The EITC is refundable at the federal level, and also in many states. Figure 13 and Figure 14 show the

number of tax filings and the average amount for each tax filing according to different family incomes in 2011. They show that the EITC and the CCTC have a small intersection of benefit recipients, but the majority of them are quite different. Scholz (1996) and Hotz et al. (2003) find that the enactment of EITC increases the labor force participation for single women by 3-6 percentage points. Eissa and Hoynes (2004) find that the EITC has a small, adverse effect on married women. Bastian and Michelmore (2018) find that the implementation of the federal EITC in 1975 has a significant effect on the labor force participation of single women and has a minuscule effect on married women.

The federal EITC is not a problem for my identification because controlling for individual characteristics the federal EITC affects all the residents in the same way. However, the state-level EITC can potentially cause some confounding effects. Similar to the CCTC, many states provide their state EITC with a match-up rate to the federal EITC. However, the legislative history of the two tax credits shows that states with the CCTC are not all states that have the EITC, and vice versa. For the states that have both the CCTC and the EITC, the timing of enactment and amendment are not all the same. As long as the two policies do not change at the same time for most of the variation, my identification is valid.

From Tables 3-4 and Tables 6-7, the results across different specifications show evidence that the CCTC and the EITC work independently. The CCTC has more significant effects on married mothers, and the EITC has more significant effects on single mothers. And the results of the EITC are consistent with the results in the literature.

7.3 Other Child Care Subsidy Programs

Some research has shown the effects of public school on maternal labor supply. Gelbach (2002) uses the children's quarter of birth in a year and the cut-off age of school entering to estimate the effect of free public school on female labor supply. He finds a positive effect only on single mothers but not on married mothers. Cascio and Schanzenbach (2013) evaluate

the impact of the introduction of universal preschool for four-year-olds in Oklahoma and Georgia, and find a moderate effect on single mothers. The results in this study show that the effect of the CCTC is more pronounced in married mothers with the youngest child between 0-3 or 7-12 years old, while the effect of public school is plausibly more significant on mothers whose children are 5-7 years old. Furthermore, as long as the state legislation on schooling did not change at the same time as the CCTC legislation, my empirical strategy can rule out the effects of public school.

Other child care subsidy programs are less likely to affect the identification of this study. D. Blau (2003) documents the subsidy programs related to child care in the United States. Figure 15 is adopted from the Table 7.1 of his paper. It shows that many of these programs either focus on low-income families, have no requirement for parents working, or only apply to the families with children of a young age (for example the Head Start). They do not cover the same demographic group of benefit recipients as the CCTC.

Furthermore, when adopted at the federal level, they affect all the eligible in all states in the same way, then the effects of these programs can be absorbed by year fixed effects. When adopted at the state level, they usually have different targeted population and seldom have as much variation as the CCTC does, the effects can mostly be absorbed by the state fixed effects.

8 Conclusion

In this paper, I exploit the variation in the CCTC adoption and adjustment of generosity to estimate the effect of the CCTC on maternal labor supply. I find that the CCTC considerably increases the labor force participation rates of women with young children. Estimates derived from using the state-level CCTC treatment variable and a differences-in-differences method indicate that a $1000 increase of the CCTC increases the labor force participation rate

by three percentage points for women with young children. Estimates derived from using individual CCTC treatment variable and the IV estimation show that a $1000 increase of the CCTC increases the labor force participation rate by six percentage points. Conditional on being in the labor force, the CCTC also significantly increases annual work hours for women with young children. The effect of the CCTC is more pronounced in married mothers.

This study provides new evidence about the responsiveness of the maternal labor supply to child care subsidy programs. Future work can explore the effects of the CCTC on children's outcome for example, cognitive ability, non-cognitive ability, employment, etc. With a comprehensive understanding on the effects of the policy on children's outcome, a thorough conclusion for the welfare analysis of the CCTC is possible.

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Tables

Table 1: Current Federal CCTC: Applicable rate and the maximum credit allowable

AGI	**Applicable Rate**	**1 child**	**2+ children**
\$0-\$15,000	35%	\$1050	\$2100
\$15,001-\$17,000	34%	\$1020	\$2040
\$17,001-\$19,000	33%	\$990	\$1980
\$19,001-\$21,000	32%	\$960	\$1920
\$21,000-\$23,000	31%	\$930	\$1860
\$23,001-\$25,000	30%	\$900	\$1800
\$25,001-\$27,000	29%	\$870	\$1740
\$27,001-\$29,000	28%	\$840	\$1680
\$29,001-\$31,000	27%	\$810	\$1620
\$31,001-\$33,000	26%	\$780	\$1560
\$33,001-\$35,000	25%	\$750	\$1500
\$35,001-\$37,000	24%	\$720	\$1440
\$37,001-\$39,000	23%	\$690	\$1380
\$39,001-\$41,000	22%	\$660	\$1320
\$41,001-\$43,000	21%	\$630	\$1260
\$43,001+	20%	\$600	\$1200

Table 2: Summary Statistics

	Married	Single
LFP rate(%)	65.0	78.9
	(47.11)	(42.94)
Work Hours	1042.0	1113.7
	(902.58)	(952.08)
Work Hours(1-3000)	1420.6	1528.0
	(699.59)	(691.27)
Age	31.8	30.6
	(6.64)	(6.67)
Years of Education	12.5	12.0
	(3.21)	(2.68)
Husband's annual income($)	52635.5	
	(49835.2)	
Number of Children	2.08	2.06
	(0.947)	(1.015)
State-year CCTC($)	1020.4	941.5
	(694.84)	(616.43)
Individual CCTC($)	452.2	687.5
	(320.79)	(512.47)
State-year EITC($)	963.2	1100.9
	(759.00)	(881.87)
Individual EITC($)	556.9	945.3
	(584.48)	(797.49)
White	64.2%	27.4%
Black	24.1%	62.8%
Latino	10.0%	8.8%
Other Races	1.7%	1.0%
Observations	64,261	22,372

Note: Samples are from PSID 1968-2015 waves, all women aged 20 to 55, either a household head or wife of a household head. Husband's income, number of children, the CCTC and the EITC are all conditional on positive values. Standard deviations are in the parentheses.

Table 3: The state-level CCTC Treatment on the Labor Force Participation Rate

	With Eligible Children				No Eligible Children		All
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All Women	All Women	Married Women	Single Women	Older Children	No Children	Triple-Differences
State-level CCTC ($1000)	3.28***	1.75*	1.74	1.30	0.305	0.625	1.97*
	(0.716)	(0.799)	(0.949)	(1.56)	(1.61)	(0.730)	(0.871)
State-level EITC ($1000)	1.86*	1.84*	0.826	4.19*	1.78	0.129	
	(0.803)	(0.867)	(1.01)	(1.76)	(1.39)	(0.736)	
Individual Fixed Effects	no	yes	yes	yes	yes	yes	yes
Observations	86,633	86,633	64,261	22,372	15,625	30,756	134,037
Adjusted R^2	0.089	0.047	0.052	0.034	0.013	0.0267	0.0623

Note: Samples are from PSID 1968-2015 waves, all women aged 20 to 55, either a household head or wife of a household head. Column 1-2 include all mothers with one to five eligible children; column 3 and column 4 include married and single mothers respectively; column 5 inlcudes women with children oldren than the eligible age; and column 6 includes women with no children; column 7 pool all the sample together. The dependent variable in all specifications is the labor force participation rate. The treatment variables are the state-level CCTC and the state-level EITC measured at the maximum state level. Controls are years of education, age, age squared, marital status (except columns 3 and 4), husband's income (except columns 4), the number of children (except for column 6), age of the youngest child (except Column 6 and 7), and state and year fixed effects. In column 7 I include a dummy variable indicating having CCTC eligible children and interact it with all control variables. Standard errors are in parentheses, clustered at the individual level. All money terms are inflation adjusted using 2015 price. R^2 in column 2 are within R^2. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 4: The state-level CCTC Treatment on Maternal Annual Work Hours Conditional on being in the Labor Market

	With Eligible Children				No Eligible Children		All
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All Women	All Women	Married Women	Single Women	Older Children	No Children	Triple-Differences
State-level CCTC ($1000)	34.0**	17.8	22.9	-16.7	4.49	15.6	12.4
	(11.8)	(13.2)	(15.3)	(29.4)	(32.5)	(13.4)	(15.99)
State-level EITC ($1000)	9.57	6.77	-3.40	35.1	34.4	-18.2	
	(13.5)	(15.8)	(17.5)	(34.8)	(41.9)	(15.6)	
Individual Fixed Effects	no	yes	yes	yes	yes	yes	yes
Observations	61,063	61,063	45,591	15,472	12,053	26075	101,946
Adjusted R^2	0.090	0.066	0.062	0.055	0.016	0.0351	0.0903

Note: Samples are from PSID 1968-2015 waves, all women aged 20 to 55, either a household head or wife of a household head. Column 1-2 include all mothers with one to five eligible children; column 3 and column 4 include married and single mothers respectively; column 5 includes women with children older than the eligible age; and column 6 includes women with no child. The dependent variable in all specifications is annual work hours, but restricted to greater than zero and less than 3000. The treatment variables are the state-level CCTC and the state-level EITC measured at the state maximum level. Controls are years of education, age, age squared, marital status (except columns 3 and 4), husband's income(except columns 4), the number of children (except for column 6), age of the youngest child (except column 6 and 7), and state and year fixed effects. In column 7 I include a dummy variable indicating having CCTC eligible children and interact it with all control variables. Standard errors are in parentheses, clustered at the individual level. All money terms are inflation adjusted using 2015 price. R^2 in column 2 are within R^2. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 5: The individual CCTC treatment on the labor force participation for low-income families

