An Unintended Consequence of the Earned Income Tax Credit: Maternal Labor Supply and Child Development

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Abstract

This paper examines the impact of the Earned Income Tax Credit (EITC) on the children of single mothers. While the EITC is typically thought to benefit low-income children by increasing family income, it may also decrease caregiving inputs as a result of increased parental labor supply. Children of single mothers may be particularly sensitive to such decreases due to the lack of other parental support. Using a difference-in-differences (DID) approach to look at the impact of the 1993 EITC expansion, I find that EITC expansion reduces the combined math and reading test scores of children of single mothers by 13.61 percent of a standard deviation. The most important mechanism is reduced mother-child interactions due to the increased maternal labor supply. These results suggest that for the EITC to be an effective poverty reduction tool, it may need to be paired with other interventions such as child care.

Keywords: EITC, Maternal Labor Supply, Education, Child Development **JEL Codes:** H24,H31, I21, I38,J13

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1 Introduction

Policymakers who design social safety nets must balance multiple competing objectives. First, they need to provide adequate financial support to low-income families. Second, at the same time, they should avoid disincentivizing work or accumulation of human capital. The welfare reforms of the 1990s tried to find the right balance between these two objectives and ended up putting more weight on the second objective. For example, the Aid to Families with Dependent Children (AFDC) was replaced by the more restrictive Temporary Aid to Needy Families (TANF), which implemented work requirements and limited the duration of benefits. The reform also included large expansions of the Earned Income Tax Credit (EITC), which has encouraged people to work more by giving greater benefits with greater earned income. As a result, the annual employment of single mothers increased by about nine percentage points between 1986 and 1996 (Meyer and Rosenbaum, 2001).

However, the impact of these pro-work welfare programs on children is ambiguous. They may increase earnings and reduce the culture of dependency, which affects the children positively. However, as they require parents to work for the benefit or to work more for higher benefits, parents are not able to spend as much time with their children. Requiring parents to work might cause a reduction in both the quantity and quality of time with their children if the parents experience stress or physical fatigue from working. This can have adverse effects on children.

This paper investigates how the EITC affects development outcomes of single mothers' children and looks into the mechanisms that can explain them. There are two reasons that I focus on single mothers. First is that they are the primary target of the EITC and the major beneficiaries. Single mothers made up 50% of the overall recipients in 2008 and received 48% of the 2007 transfers (Meyer, 2010; Athreya et al., 2010). The second reason is that the effect on children of single mothers will differ from that on children in two parent households. As single mothers are both the primary earners and only caretakers for the children, taking them away from their children and pushing them to work may cause a substantial decline in both the amount and quality of childcare. On the other hand, in a two parent household, if one of the parents works, there is still the other to take care of the child, which makes it easier to find good quality, stable childcare. It is very difficult and costly for single mothers to find in the market.

Many previous studies on the EITC analyze how it affects the labor supply. They find that it successfully increases the labor supply of the recipients in the large work incentive range (the phase-in range).[1] The most representative example is the group

[1] As shown in Figure 1, the EITC has three ranges: phase-in, plateau, and phase-out regions. In the phase-in region, the benefit increases as the income increases. However, on the plateau or phase-out region,

of single mother recipients. As they are sole and primary earners in the household and less educated, their income is low enough to put them in the high work incentive range (the phase-in range). They increase their labor force participation by 2.8% (Eissa and Liebman, 1996; Meyer and Rosenbaum, 2001; Blundell et al., 2016; Kleven, 2019; Adireksombat, 2010). However, a comparable group, married mothers are not responsive. It is because most of them are secondary earners in the household, which makes their labor supply inelastic, and they are in the plateau and phase-out ranges, where there are no labor supply incentives (Eissa and Hoynes, 2004; Heim, 2010; Dickert et al., 1995).[2]

Another main branch of the EITC literature studies how the increase in family income from the EITC affects child development. So far, many studies have focused on the income channel and have found positive impacts on birth weight, academic scores, college enrollment, and future outcomes such as earnings in adulthood (Chetty et al., 2011; Bastian and Michelmore, 2018; Baker, 2008; Dahl and Lochner, 2012; Manoli and Turner, 2018; Hoynes et al., 2015). However, these papers don't consider another important channel of the EITC: decrease in time with the mothers. This channel is particularly important for some recipients, such as single mothers' children, as the time effects are expected to be large.

The maternal labor supply channel is important but is rarely explored. To the best of my knowledge, there is no paper that links the EITC and child outcomes using the maternal labor supply mechanism except Agostinelli and Sorrenti (2018). Their study explores the income and time effects of maternal work from the EITC, building on Dahl and Lochner (2012) and using the IV strategy. They find that an increase in mother's labor supply influences children negatively, and this negative impact dominates the positive income effect from the EITC for the low-income households, which implies negative net impacts of the EITC.

My paper builds on the findings of Agostinelli and Sorrenti (2018). For example, we both consider the mothers' labor supply channel and explore potential mechanisms through which maternal work negatively affects their children. When exploring the mechanisms, however, Agostinelli and Sorrenti (2018) rely on cross-sectional comparisons between children of mothers who are employed and not employed across income groups, which is subject to selection bias. In addition, they switch data sets when they analyze the mechanism, which might cause a problem as the children in the new data set are not the same as in the other and might have had different experience related to

the benefit amount stays the same or decreases. Thus, the phase-in range is the only part where the EITC has the work incentive structure.

[2]Some papers report significant impacts on subsamples of married mothers. Married mothers with low-earning spouses increased their labor supply after the adoption of the EITC at the extensive margin (Bastian, 2017), and self-employed married mothers increased their labor supply (Lim and Michelmore, 2018). Yang (2018) finds income seasonality caused by the EITC receipt affects the labor supply of secondary earners.

maternal work. In this paper, I analyze more diverse mechanisms related to the EITC and mothers' labor supply in a more rigorous way. Using the same sample of children in a data set, and a DID approach, I explore changes in income, home environment, goods investment in children, and various forms of mothers' labor supply. This will be helpful in explaining why and how mothers' work affects children, as well as in designing policies to help the recipients more effectively.

This paper also contributes to an array of papers on maternal work and child development. Even though empirical findings are mixed (James-Burdumy, 2005; Schildberg-Hoerisch, 2011; Fort et al., 2016; Bernal, 2008; Bernal and Keane, 2011; Felfe and Hsin, 2012; Brooks-Gunn et al., 2002; Paxson and Waldfogel, 2003), studies on single mothers' children suggest negative relationships. For example, Bernal and Keane (2011) finds that welfare recipient single mothers' work and related child care leads to a 2.1% decrease in children's test scores. Also, Felfe and Hsin (2012) report that work-related stress or physical hazards, which low-income mothers often face, decrease children's cognitive and behavioral development. My paper contributes to the literature by studying EITC-recipient single mothers, who have been heavily targeted and impacted by welfare programs.

Using the difference-in-differences (DID) method, this paper finds that EITC recipient single mothers' children, experienced reductions in the combined Peabody Individual Achievement Test (PIAT) math and reading scores as much as 13.61% of a standard deviation compared to their counterparts, children of married mothers who are likely to receive the EITC but less likely to have work incentives. The reductions are attributed to reduced mother-child interactions due to increased labor supply of mothers.

The remainder of the paper is divided into eight sections. Section 2 presents the identification strategy. Section 3 explains data, the matched mother-child data of the National Longitudinal Survey of Youth (NLSY), and provides summary statistics. In Section 4, I present regression results with the regression model (Two-way fixed effect model). Section 5 includes robustness checks including common trend assumptions. In Section 6, I explore possible mechanisms through which the EITC expansion could affect child development such as maternal labor supply, family income, and child investment. In Section 7, I conclude with a summary. In the appendix, I include the Fuzzy DID approach, which compensates for the weakness of the DID approach. In Section 8, I conclude.

2 The Brief History of EITC

It has been almost 45 years since the Earned Income Tax Credit became a part of the 1975 U.S. tax code. Since then, the EITC has emerged as a popular alternative method for transferring income to low-income families with children. This popularity of the EITC stems from the structure of the tax credit which allows people to believe that the EITC can redistribute income with much less distortion of labor supply compared to other means-tested cash transfer such as the former Aid to Families with Dependent Children (AFDC) and new Temporary Aid to Needed Family (TANF) program.

The EITC encourages work by giving higher tax credits with higher earned income. Figure 1 shows how it works. There are three regions in the EITC benefit schedule: phase-in, plateau, and phase-out ranges. In the phase-in range, the EITC benefit increases with an increase in earned income until it reaches the maximum benefit, where the EITC has the largest work incentives by lowering marginal tax rates. After that, there are plateau and phase-out ranges where the benefit stays at the maximum and then phases out as earned income increases (marginal tax rate stays and increases). The EITC has its largest work incentives in the phase-in range.

Major expansions of the EITC started in the 1990s and the largest expansion was in 1993 (Figure 3). As the EITC expanded, it gave larger EITC benefits and covered households with higher income levels. The 1993 EITC expansion increased the maximum tax credit amount from $6,810 in 1990 to $8,425 in 1994. The expansion also provided larger work incentives to the recipients, particularly those who are in the phase-in range by increasing the amount of tax credit per dollar of earned income, which determines the phase-in rates. It increased the phase-in rates from 14% in 1990 to 30% in 1994 to families with more than two children. This means that the family received 19.5 cents per dollar of earned income in 1990, and it rose to 30 cents in 1994.

The popularity in the EITC also made each state have its own state EITC as a percentage of the federal EITC. Since Rhode Island enacted the first state EITC in 1986, the EITC has become widespread at the state level with 28 states and the District of Columbia. Each state decides when to adopt the state EITC, and the rate in proportion to the federal EITC. This variation will be used in the third chapter of this dissertation.

3 EITC and Child Development

There are several channels, through which the EITC may cause changes in child development. Examples are changes in family income, maternal labor supply, and family composition. In this section, I explore primary channels and discuss their potential impacts on children.

First, EITC expansions increase household incomes (Neumark and Wascher, 2011, 2000; Scholz, 1994; Hoynes and Patel, 2018). Family income is an important predictor of a child's success and future opportunities. The impact of family income on child development has been widely discussed. Previous studies have reported a positive relationship between family economic conditions during childhood and various child outcomes (Cunha and Heckman, 2007; Chetty et al., 2011; Blau, 1999; Duncan et al., 1998; Levy and Duncan, 2000; Ludwig and Miller, 2007; Deming, 2009; Markowitz et al., 2017). Increases in income from the EITC expansion also bring positive impacts on child development. Works such as Dahl and Lochner (2012) and Bastian and Michelmore (2018) employ instrumental variable techniques to confirm this positive effect both in the short-run and long-run.

A second possible channel is mothers' employment. The EITC is designed to encourage work, and it gives clear incentives to non-workers to start working. Empirical studies provide evidence that the EITC encourages work among single mothers, but little evidence that working women already in the labor market increase their working hours (Hotz et al., 2001; Eissa and Liebman, 1996; Meyer and Rosenbaum, 2001; Eissa and Hoynes, 2006). Secondary earners, such as some married women, face incentives to reduce work, and empirical studies give consistent results (Eissa and Hoynes, 2004). This discussion implies that the EITC has differential impacts on mothers' labor supply and as a result, it may have differential impacts on their children.

Empirical findings on maternal work and child development are mixed (James-Burdumy, 2005; Schildberg-Hoerisch, 2011; Fort et al., 2016; Bernal, 2008; Bernal and Keane, 2011; Felfe and Hsin, 2012; Paxson and Waldfogel, 2003). The impacts of maternal work differ depending on choices in child care, and both quantity and quality changes in mothers' care at home. Fort et al. (2016) find a negative impact of the child care usages in affluent families. The negative impacts are due to fewer interactions with adults, which are usually of high quality at home. However, children of low-educated single mothers, whose care is not considered of high quality, also experience similar negative impacts. Bernal and Keane (2011) reports that their children experience a 2.1% decrease in test scores after their mother's employment and child care usages. This implies that single mothers' choices for child care are limited, which is possible because of insufficient increases in earnings.

Qualitative and quantitative changes in mothers' care at home also affect children. Felfe and Hsin (2012) and Brooks-Gunn et al. (2002) report that work-related stress or physical hazards decrease children's cognitive and behavioral development. Bastian and Lochner (2020) show that the EITC recipients, particularly unmarried mothers, reduce the time spent with their children, even though those are mostly related to non-investment activities more than active learning and development activities with

their children. In this paper, I will explore how the resources at home related to child development change and see how mothers' employments change the home environment and affect their children.

