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

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1 Introduction

The cost of market-provided child care services is an essential factor that affects maternal labor supply (Heckman, 1974; Blau and Robins, 1988; Connelly, 1992; Ribar, 1992; Blau and Robins, 1998). 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] Analysis shows that there were 6.25 million families who claimed $3.47 billion in federal CCTC in 2017 (Ackerman et al., 2016).

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.[3] 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).

Since the enactment of the federal CCTC in 1976, 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.

Previous research either just analyzes the effects of the federal CCTC (Averett et al., 1997), or only examines the effects using snapshots of stages of the childbearing (Michalopoulos et al., 1992; Leibowitz et al., 1992). In this paper, I collect detailed CCTC legislative history and construct precise policy treatment variables to analyze how the CCTC affects maternal labor supply, and which demographic groups are most responsive to the policy.

[1] The 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] 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.

The CCTC legislative history is not documented in an explicit and organized manner because of the complicity of the states tax codes. 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 later version of TAXSIM program of the National Bureau of Economic Research, one can calculate the estimated federal and state-level CCTC (Feenberg and Coutts, 1993). However, since the tax codes are embedded in the TAXSIM program, the detailed information about the CCTC policy in different states and the variation overtime is not obvious. Therefore, in order to obtain a better observation and understanding of the CCTC policy, I document the legislative history of the federal and state-level CCTC and construct a comprehensive panel data set for the policy variation from 1976 to 2015.

Using the CCTC policy variation generated by the exogenous law changes and focusing on women from the Panel Study of Income Dynamics (PSID), I estimate the effects of the CCTC on maternal labor supply. The challenge is that the CCTC changes the entire budget constraint faced by a woman. Facing the new budget constraint, 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 the labor supply of women living in states or years with different CCTC generosities.

The pooled ordinary least squares (OLS) estimation shows that, on average, a $1000 increase in the CCTC increases the maternal labor force participation rate by four percentage points. 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 deal with the potential challenge faced by differences-in-differences design, I include women without CCTC eligible children as the

[4] I describe the details of the policy in the following sections

control group and carry out a triple-differences analysis. The results from using triple-differences analysis show that the CCTC only has a significant impact on the labor force participation of women with CCTC eligible children, a $1000 increase in the CCTC increases maternal labor force participation rate by two percentage points. It is evident that the effects of the CCTC is not merely a reflection of a common trend.

Comparing the effects of the CCTC by subgroups generated by the age of the youngest child, I find that the effects of the CCTC on maternal labor force participation are more pronounced in mothers with older eligible children. Also, among subgroups of married women generated by the husband's income quintile, women whose husbands are in the top income quintile are relatively more responsive to the CCTC by joining the labor market.

Conditional on being in the labor force, the effects of the CCTC on working hours are small in most specifications. The pooled OLS estimation shows that a $1000 increase in the CCTC increases annual work hour by 40. The triple-differences estimation shows that a $1000 increase in the CCTC increases annual work hour by 28 for women with CCTC eligible children.

To incorporate the multi-dimensional policy variation generated by the federal and 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 5.5 percentage points. Incorporating individual fixed effects reduces the magnitude of the treatment effect to 3.6 percentage points.

However, the measurement of the individual CCTC treatment variable is based on the maximum allowable 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 seven 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 93 hours. The effects are also mainly pronounced in married mothers.

This study add to the literature on impact of the CCTC policy on maternal labor supply. Michalopoulos et al. (1992) use the 1984 wave of Survey of Income and Program Participation and simulate child care expenses and mothers' labor supply and child care expenditure 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. However, they only use cross-sectional data and cross-sectional variation of the state CCTC documented by Blau (1991), without using the variation overtime. The estimates obtained from using cross-sectional variation may suffer from the confounding effects of many other co-existing state-level policies.

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. Since they only look at two snapshots in the life time, it is not clear how mothers respond to the CCTC when they have more children and when their children are older.

Averett et al. (1997) use the 1986 wave of the National Longitudinal Survey of Youth 1979 to estimate the kinked budget constraint generated only 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. 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 in-

creases the female labor force participation, an effect that is significant mainly for lower-skilled women. However, since a few states have very generous state-level CCTC in some years, not incorporating the state-level CCTC leads to biased estimates.

Some studies examine the effects 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 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.

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,

[5] Among the twenty-five states provided a state level CCTC, Alaska, California, Colorado, Hawaii, Iowa, Louisiana, Maine, Minnesota, Nebraska, New Mexico, New York, and Vermont 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 from the federal CCTC.

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 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.

Table 1: The Federal CCTC Applicable Rate and the Maximum Benefit

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

Appendix A 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 Washington D.C. offered a state CCTC.[7] Another four states offered a tax deductions for child care expenses.[8] Figure 2 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 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

[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 states only providing a child care tax deduction policy.