	(1)	(2)	(3)	(4)	(5)
	All	All	All	Married	Single
	OLS	Panel	IV	IV	IV
Individual CCTC ($1000)	2.79**	1.71	6.35***	8.41*	3.92**
	(0.985)	(1.05)	(1.81)	(3.33)	(1.63)
Individual EITC ($1000)	2.47*	2.22	3.07*	1.78	4.91**
	(1.06)	(1.21)	(1.33)	(2.42)	(1.50)
Individual Fixed Effects	no	yes	yes	yes	yes
Observations	58,738	58,738	58,738	36,688	22,050
R^2	0.0863	0.0393			
F value	22.46	10.70	22.55	12.79	86.55

Note: Samples are from PSID 1968-2015 waves, all women aged 20 to 55, either a household head or wife of a household head, with one to five eligible children. Columns 1-3 include all mothers; in column 4 and 5, samples are divided into married and single mothers. The dependent variable in all specifications is labor force participation rate. The treatment variables are the individual CCTC and the individual EITC measured at the individual maximum level. For the IV estimation in column 3-5, the IVs are the state-level CCTC and the state-level EITC. Controls are years of education, age, age squared, marital status(except columns 4 and 5), husband's income (except columns 5), the number of children, age of the youngest child, and state and year fixed effects. Standard errors are in parentheses, clustered at the individual level. All money terms are inflation adjusted using 2015 price. R^2 in column 2 are within R^2.* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 6: First stage results and diagnoses for instrumental variables estimation

	(1) Individual CCTC	(2) Individual EITC
State-level CCTC	0.431***	-0.000468
	(0.00105)	(0.00342)
State-level EITC	-0.00491	0.653***
	(0.006122)	(0.0130)
Observations	58,738	58,738
F test of excluded instruments:	937.35	1310.36
SW Weak indentification test	1711.58	2749.30
SW Under indentification test	1714.70	2754.31
Kleibergen-Paap rk LM statistic:	879.26	
Kleibergen-Paap Wald rk F statistic:	852.84	
Anderson-Rubin Wald test F(2,11297):	10.57	
Anderson-Rubin Wald test Chi-sq(2):	21.18	
Stock-Wright LM S statistic:	23.81	
Hansen J statistic (overidentification test of all instruments):	0.000	
Endogeneity test of endogenous regressors:	8.967	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 7: Individual CCTC treatment on annual work hours conditional on being in the Labor Market

	(1)	(2)	(3)	(4)	(5)
	All	All	All	Married	Single
	OLS	Panel	IV	IV	IV
Individual CCTC ($1000)	29.2	28.3	103.8**	178.7**	35.9
	(19.11)	(19.21)	(33.38)	(57.51)	(33.37)
Individual EITC ($1000)	-0.5	63.0	-0.5	43.4	-10.3
	(21.26)	(28.71)	(25.34)	(43.33)	(29.79)
Individual Fixed Effects	no	yes	yes	yes	yes
Observations	43,189	43,189	43,189	27,357	15,832
R^2	0.0853	0.0718			
F value	21.32	16.28	21.38	15.73	43.51

Note: Samples are from PSID 1968-2015 waves, all women aged 20 to 55, either a household head or wife of a household head, with one to five eligible children. Column 1-3 include all mothers; in column 4 and 5, samples are divided into married and single mothers. The dependent variable in all specifications is annual work hours conditional on already being in the labor market. The treatment variables are the individual CCTC and the individual EITC measured at the individual maximum level. For the IV estimation in column 3-5, the IVs are the state-level CCTC and the state-level EITC. Controls are years of education, age, age squared, marital status (except columns 4 and 5), husband's income (except columns 4 and 5), the number of children, age of the youngest child, and state and year fixed effects. Standard errors are in parentheses, clustered at the individual level. All money terms are inflation adjusted using 2015 price. R^2 in column 2 are within R^2. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Figures

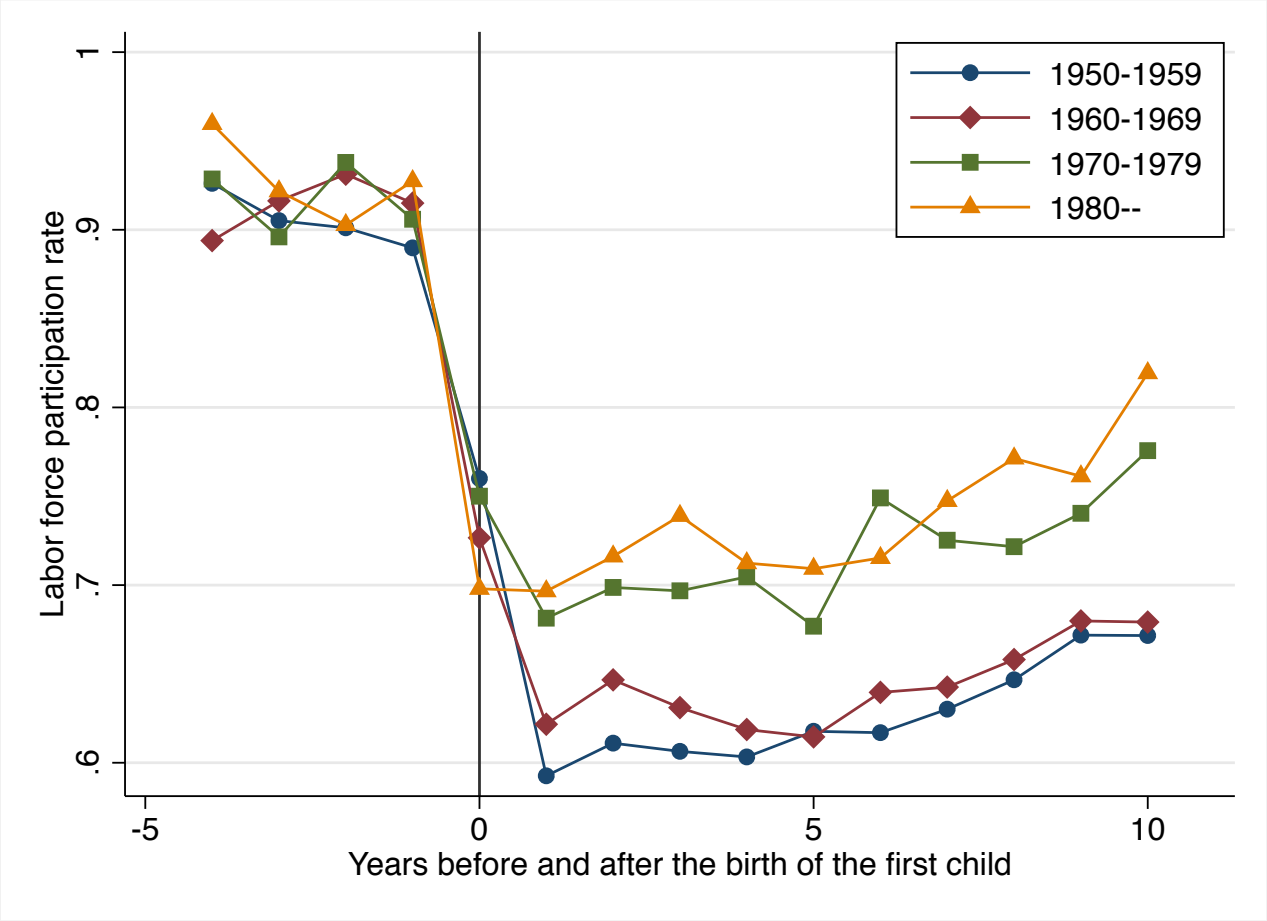

Figure 1: The female labor force participation before and after the birth of the first child by cohort. Samples are from the PSID dataset, all women ages 20 to 55, either a household head or a wife of a household head, with one to five eligible children.

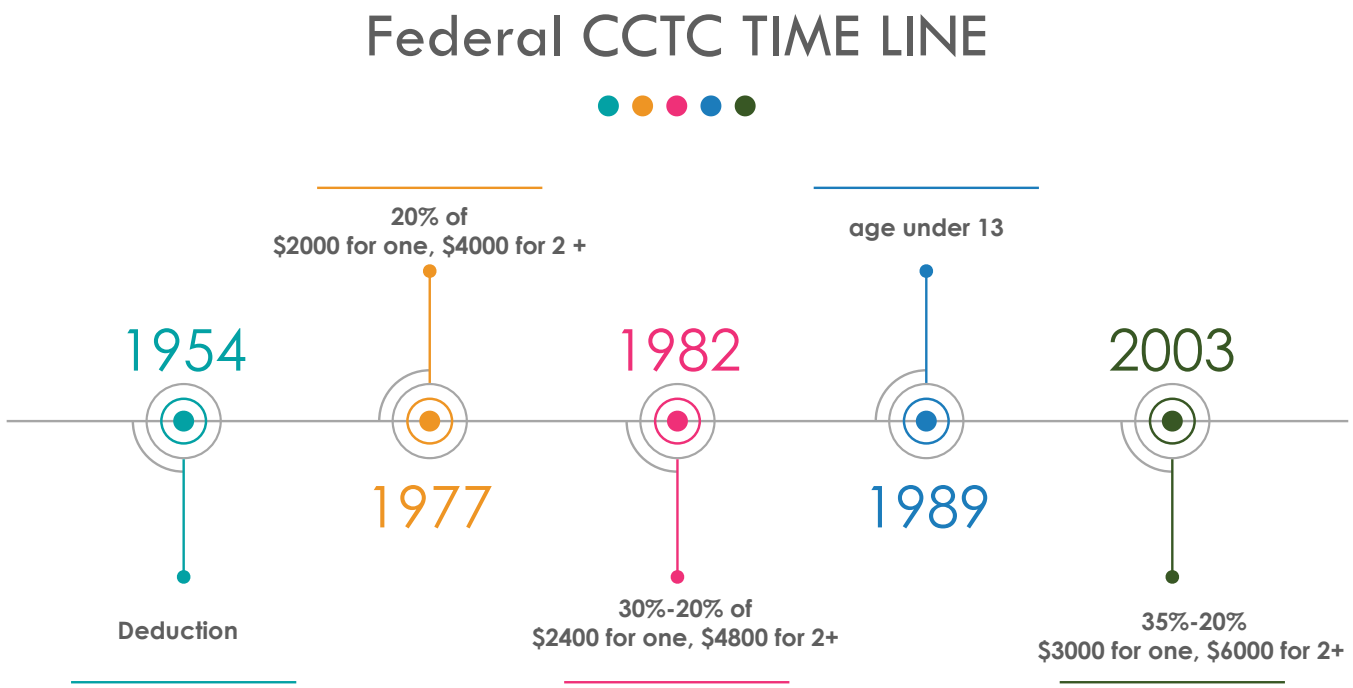

Figure 2: Major Changes of the Federal Child Care Tax Credit Legislation.