Finally, the EITC may affect children by changing the household composition such as co-residence, marriage, or fertility decisions. Theoretical predictions on marital status and fertility are mixed. Consistently, empirical findings suggest that the EITC does not induce mothers' singlehood nor fertility (Baughman and Dickert-Conlin, 2009; Dickert-Conlin and Houser, 2002; Eissa and Hoynes, 1999; Ellwood, 2000). In the robustness check of the paper, I will explore how the mother's marriage decision and family composition are affected by the EITC.

4 Identification Strategy

The identification strategy is to compare the academic achievements of single mothers' children before and after the EITC expansion in 1993, using the difference-in-differences (DID) approach. The treatment group in my paper is children of single mothers who are likely to receive the EITC. To ensure the sample include EITC recipients, I restrict the sample to children of mothers with a high school education or less, and with (expected) household earnings below $30,000.[3] The low education level has been often used in previous studies such as Eissa and Liebman (1996) and Meyer and Rosenbaum (2001) to make the sample a high-impact group.[4] However, it is a loose restriction, and allows many high-income families to be included, who are not eligible for the EITC. I add another restriction, low expected household earnings in 1992, below $30,000. $30,000 is the maximum level of household earnings for the eligibility during the reference period.

As this project focuses on the impacts of mothers' labor supply from the EITC on children, an ideal control group would be a group: (1) which is similar to the treatment group and has the same pre-trends in child outcomes, (2) which does not experience an increase in the mothers' labor supply after the expansion, and (3) at the same time, whose changes in income related to mothers' labor supply does not differ from those of the treatment group. I explore the candidates for the control group, and I find that the children of married mothers with low education and low household incomes is a satisfactory control group. I will provide evidence of the above in the following sections on robustness checks and mechanisms.[5]

[3] I estimated an earning's equation using the sample of earners before 1993. For the regression, I used exogenous variables, such as age (squared and cubed), an education level (squared and cubed), and one race dummy variable (nonwhite) following Eissa and Liebman (1996). Using the estimated coefficients and individual characteristics, I predict an earned income for each mother in the sample.

[4] Previous literature used the restriction based on their findings that over 60% of married couples with less than a high school education were eligible for the EITC.

[5] Plausible alternative control groups will be children of single mothers with high education levels or single

My final treatment and control groups are children of single mothers and married mothers with low education levels (≤ 12) and low (expected) household earnings ($\leq \$30,000$). The two groups are similar in that they are all low-income and likely EITC recipients. However, they are different in that only the treatment group, children of single mothers experience changes in mothers' labor supply. The logic behind this is that the single mother recipients are usually in the phase-in range and have large labor supply incentives while the married mothers are usually in the plateau or phase-out ranges, and do not have the same incentives. The 1993 EITC expansion provided recipients in the phase-in range large tax cuts, 116% decrease in the marginal tax rate (from -16% to -34%). At the same time, the tax rates for the recipients in the plateau range did not change. However, for the people in the phase-out range faced increase in the tax rates by 70%. Figure 2 shows the location of single and married mothers on the 1994 EITC benefit schedule,[6] where 58% of single mothers were in the phase-in range, while only 15% of married mothers were. As a result, the EITC gives large work incentives primarily to single mothers.

As the marital status is not a perfect determinant of being in the phase-in range, the estimate of the DID will be smaller than the actual impact. To compensate for this, I use the Fuzzy DID approach as an alternative approach by using the income level for the treatment status. I use the income threshold \$8,000 (in 1996 dollars), where the phase-in range ends according to the 1994 EITC schedule. For this alternative specification, the treatment group is children of single mothers with a household income less than or equal to \$8,000 in 1993, and the control group is children of single mothers with a household income between \$8,000 and \$24,000. However, as income level is endogenously determined and so is the treatment status, I use the expected household income as an instrumental variable (IV), which makes this approach different from the Sharp DID method. I found single mothers' children in the phase-in range show a reduction in their academic scores, which is even larger than that of the DID approach using mothers' marital status. For more details on theses, see the appendix.

5 Data and Statistics

To address the research question, I begin with the National Longitudinal Survey of Youth data 1979 (NLSY79), a nationally representative, longitudinal study. Started in 1979, it includes schooling, labor market activity, marriage, and family background

mothers who have a larger number of children. However, the mothers in those groups either increase labor supply sharply or have large changes in incomes.

[6] I use the EITC schedule disclosed in 1994, which was formed by the enactment of the 1993 expansions. The household incomes in 1993 are used. I calculate the EITC benefits based on the information on the EITC schedules, incomes, and the number of children.

information on 12,686 males and females, between the ages of 15 and 22 at that time. From this group, I only look at the female respondents, who comprise the sample of mothers in my paper.

I match these mothers to their children using a related study, the National Longitudinal Survey of Youth 1979 Child and Young Adults (NLSY79 Child and Young Adults). Begun in 1985, the dataset interviews the children of the female NLSY79 respondents and includes child-specific information on various child outcomes in cognitive, socioemotional, and physiological assessments. Linking the two datasets allows me to investigate the impact of the EITC both on the mothers and their children.

Among the various child outcome measures provided by the NLSY, I use the scores on the Peabody Individual Achievement Tests (PIAT) to evaluate cognitive achievement. The PIAT measures academic achievement for children aged five and over, and the NLSY79 provides raw, percentile, and standard scores on the Mathematics, Reading Recognition, and Reading Comprehension assessments. I utilize the standard scores of Mathematics and Reading Recognition and combine the two scores, which are commonly used by the previous researchers (Agostinelli and Sorrenti, 2018; Bastian and Michelmore, 2018; Dahl and Lochner, 2012; Ruhm, 2004). The standard scores are derived on an age-specific basis from the child's raw score, and the norming sample has a mean 100 and a standard deviation of 15. To make the scores more interpretable, I create normalized test scores with a mean of zero and a standard deviation of one based on the random sample of test takers.

In addition to the measures of cognitive achievement, I use the Behavioral Problem Index (BPI) and Motor and Social Development (MSD) as measures of noncognitive achievement. The BPI measures the frequency of childhood behavior problems from children age four and over (Zill and Peterson, 1986). The questions ask mothers about specific behaviors that their children may have exhibited in the previous three months. For the BPI, higher scores present higher frequency or greater levels of behavior problems. The MSD measures the motor, social, and cognitive development of young children from birth to three years by asking mothers to answer questions on the age-appropriate motor and social development items. Exploring the non-cognitive achievements is useful as it helps us to predict future earnings and educational attainment (Heckman and Rubinstein, 2001). Especially, by exploring the MSD, we can see how much the early investment matters for the development of younger children, which has been explored by many studies (Ruhm, 2004; James-Burdumy, 2005). For these measures, I also create normalized scores with a mean of zero and a standard deviation of one.

Finally, I use information on maternal labor supply and family income from the NLSY79 for the analysis of the mechanisms. The NLSY79 provides information on

weekly labor hours and the number of jobs. Based on the information, I created a variable for annual labor hours and dummy variables for holding any jobs, positive working hours, and working full-time. I also utilize information on family income including earnings, government welfare, and imputed EITC benefits. The imputed EITC amounts are calculated based on information on the number of children in the household and household income using the TAXSIM program (version 27) maintained by Daniel Feenberg and the National Bureau of Economic Research.[7]

Out of the many EITC expansions in the 1990s and early 2000s, I use the 1993 expansion, which is the largest (see Figure 3) and is known to have caused the biggest changes to low-income households including maternal labor supply.[8] Due to possible bias arising from the later policy changes, I limited my timeframe to the period 1990 to 1996, because there was another EITC expansion, which became effective in 1987 and possibly affected child outcomes in 1988 due to the Tax Reform Act of 1986,[9] and 1996 was the year when there were another large policy changes for single mothers, replacing the AFDC with the TANF. As the cognitive achievement variables are released biannually, the actual years of data available are 1990, 1992, 1994 and 1996.

The sample includes children of married and single mothers (widowed, divorced, and never married), where single mothers comprise 40% of the sample. The mothers are between 25 and 39 years old. I exclude the children with mothers who are in school, who are not able to work, or who have a spouse who cannot work. I also exclude the children in the household with extremely high values in net worth (more than $50,000).

Table 1 presents the summary statistics of the treatment and control groups. Column 1 presents the characteristics of children of single mothers with less than or equal to high school education and with (predicted) household earnings below $30,000 (treatment group); Column 3 presents characteristics of children of married mothers with the same levels of education and household earnings (control group). There are some differences between the two groups. A group of children of single mothers, the treatment group, tends to be non-white and to be in families with lower income, higher total welfare, and fewer adults as we can expect. Single mothers' children are more likely to live with their grandparents. They have the lower PIAT math, reading, the Motor and Social Development (MSD) scores and have more behavioral problems on average. The table also indicates that the married and single mothers are almost at the same age, have similar education level and have similar labor market activities on aver-

[7]The TAXSIM program calculates federal and state income tax liabilities from typical survey data. For more details, see http://www.nber.org/taxsim.

[8]Kleven (2019) find the only the EITC reform in 1993 is associated with clear employment increases. For the other expansions, he reports that the labor market conditions in the 1990s contributed more to the increase in the labor supply.

[9]Including 1986 and 1988, however, does not change the main findings.

age. The employment rates are 60% for single mothers and 75% for married mothers.[10]

6 Results

To analyze the impact of the 1993 EITC expansion on child development, I use a difference-in-differences (DID) approach with the child fixed effect. I choose the expansion as it is the largest expansion of the EITC and it gave large labor supply incentives to single mothers. I estimate the following child development model:

$$y_{it} = \alpha + \beta Single_i \times Expansion1993_t + X'_{it}\delta_1 + Z_i + \lambda_t + \varepsilon_{it}, \quad (1)$$

where y_{it} is a cognitive or noncognitive development of child i at time t such as the PIAT mathematics and reading scores, the Behavioral Problem Index (BPI), and the Motor and Social Development (MSD) score. The control variables in X_{it} include child characteristics (ages of children), mother characteristics (ages of mothers), nonwage income, [11] and region dummies.[12] Z_i controls for child fixed effects such as children's characteristics (sex, race and time-invariant unobsereved ability) as well as maternal characteristics (education level, race and marital status), and λ_t controls for time effect. The remaining variables are all dummy variables, where $Single_i$ equals one if the child's mother is single in 1992, and $Expansion1993_t$ equals one for any year after 1993.

This paper tests the size and direction of β, the coefficient of the interaction term between $Single_i$ and $Expansion1993_t$. If the estimate for β is a negative number (positive for the BPI), this implies that children of single mothers obtain lower test scores, develop more slowly, and exhibit more behavioral problems. In other words, the children of single mothers have a negative net effect after the expansion possibly because single mothers work so much more but end up with an insufficient increase in

[10] They are higher than those in previous studies, which are 49% and 52% for single and married mothers with less than high school education (Eissa and Liebman, 1996; Eissa and Hoynes, 2004). The difference seems to be due to the different ethnicity composition.

[11] The NLSY provides information on income from a variety of sources such as income from working, transfer from the government, transfer from nongovernment sources such as child support, alimony, and parental payments, and income from other sources such as scholarships. I calculated the unearned income by subtracting the mother's wages and salary and government transfer from the total net family income variable. Total net family income is a composite income figure from the income sources for household members related to the respondent by blood and marriage. Therefore, for married mothers, unearned income includes a spouse's earnings. All income variables are in the past calendar year.

[12] The NLSY provides rich information on the household composition such as ages of the youngest child in the household, number of family members, number of adults and children in the household, number of members in certain age groups, number of adults working, a dummy variable for living with grandparents. However, in my paper, to avoid an argument regarding the EITC's impact on the household composition, I stick to the parsimonious model excluding those variables. I will discuss this issue more detailed in the next chapter, the robustness check. Including the control variables does not change the main findings.

income.

I start by analyzing the impacts on children's cognitive development measures, the PIAT math and reading scores. The first column in Table 2 shows the estimation result of the combined PIAT math and reading scores, and the second and third columns show the estimation results of the individual math and reading scores, respectively. Results suggest that children of single mothers have lower scores on the test. They have 13.61 percent reduction of a standard deviation in the combined scores. The negative effects in the test scores are larger for the reading test; the reading scores decrease by 14.36 percent of a standard deviation, while the math scores decrease by 10.16 percent of standard deviation. This implies that the major environment changes which the EITC brings to the children, are more related to language development such as the decrease in interactions with their mothers. The size of the effects is comparable to previous findings. Bernal and Keane (2011) relate a 2.1% decrease in the test scores of children of single mothers as a response to one year of child care instead of mother care. Agostinelli and Sorrenti (2018) find a larger impact, a one-hundred-hour per year increase in maternal work is related to a 6% standard deviation decrease in the children's math and reading test scores. As their findings can be converted to 6.3 and 18 percent standard deviation decrease for 3 years, my finding is between these two.