[9] For example, a two-child family in Georgia with AGI $14,000 can claim $630 ($2,100 \times$

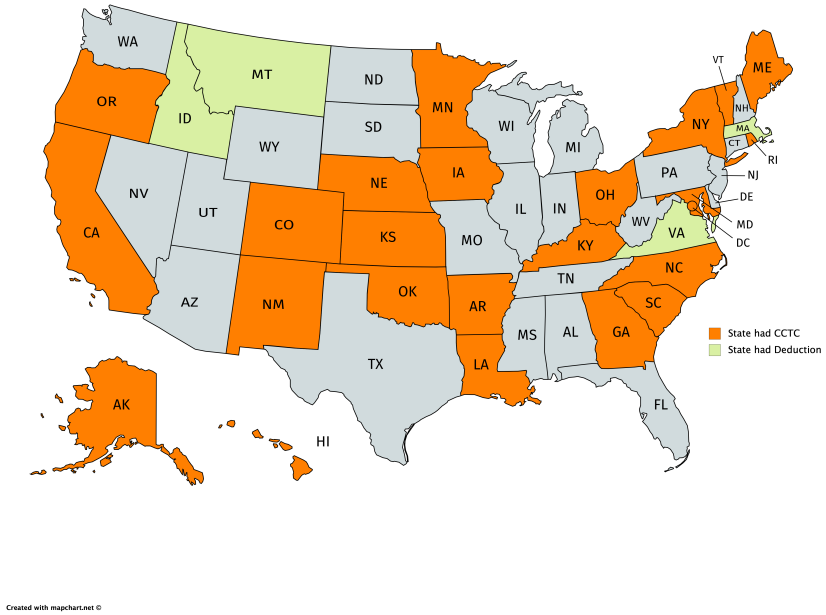

Figure 1: States Had Child Care Tax Credit Policies.

match-up rates according to the family income.[10] 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.

I collect and explicitly 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.[11] 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 effects of the CCTC on maternal labor supply thoroughly and rigorously.

The Earned Income Tax Credit (EITC) is another subsidy policy that mainly assistants low-income families. In order to deal with the potential

30% = \$630) of the state CCTC if the earned income of any parent is higher than \$6000.

[10] There are 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.

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

confounding effects of the EITC, I collect the legislative history of the federal EITC and adopt the state EITC history documented by Shapiro (2019) from the National Bureau of Economic Research. I discuss the details of the information used to calculate the EITC in Appendices D and E.

3 Theoretical Framework

The CCTC changes the budget constraint faced by women with young children. To illustrate the effects of the CCTC (and the EITC) on a woman's budget constraint, I create the following scenario. I assume a married woman who has two children under thirteen years old. Her husband works full-time and has an annual income of $30,000.[12] 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).[13] 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 3, the horizontal axis represents the hours allocated on home production, the opposite of which is the hours of labor supply; the vertical axis represent 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 has any 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 to the right end represents the family's after-tax income when the wife does not work. This income includes a refund from the EITC.

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

[12] 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.

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

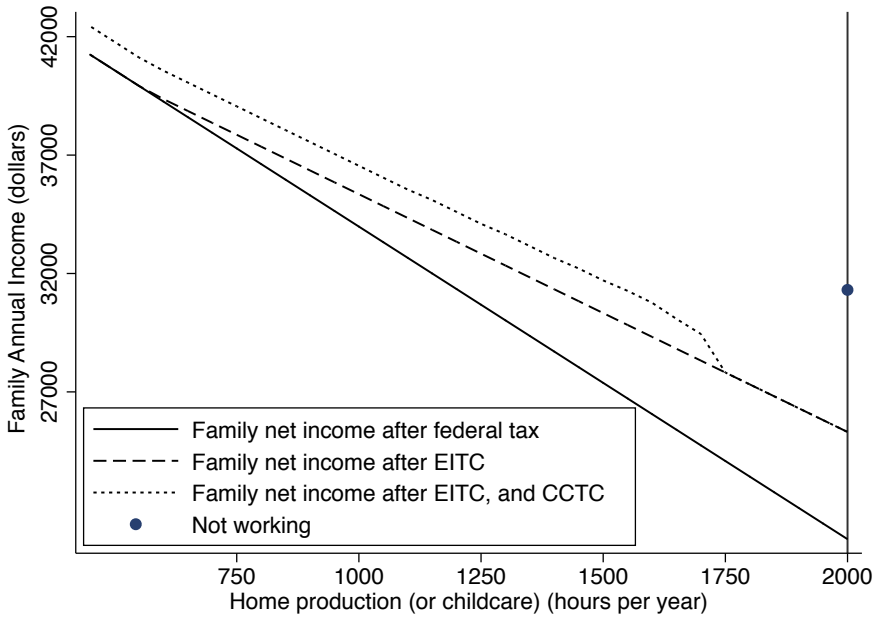

Figure 2: Imaginary Budget Constraint

Notes: 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.

after paying for child care services and after federal income taxes according to the time allocation of the woman. The dashed line in Figure 3 represents the family income after paying for child care services and after federal income taxes and the 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. As the woman supply more work hours, the EITC phases out completely.