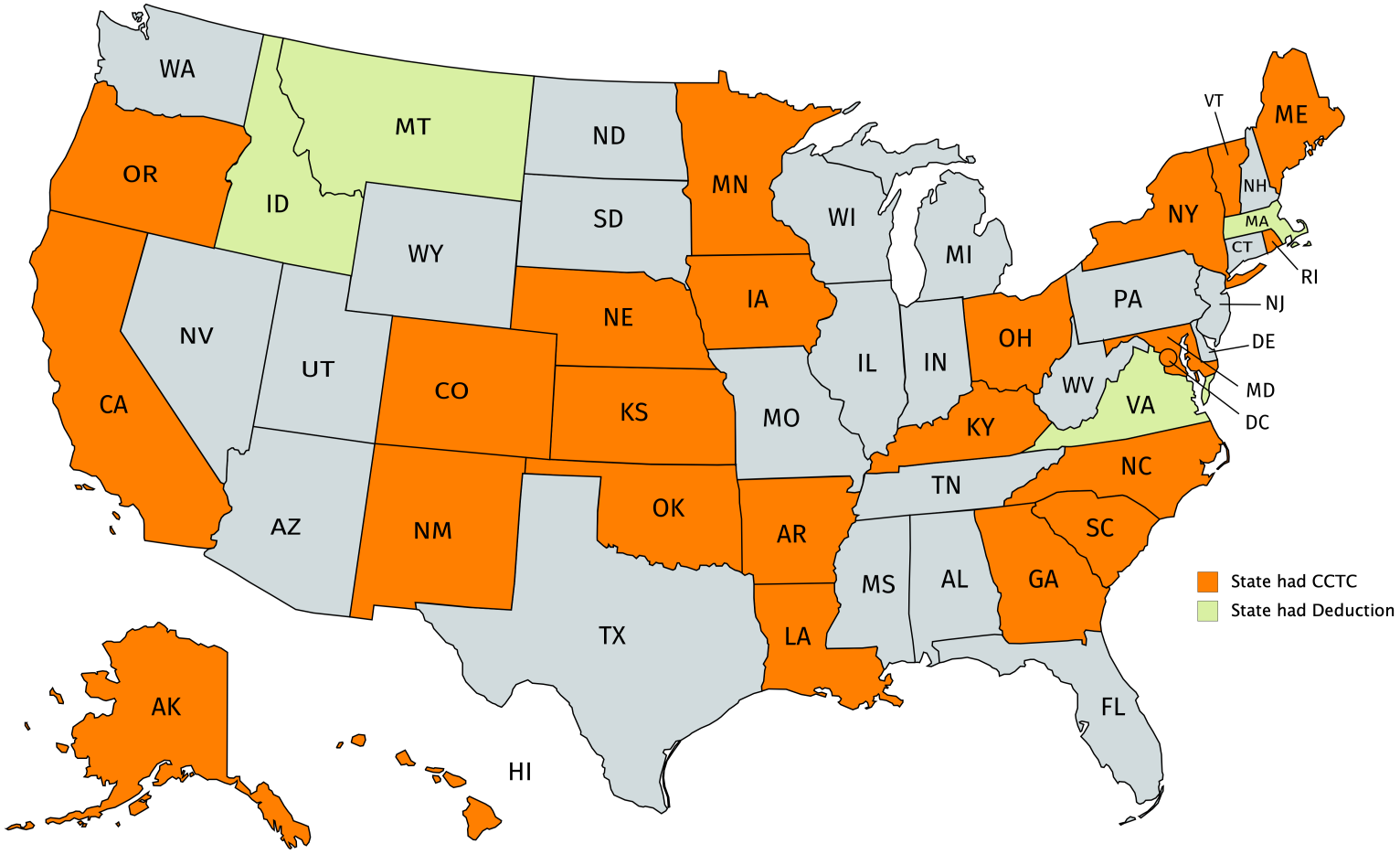

Figure 3: States Had Child Care Tax Credit Policies.

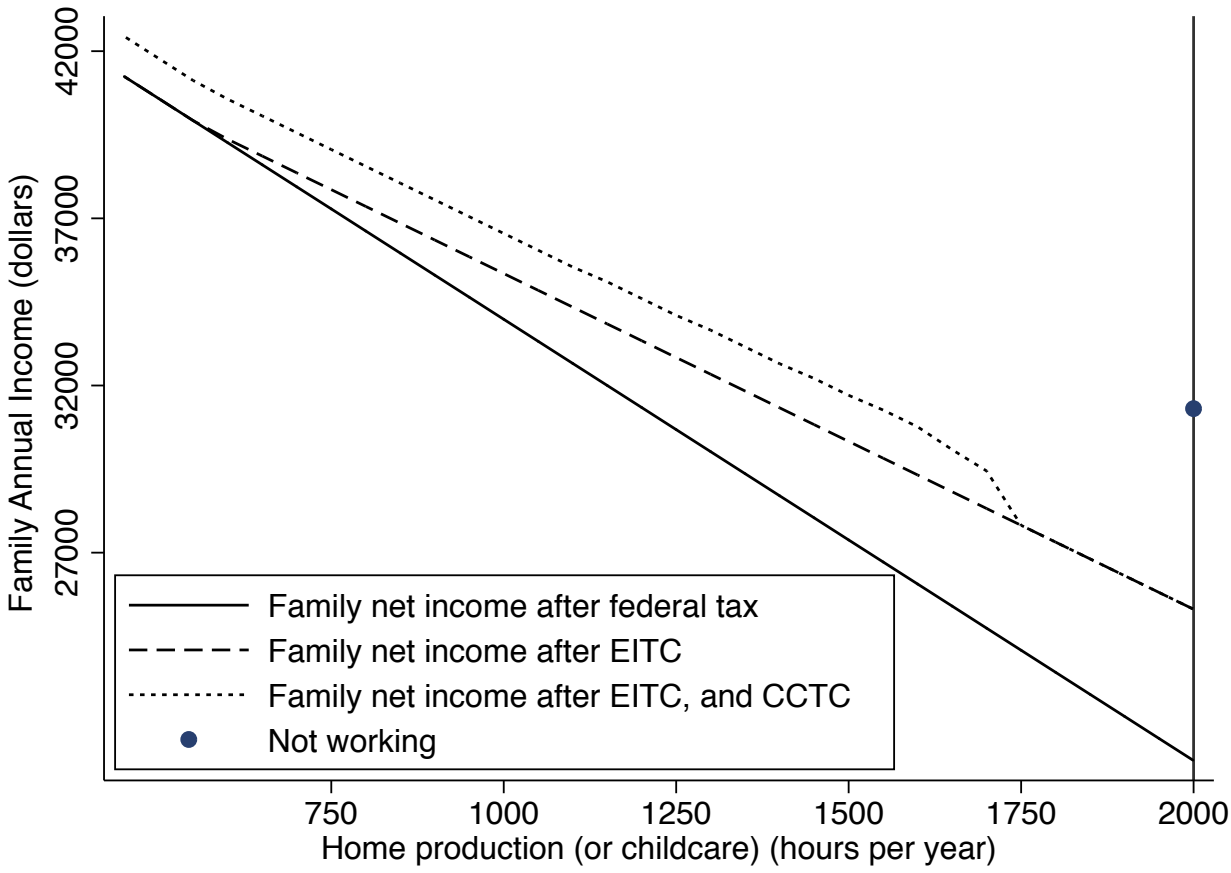

Figure 4: In making this budget line, I assume the following conditions: a married woman with two children under 13 years old and a husband with a full-time job with $30,000 of annual income; childcare costs of $3,000 day per child if wife works; tax rate and credit based on federal income tax regulations of 2018.