Table 3 shows the analysis of noncognitive development measured by the Behavioral Problem Index (BPI) and the Motor and Social Development (MSD) scores. I only find strong negative impacts on children, younger than 3 years old. The MSD scores decrease by 68 percent of a standard deviation. On the other hand, the BPI does not change significantly. Although many studies recognize that time with mothers is especially important for early childhood development, the impacts of mothers' working on the MSD has not been widely shown before. This result indicates that single mothers' early employment have more adverse impacts on younger children.[13]

Subgroup analyses for the PIAT math and reading scores, and Motor and Social Development (MSD) are also available in the appendix table section (Table B3 to Table B5). Overall, the negative impacts are concentrated among younger children who are between 5 and 12 years, and children with Non-white mothers. The PIAT scores decrease by 14% for children who are between 5 and 12 years old while children who are older than 12 do not show the similar reductions. Children with Non-white mothers show larger reduction in the PIAT and MSD scores by 14% and 70%, respectively.

[13]There are a number of studies on the impact of maternal work on early childhood development. However, they report mixed conclusions. Some authors such as Sherlock et al. (2008), Belsky (1988) and Baydar and Brooks-Gunn (1991) conclude that maternal employment in the first year of child causes increased behavioral problems. In contrast, several studies did not find significant impacts (Vandell and Ramanan, 1992; Desai et al., 1989).

7 Common Trend Assumption and Robustness Checks

7.1 Common Trend Assumption

Since child and mother characteristics, child fixed effects and year fixed effects are included in the regressions, it is essentially a generalized difference-in-differences (DID) model. The underlying assumption for an unbiased estimate of β is that the trends in the child outcomes for both control and treatment groups before the expansion are parallel. I examine the parallel pretreatment trends assumption for the outcome variables, particularly for the PIAT math and reading scores, and the Motor and Social Development (MSD) scores. To test the assumption, I estimate the following equation:

$$y_{it} = \alpha + \sum_k \beta_k \cdot Single_i \cdot D_t^k + X_{it}'\delta_1 + Z_i + \lambda_t + \varepsilon_{it}, \tag{2}$$

where $k = 1992, 1994, 1996$. y_{it} represents the child i's outcome in year t. D_t^k are dummy variables equal to one if it is in year k. Note that the dummy for $k = 1990$, D_t^{1990} is omitted so that the treatment effects are relative to 1990. Thus, coefficients of $Single_i \times D_t^k$, β_k captures the average differences between child outcomes of single and married mothers in year k compared to 1990. I include the child fixed effects, the time effects, and the control variables as in equation (1).

Table 4 reports the regression results. A test of the parallel trend assumption shows that $\beta_{1992} = 0$ for the PIAT math and reading scores and Motor and Social Development (MSD) scores, which means the differences in the outcomes are constant overtime before the 1993 expansion. Based on this, I conclude that the pretreatment trends in the child outcomes of single and married mothers are similar, and married mothers' children can serve as a control group for single mothers' children in the treatment period.[14]

The table also confirms that the negative impacts come after 1993, in 1994 and 1996, and the impact on the combined PIAT math and reading scores is larger in 1996. Figure 4 provides a graphical display of the same information in the table.

7.2 Placebo Test

With this placebo test, I check if there are still similar negative impacts among the less likely EITC recipients, children in the household with high-income levels. It will make

[14]It might be ideal to test the assumption with data before the major EITC expansions started such as before 1986. However, as the data is only available after 1986, I test the assumption using 1990 and 1992 for pretreatment periods.

sure if the EITC has its largest effects among children most likely to be eligible for the credit. For the test, I use the sample with children of single and married mothers with the expected household income higher than $30,000.

As shown in Table 5, the impacts on both combined PIAT math and reading and Motor and Social Development (MSD) scores become smaller and insignificant with the less likely EITC recipient sample. In other words, the large reductions in the scores among children of single mothers compared to those of married are only for EITC recipients.

7.3 Other Welfare Reforms

Around 1993 and 1996, there were many welfare reforms other than the EITC expansions. Even though the Aid to Families with Dependent Children (AFDC) was replaced with the Temporary Asistance for Needy Families (TANF) in 1997 at the national level, the federal government allowed states to experiment with their welfare programs, under the heading of welfare waivers. The state waivers included all the key elements that would later be implemented on national scale through TANF reform, including time limits, work requirements, and financial incentives to work.

To check if those state-level reforms were primary causes of the negative impacts, I include additional state dummies and state dummies interacted with year dummies. As the welfare reforms were mostly state-wide and the dates of the implementation were determined by states, the state dummies and state by year dummies capture the welfare changes well. Specification B in Table 6 shows that the impacts on the combined PIAT math and reading scores, and Motor and Social Development (MSD) scores remain negative and significant as they are in Table 2 and 3, which are repeated in Specification A. The results confirm that the EITC accounts for the most of the negative impacts.

7.4 Child Care-Grandparents

As mothers start working, they need child care and, depending on its quality, the impacts of mothers' work on children can differ. In this paper, if single mothers' alternative care is of lower quality than that of married mothers', the estimates in equation (1) will be downward biased.

To check this possibility, I use the information on the presence of grandparents in the household. After the parents, grandparents provide the most childcare (Fort et al., 2016; Blau and Currie, 2006). While the presence of grandparents within a household does not necessarily mean they provide child care, if grandparents decide to live with their grandchildren more often after the EITC expansion to help the mothers, it can be

used to see the impact.[15] I add a dummy variable for the presence of grandparents and a triple interaction term among three dummy variables for the presence of grandparents, single mothers, and the 1993 expansion in addition to the other control variables in equation (1) as follows:

$$\begin{aligned} y_{it} =& \alpha + \beta Single_i \times Expansion1993_t + \gamma Single_i \times Expansion1993_t \times Grand_{it} \\ &+ X'_{it}\delta_1 + Z_i + \lambda_t + \varepsilon_{it}. \end{aligned} \tag{3}$$

With the new regression, I first check if the treatment effects (β) change with the additional variables. Then, I check the coefficient of the triple interaction (γ), which shows if the grandparents' cares are different from the other alternative cares for single mothers' children.

Specification E in Table 6 shows that controlling for the presence of grandparents variables doesn't change the estimates of the treatment effects much for both combined PIAT math and reading scores and Motor and Social Development (MSD) scores compared to the baseline estimates in Specification A in Table 6. Table 7 shows more detailed results including estimates for the triple interaction. I find that both for the combined PIAT math and reading scores and the MSD scores, the grandparents' cares are not different from the other alternative cares for single mothers' children. Thus, the quality of the alternative child care, the presence of grandparents, does not affect the estimates.

7.5 EITC and Marital Status

Whether the expansion in 1993 affected marriage decisions or not is important in this study. If mothers' marriage decisions were directly affected, and many of the mothers changed their marital decisions, it would have violated the group-composition condition for the difference-in-differences (DID), and the estimates would have been biased. Even though available evidence suggests that the EITC does not encourage the existence of female-headed families or family formation (Dickert-Conlin and Houser, 2002; Eissa and Hoynes, 1999; Ellwood, 2000),[16] I explore this possibility in my sample. In this subsection, I check how many mothers change their marital status by looking

[15] An ideal way to explore the impacts of alternative care is to use the information on child care usage while mothers work. However, unfortunately, the NLSY provides child care information for very limited periods, only for 3 months after childbirth.

[16] Some recent studies find significant impacts. However, they do not give a solid answer as they report conflicting results. Herbst (2011) finds that a $1,000 increase in the EITC benefit resulted in a 4.9% decrease in the probability that single mothers would marry. However, Bastian (2017) finds the opposite. He found that a 10% point increase in the state EITC rates led to a 1.5% point increase (or 2.9%) in the probability of being married the following year.

at the statistics, and if the expansion causes changes in their marital status by using a difference-in-differences (DID) regression.

I first check the frequency of marital status change. I check the percentage of mothers who changed their marital status around 1993, between 1992 and 1994, and between 1992 and 1996. I first check the marital status change pattern of mothers with all education levels. Between 1992 and 1994, 3% of married mothers changed their marital status to single, and 12% of single mothers changed their marital status to married. Between 1992 and 1996, the rates were 7% and 19% for the mothers. Similar patterns are observed among the likely EITC recipients, mothers with low education levels. I find a 4% change for married mothers and 11% change for single mothers between 1992 and 1994. These become 9% and 18% respectively between 1992 and 1996. From the statistics, I observe that EITC recipients were equally likely to change their marital status before and after the expansion compared to the all mother samples. The similar patterns in the changes in the marital status among non-EITC recipients and likely EITC recipients imply that the EITC would not affect mothers' marital decision.

I then address this issue more rigorously by using the difference-in-differences (DID) approach around the 1993 EITC expansion. The treatment group includes likely EITC recipients, mothers with a high school education or less. The control group is non-recipients, mothers with more than 12 years of education. The empirical model is as follows:

$$y_{it} = \alpha + \beta LOW_i \times Expansion1993_t + X'_{it}\delta + Z_i + \lambda_t + \varepsilon_{it}, \tag{4}$$

where y_{it} indicates whether the mother i's marital status changes or whether the mother i is single during the year t. LOW_i equals one if the mother i is a likely EITC recipient, or has a high school education or less in 1992.

Tables 8 and 9 show that the 1993 EITC expansion does not affect the marriage decision of the EITC recipient mothers in my sample. I find no evidence that the EITC increases the probability of marital status changes or being single more compared to non-EITC recipients for all, single and married mothers.

Based on the analyses above, I conclude that it is less likely that the EITC influences the children by changing the mothers' marriage decisions. However, as still some mothers change their marital status around 1993, 19% for single mothers and 7% for married mothers between 1992 and 1996, I check if the results change when I exclude the mothers who change their marital status. Specification C in Table 6 includes only mothers who have constant marital status from 1990 to 1996. The estimates do not change much for the combined PIAT math and reading scores, even larger. However, the impact on Motor and Social Development (MSD) scores decreases and becomes insignificant.

7.6 Unmarried Mother Sample

By controlling for child and mother characteristics and child fixed effect, most heterogeneities between the treatment and control groups are handled, and it is partly proven as the parallel trends assumption is satisfied.

However, a concern that is hard to be dealt with is that single mothers' children experienced changes in family composition at least once when their parents divorced or lost a parent in the past. If the effects of past events last for a long time, and if the effects on children cannot be systematically controlled in the regression, it would bias the estimates.

I check if this scenario happens by using a subsample of the treatment group, children of unmarried mothers. As unmarried mothers did not experience divorce or losing a partner, the concern on the family events can be moderated. Specification D in Table 6 reports that there are similar patterns and actually larger impacts for both the combined PIAT math and reading scores and Motor and Social Development (MSD) scores. This provides an evidence that the decrease in child outcomes are not driven by negative family events, which only the single mothers' children experience.[17]

8 Mechanisms of Impact

In Sections 2 and 3, I have shown that the 1993 expansion had adverse impacts on the children of single mothers. To explain these surprising findings, I explore several mechanisms through which the EITC possibly affects the children. As the EITC is designed to reward work, the primary channels are a change in the labor supply and a change in household incomes related to the work. I first check if single mothers work more than married mothers, and then if the changes accompany related household income changes.

In addition, I explore a more direct mechanism, changes in investments in children to show implications why the changes in mothers' labor supply and incomes influence children negatively.

8.1 Maternal Labor Supply

In this subsection, I test if there is a relative increase in the labor supply of single mothers compared to that of married mothers. I use the mothers of the estimating

[17] There can be some arguments about solo motherhood of unmarried mothers. However, what the psychology literature reports is that single motherhood itself does not result in psychological problems for children. For more detail, please refer to Golombok et al. (2016).

sample children. I use the similar DID approach in equation (1) as follows:

$$mls_{it} = \alpha + \beta Single_i \times Expansion1993_t + X'_{it}\delta_1 + Z_i + \lambda_t + \varepsilon_{it}, \tag{5}$$

where mls_{it} is a measure of mother i's labor supply during the year t. The control variables in X_{it} are similar to those in equation (1), and include mothers' characteristics (age, age squared, age cubed), nonwage income, and region dummies. λ_t controls for time effect and Z_i controls for mother fixed effects (race, and marital status). The remaining variables are all dummy variables where $Single_i$ equals one if the mother is single in 1992, and $Expansion1993_t$ equals one for any year after 1993. I test whether β, the coefficient of the interaction term between $Single_i$ and $Expansion1993_t$ is positive, which indicates that single mothers work more after the expansion.

I use four measures of the maternal labor supply mls_{it}: annual labor hours, an indicator for whether a mother reports positive hours worked during past calendar year, an indicator for whether a mother has at least one job, and an indicator for whether the mother works full time (i.e.,1650 + hours in a year). I analyze the impacts for the all mothers sample and then the working mothers sample to separate and see the intensive margin effect.