The federal 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 3 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 the 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.[14] Without the CCTC, it is possible that the woman finds 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

The CCTC changes the budget constraint faced by women with young children. Consequently, the shift of the budget constraint introduces challenges for identification. The actual CCTC benefit received by a woman is endogenous. First, it is a joint decision for a mother to work more hours and to purchase more child care services.[15] Second, the mother's income and purchased child

[14] 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.

[15] In reality, families can use child care from other family members or friends, but unpaid informal care are not eligible for claiming the CCTC.

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. First, I use the variation of the state CCTC adoption and adjustment in generosity to construct a state-level CCTC treatment variable measured at the maximum level and perform a differences-in-differences analysis with treatment intensity. Second, I 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.

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 effects of the federal CCTC are 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.

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 immediately after the enactment of the federal CCTC.[16] Georgia is the most recent state to adopt the policy, creating its own CCTC in 2006 (restricting the cases to before 2016). The variation in the timing of the CCTC enactment offers the first opportunity for identification. The implementation of a state CCTC provides additional incentives for mothers to enter the labor force. All other things

[16]The earliest states that enacted the CCTC are Arkansas, California, Hawaii, Iowa, Kansas, Minnesota, New York, Oklahoma, Oregon, Vermont, and Washington D.C.

equal, women with CCTC eligible children living in states that allow the state CCTC are more likely to participate in the labor market compared to women living in states that do not allow the state CCTC.

Among states offering a CCTC, some states seldom change their CCTC regulations, while others adjust their CCTC regulations frequently. Additionally, some states offer more CCTC benefits than others. 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 bracket. On the other hand, Iowa matched the federal CCTC by as low as 5% when it first adopted its state CCTC.

The variation in the generosity of the policy across states and over time provides more power for identification. 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 be incentivized to join the labor force when compared to 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 in general.

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

$$Y_{ist} = \beta_0 + \beta_1 maxCCTC_{st} + \beta_2 X_{ist} + \beta_3 maxEITC_{st} + \lambda_s + \delta_t + \xi_i + \epsilon_{ist}, \quad (3)$$

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 effects 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 timing of the CCTC adoption or adjustment in generosity, and therefore affect the maternal labor supply at the same time, for example, stigma towards working mothers. 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 individuals in a state-year cell, it has different impacts on different demographic groups. If the enactment of the state CCTC and the following adjustment in the generosity can affect the female labor supply, it can only affect 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 empirical model for the triple-differences analysis is

$$\begin{aligned} Y_{ist} = \pi_0 + \pi_1\ maxCCTC_{st} + \pi_2\ eligible_{ist} + \pi_3\ maxCCTC_{st} \cdot eligible_{ist} \\ + \pi_4\ X_{ist} + \pi_5\ X_{ist} \cdot eligible_{ist} + +\pi_6\ EITC_{st} + \pi_7\ EITC_{st} \cdot eligible_{ist} \\ + \lambda_s + \pi_8\ \lambda_s \cdot eligible_{ist} + \delta_t + \pi_9\ \delta_t \cdot eligible_{ist} + \xi_i + \epsilon_{ist}, \end{aligned} \tag{4}$$

where $eligible_{ist}$ is a dummy variable indicating that individual i in state s and year t has at least one CCTC eligible child . 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 relatively coarse proxy for the CCTC treatment, because 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 in some cases, such regulations frequently change over time. As a result, the maximum state-level CCTC is not relevant for some 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 more 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 potential benefit received from the state CCTC by 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 state CCTC treatment intensity.

4.2.1 Identification Strategy

The empirical model using the individual CCTC treatment variation is

$$Y_{ist} = \gamma_0 + \gamma_1\, maxCCTC_{ist} + \gamma_2\, Z_{ist} + \gamma_3\, maxEITC_{ist} + \zeta_s + \eta_t + \theta_i + \mu_{ist}. \quad (5)$$

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 used to calculate the CCTC (which takes the value zero, one, or two), because it is an element that both decides the treatment intensity and the labor supply at the same time. The covariate $maxEITC_{ist}$ represents the maximum individual ETIC that is applicable to woman i in state s and year t.[17] 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 effects of the individual CCTC treatment variable on maternal labor supply.

The calculation of the individual CCTC treatment variable follows the function

$$maxCCTC_{ist} = f_{st}(E_i, N_i), \quad (6)$$

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

[17] The construction of the individual EITC treatment variable follows the similar way as that of the individual CCTC treatment variable. The detailed information about EITC treatment variable can be found in Appendices D and E.

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).