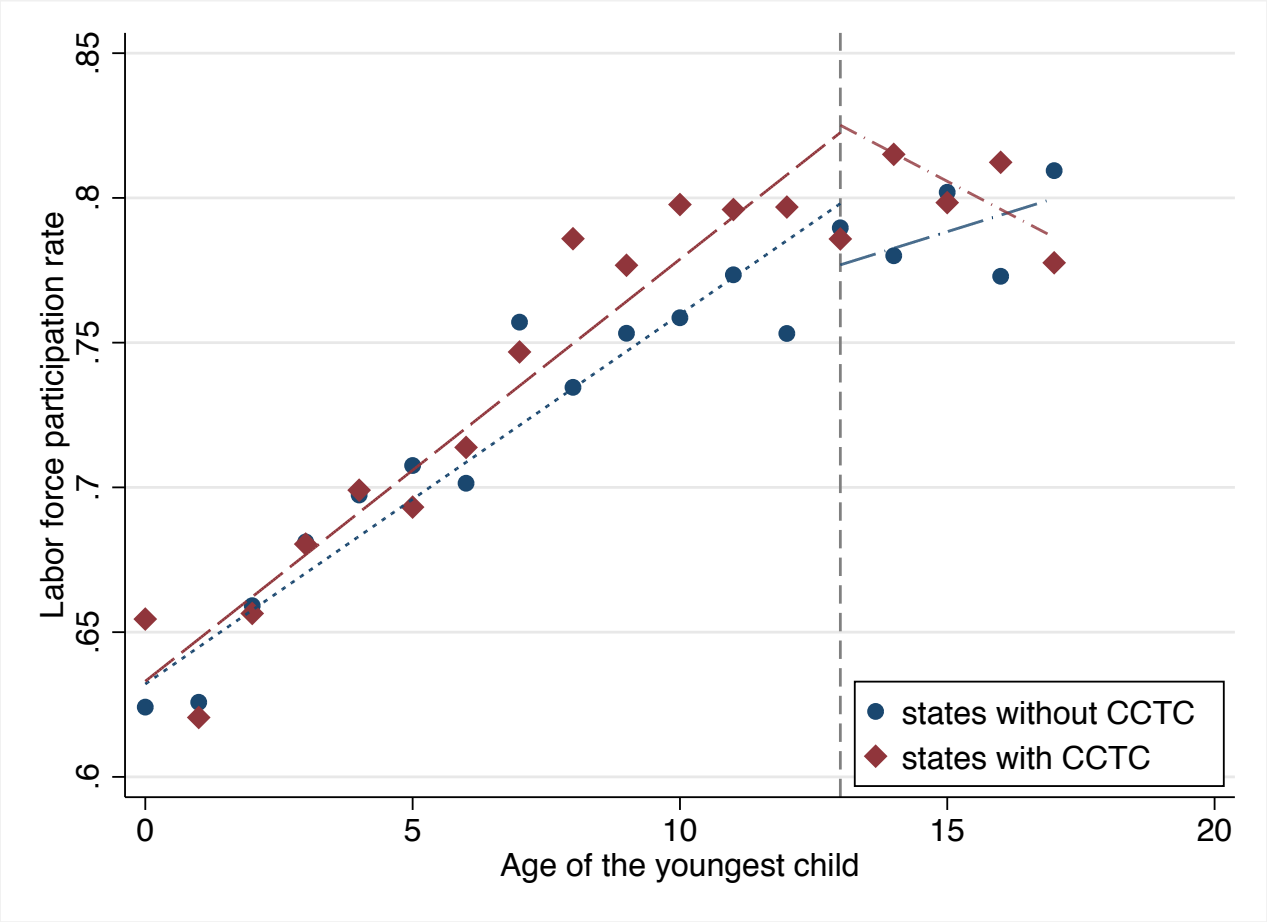

Figure 5: Binscatter plot of the labor force participation and age of the youngest child by states with or without the state-level CCTC. Samples are married women aged 20 to 55 with one to five children from PSID data. Because the legisilation lowered the eligible age of children from under 15 years old to under 13 years old, the samples are restricted to the survey years between 1989 to 2015.

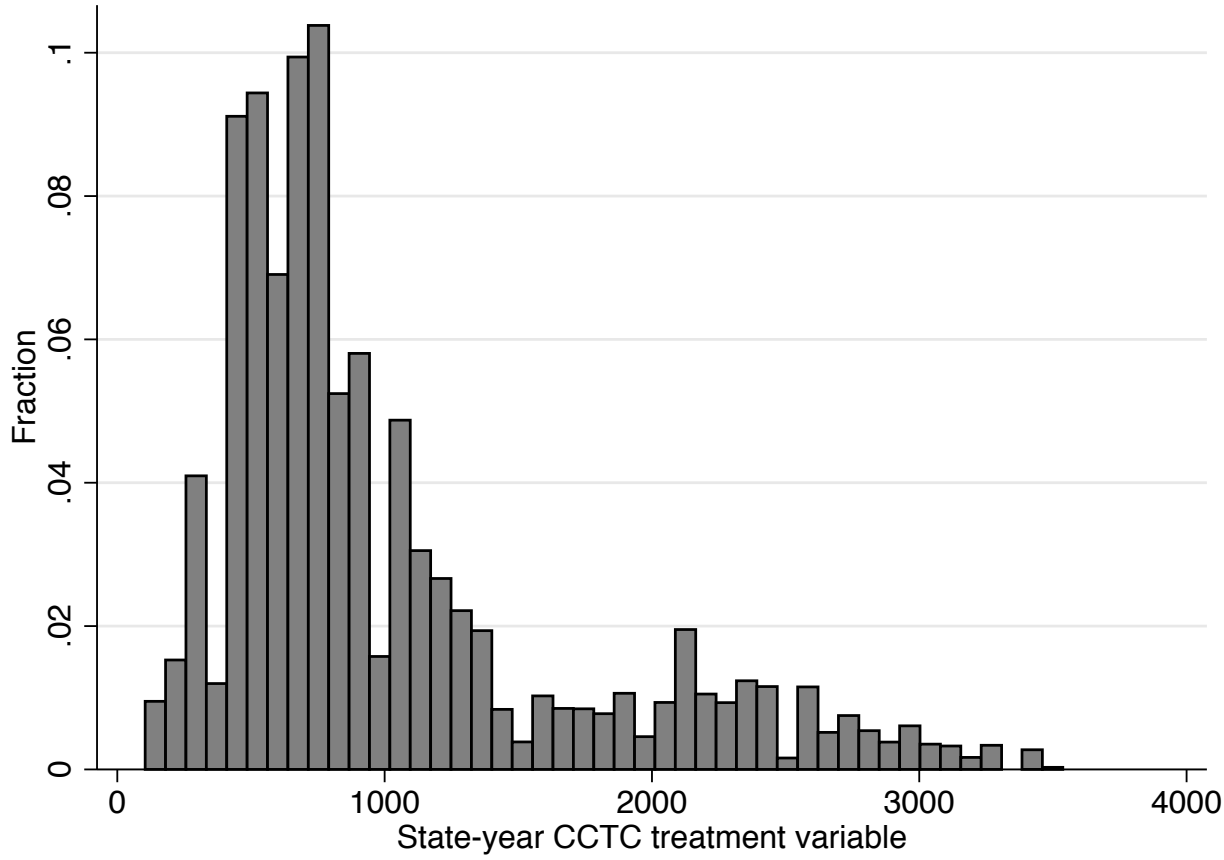

Figure 6: Histogram of the State-Year CCTC Treatment Variable. Samples are from PSID data, all women aged 20 to 55, either a household head or wife of a household head, with one to five eligible children. The value is inflation-adjusted using the 2015 dollar, conditional on a positive number.

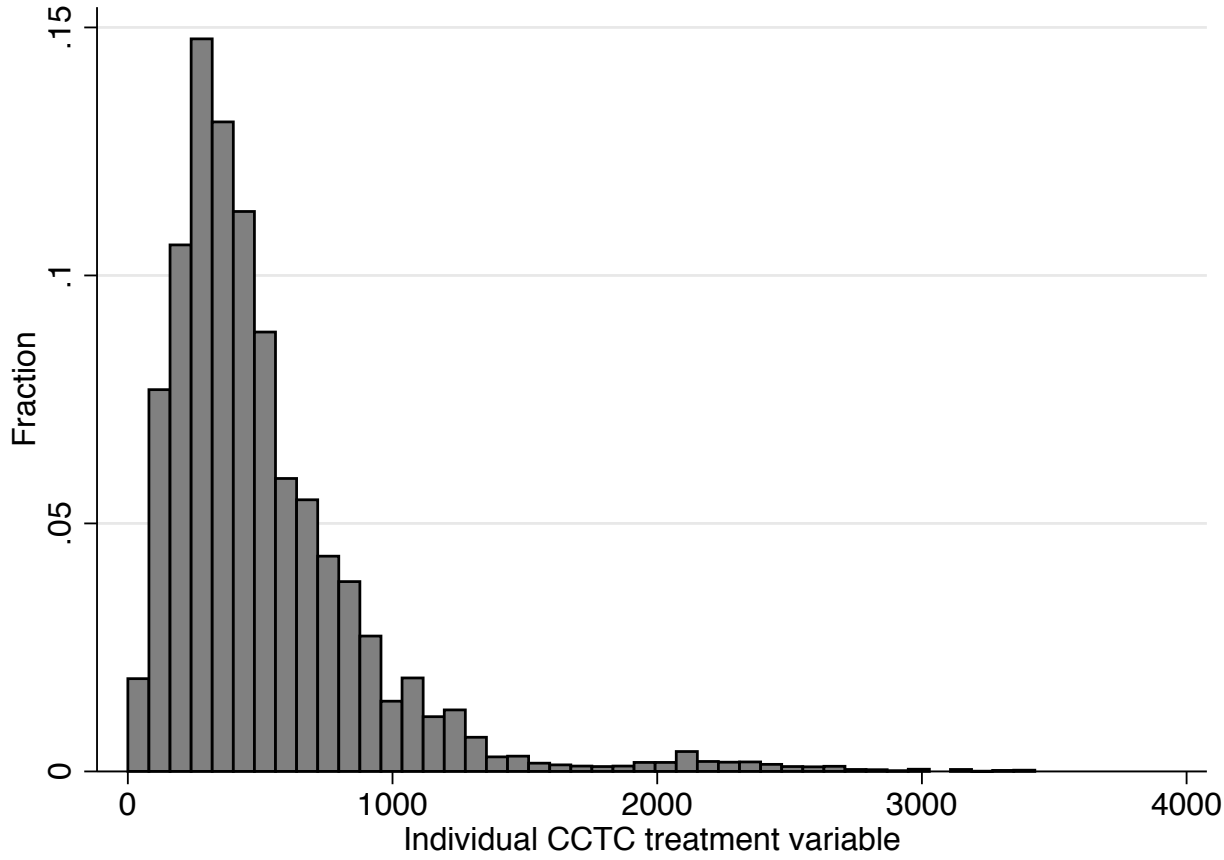

Figure 7: Histogram of the Individual CCTC Treatment Variable. Samples are from PSID data, all women aged 20 to 55, either a household head or wife of a household head, with one to five eligible children. The value is inflation-adjusted using the 2015 dollar, conditional on a positive number.