From the analysis, I observe that single mothers increase their labor supply only at the extensive margin. As in column 1 and 2 in Table 10, for the all mothers sample, mothers are more likely to work (4.96%) and more likely to have a job (5.13%) after the expansion. The size of the extensive margin effect is larger than the previous findings, 2.8% (Eissa and Liebman, 1996). The effects on working mothers are in the column 3 and 4. As the previous literature finds, single mothers, who are already working, do not increase their annual labor hours or are not more likely to work full time.

These regression results suggest that single mothers devote more time to work. The extensive margin increase solely can accompany a large reduction in caregiving inputs as searching for jobs and starting to work is costly in terms of time and energy. Those mothers need to spend time visiting multiple workplaces during job search, to adjust themselves to new environments and tasks, or to commute to the workplaces, which reduce both quantity and quality of childcare at home, and potentially affect child outcomes.

8.2 Other Family Incomes

In this subsection, I explore changes in the family income sources related to the mothers' labor supply choices such as mother's earned incomes, government welfare amounts,

and EITC benefits.[18] In equation (1) for the child outcome analyses, I do not include these income sources as control variables since the EITC also affects those income sources by changing mothers' labor supply decisions. I test if there are income source changes, which are plausibly attributable to the child outcome by using the same two-way fixed effect model as Equation (4) with the same mother sample.

The regression results are in Table 11. I first check the sum of the three income sources in column 1, and I find that it decreases but the decrease is not significant. I look into subcategories of the sum and I find that maternal earnings increase but the increase is statistically insignificant. However, the imputed EITC and government welfare change significantly; the imputed EITC increases by $351.78, and the government welfare decreases by $504.95. One explanation of why the mothers' earnings do not increase much is that single mothers are not rewarded much for their entry into the labor market as they are mostly low-skilled workers, or they are not ready to work full time because of their child care burdens. However, as the EITC gives the largest marginal benefits to those who start working or are in the phase-in rage, single mothers still receive the greater benefits.

From the analysis, I found that the sharp increase in the maternal labor supply does not result in a significant increase in the sum of other related incomes. The insignificant income changes are because of an insignificant decrease in mothers' earned income, a significant but small increase in the EITC benefit, and a significant decrease in government transfers. As the change in the sum of other income sources is insignificant, assuming that parents are indifferent about income sources — do not use a specific source of income for children, I conclude that the changes in income do not play an important role in explaining the changes in the child outcomes.

8.3 Investments in Children

The EITC mostly affects children by increasing the maternal labor supply and household incomes. However, those changes will be effective for children when they are attributable to changes in their home environments. I explore the changes in the quality of children's home environments using the Home Observation Measurement of the Environment-Short Form (HOME-SF) scores in the NLSY 79 Child and Adults.

The HOME-SF measures the quality of a child's home environment, such as the quality of cognitive stimulation and emotional support provided by a child's family. It has been used in previous studies as an input, which helps to explain other child

[18] Among three income sources, the EITC benefits are calculated using the TAXSIM program (version 27) maintained by Daniel Feenberg and the National Bureau of Economic Research. The TAXSIM program calculates federal and state income tax liabilities from typical survey data. For more details, see http://www.nber.org/taxsim.

characteristics or behaviors. It includes information on time and goods investments in children such as the number of books and instruments children have, whether to discuss TV programs, to eat dinner together or to do outdoor activities. Questions are mostly asked to mothers but some questions are recorded by interviewers. Answers are in binary or nominal variables, and the HOME-SF index is constructed based on the answers.

For the analysis, I use the same DID model and control variables as in equation (1). The sample is the estimating sample children. The dependent variable y_{it} is the HOME-SF score and two subscores, cognitive stimulation and emotional support scores. Column 1 in Table 12 shows that the HOME-SF scores do not change significantly, implying that overall home environment does not change much. However, a cognitive stimulation subscores decrease by 29.03, or by 2.4% from the sample mean. This shows that single mothers' children have less cognitive stimulation at home after the expansion compared to married mothers' children. Emotional support subscores do not change.

I look into the items of the cognitive stimulation scores to see the details of the decrease. As the questions are asked based on the child's age, the analysis is also age-specific. Among the 13 to 14 questions, I choose several questions which are related to time and goods inputs for children at home.

Table 13 shows some signs that mothers spend less time on children's cognitive developments. In column 1, mothers have fewer discussions over TV programs with their children (6-9 years old) by 15.96%. In addition, 12.72% fewer mothers take their children (10-14 years old) to musical or theatrical performances.[19] On the other hand, there are no signs of fewer or more goods inputs. As Table 14 shows, for both age groups, there are not significant changes in whether to have enough number of books (ten or twenty) or to have a musical instrument.

The analysis on the home environment shows that single mothers' children have less cognitive stimulation at home and it is mostly due to less time invested. The results are consistent with the findings that single mothers start working but their incomes do not change much. Combining the analyses on mothers' labor supply, incomes and home environment, I conclude that reduced mother-child interaction due to the increased mother's work is attributable to reductions in the child development.

[19]The study of Bastian and Lochner (2020) finds different results with the American Time Use Surveys data. Mothers decrease time in home production. However, they spend the same amount of time attending museums or events with children.

9 Conclusions

Using the mother-child matched data (NLSY) from 1990 to 1996, I find that the biggest EITC expansion in the 1990s has negative impacts on single mothers' children. There is a large reduction in the combined PIAT math and reading scores by 14 percent of a standard deviation and in the Motor and Social Development by 68 percent of a standard deviation. This is surprising as the previous literature has reported mostly positive impacts among the EITC recipients.

The analyses of the mechanisms of the EITC show that reduced mother-child interaction due to an increase in the mother's labor supply mostly explains the negative impacts. After the expansion, 5% more single mothers start to work, and 5% have jobs. Their entry to the labor market leads to a increase in the EITC benefits and a decrease in welfare. However, it only increases their earned income slightly, and they end up with no significant changes in income. Plus, children at home experience less cognitive stimulation, which is mostly attributable to less time investment from mothers such as discussing TV programs or going to musical or theatrical performances. There were no changes in goods investments on the children.

These findings suggest that in case of the low-educated and low-income single mothers, a more disadvantaged group, the time channel effect (less time with mothers) can dominate income channel effect (increase in household income). This dominance is also observed in Agostinelli and Sorrenti (2018), where children in the low-income households with low hourly wages were less benefited from the EITC, and their test scores decreased after mothers' employment.

These results suggest a different but constructive perspective on the pro-work welfare programs, which have been popular since they were initiated. For those programs to be an effective poverty reduction tool, they need to be paired with other interventions such as child care.[20] Otherwise, the financial benefit of the program will be outweighed by the negative impact of decreased mother-child interactions. It is particularly important for single mothers as they are mostly low-skilled workers and they cannot afford a child care of good quality in the market even though they start working.

[20]There can be some arguments that larger cash transfers might work better to solve this problem without government's intervention in the child care market. However, Bergmann (1996) argues that high-quality child care provided by the government has more benefits to children that parents may not fully account of in their spending decisions than cash transfer programs as children have little or no say in how parents spend a cash grant.

References

Adireksombat, K. (2010). The effects of the 1993 earned income tax credit expansion on the labor supply of unmarried women. *Public Finance Review*, 38(1):11–40.

Agostinelli, F. and Sorrenti, G. (2018). Money vs. time: family income, maternal labor supply, and child development. *University of Zurich, Department of Economics, Working Paper*, (273).

Andrews, I., Stock, J. H., and Sun, L. (2019). Weak instruments in instrumental variables regression: Theory and practice. *Annual Review of Economics*, 11:727–753.

Athreya, K., Reilly, D., and Simpson, N. (2010). Earned income tax credit recipients: Income, marginal tax rates, wealth, and credit constraints.

Baker, K. (2008). Do cash transfer programs improve infant health: Evidence from the 1993 expansion of the earned income tax credit. *manuscript, University of Notre Dame*.

Bastian, J. (2017). The rise of working mothers and the 1975 earned income tax credit. *Unpublished mimeo*.

Bastian, J. and Lochner, L. (2020). The eitc and maternal time use: More time working and less time with kids? Technical report, National Bureau of Economic Research.

Bastian, J. and Michelmore, K. (2018). The long-term impact of the earned income tax credit on children's education and employment outcomes. *Journal of Labor Economics*, 36(4):1127–1163.

Baughman, R. and Dickert-Conlin, S. (2009). The earned income tax credit and fertility. *Journal of Population Economics*, 22(3):537–563.

Baydar, N. and Brooks-Gunn, J. (1991). Effects of maternal employment and child-care arrangements on preschoolers' cognitive and behavioral outcomes: Evidence from the children of the national longitudinal survey of youth. *Developmental Psychology*, 27(6):932.

Belsky, J. (1988). The "effects" of infant day care reconsidered. *Early Childhood Research Quarterly*, 3(3):235–272.

Bergmann, B. R. (1996). *Saving our children from poverty: What the United States can learn from France*. Russell Sage Foundation.

Bernal, R. (2008). The effect of maternal employment and child care on children's cognitive development. *International Economic Review*, 49(4):1173–1209.

Bernal, R. and Keane, M. P. (2011). Child care choices and children's cognitive achievement: The case of single mothers. *Journal of Labor Economics*, 29(3):459–512.

Blau, D. and Currie, J. (2006). Pre-school, day care, and after-school care: who's minding the kids? *Handbook of the Economics of Education*, 2:1163–1278.

Blau, D. M. (1999). The effect of income on child development. *The Review of Economics and Statistics*, 81(2):261–276.

Blundell, R., Costa Dias, M., Meghir, C., and Shaw, J. (2016). Female labor supply, human capital, and welfare reform. *Econometrica*, 84(5):1705–1753.

Brooks-Gunn, J., Han, W.-J., and Waldfogel, J. (2002). Maternal employment and child cognitive outcomes in the first three years of life: The nichd study of early child care. *Child Development*, 73(4):1052–1072.

Chetty, R., Friedman, J. N., and Rockoff, J. E. (2011). New evidence on the long-term impacts of tax credits. *IRS Statistics of Income White Paper*.

Cunha, F. and Heckman, J. (2007). The technology of skill formation. *American Economic Review*, 97(2):31–47.

Dahl, G. B. and Lochner, L. (2012). The impact of family income on child achievement: Evidence from the earned income tax credit. *American Economic Review*, 102(5):1927–56.

De Chaisemartin, C. and d'Haultfoeuille, X. (2018). Fuzzy differences-in-differences. *The Review of Economic Studies*, 85(2):999–1028.

de Chaisemartin, C., D'Haultfœuille, X., and Guyonvarch, Y. (2019). Fuzzy differences-in-differences with stata. *The Stata Journal*, 19(2):435–458.

Deming, D. (2009). Early childhood intervention and life-cycle skill development: Evidence from head start. *American Economic Journal: Applied Economics*, 1(3):111–34.

Desai, S., Chase-Lansdale, P. L., and Michael, R. T. (1989). Mother or market? effects of maternal employment on the intellectual ability of 4-year-old children. *Demography*, 26(4):545–561.

Dickert, S., Houser, S., and Scholz, J. K. (1995). The earned income tax credit and transfer programs: a study of labor market and program participation. *Tax Policy and the Economy*, 9:1–50.

Dickert-Conlin, S. and Houser, S. (2002). Eitc and marriage. *National Tax Journal*, pages 25–40.

Duncan, G. J., Yeung, W. J., Brooks-Gunn, J., and Smith, J. R. (1998). How much does childhood poverty affect the life chances of children? *American Sociological Review*, pages 406–423.

Eissa, N. and Hoynes, H. W. (1999). Good news for low-income families? tax-transfer schemes and marriage. *polycopié, University of California, Berkeley*.

Eissa, N. and Hoynes, H. W. (2004). Taxes and the labor market participation of married couples: the earned income tax credit. *Journal of Public Economics*, 88(9-10):1931–1958.

Eissa, N. and Hoynes, H. W. (2006). Behavioral responses to taxes: Lessons from the eitc and labor supply. *Tax Policy and the Economy*, 20:73–110.

Eissa, N. and Liebman, J. B. (1996). Labor supply response to the earned income tax credit. *The Quarterly Journal of Economics*, 111(2):605–637.

Ellwood, D. T. (2000). The impact of the earned income tax credit and social policy reforms on work, marriage, and living arrangements. *National Tax Journal*, pages 1063–1105.

Felfe, C. and Hsin, A. (2012). Maternal work conditions and child development. *Economics of Education Review*, 31(6):1037–1057.