4.2.2 Identification Assumptions

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 individual state CCTC treatment variable will be quite different from what they can receive. However, in this case, the treatment effect will be biased towards zero. Furthermore, the marginal women who are indifferent between working or staying at home contribute to the identification the most. 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.

The construction of the individual CCTC treatment variable is also based on the assumption that the husband's income are exogenous for married women, which is widely used in the literature (Mroz, 1987; Michalopoulos et al., 1992; Van der Klaauw, 1996; Francesconi, 2002). 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.

Another assumption is that people do not choose the number of CCTC eligible children, which is plausible because the design of the CCTC makes it unlikely to affect 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.[18]

Another challenge involved in the individual CCTC treatment variable is that the individual CCTC treatment variable is defined at the individual maximum level, which 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. In addition, even controlling for husband's income, number of CCTC eligible 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. Some women's fertility decisions and timing may be related to the availability of the help they expect to receive from their parents or other family members. Some of the factors are relatively hard to

[18] I test the effects of the state CCTC on the number of children and number of CCTC eligible children, none of them are associated with the treatment of the CCTC.

control for. 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 is the maximum CCTC a state allows, reflecting the generosity of a state in providing CCTC in general. Being exposed to certain level of state-level CCTC does not directly affect the labor supply of women. 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), 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 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 adjusts 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 for some income groups (usually the low-income families) and 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 sample.

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 husbands are in the higher income groups. To deal with the problem caused by the potential existence of the defiers, I restrict my sample used to perform the IV analysis to married women whose husbands have an income below the median level in the given year. 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.

5 Data

The samples used in this paper are from the Panel Study of Income Dynamics (PSID).[19] 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.[20]

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 a household head or the wife of the household head 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 and triple-differences analysis. The information about the labor market and family structure is useful for examining the effects of the CCTC on labor supply decisions. I include female observations from all 50 U.S. states and Washington 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

[19] The Panel Study of Income Dynamics, public use dataset. Produced and distributed by the Survey Research Center, Institute for Social Research, University of Michigan, Ann Arbor, MI (2015). (The Panel Study of Income Dynamics, 2015)

[20] 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).

women who have five or fewer 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 main sample with at least one CCTC eligible children by marital status. LFP is a dummy variable denoting whether a woman is in the labor market. I assign one to the variable if someone reports positive work hours, and zero otherwise. Using this criteria, I obtain a consistent measurement for the labor force participation through out the survey years. The LFP for the married women is 70%, and the LFP for the single women is 76%. Conditional on being in the labor market, the number of annual work hours is 1451 and 1578 for married and single women respectively. On average the married women are 32 years old, while the single women are 31 years old. The married women have 12.45 years of education, which is 0.38 years more than the single mothers. For married women, the average husband's annual income (in 2015 dollars) is $55,000 (conditional on the husband having income). The average number of children is around 2.27 for married mothers and 2.33 for single. The racial composition is quite different. The single women are more likely to be black compared with married mothers. The mean value of the state-level CCTC measured at the maximum level is around $1000. The mean value of the state-level EITC is about the same range. The mean value of the state CCTC measured at the individual maximum level is smaller.

In Appendix F, Figure F.1 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 the state CCTC is on average higher than that of the states or years that do not provide the state CCTC. Right after the cut-off age, the labor force participation rates of the two groups converge together. In Appendix F, Figure F.2 shows the distribution of the state-level CCTC treatment variable, and Figure F.3 shows the distribution of the individual CCTC treatment variable. Figure F.4 shows the correlation between the state-level CCTC treatment variable

Table 2: Summary Statistics

	Single			Married		
VARIABLES	Observations	Mean	Std. Dev.	Observations	Mean	Std. Dev.
Labor Force Participation	21,970	0.760		68,851	0.702	
Annual Work Hour	16,690	1,578	747.0	48,325	1,451	738.1
Age	21,970	31.12	6.835	68,851	31.98	6.736
Years of Education	21,970	12.07	2.399	68,851	12.45	3.262
Number of Children	21,970	2.333	1.149	68,851	2.270	1.061
Husband's Annual Income ($)				65,663	55,025	54,085
Age of the Youngest Child	21,970	6.025	3.902	68,851	4.961	3.968
White	21,970	0.291		68,851	0.669	
Black	21,970	0.654		68,851	0.254	
Latino	21,970	0.0402		68,851	0.0504	
Other Races	21,970	0.0131		68,851	0.0202	
State CCTC ($)	5,926	931.7	608.4	19,172	1,020	692.2
Individual CCTC ($)	5,770	679.9	508.6	14,864	451.4	321.0
State EITC ($)	2,507	1,115	895.4	7,208	961.2	759.7
Individual EITC ($)	2,507	1,008	835.2	3,206	581.2	612.7

Notes: Samples are from the 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.

and the individual CCTC treatment variable for the sample used in the IV estimation.