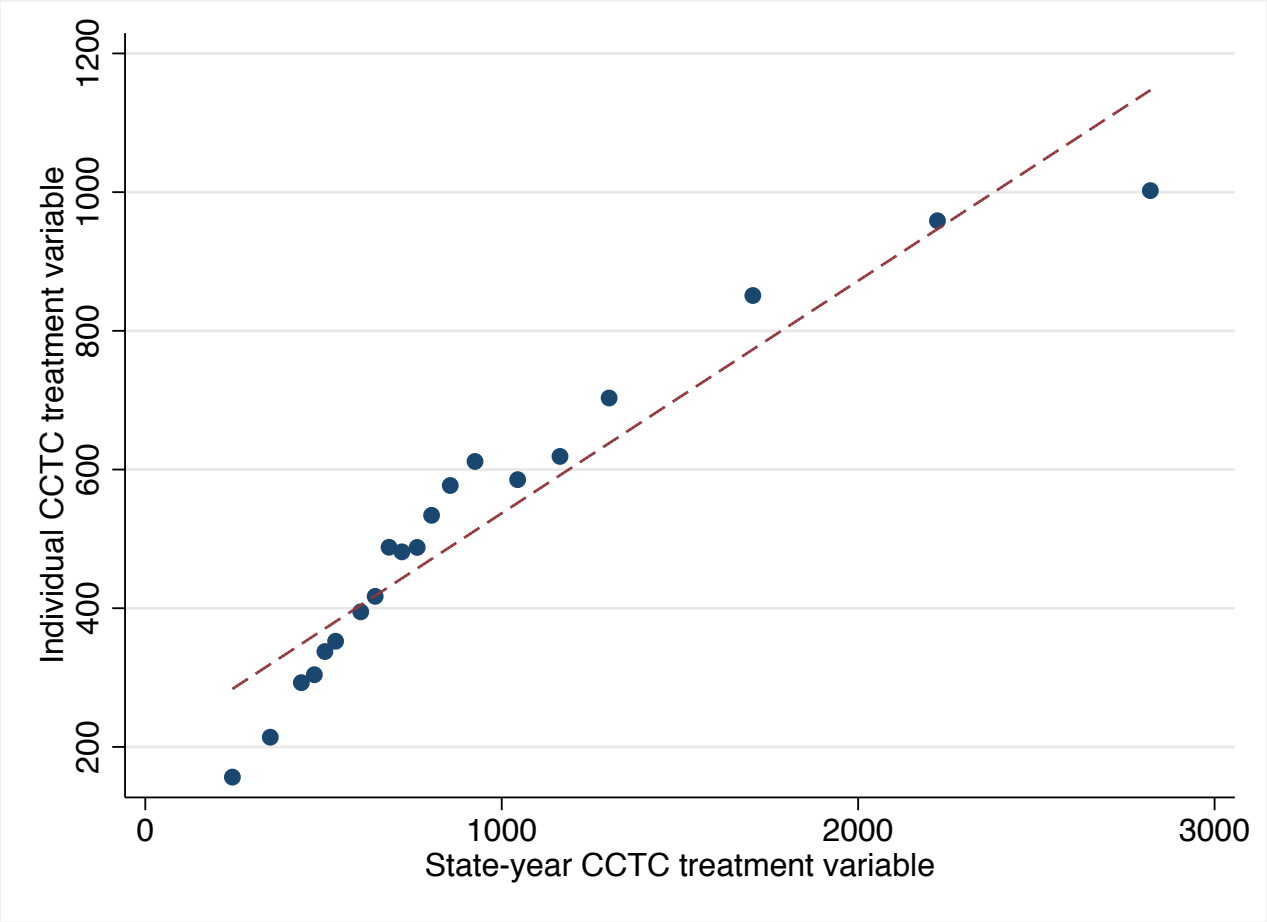

Figure 8: Correlation between the state-year CCTC treatment variable and the individual CCTC treatment variable. Samples are from PSID data, all women aged 20 to 55, either a household head or wife of a household head, with one to five eligible children. The value is inflation-adjusted using the 2015 dollar, conditional on both being positive numbers.

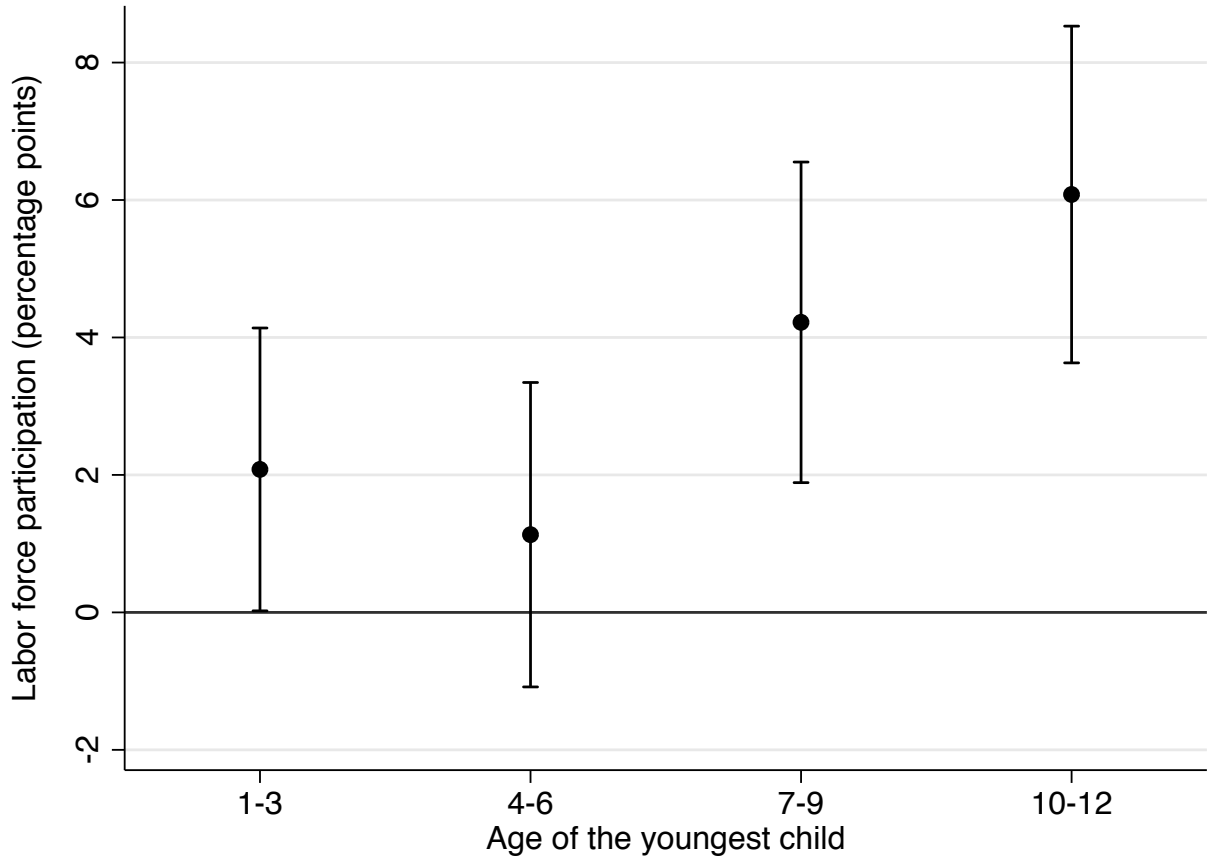

Figure 9: Regression coefficients of the CCTC on the maternal labor force participation by the age of the youngest child using the state-year CCTC treatment variable. Samples are from PSID data, all women aged 20 to 55, either a household head or wife of a household head, with one to five eligible children. The black dots represent the regression coefficients from OLS regressions of the CCTC on the labor force participation rate, using the state-year CCTC treatment variable. All regressions control for age, age squared, years of education, husband's annual income, marital status, number of children, the state-year EITC treatment variable, and the state and year fixed effects. Confidence intervals are at the 95% level. All money terms are inflation adjusted using 2015 price.