Fort, M., Ichino, A., and Zanella, G. (2016). Cognitive and non-cognitive costs of daycare 0–2 for girls.

Golombok, S., Zadeh, S., Imrie, S., Smith, V., and Freeman, T. (2016). Single mothers by choice: Mother–child relationships and children's psychological adjustment. *Journal of Family Psychology*, 30(4):409.

Heckman, J. J. and Rubinstein, Y. (2001). The importance of noncognitive skills: Lessons from the ged testing program. *American Economic Review*, 91(2):145–149.

Heim, B. T. (2010). The impact of the earned income tax credit on the labor supply of married couples: A structural estimation. *Manuscript. School of Public and Environmental Affairs, Indiana University, Bloomington, IN*.

Herbst, C. M. (2011). The impact of the earned income tax credit on marriage and divorce: Evidence from flow data. *Population research and Policy review*, 30(1):101–128.

Hotz, V. J., Mullin, C. H., Scholz, J. K., et al. (2001). The earned income tax credit and labor market participation of families on welfare. *Poverty Research News*, 5(3):13–15.

Hoynes, H., Miller, D., and Simon, D. (2015). Income, the earned income tax credit, and infant health. *American Economic Journal: Economic Policy*, 7(1):172–211.

Hoynes, H. W. and Patel, A. J. (2018). Effective policy for reducing poverty and inequality? the earned income tax credit and the distribution of income. *Journal of Human Resources*, 53(4):859–890.

James-Burdumy, S. (2005). The effect of maternal labor force participation on child development. *Journal of Labor Economics*, 23(1):177–211.

Kleven, H. (2019). The eitc and the extensive margin: A reappraisal. Technical report, National Bureau of Economic Research.

Levy, D. and Duncan, G. J. (2000). Using sibling samples to assess the effect of childhood family income on completed schooling. jcpr working paper.

Lim, K. and Michelmore, K. (2018). The eitc and self-employment among married mothers. *Labour Economics*, 55:98–115.

Ludwig, J. and Miller, D. L. (2007). Does head start improve children's life chances? evidence from a regression discontinuity design. *The Quarterly Journal of Economics*, 122(1):159–208.

Manoli, D. and Turner, N. (2018). Cash-on-hand and college enrollment: Evidence from population tax data and the earned income tax credit. *American Economic Journal: Economic Policy*, 10(2):242–71.

Markowitz, S., Komro, K. A., Livingston, M. D., Lenhart, O., and Wagenaar, A. C. (2017). Effects of state-level earned income tax credit laws in the us on maternal health behaviors and infant health outcomes. *Social Science & Medicine*, 194:67–75.

Meyer, B. D. (2010). The effects of the earned income tax credit and recent reforms. *Tax Policy and the Economy*, 24(1):153–180.

Meyer, B. D. and Rosenbaum, D. T. (2001). Welfare, the earned income tax credit, and the labor supply of single mothers. *The Quarterly Journal of Economics*, 116(3):1063–1114.

Neumark, D. and Wascher, W. (2000). Using the eitc to help poor families: New evidence and a comparision with the minimum wage. Technical report, National Bureau of Economic Research.

Neumark, D. and Wascher, W. (2011). Does a higher minimum wage enhance the effectiveness of the earned income tax credit? *ILR Review*, 64(4):712–746.

Olea, J. L. M. and Pflueger, C. (2013). A robust test for weak instruments. *Journal of Business & Economic Statistics*, 31(3):358–369.

Paxson, C. and Waldfogel, J. (2003). Welfare reforms, family resources, and child maltreatment. *Journal of Policy Analysis and Management*, 22(1):85–113.

Ruhm, C. J. (2004). Parental employment and child cognitive development. *Journal of Human resources*, 39(1):155–192.

Schildberg-Hoerisch, H. (2011). Does parental employment affect children's educational attainment? *Economics of Education Review*, 30(6):1456–1467.

Scholz, J. K. (1994). The earned income tax credit: Participation, compliance, and antipoverty effectiveness. *National Tax Journal*, pages 63–87.

Sherlock, R., Synnes, A., and Koehoorn, M. (2008). Working mothers and early childhood outcomes: Lessons from the canadian national longitudinal study on children and youth. *Early Human Development*, 84(4):237–242.

Vandell, D. L. and Ramanan, J. (1992). Effects of early and recent maternal employment on children from low-income families. *Child Development*, 63(4):938–949.

Yang, T.-T. (2018). Family labor supply and the timing of cash transfers evidence from the earned income tax credit. *Journal of Human Resources*, 53(2):445–473.

Zill, N. and Peterson, J. L. (1986). Behavior problems index. *Washington, DC: Child Trends*.

10 Tables and Figures

Table 1
Summary Statistics

Sample:	Children of Single Mothers		Children of Married Mothers	
	Mean	S.t.Dev	Mean	S.t.Dev
	(1)	(2)	(3)	(4)
1. Child Characteristics				
Combined PIAT Math and Reading Scores (average)	95.57	11.82	99.69	11.71
PIAT Math Scores	94.33	12.76	97.90	12.71
PIAT Reading Scores	96.72	14.23	101.36	14.10
Behavioral Problem Index	108.23	16.09	106.25	13.97
Motor and Social Development	99.29	14.84	99.80	14.55
Age of child (in months)	100.69	49.71	91.94	48.29
Male	0.51	0.50	0.50	0.50
Black	0.60	0.49	0.23	0.42
Hispanic	0.24	0.43	0.37	0.48
2. Household Charactersitcs				
Total net family income (truncated)	16058.27	13722.57	37018.94	19542.51
Nonwage income (truncated)	4599.55	10057.38	27226.07	17716.26
Total welfare amount (truncated)	4178.35	4221.77	549.42	1765.09
Number of family members in the housheold	4.07	1.60	4.73	1.33
Number of adults in the household	1.55	0.77	2.04	0.46
Number of children of mother in the household	2.68	1.26	2.70	1.19
Number of preschooler	1.53	1.07	1.51	1.02
Grandparents in the household	0.08	0.27	0.04	0.20
3. Mother Characteristics				
Age of mother	31.10	2.94	31.15	2.72
Education level	11.15	1.48	11.22	1.73
Positive annual working hours	0.60	0.49	0.76	0.43
Number of jobs held	1.11	1.06	1.36	0.97
Annual working hours	953.12	994.78	1203.34	949.30
Annual working hours (conditional on working)	1593.01	796.46	1579.47	767.23
Working fulltime (conditional on working)	0.58	0.49	0.56	0.50
Mother's earned income	13204.09	10033.05	13181.30	9063.12
Mother's earned income (conditional on working)	7280.38	9931.18	9243.45	9695.57
Observations	2258		3267	

Notes: This table shows the summary statistics of estimating sample. Data is from the children of the NLSY79 Child and Young Adults and linked to their mothers in the main NLSY79, which ranges from 1990 to 1996. The sample contains married and single mothers with children between age 25 and 39. I exclude mothers who were unable to work or who were in school. I also excluded married mothers whose spouses did not work or never worked. Women with negative unearned income were excluded as well. All dollar amounts are in 1996 dollars. The total net family income and total welfare amount are truncated at the top 2% level.

Table 2
Regression Results of Children's Cognitive Achievement

Dependent variables:	PIAT Math+Reading	PIAT Math	PIAT Reading
	(1)	(2)	(3)
Expansion in 1993 × Single	-0.1361***	-0.1016*	-0.1436**
	(0.0470)	(0.0528)	(0.0566)
Age of child	-0.0323***	-0.0325**	-0.0260***
	(0.0105)	(0.0129)	(0.0082)
Age of mother	1.2087	1.6195	0.4931
	(0.9478)	(1.0818)	(1.1281)
Age of mother squared	-0.0381	-0.0517	-0.0144
	(0.0300)	(0.0341)	(0.0359)
Age of mother cubed	0.0004	0.0005	0.0002
	(0.0003)	(0.0004)	(0.0004)
Nonwage income (last calendar year)	0.0010	-0.0011	0.0030
	(0.0037)	(0.0044)	(0.0043)
Constant	-10.3112	-14.4511	-3.5748
	(10.0078)	(11.5043)	(11.7834)
Child fixed effect	Yes	Yes	Yes
Year and region dummies	Yes	Yes	Yes
Number of children	1,829	1,832	1,849
Observations	3,753	3,773	3,812
R-squared	0.0201	0.0200	0.0154

Notes: Sample includes children of mothers with a high school education or less, and with expected household earnings below $30,000 in 1992. Data are from the children of the NLSY79 Child and Young Adults linked to their mothers in the main NLSY79, which ranges from 1990 to 1996. Expansion1993 equals one for 1994, and 1996. Single equals one if mother of child is single in 1992. I use nonwage income in terms of quadruple root instead of log to include samples with zero amounts. Robust standard errors in parentheses and clustered at the child level.***p <0.01, ** p <0.05, $*p$ <0.1

Table 3
Regression Results of Children's Noncognitive Achievement

Dependent variables:	Behavioral Problem Index	Motor and Social Development
	(1)	(2)
Expansion in 1993× Single	-0.0332	-0.6821**
	(0.0571)	(0.2780)
Age of child	0.0031	-0.0738*
	(0.0096)	(0.0391)
Age of mother	-0.2506	3.3181
	(1.0126)	(4.7355)
Age of mother squared	0.0075	-0.0858
	(0.0319)	(0.1532)
Age of mother cubed	-0.0001	0.0008
	(0.0003)	(0.0016)
Nonwage income (last calendar year)	0.0062	0.0042
	(0.0044)	(0.0157)
Constant	2.3945	-42.4780
	(10.7052)	(48.6067)
Child fixed effect	Yes	Yes
Year and region dummies	Yes	Yes
Number of children	1,995	798
Observations	4,233	1,081
R-squared	0.0151	0.0767

Notes: Sample includes children of mothers with a high school education or less, and with expected household earnings below $30,000 in 1992. Data are from the children of the NLSY79 Child and Young Adults linked to their mothers in the main NLSY79, which ranges from 1990 to 1996. Expansion1993 equals one for 1994, and 1996. Single equals one if mother of child is single in 1992. I use nonwage income in terms of quadruple root instead of log to include samples with zero amounts. Robust standard errors in parentheses and clustered at the child level.***p <0.01, ** p <0.05, $*p$ <0.1

Table 4
Tests for the Parallel Trends Assumption

Dependent Variables:	PIAT Math+Reading	Motor and Social Development
	(1)	(2)
Year 1992 × Single	0.0501	-0.2631
	(0.0497)	(0.2055)
Year 1994 × Single	-0.0758	-0.9509***
	(0.0583)	(0.3522)
Year 1996 × Single	-0.1564**	-0.8859*
	(0.0718)	(0.4729)
Child fixed effects	Yes	Yes
Year and region dummies	Yes	Yes
Controls	Yes	Yes
Number of children	1,829	798
Observations	3,753	1,081
R-squared	0.0215	0.0818

Notes: Sample includes children of mothers with a high school education or less, and with expected household earnings below $30,000 in 1992. Data are from the children of the NLSY79 Child and Young Adults linked to their mothers in the main NLSY79, which ranges from 1990 to 1996. Expansion1993 equals one for 1994, and 1996. Single equals one if mother of child is single in 1992. I use nonwage income in terms of quadruple root instead of log to include samples with zero amounts. Robust standard errors in parentheses and clustered at the child level.$^{***}p$ <0.01, ** p <0.05, $*p$ <0.1

Table 5
Placebo Tests with Children of Mothers with High-Income Levels

Dependent variables:	PIAT Math + Reading	Motor and Social Development
	(1)	(2)
Expansion in 1993× Single	-0.0570	-0.2975
	(0.0513)	(0.2402)
Age of child	-0.0155	-0.0576
	(0.0141)	(0.0391)
Age of mother	-0.5794	-6.1077*
	(0.8468)	(3.3454)
Age of mother squared	0.0135	0.1997*
	(0.0261)	(0.1049)
Age of mother cubed	-0.0001	-0.0022**
	(0.0003)	(0.0011)
Nonwage income (last calendar year)	0.0020	0.0172
	(0.0045)	(0.0182)
Constant	9.7211	61.0221*
	(9.1649)	(35.5721)
Child fixed effect	Yes	Yes
Year and region dummies	Yes	Yes
Number of children	2,127	1,341
Observations	4,361	1,895
R-squared	0.0119	0.0387

Notes: Sample includes children with expected household earned income larger than $30,000 in 1992. Data is from the children of the NLSY79 Child and Young Adults and linked to their mothers in the main NLSY79, which ranges from 1990 to 1996. Single equals one if mother of child is single in 1992. I use nonwage income in terms of quadruple root instead of log to include samples with zero amounts. Robust standard errors in parenthesis and clustered at the child level.***p <0.01, ** p <0.05, $*p$ <0.1.