6 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 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 0.04, 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 4 percentage points. [21]

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 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. 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 effects of the CCTC are 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) for the interaction between the state CCTC treatment variable and dummy variable indicating eligibility. The result shows that a $1000 increase in CCTC increases the labor force participation rate by 2.1 percentage points only for women with CCTC eligible children.

[21] The treatment unit of the CCTC (and EITC) is normalized to $1000 because the magnitude of $1000 is about the mean value of the state-level CCTC treatment variable and the state-level EITC 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 the state-level treatment variable.

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

	With Eligible Children				No Eligible Children		All
	(1) All Women	(2) All Women	(3) Married Women	(4) Single Women	(5) Older Children	(6) No Children	(7) Triple-Differences
State CCTC	0.040	0.021	0.023	0.014	0.004	-0.000	-0.000
	(0.007)	(0.007)	(0.008)	(0.014)	(0.014)	(0.010)	(0.006)
State EITC	0.011	0.018	0.012	0.038	0.004	0.005	0.008
	(0.008)	(0.008)	(0.010)	(0.017)	(0.014)	(0.010)	(0.007)
Eligible×*State CCTC*							0.021
							(0.007)
Observations	90,821	90,821	68,851	21,327	19,327	53,258	163,406
R-squared	0.092	0.039	0.041	0.024	0.018	0.010	0.044
Individual FE	No	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of ID		11,388	9,857	4,353	6,088	9,723	18,771

Notes: Samples are from the 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 CCTC eligible children; column 3 and column 4 include married and single mothers respectively; column 5 includes women with children older than the CCTC eligible age; and column 6 includes women with no children; column 7 pools all the sample together. The dependent variable in all specifications is labor force participation. 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 are within R^2 except for column 1.

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 effects 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. With the same controls as in Table 3, column 1 shows that a $1000 increase in CCTC increases annual work hours by 40. Column 2 adds control for individual fixed effects, and the effects of the CCTC are 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-differences method. It shows that conditional on being in the labor force, a $1000 increase in the CCTC increases the annual work hours by 28.

Table 4: The state CCTC on Maternal Annual Work Hours Conditional on Working

	With Eligible Children				No Eligible Children		All
	(1) All Women	(2) All Women	(3) Married Women	(4) Single Women	(5) Older Children	(6) No Children	(7) Triple-Differences
State CCTC	40.080	25.088	26.638	3.815	18.544	19.957	16.573
	(12.372)	(14.128)	(16.291)	(30.828)	(29.663)	(19.142)	(12.757)
State EITC	16.471	18.215	-6.119	63.788	47.493	-5.580	-12.827
	(14.116)	(16.968)	(18.296)	(40.329)	(34.472)	(22.809)	(14.625)
Eligible×$StateCCTC$							27.784
							(13.314)
Observations	65,015	65,015	48,325	16,690	15,402	39,289	119,706
R-squared	0.095	0.073	0.070	0.059	0.022	0.032	0.089
Individual FE	No	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of ID		10,262	8,739	3,956	5,201	8,248	16,296

Notes: Samples are from the 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 CCTC eligible children; column 3 and column 4 include married and single mothers respectively; column 5 includes women with children older than the CCTC eligible age; and column 6 includes women with no children; column 7 pools all the sample together. The dependent variable in all specifications is annual work hours. 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 are within R^2 except for column 1.

6.2 Individual CCTC Treatment Variable

This subsection reports the estimation results using the individual CCTC treatment variable. I first apply the method to examine the effects on labor force participation rates, and Table 5 shows the results. The controls are the same as 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 (whick takes the value of zero, one, or two) 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 5.5 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 some of the variation.

Table 5: Individual CCTC Treatment on Labor Force Participation

	(1) All Women OLS	(2) All Women Panel	(3) All Women IV	(4) Married Women IV	(5) Single Women IV
Individual CCTC	0.055	0.036	0.070	0.095	0.047
	(0.010)	(0.010)	(0.018)	(0.030)	(0.018)
Individual EITC	0.017	0.030	0.013	-0.013	0.037
	(0.011)	(0.012)	(0.013)	(0.021)	(0.017)
Observations	56,659	56,659	56,659	34,689	21,970
Individual FE	No	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
F-test	19.79	9.030	19.71	122.6	11.75

Notes: Samples are from the 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 with CCTC eligible children; in column 4 and 5, samples are divided into married and single mothers. The dependent variable in all specifications is labor force participation. 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 measured at the state maximum level. 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.