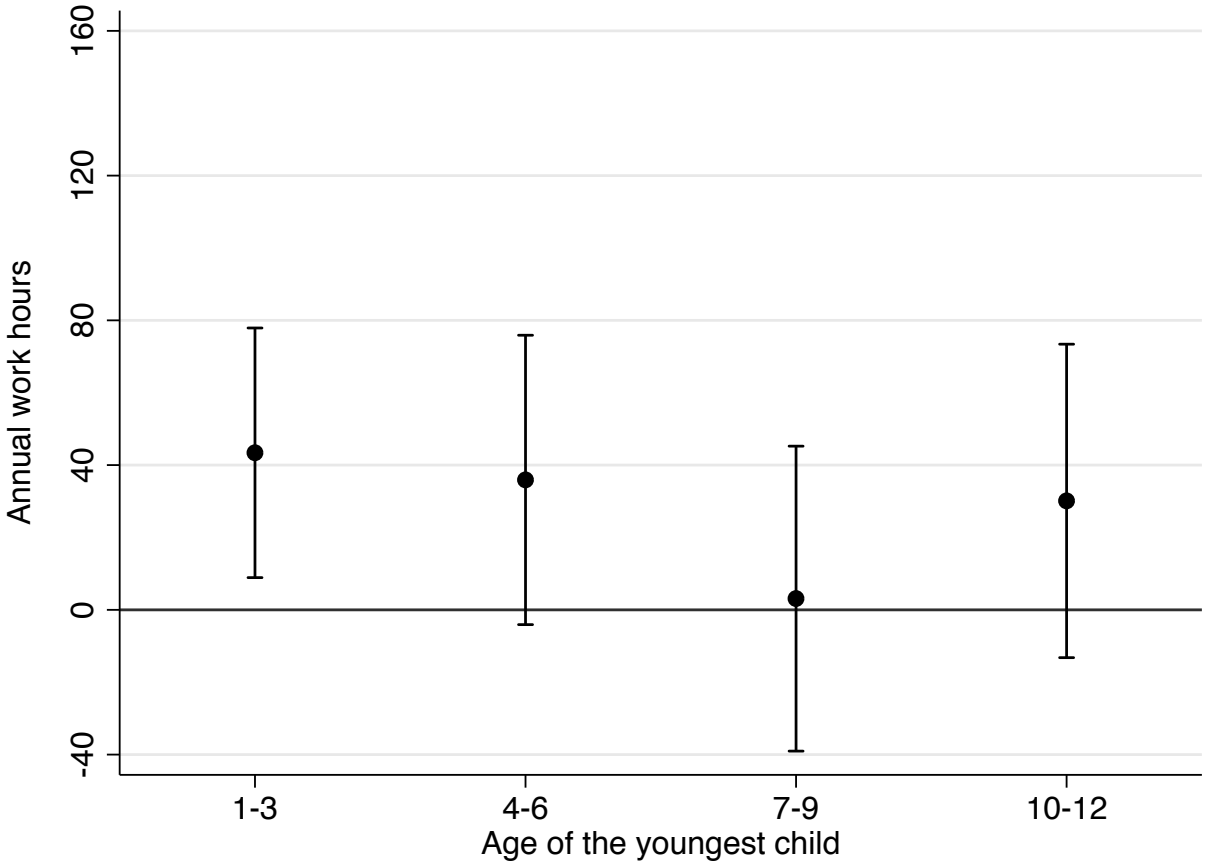

Figure 10: Regression coefficients of the CCTC on annual work hours by age of the youngest child using the state-year CCTC treatment variable conditional on positive hours. Samples are from PSID dataset, all women aged 20 to 55, either a household head or wife of a household head, with one to five eligible children. The black dots represent the regression coefficients from OLS regressions of the CCTC on annual work hours conditional on annual work hours being greater than zero and less than 3000, using the state-year CCTC treatment variable. All regressions control for age, age squared, years of education, husband's annual income, marital status, number of children, the state-year EITC treatment variable, and the state and year fixed effects. The confidence intervals are at 95% level. All money terms are inflation adjusted using 2015 price.

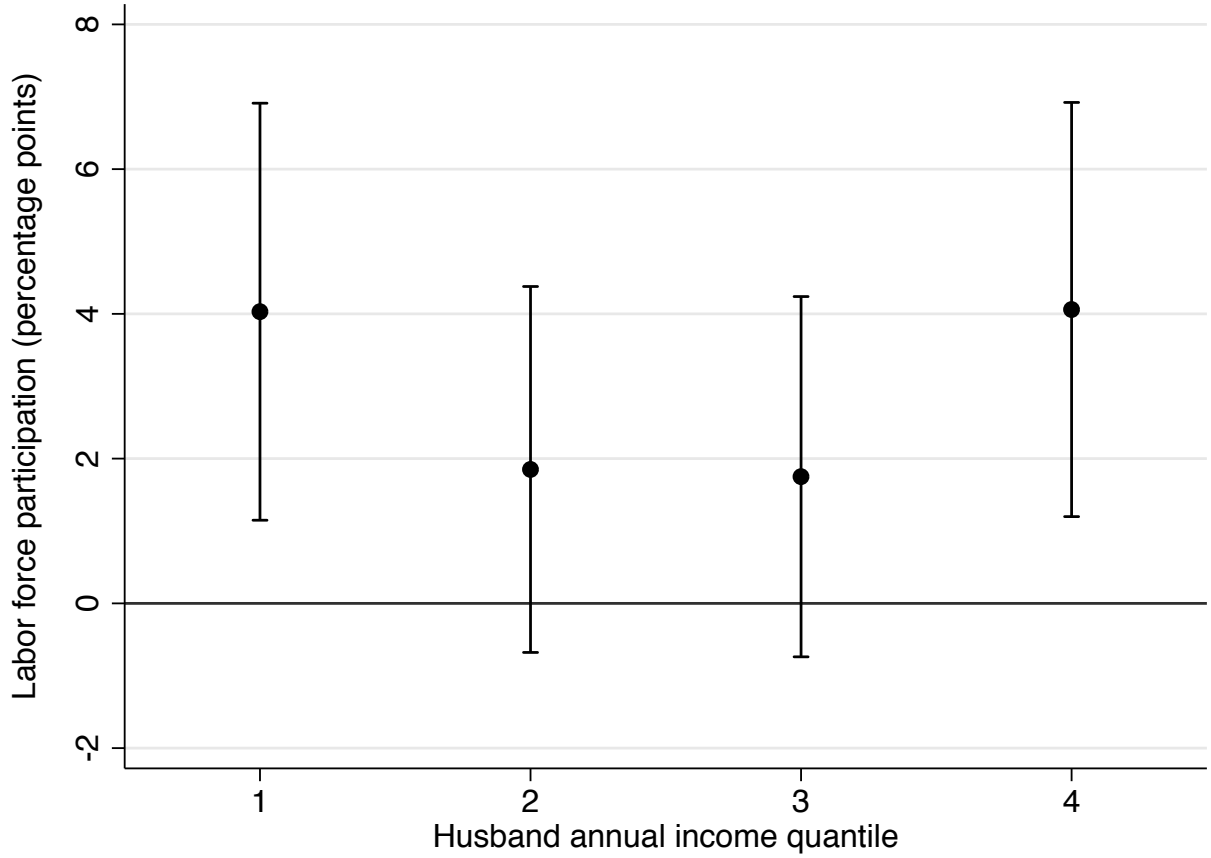

Figure 11: Regression coefficients of the CCTC on the maternal labor force participation by husband's income quantile using the state-year CCTC treatment variable. Samples are from PSID dataset, all married women aged 20 to 55 with one to five eligible children. The black dots represent the regression coefficients from OLS regressions of the CCTC on the labor force participation, using the state-year CCTC treatment variable. All regressions control for age, age squared, years of education, number of children, age of the youngest child, the state-year EITC treatment variable, and the state and year fixed effects. The confidence intervals are at the 95% level. All money terms are inflation adjusted using 2015 price.