Table 6
Robustness of the Estimates

Dependent variable:	PIAT Math +Reading	Motor and Social Development
	(1)	(2)
A. Baseline sample	-0.1361***	-0.6821**
	(0.0470)	(0.2780)
B. State dummies & State × Year dummies	-0.1218**	-0.7580**
	(0.0517)	(0.2780)
C. Mothers with constant marital status	-0.2080***	-0.4318
	(0.0597)	(0.3441)
D. Unmarried single mothers	-0.2298***	-0.7664***
	(0.0525)	(0.2894)
E. Presence of Grand Parents	-0.1320***	-0.6647**
	(0.0478)	(0.2876)
Child fixed effect	Yes	Yes
Year and region dummies	Yes	Yes

Notes: Specifications identical to those in Table 2 and 3. Estimates of treatment effect, Expnasion in 1993 × Single. Specification A repeats the results in Tables 2 and 3. Specification B includes state dummies and state dummies interacted by year dummies to capture the effects of state-level welfare waivers. Specification C is a regression with children of mothers with constant marital status. Specification D is a regression with children of single mothers who have never married for the treatment group. Control group is identical. Specification E includes a dummy variable for the presence of grandparents and interactions among dummy variables of the presence of grandparents, children of single mothers and years after 1993. Table 9 shows the results in detail. Standard errors (in parentheses) are robust for heteroskedasticity and clustered at the child level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 7
Impacts of Child Care (Presence of Grandparents in the Households)

Dependent variables:	PIAT Math + Reading	Motor and Social Development
	(1)	(2)
Expansion in 1993 × Single	-0.1320***	-0.6647**
	(0.0478)	(0.2876)
Expansion in 1993 × Single × Grandparents	-0.0676	-0.5825
	(0.1824)	(0.4394)
Grandparents in the household	-0.0021	-0.0120
	(0.0958)	(0.4801)
Age of child	-0.0323***	-0.0746*
	(0.0105)	(0.0389)
Age of mother	1.2046	3.3221
	(0.9471)	(4.7698)
Age of mother squared	-0.0380	-0.0862
	(0.0300)	(0.1544)
Age of mother cubed	0.0004	0.0008
	(0.0003)	(0.0017)
Nonwage income (last calendar year)	0.0010	0.0040
	(0.0037)	(0.0162)
Constant	-10.2645	-42.4796
	(10.0025)	(48.9479)
Child fixed effect	Yes	Yes
Year and region dummies	Yes	Yes
Number of children	1,829	798
Observations	3,753	1,081
R-squared	0.0202	0.0774

Notes: The sample is children of mothers with a high school education or less, and had expected income less than $30,000 in 1992. Data from survey years 1990 to 1996 of the matched data of NLSY79 and NLSY79 Child and Young Adults. Expansion1993 equals one for 1994, and 1996. Single in 1992 equals one if mother of child is single. I use nonwage income in terms of quadruple root instead of log to include samples with zero amounts. Robust standard errors in parentheses and clustered at the child level.$^{***}p<0.01$, ** $p<0.05$, $*p<0.1$

Table 8
Impact of the EITC on Change in Marital Status

Dependent variable:	Any Change in Marital Status		
Samples:	All Mothers	Single Mothers	Married Mothers
	(1)	(2)	(3)
Expansion in 1993 × Low education	0.0029	0.0067	0.0120
	(0.0095)	(0.0257)	(0.0087)
Age of mother	0.1855	0.4143	-0.0008
	(0.1943)	(0.3928)	(0.1991)
Age of mother squared	-0.0052	-0.0129	0.0007
	(0.0060)	(0.0121)	(0.0061)
Age of mother trupple	0.0001	0.0001	-0.0000
	(0.0001)	(0.0001)	(0.0001)
Nonwage income (truncated)	-0.0304***	-0.0278***	-0.0301***
	(0.0016)	(0.0021)	(0.0024)
Constant	-1.6886	-3.4395	0.0735
	(2.1146)	(4.2615)	(2.1667)
Mother fixed effect	Yes	Yes	Yes
Year and region dummies	Yes	Yes	Yes
Number of mothers	2,763	871	1,781
Observations	9,231	2,763	6,265
R-squared	0.2286	0.2596	0.2682

Notes: Sample includes all mothers. Data comes from survey years 1990 to 1996 of NLSY79. Dependent variable is a dummy variable equal to one if the mother is single. Expansion1993 equals one for 1994, and 1996. Low education equals one if mother has a high school education or less. I use nonwage income in terms of quadruple root instead of log to include samples with zero amounts. Robust standard errors in parenthesis and clustered at the mother level.$^{***}p$ <0.01, ** p <0.05, $*p$ <0.1.

Table 9
Impact of the EITC on Probability to be Single Mothers

Dependent variable:	Being Single Mothers		
Samples:	All Mothers	Single Mothers	Married Mothers
	(1)	(2)	(3)
Expansion × Low education	0.0024	0.0079	0.0103
	(0.0093)	(0.0256)	(0.0085)
Age of mother	0.1689	0.4177	-0.0068
	(0.1915)	(0.3915)	(0.1950)
Age of mother squared	-0.0048	-0.0131	0.0008
	(0.0059)	(0.0121)	(0.0060)
Age of mother cubed	0.0001	0.0001	-0.0000
	(0.0001)	(0.0001)	(0.0001)
Nonwage income (truncated)	-0.0305***	-0.0277***	-0.0304***
	(0.0016)	(0.0020)	(0.0024)
Constant	-1.4783	-3.4329	0.1838
	(2.0823)	(4.2463)	(2.1200)
Mother fixed effect	Yes	Yes	Yes
Year and region dummies	Yes	Yes	Yes
Number of mothers	2,857	880	1,860
Observations	9,517	2,789	6,518
R-squared	0.2294	0.2604	0.2695

Notes: Sample includes all mothers. Data comes from survey years 1990 to 1996 of NLSY79. Dependent variable is a dummy variable equal to one if mothers change the marital status. Expansion1993 equals one for 1994, and 1996. Low education equals one if mother has a high school education or less. I use nonwage income in terms of quadruple root instead of log to include samples with zero amounts. Robust standard errors in parentheses and clustered at the mother level.$^{***}p<0.01$, ** $p<0.05$, $*p<0.1$.

Table 10
Changes in the Mothers' Labor Supply

Samples:	All Mothers		Working Mothers	
Dependent Variables:	Positive Working Hours	Having a Job	Annual Working Hours	Working As Full Time
	(1)	(2)	(3)	(4)
Expansion in 1993 × Single	0.0496*	0.0513**	-25.2120	0.0137
	(0.0265)	(0.0261)	(60.5966)	(0.0371)
Mother fixed effect	Yes	Yes	Yes	Yes
Year and region dummies	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Number of mothers	959	959	803	803
Observations	3,268	3,268	2,495	2,495
R-squared	0.0070	0.0087	0.0108	0.0159

Notes: Sample is the mothers of the estimating sample children for the combined reading and math scores, the BPI and the MSD. Data from survey years 1990 to 1996 of the matched data of NLSY79 and NLSY79 Child and Young Adults. Expansion1993 equals one for 1994, and 1996. Single in 1992 equals one if the mother is single. I use nonwage income in terms of quadruple root instead of log to include samples with zero amounts. Standard errors (in parenthesis) are robust for heteroskedasticity and clustered at the mother level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 11
Changes in the Other Income Sources

Dependent Variables:	Sum	Mother's Wages and Salaries	Welfare	Imputed EITC
	(1)+(2)+(3)	(1)	(2)	(3)
Expansion in 1993 × Single	-497.1784	144.9330	-504.9465***	351.7840***
	(623.4318)	(556.5022)	(110.3567)	(68.3750)
Mother fixed effect	Yes	Yes	Yes	Yes
Year and region dummies	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Number of mothers	947	959	959	947
Observations	2,489	3,268	3,268	2,489
R-squared	0.0397	0.0214	0.0386	0.1586

Notes: Sample is the mothers of the estimating sample children for the combined reading and math scores, the BPI and the MSD. Data from survey years 1990 to 1996 of the matched data of NLSY79 and NLSY79 Child and Young Adults. Expansion1993 equals one for 1994, and 1996. Single in 1992 equals one if the mother is single. I calculated the imputed EITC benefits using the TAXSIM program (version 27) maintained by Daniel Freenberg and the National Bureau of Economic Research. I use nonwage income in terms of quadruple root instead of log to include samples with zero amounts. Standard errors (in parentheses) are robust for heteroskedasticity and clustered at the mother level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 12
Changes in Home Environment

Dependent Variables:	HOME-SF Score	Cognitive Stimulation	Emotional Support
	(1)	(2)	(3)
Expansion in 1993 × Single	-14.1150	-29.0268***	-1.9803
	(8.8504)	(9.5484)	(10.2542)
Child fixed effects	Yes	Yes	Yes
Year and region dummies	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Number of children	2,301	2,267	2,176
Observation	5,222	5,037	4,647
R-squared	0.0176	0.0119	0.0205

Notes: Sample is the estimating sample children for the combined reading and math scores, the BPI and the MSD. Dependent variables include the HOME-SF score and two subscores, cognitive stimulation and emotional support. The HOME-SF represents the Home Observation Measurement of the Environment-Short Form. The HOME-SF is the primary measure of the quality of a child's home environment included in the NLSY79 child survey. Data from survey years 1990 to 1996 of the matched data of NLSY79 and NLSY79 Child and Young Adults. Expansion1993 equals one for 1994, and 1996. Single in 1992 equals one if mother of child is single. I use nonwage income in terms of quadruple root instead of log to include samples with zero amounts. Standard errors (in parentheses) are robust for heteroskedasticity and clustered at the child level. $***p < 0.01$, $**p < 0.05$, $*p < 0.1$.

Table 13
Changes in Cognitive Stimulation Related to Time Inputs (detailed)

Dependent variables:	Discuss TV Programs with Child	Took Child to Musical/Theatrical Performance Last Year
Sample:	6-9 years	Older than 10 years old
	(1)	(2)
Expansion in 1993 × Single	-0.1596**	-0.1272*
	(0.0716)	(0.0673)
Child fixed effect	Yes	Yes
Year and region dummies	Yes	Yes
Controls	Yes	Yes
Number of children	1,188	1,227
Observations	1,684	1,934
R-squared	0.0257	0.1753

Notes: Samples are children who are 6-9 or 10-14 years old, and whose mothers have a high school education or less, and have expected household earnings below $30,000 in 1992. Data from survey years 1990 to 1996 of the matched data of NLSY79 and NLSY79 Child and Young Adults. Expansion1993 equals one for 1994, and 1996. Single in 1992 equals one if mother of child is single. I use nonwage income in terms of quadruple root instead of log to include samples with zero amounts. Robust standard errors in parentheses and clustered at the child level.$***p$ <0.01, ** p <0.05, $*p$ <0.1

Table 14
Changes in Cognitive Stimulation Related to Goods Inputs (detailed)

Dependent variables:	Have More Than Ten Books	Have More Than Twenty Books	Musical Instrument for Child	
Sample:	6-9 years old	10-14 years old	6-9 years old	10-14 years old
	(1)	(2)	(3)	(4)
Expansion in 1993 × Single	-0.0356	0.0868	0.0252	-0.0372
	(0.0636)	(0.0660)	(0.0754)	(0.0696)
Child fixed effect	Yes	Yes	Yes	Yes
Year and region dummies	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Number of children	1,197	1,230	1,195	1,227
Observations	1,700	1,929	1,701	1,925
R-squared	0.0346	0.0349	0.0230	0.0173

Notes: Samples are children who are 6-9 years old or 10-14 years old. Data from survey years 1990 to 1996 of the matched data of NLSY79 and NLSY79 Child and Young Adults. Expansion1993 equals one for 1994, and 1996. Single in 1992 equals one if mother of child is single. I use nonwage income in terms of quadruple root instead of log to include samples with zero amounts. Standard errors (in parentheses) are robust for heteroskedasticity and clustered at the child level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 15
Correlation between Home Indexes and Child Development Measures