The state-level CCTC and the state-level EITC treatment variables are exogenous and work as the instrumental variables for the individual CCTC and the individual EITC treatment variables. Column 3 of Table 5 reports results for instrumental variables 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 7 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 F.1 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 6 show that the individual CCTC treatment has little effect under OLS or penal estimations. However, the IV estimation results in column 3 show that the CCTC does have a statistically significantly effect on annual work hours. A $1000 increase in CCTC increases the annual working hours by 93 hours. Such an increase is equivalent to about two 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 6, 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 mecha-

Table 6: Individual CCTC Treatment on Annual Work Hours Conditional on Working

	(1) All Women OLS	(2) All Women Panel	(3) All Women IV	(4) Married Women IV	(5) Single Women IV
Individual CCTC	34.809	20.379	92.900	161.004	34.009
	(19.207)	(19.484)	(32.303)	(55.831)	(33.145)
Individual EITC	-5.256	54.873	-7.757	22.580	-10.996
	(20.505)	(25.900)	(23.370)	(37.584)	(28.062)
Observations	41,444	41,444	41,444	24,798	16,646
Individual FE	No	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
F-test	20.07	14.69	20.11	13.74	9.992

Notes: Samples are from the PSID 1968-2015 waves, all women aged 20 to 55, either a household head or wife of a household head, with CCTC 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 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 measured at the state maximum level. 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.

nisms 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 using individual CCTC treatment variable and

baseline individual fixed effects can be transferred into a back-of-the-envelope calculation of the labor supply elasticity to be 1.0 for all women. The results from IV estimation is bigger, however, the standard error is much bigger than that of the baseline individual fixed effect estimate as well. As expected, the labor force participation responsiveness to the CCTC for single mothers are smaller than that of the married mothers.

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 4. The horizontal axis of the upper panel represents the age groups of the youngest child. 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. The upper panel of Figure 4 shows that women whose youngest child is between seven and twelve years old are more responsive to the CCTC treatment, while women whose youngest child is between one and six years old are less responsive to the policy.

Similarly, the lower panel of Figure 4 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. The explanation is that the cost of the market-provided child care services reduces as children grow older. The same amount of child care subsidy provides higher proportional subsidy for women with older children than for women with younger children. Women with younger children face a higher cost of child care services and a more restricted time constraint, therefore, they are less likely to be incentivized to join the labor force.

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 quintiles

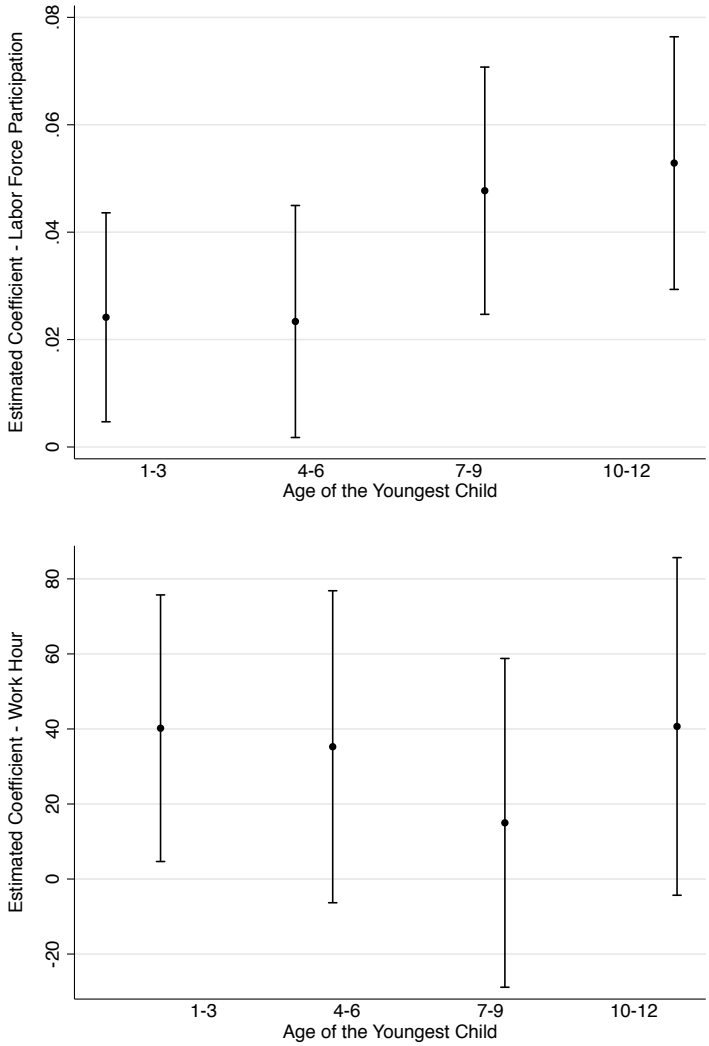

Figure 3: Regression coefficients of the CCTC on labor force participation and annual work hours by age of the youngest child

Notes: The upper panel and the lower panel show the effects of the CCTC on labor force participation and annual work hours (conditional on working) respectively. Samples are from the PSID 1968-2015 waves, all women aged 20 to 55, either a household head or wife of a household head. The black dots represent the regression coefficients from OLS regressions using the state CCTC measured at the state maximum level as the treatment variable. The coefficients are adjusted to reflect the effects of a $1000 dollar increase in the CCTC treatment variable. All regressions control for age, age squared, years of education, husband's annual income, marital status, number of children, the state 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.