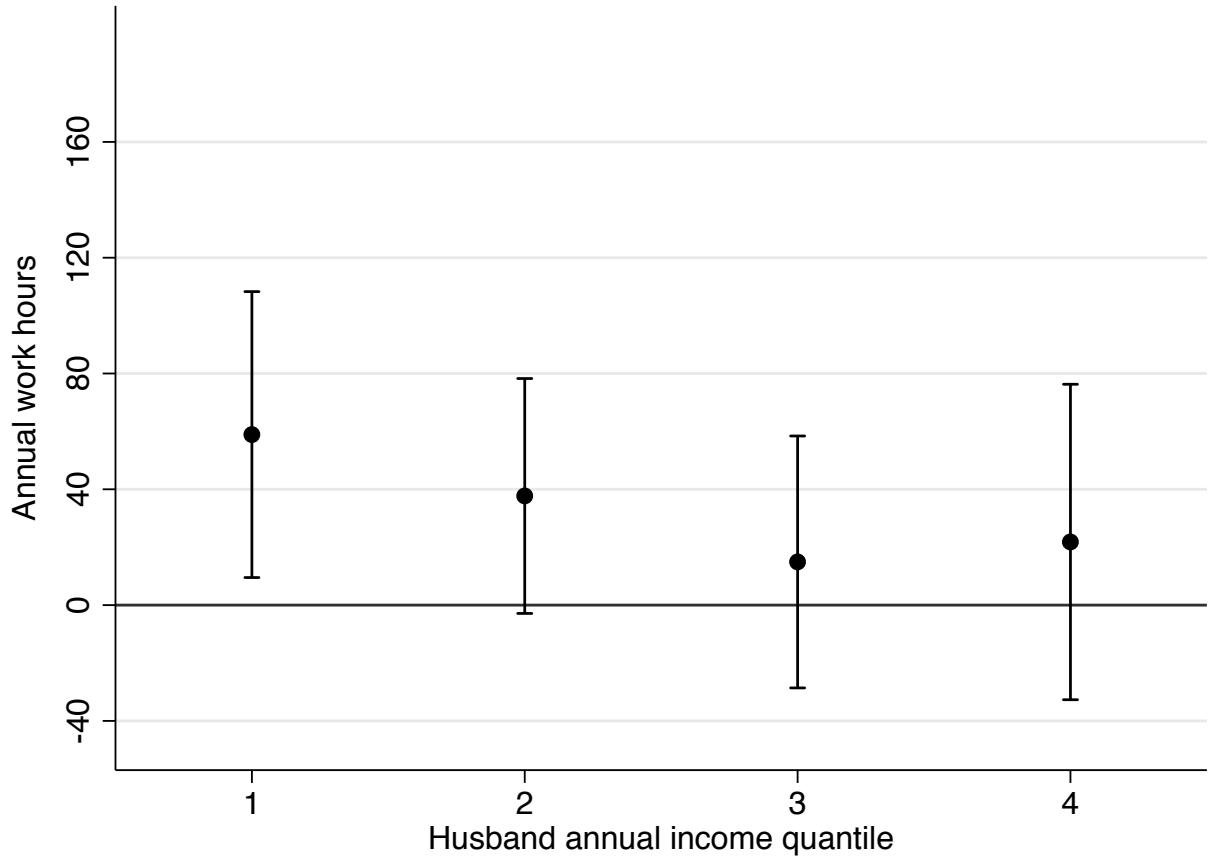

Figure 12: Regression coefficients of the CCTC on LFP by the age of the youngest child using the state-year CCTC treatment variable conditional on positive hours. Samples are from PSID dataset, all married women aged 20 to 55 with one to five eligible children. The black dots represent the regression coefficients from OLS regressions of the CCTC on work hours conditional on work hours being greater than zero and less than 3000, using the state-year CCTC treatment variable. All regressions control for age, age squared, years of education, number of children, age of the youngest child, the state-year EITC treatment variable, and the state and year fixed effects. The confidence intervals are at the 95% level. All money terms are inflation adjusted using 2015 price.

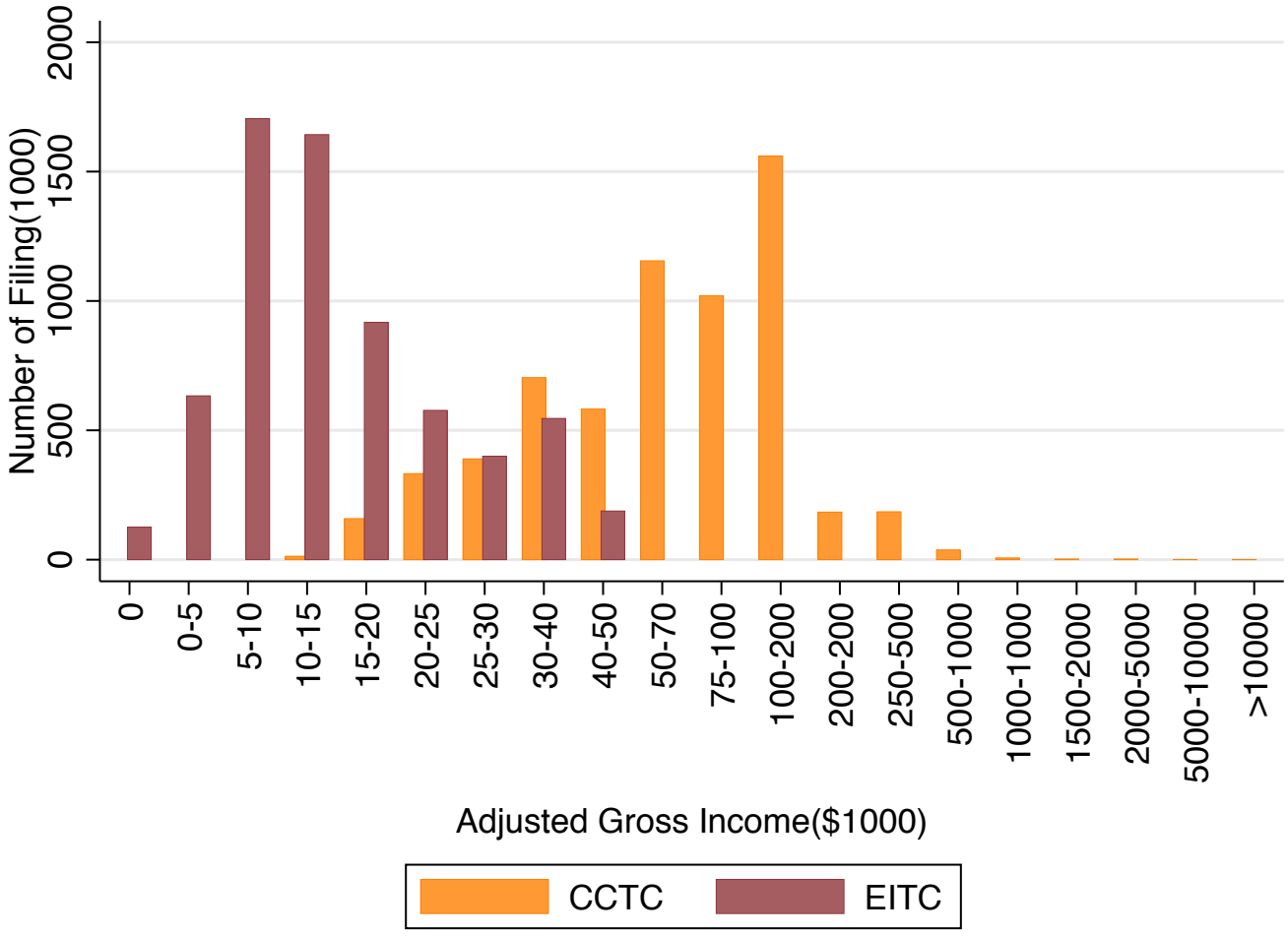

Figure 13: EITC and CCTC: number of filings by family adjusted gross incomes in 2011. Source: IRS, Statistics of Income Division, July 2013.

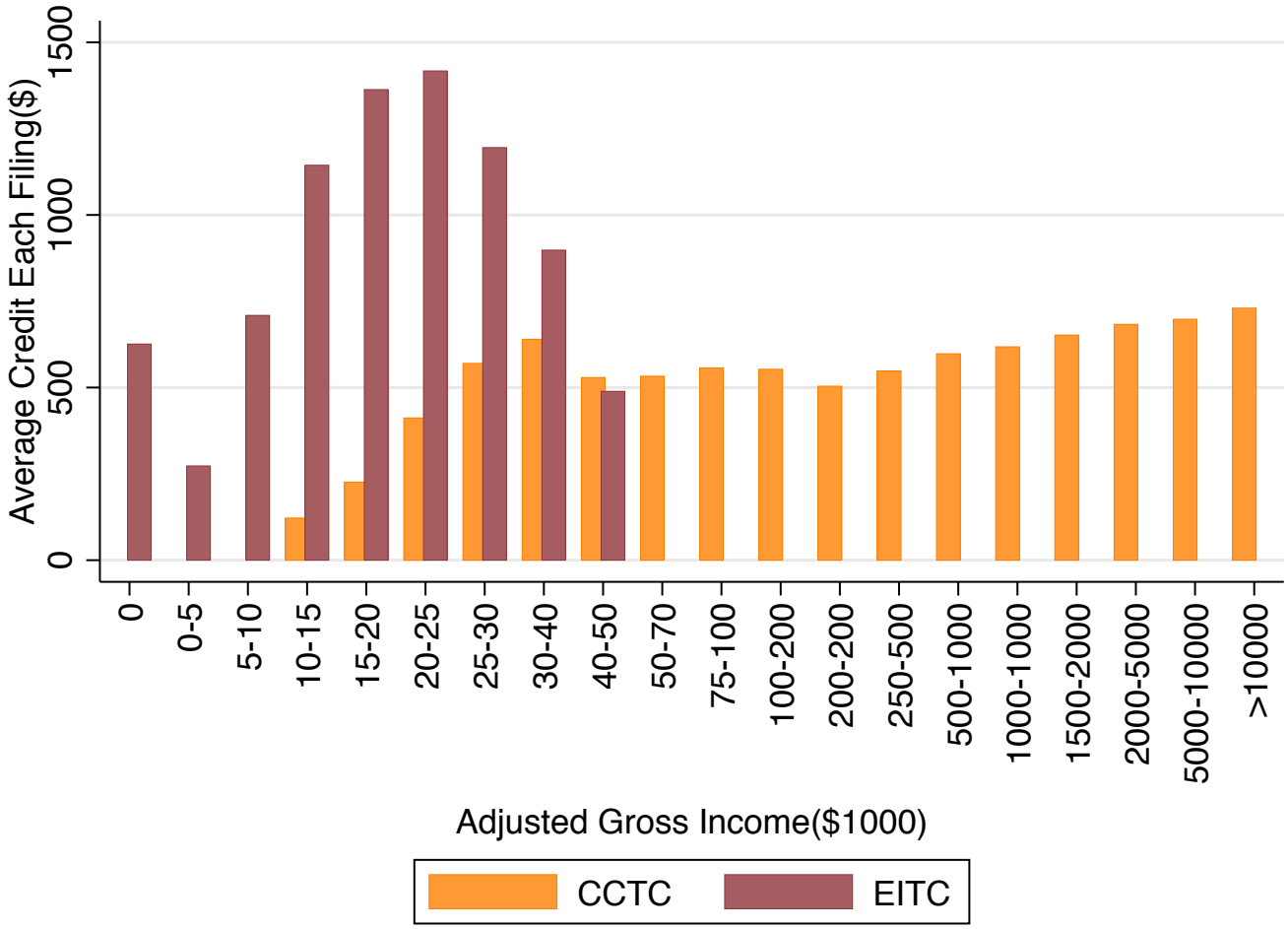

Figure 14: EITC and CCTC: average credit value of each filing by group of family's adjusted gross incomes in 2011. Source: IRS, Statistics of Income Division, July 2013.