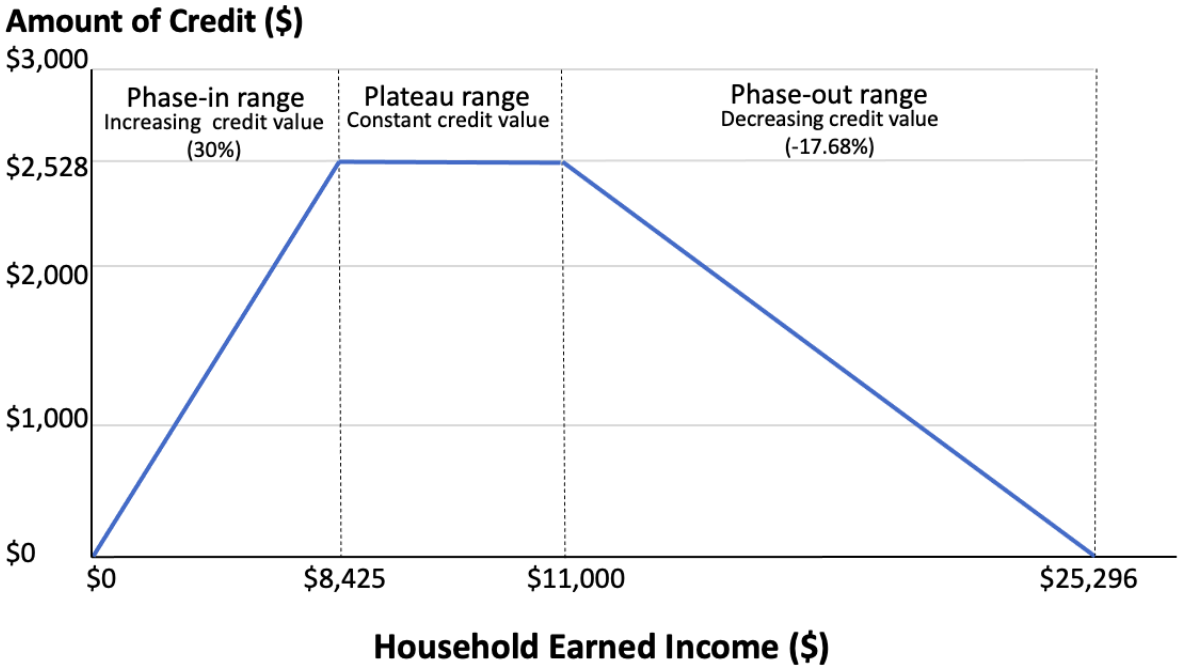
	PIAT Math+Reading	Reading	Math	Motor Social Development (MSD)
Home Index	0.3311*	0.2898*	0.3007*	0.2635*
Cognitive Stimulation Index	0.3217*	0.2869*	0.2860*	0.2624*
Discuss TV Programs with Child (6-9 years)	0.1488*	0.1214*	0.1466*	
Took Child to Musical/Theatrical Performances (Older than 10)	0.0988*	0.0865*	0.0872*	

Table 16
Fuzzy DID Estimates for Combined PIAT Math and Reading Scores

Dependent variables:	PIAT Math +Reading		
Samples:	All mothers	Single mothers	Married mothers
	(1)	(2)	(3)
Expansion in 1993 × Phase-in Range (D)	0.2343	-1.8200***	0.4701
	(0.5071)	(0.2850)	(0.4652)
Age of child	-0.0152	-0.1131**	0.0133
	(0.0208)	(0.0507)	(0.0281)
Age of mother	-1.9414	-3.3429	-4.2968*
	(1.9804)	(3.7865)	(2.1935)
Age of mother squared	0.0584	0.0964	0.1372**
	(0.0619)	(0.1166)	(0.0682)
Age of mother cubed	-0.0006	-0.0009	-0.0014**
	(0.0006)	(0.0012)	(0.0007)
Nonwage income (truncated)	0.0011	-0.0090	0.0037
	(0.0067)	(0.0099)	(0.0114)
Cragg-Donald Wald F statistic	30.436	2.126	36.182
Kleibergen-Paap rk Wald F statistic	27.927	64.403	24.793
Child fixed effects	Yes	Yes	Yes
Year dummies and region dummies	Yes	Yes	Yes
Number of children	363	181	182
Observations	951	464	487
R-squared	0.0457	-0.8950	0.0658

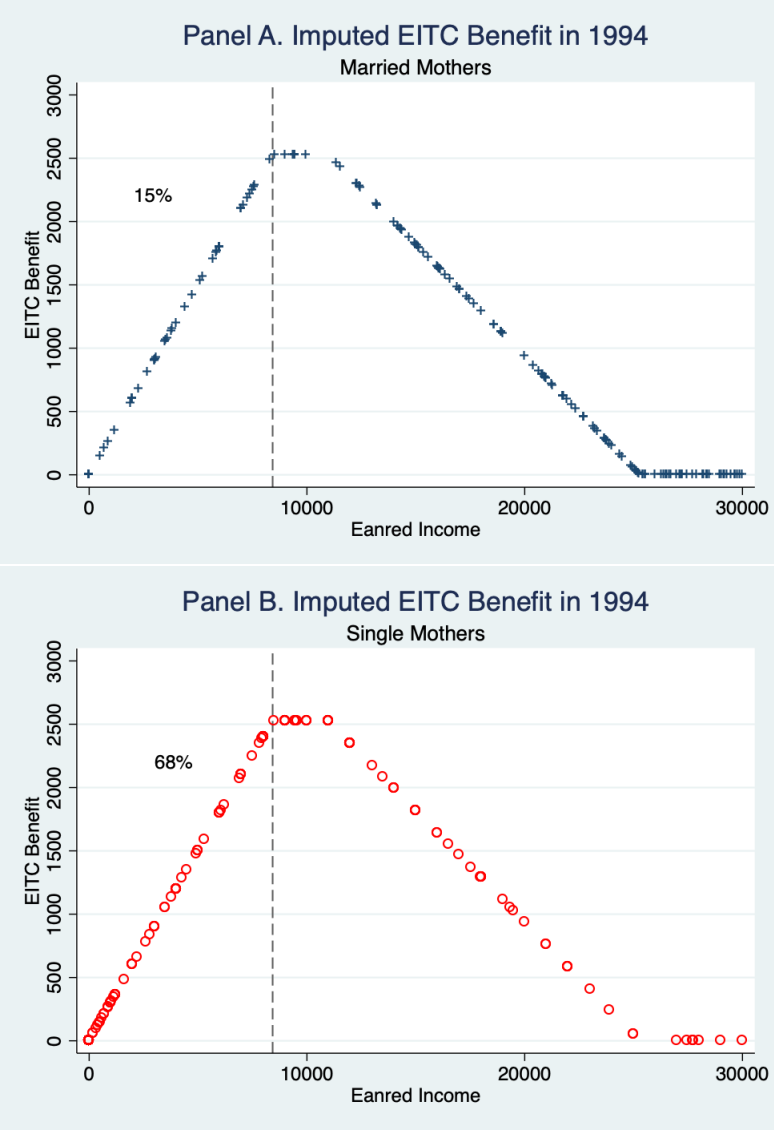
Notes: Samples are children with expected household earnings below $24,000. Data from survey years 1990 to 1996 of the matched data of NLSY79 and NLSY79 Child and Young Adults. Expansion1993 equals one for 1994, and 1996. Phase-in Range equals one if the children are in the household with the household earnings below $8,000, and they are in the phase-in range in 1993. I use predicted value for Expansion1993 × phase-in range by using exogenous treatment status variable (G) which is based on the predicted earned income. I use nonwage income in terms of quadruple root instead of log to include samples with zero amount. Standard errors (in parenthesis) are robust for heteroskedasticity and clustered at the child level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Figure 1
The EITC Benefit Schedule in 1994 for families with two children



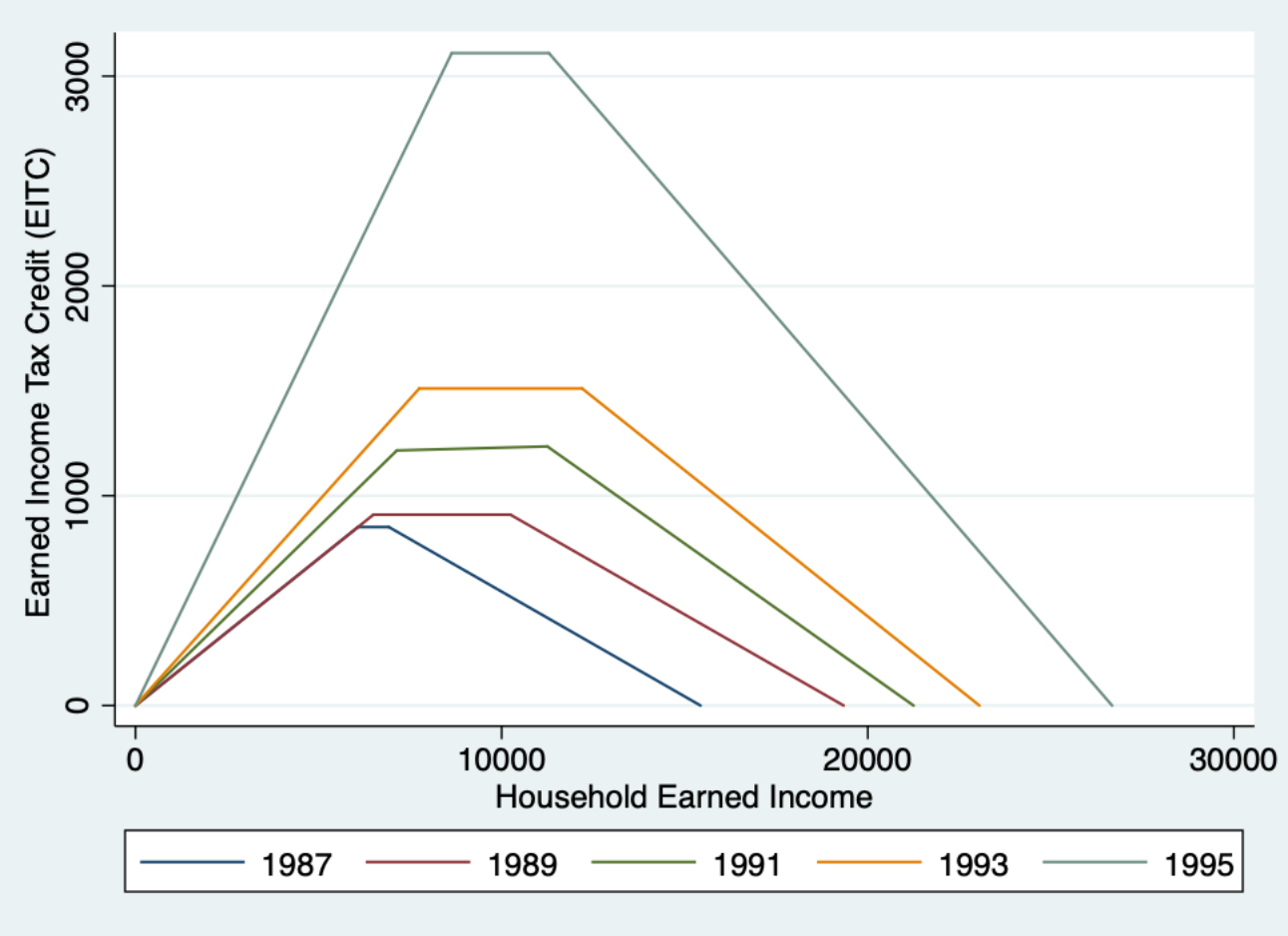
Notes: The figure shows the EITC benefit schedule in 1994 for families with more than two children. There are three regions in the EITC benefit schedule: the phase-in, plateau and phase-out ranges. The benefit increases with earned income upto a certain point (phase-in range), stays the same and decreases afterwards (plateau and phase-out ranges). The phase-in rate was 30% in 1994, which means people in the range received 30 cents per a dollar of earned income. The phase-out tate was 17.68%, which means the EITC benefit decreased by 17.68 cents per a dollar of earned income. The clear (extensive margin) work incentives exist only within the phase-in range.