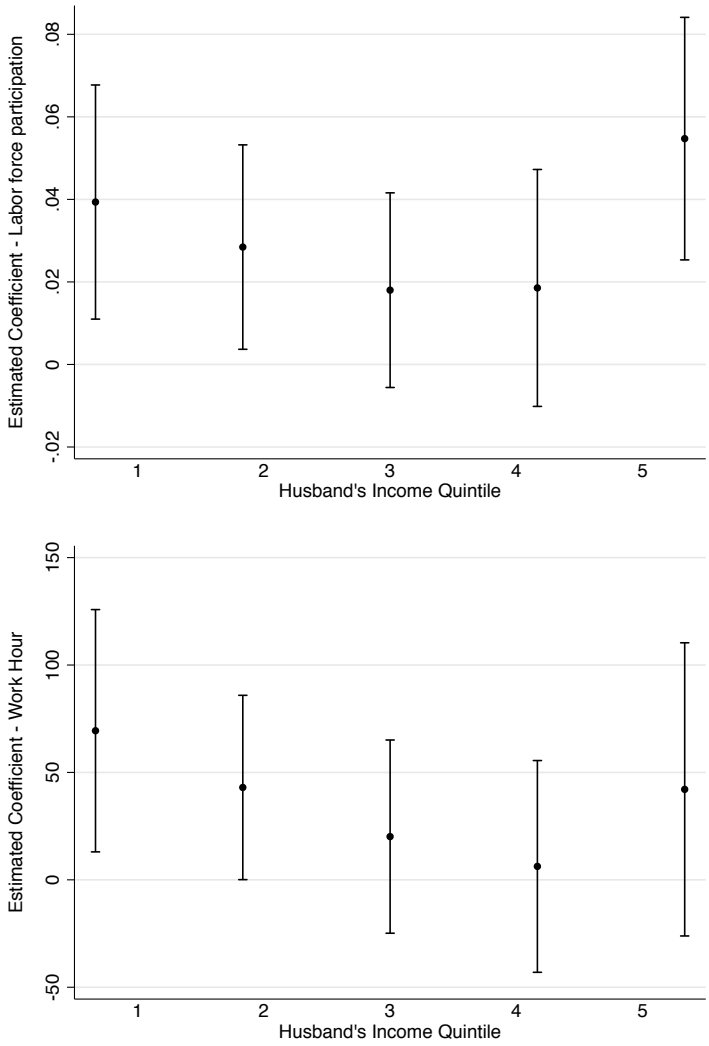

Figure 4: Regression coefficients of the CCTC on labor force participation and work hours by husband's income quintile

Notes: The upper panel and the lower panel show the effects of the CCTC on labor force participation and annual work hours (conditional on working) respectively. Samples are from the PSID 1968-2015 waves, all women aged 20 to 55, either a household head or wife of a household head. The black dots represent the regression coefficients from OLS regressions using the state CCTC measured at the state maximum level as the treatment variable. The coefficients are adjusted to reflect the effects of a $1000 dollar increase in the CCTC treatment variable. All regressions control for age, age squared, years of education, husband's annual income, marital status, number of children, the state 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.

of the husband and run the pooled OLS estimation on different groups. The upper panel of Figure 5 shows the results of the CCTC treatment on the labor force participation rate. Women whose husbands are in both the lowest and highest income quintiles are the most responsive to the CCTC in terms of extensive margin. The lower panel of Figure 5 shows that women whose husbands are in the lowest income quintile 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.

Even though women from the two ends have a similar response, the mechanisms are not the same. It is likely that women with higher non-labor income pay for child care service regardless of their own labor force participation. when faced with more generous CCTC benefit, they join the labor force to utilize benefits. For women with lower non-labor income, 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 market price. When provided with a subsidy, women with lower non-labor income are attracted to the labor force because the subsidized child care service make it beneficial for them to join the labor force.

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 effects 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 of married women. As long as the family has earned income and the earned income is below a certain threshold, the family is 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. The upper panel and the lower panel of Figure 6 show the number of tax filings and the average amount for each tax filing according to 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 (2020) 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 5-6, 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. The magnitude of the labor force participation responsiveness of single mothers to the EITC in this study is comparable to the results of Eissa and Liebman (1996), who find that the participation elasticity for single mothers is approximately 0.6.