Child care related subsidy programs (David Blau 2003)

	Aid to Families with Dependent Children Child care	Transitional Child Care	At-Risk Child Care	Child Care and Development Block Grant	Title XX social Services Block Grant	Head Start	Child and Adult Care Food Program	Title I, Part A of the Elementary and Secondary Education Act
Acronym	AFDC-CC	TCC	ARCC	CCDBG	TXX-CC	HS	CCFP	Title IA
Year began	1988	1988	1990	1990	1975	1965	1968	1965
Eligibility criteria for income	1996, these four programs are consolidated into a single program, the Child Care and Development Fund (CCDF).Family income no more than 85% of SMI, but states can impose a lower income eligibility limit				state choose income level	90% of the enrollees must be below the poverty line. 10% of the slots reserved for disabled children.	Mainly serve low-income children. subsidy amount depends on whether income <130%; 185%; or >185 of poverty line.	School with highest percentage of children from low-income families.
Eligibility criteria for age	<13					0-5		
Eligibility criteria for working	Yes				Yes	No	No	No

Figure 15: Other government programs aimed at families with children. This table is adopted from Table 7.1 of D. Blau (2003).

A The Federal CCTC History

Statute: 26 USCS § 21

- 1976-1981: 20% of the expense up to $2000 for one eligible child, or $4000 for two or more eligible children.

- 1982-2002: Up to 30% of the expense up to $2400 for one eligible child, or $4800 for two or more eligible children; the applicable rate reduces by 1 percent for every $2000 additional family AGI.

Table A1: The Federal CCTC applicable rate and maximum credit, 1982-2002

AGI	**Applicable Rate**	**max 1 child**	**max 2+ children**
$0-$10,000	30%	$720	$1440
$10,001-$12,000	29%	$696	$1392
$12,001-$14,000	28%	$672	$1344
$14,001-$16,000	27%	$648	$1296
$16,001-$18,000	26%	$624	$1248
$18,001-$20,000	25%	$600	$1200
$20,001-$22,000	24%	$576	$1152
$22,001-$24,000	23%	$552	$1104
$24,001-$26,000	22%	$528	$1056
$26,001-$28,000	21%	$504	$1008
$28,001+	20%	$480	$960

- 2003-2015: See Table 1.

B State Statutes of Child Care Tax Credit

"Making Care Less Taxing" of the National Women's Law Center has a list of the state CCTC statutes and some details of the state CCTC for a few recent cross-sectional years (Campbell et al., 2011). Appendix A is adopted from this report.

Table A2: the State CCTC Legislation

state	state child care tax credit legislation
Alaska	Alaska Stat. § 43.20.013
Arkansas	Ark. Code Ann. § 26-51-502
California	Cal. Ann. Rev. & Tax Code § 17052.6
Colorado	Colo. Rev. Stat. § 39-22-119
Delaware	Del. Code Ann. tit. 30, § 1114
District of Columbia	D.C. Code § 47-1806.04(c)
Georgia	Ga. Code Ann. § 48-7-29.10
Hawaii	Haw. Rev. Stat. Ann. § 235-55.6
Iowa	Iowa Code Ann. § 422.12C
Kansas	Kan. Stat. Ann. § 79-32, 111a
Kentucky	Ky. Rev. Stat. Ann. § 141.067
Louisiana	La. Rev. Stat. Ann. § 47:297.4
	La. Rev. Stat. Ann. § 47:6104
	La. Rev. Stat. Ann. § 47:297.2
Maine	Me. Rev. Stat. Ann. tit 36, § 5218

Table A3: the State CCTC Legislation continue

Maryland	Md. Code Ann., Tax-Gen. § 10-716
	Md. Code Ann., Tax-Gen. § 10-208(e)
	Md. Code Ann., Tax-Gen. § 10-207
Minnesota	Minn. Stat. Ann. § 290.067
Nebraska	Neb. Rev. Stat. Ann. § 77-2715.07(2)(a), (b)
New Mexico	N.M. Stat. Ann. § 7-2-18.1
New York	N.Y. Tax Law § 606(c)
North Carolina	N.C. Gen. Stat. § 105-151.11
Ohio	Ohio Rev. Code Ann. § 5747.054
Oklahoma	Okla. Stat. Ann. tit. 68, § 2357(B)(2)
Oregon	ORS 316.078
	ORS 315.262
Rhode Island	R.I. Gen. Laws § 44-30-2.6(K)(2)
South Carolina	S.C. Code Ann. § 12-6-3380
Vermont	Vt. Stat. Ann. tit. 32, § 5822(d)
	Vt. Stat. Ann. tit. 32, § 5811(4)
	Vt. Stat. Ann. tit. 32, § 5828c

C State Child Care Tax Credit Calculation Formula

See On-line appendix.

D The Earned Income Tax Credit (EITC)

The Earned Income Tax Credit (EITC) is a subsidy policy aiming at low-income families. The federal EITC came into effect in 1976. After the enactment of the federal EITC, some states also provided a state-level EITC. The EITC and the CCTC have overlapping benefit recipients and time of effectiveness. However, the EITC has some significant differences from the CCTC. For instance, the EITC does not require the secondary earner of a family, which means that for a married couple, as long as one of the parents has earned income falling into certain income bracket, the family is eligible for EITC. However, EITC phases out entirely after the family income reaches a certain level, while CCTC does not. Also, EITC is refundable. I collect the legislative history of the federal EITC and adopt the state EITC history documented by Shapiro (2019) from National Bureau of Economic Research. I code the state-level EITC and the individual EITC control variables in a similar way as the CCTC treatment variables. See on-line appendix for details.

E Utility Maximization Framework

CCTC changes the incentives faced by the parents, especially the mothers. The results obtained from the analysis of the CCTC reflect a substitution effect for the marginal population.

A mother with young children maximizes her utility function denoted as

$$U_i = U(G_i, C_i, l_i), \tag{8}$$

where G_i is consumption goods, C_i is child outcome, and l_i is leisure. Within the utility

function, the child outcome is produced according to a production function denoted by

$$C_i = C(m_i, d_i, G_i), \tag{9}$$

where m_i is mother's time input on child care, and d_i is purchased time on child care.

The mother is subject to several constraints. Her budget constraint is

$$P_G \cdot G_i + P_d \cdot d_i = W \cdot h_i + E_i, \tag{10}$$

where P_G is the price of the consumption good, P_d is the price of purchased child care, W is the wage, h_i is labor supply, and E_i is non-labor income. The mother's constraint of time allocation is

$$h_i + l_i + m_i = 1. \tag{11}$$

The amount of time necessary for the children to be taken care of differs according to the number and age of her children, available alternative arrangements, etc. The time constraint imposed by the need of children is

$$d_i + m_i = H_i, \tag{12}$$

where H_i is hours necessary for the children to be taken care of.

The utility maximization problem is

$$\begin{aligned} &\underset{\{G,h,m,d,l\}}{\text{Max}} \quad U_i(G_i, C(m_i, d_i, G_i), l_i), \\ &s.t. \qquad\quad P_G \cdot G_i + P_d \cdot d_i = W \cdot h_i + E_i \ , \quad m_i + d_i = H_i \ , \ and \quad h_i + l_i + m_i = 1. \end{aligned}$$

Solving the system for the first order conditions and assuming there are interior solutions yields

$$h_i = F(P_G, P_d, W, E_i, H_i), \tag{13}$$

$$G_i = F(P_G, P_d, W, E_i, H_i), \tag{14}$$

$$d_i = F(P_G, P_d, W, E_i, H_i), \tag{15}$$

$$m_i = F(P_G, P_d, W, E_i, H_i), \tag{16}$$

and

$$l_i = F(P_G, P_d, W, E_i, H_i). \tag{17}$$

Here, the variable of interest is h_i, the maternal labor supply. It is a function of the price of consumption goods, the price of purchased child care, one's own wage rate, non-labor income, and time necessary for the child care. The child care tax credit can come into the system in two ways. It can reflect the change of child care price, or, assuming money is fungible, it can also reflect the change of wage net of the cost of working.

F Summary Statistics for Samples Used to Perform Instrumental Variables Estimation

Table A4: Summary Statistics for the sub-sample with lower family income

	Married	Single
LFP rate(%)	67.8	75.9
	(46.72)	(42.76)
Work Hours	1115.4	1129.3
	(906.13)	(949.40)
Work Hours(1-3000)	1465.3	1527.9
	(687.14)	(691.31)
Age	30.4	30.6
	(6.59)	(6.68)
Years of Education	11.9	12.0
	(3.28)	(2.65)
Husband's annual income($)	27859.8	
	(14544.65)	
Number of Children	2.06	2.06
	(0.98)	(1.02)
State-level CCTC($)	1003.6	940.0
	(682.95)	(615.98)
Individual CCTC($)	504.9	686.4
	(357.38)	(512.14)
State-level EITC($)	916.0	1101.5
	(765.74)	(883.36)
Individual EITC($)	564.3	944.9
	(588.32)	(797.89)
White	54.69%	26.89%
Black	31.53%	63.24%
Latino	12.23%	8.85%
Other Races	1.55%	1.03%
Observations	36,688	22,050

Note: Samples are from PSID 1968-2015 waves, all women aged 20 to 55, either a household head or wife of a household head, and with husband's annual income lower than $50,000. Husband's income, number of children, the CCTC and the EITC are all conditional on positive values. All money terms are inflation adjusted using 2015 price. Standard deviations are in the parentheses.