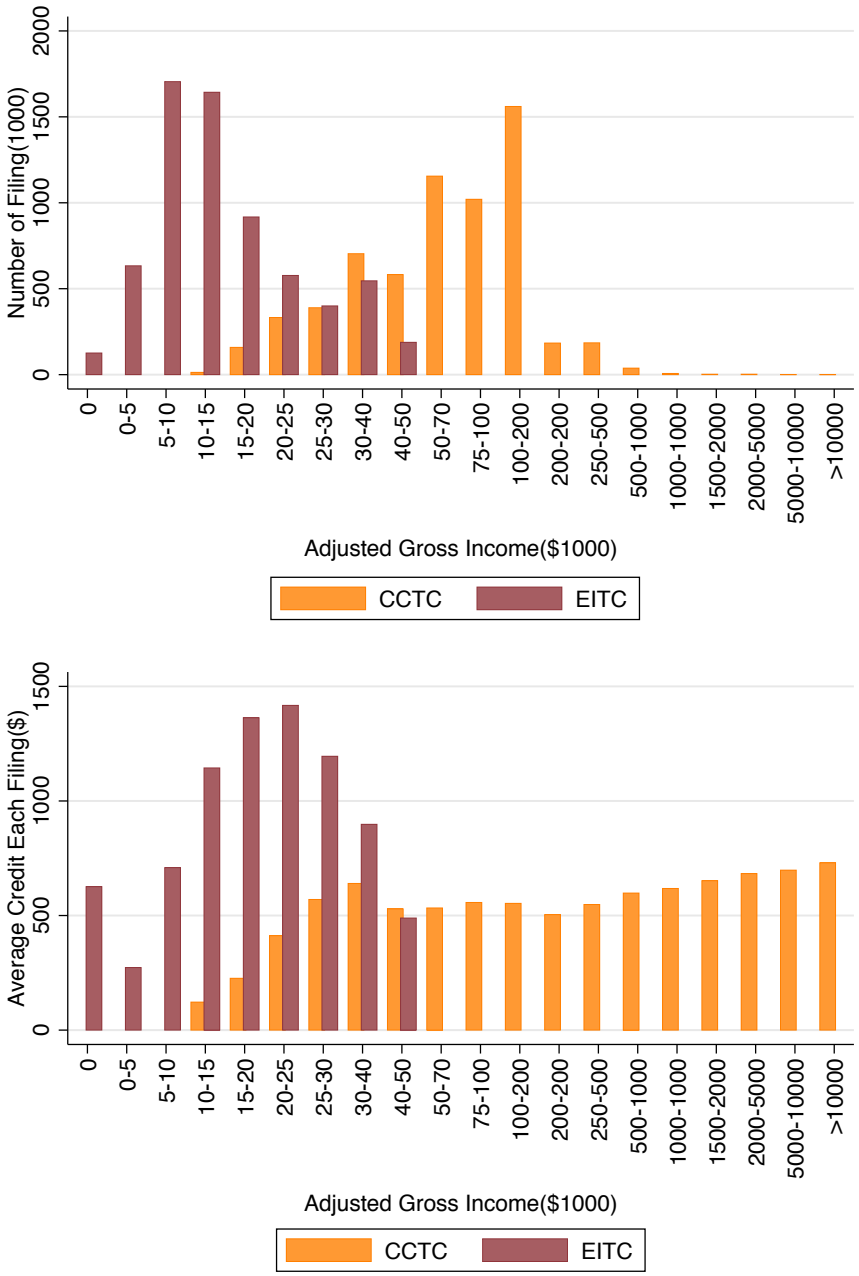

Figure 5: The CCTC and the EITC: number of filings and average credit value of each filing by group of family's adjusted gross incomes in 2011.

Notes: Source: IRS, Statistics of Income Division, July 2013.

7.3 Other Child Care Subsidy Programs

Some research has shown the effects of public school on maternal labor supply (Gelbach, 2002; Cascio and Schanzenbach, 2013). They find positive effects on maternal labor supply mainly in single mothers. The results in this study show that the effects of the CCTC are more pronounced in married mothers, showing the CCTC works through different channels.

Other child care subsidy programs are less likely to affect the identification of this study. Blau (2003) documents the subsidy programs related to child care in the United States. Figure F.5 in Appendix F is adopted from the Table 7.1 of his paper. These programs either have no requirement for parents working, or only apply to the families with children of a young age (for example the Head Start), or require no child care expenses. As a result, they do not cover the same demographic group of benefit recipients as the CCTC. Furthermore, when adopted at the federal level and controlling individual characteristics, these programs affect all the eligible in the same way, the effects of these programs can be absorbed by year fixed effects.

8 Conclusion

In this paper, I exploit the variation in the CCTC enactment and amendment across states and overtime to estimate the effects of the CCTC on maternal labor supply. I find that the CCTC considerably increases the labor force participation rates of women with young children. The effects of the CCTC are more pronounced in married mothers than single 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 well-beings, for example, cognitive ability, non-cognitive ability, employment, etc. With a comprehensive understanding about the effects of the CCTC on children's well-beings, a thorough welfare analysis of the CCTC is possible.

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