Figure 2
Distribution of Family Incomes and Imputed EITC Benefits–Households with More than Two Children



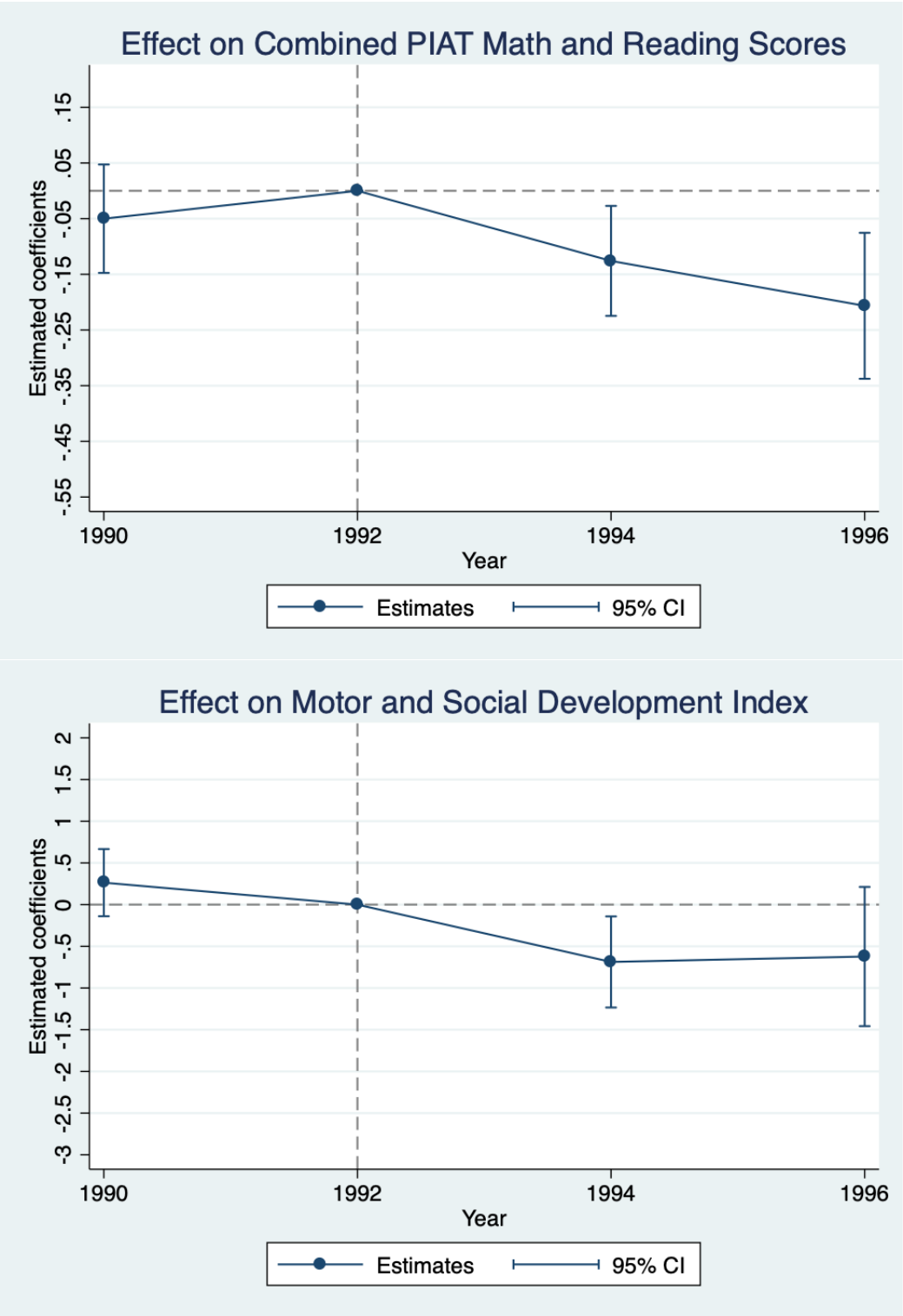
Notes: Sample is the mothers with a high school education or less, and had expected incomes less than $30,000 in 1992. Gray vertical dashed line indicates the end of the phase-in range of the EITC benefit schedule in 1994, $8,425. The single mothers are located themselves within the phase-in range more frequently compared to married mothers (68% compared to 15%). It suggests that single mothers have more incentives for participating in the labor force.

Figure 3
Expansions of Earned Income Tax Credit for Families with More than Two Children in the 1990s



Notes: The figure shows the changes in the federal EITC schedule for families with two children. I calculated the EITC benfits over time using the TAXSIM program (version 27) maintained by Daniel Freenberg and the National Bureau of Economic Research. This picture shows how EITC has expanded through a series of expansions in terms of maximum benefit amounts and coverage. The big jump from the EITC benefit schedule of 1993 to that of 1994 was due to the EITC expansion in 1993.

Figure 4
Estimated Effect of the EITC for Years Before and After the 1993 Expansion



Notes: These figures show that children of married and single mothers shared common trends in combined PIAT Math and Reading scores and the MSD before 1993. After 1993, there were relative reductions in the scores of single mother's children.

A Appendix: Fuzzy DID Estimation

In this appendix, I explain the alternative specification where I use an income threshold to determine the treatment status with the Fuzzy DID method. The idea behind this is that as single mothers in the phase-in range in 1994 have larger work incentives due to the 1993 EITC expansion, their children have less time with their mothers, which possibly affects child development. Children in plateau or phase-out ranges do not have the same impacts as the expansion decreases the labor supply incentives for their mothers.

For the treatment group, I use single mothers' children on the phase-in range in 1994 as their household earned incomes were less than $8,000 in 1993. The control group is single mothers' children in plateau or phase-out ranges in 1994 as their household earned incomes were between $8,000 and $24,000 in 1993.

To determine the treatment status, I use expected household earned incomes instead of actual incomes. As earned incomes depend on mothers' labor supply decisions, treatment based on it will be endogenous. I estimate the expected household earned incomes based on mothers' age, education, and ethnicity.

However, using the predicted incomes does have costs; it makes the DID design fuzzy. As the predicted income is not the same as the actual earned income, treatment status based on the predicted income might not be the same as the actual treatment. For instance, if the actual income levels are less than $8,000 but the predicted incomes are $8,050, the treatment status is zero while they are treated.

Empirical Model: Fuzzy DID To deal with the possible fuzziness in the standard sharp DID approach, I use the fuzzy DID approach. The fuzzy DID approach links an actual (observed) treatment with treatment status by using the following IV strategy:

First Stage:

$$D_{it} = \alpha_1 + \beta_1 G_i \times Expansion1993_t + X'_{it}\delta_1 + Z_i + \lambda_t + u_{it} \tag{6}$$

Second Stage:

$$y_{it} = \alpha_2 + \beta_2 D_{it} + X'_{it}\delta_1 + Z_i + \lambda_t + \varepsilon_{it}, \tag{7}$$

where y_{it} is child i's academic score at time t. $G_i \times Expansion1993_t$ is the treatment status based on predicted incomes, and D_{it} is observed treatment based on actual incomes. G_i equals one if predicted household income is less than or equal to $8,000. $Expansion1993_t$ equals one if the year is after 1993. D_{it} equals one only when the actual household income

is less than or equal to \$8,000, and the time is after 1993. The control variables in X_{it} include child characteristics (ages of children), mother characteristics (ages of mothers), nonwage income, and area characteristics (SMSAs). Z_i controls for child fixed effects such as children's characteristics (sex, race, and unobservable ability) and mothers' characteristics (education level, race, and marital status) and λ_t controls for time effect. In this model, I fix the fuzziness in $Gi \times Expansion1993_t$ by utilizing the information on D_{it}.

Results Table A1 shows the Fuzzy DID estimation results for the combined PIAT Math and Reading scores. I analyze for children of all mothers, single mothers, and married mothers. The first stages are strong for three samples and have large Kleibergen-Papp F statistics.[21] For single mothers' children in Column 2, I found that children of single mothers on the phase-in range have lower scores compared to those on the plateau or phase-out ranges by -1.8 standard deviation. It is larger than the DID specification based on the marital status in Section 3 (-0.1361). For children of married mothers, the result is not the same. Married mothers' children on the phase-in range increase by 0.47 standard deviation in the scores.[22] One explanation is that as low-income married mothers are usually secondary earners, their spouses work more and have higher incomes, while married mothers stay at home.

For now, as I have not explored the related mechanisms fully such as changes in mothers' labor supply or household earned income, I should interpret the results with caution. However, it seems apparent that the EITC has differential impacts on children of single and married mothers. This is consistent with the results in the DID approach using mothers' marital status for the treatment status, where the EITC had negative impacts only on the children of single mothers.

[21] As Andrews et al. (2019) notes when there is only one instrument variable, an effective first-stage F-statistics of Olea and Pflueger (2013) equals a robust first-stage F-statistics, Kleibergen-Paap F-statistics. Thus, we should compare the Kleibergen-Paap F-statistics to the Stock-Yogo critical values. The Kleibergen-Paap F-statistic for single mothers' children is larger than the critical value for 10% maximal IV size, and The Kleibergen-Paap F-statistic for all and married mothers' children are larger than the critical value for 15% maximal IV size.

[22] The estimates are Wald-DID. To insist that the estimates are the Local Average Treatment Effect (LATE), I need to show additional two conditions: common trends assumption and stable treatment effect over time. For more details about the assumptions please refer to De Chaisemartin and d'Haultfoeuille (2018) and de Chaisemartin et al. (2019).

Table A1
Fuzzy DID Estimates for Combined PIAT Math and Reading Scores

Dependent variables:	PIAT Math +Reading		
Samples:	All mothers	Single mothers	Married mothers
	(1)	(2)	(3)
Expansion in 1993 × Phase-in Range (D)	0.2343	-1.8200***	0.4701
	(0.5071)	(0.2850)	(0.4652)
Cragg-Donald Wald F statistic	30.436	2.126	36.182
Kleibergen-Paap rk Wald F statistic	27.927	64.403	24.793
Child fixed effects	Yes	Yes	Yes
Year dummies and region dummies	Yes	Yes	Yes
Number of children	363	181	182
Observations	951	464	487
R-squared	0.0457	-0.8950	0.0658

Notes: Samples are children with expected household earnings below $24,000. Data from survey years 1990 to 1996 of the matched data of NLSY79 and NLSY79 Child and Young Adults. Expansion1993 equals one for 1994, and 1996. Phase-in Range equals one if the children are in the household with the household earnings below $8,000, and they are in the phase-in range in 1993. I use predicted value for Expansion1993 × phase-in range by using exogenous treatment status variable (G) which is based on the predicted earned income. I use nonwage income in terms of quadruple root instead of log to include samples with zero amount. Standard errors (in parenthesis) are robust for heteroskedasticity and clustered at the child level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table A2
Fuzzy DID Estimates for Combined PIAT Math and Reading Scores

Dependent variables:	PIAT Math +Reading		
Samples:	All mothers	Single mothers	Married mothers
	(1)	(2)	(3)
Expansion in 1993 × Phase-in Range (D)	-0.0331	-2.3294***	0.2893
	(0.4596)	(0.2878)	(0.4323)
Kleibergen-Paap rk LM statistic	12.550	1.023	13.742
Kleibergen-Paap rk Wald F statistic	308.636	94.027	241.082
Child fixed effects	Yes	Yes	Yes
Year dummies and region dummies	Yes	Yes	Yes
Number of children	403	218	185
Observations	1109	606	503
R-squared	0.0491	-1.1154	0.0749

Table A3
Fuzzy DID Estimates for Mothers' Labor Supply

Sample	Single Mothers		Married Mothers	
Dependent variables:	Labor Force Participation	Annual Working Hours	Labor Force Participation	Annual Working Hours
	(1)	(2)	(3)	(4)
Expansion in 1993 × Phase-in Range (D)	0.7368***	-578.5155*	0.2450	-1,631.3913
	(0.1733)	(335.0932)	(0.3129)	(1,206.3642)
Kleibergen-Paap rk LM statistic	1.014	1.014	4.913	4.913
Kleibergen-Paap rk Wald F statistic	42.698	42.698	79.011	79.011
Mother fixed effects	Yes	Yes	Yes	Yes
Year dummies and region dummies	Yes	Yes	Yes	Yes
Number of mothers	180	180	155	155
Observations	461	461	397	397
R-squared	-0.1494	0.0390	0.0322	-0.0433

B Appendix: Additional Tables

Table B1
DID Regression Results of Children's Cognitive Achievements
(Additional Controls)

Dependent variables:	PIAT Math+Reading	PIAT Math	PIAT Reading
	(1)	(2)	(3)
Expansion in 1993 × Single	-0.1317***	-0.1140**	-0.1176**
	(0.0481)	(0.0544)	(0.0575)
Child fixed effect	Yes	Yes	Yes
Year and region dummies	Yes	Yes	Yes
Controls	Additional	Additional	Additional
Number of children	1,795	1,814	1,800
Observations	3,612	3,667	3,632
R-squared	0.0256	0.0203	0.0275

Notes: The sample is children of mothers with a high school education or less, and had expected income less than $30,000 in 1992. Data from survey years 1990 to 1996 of the matched data of NLSY79 and NLSY79 Child and Young Adults. Expansion1993 equals one for 1994, and 1996. Single in 1992 equals one if mother of child is single.I use nonwage income in terms of quadruple root instead of log to include samples with zero amounts. Additional control variables are on household composition such as ages of the youngest child in the household, number of family members (adults, children, children in certain age groups, adults who worked), and a dummy variable for living with grandparents. Robust standard errors in parentheses and clustered at the child level.***p <0.01, ** p <0.05, $*p$ <0.1

Table B2
Regression Results of Children's Noncognitive Achievement (Additional Controls)

Dependent variables:	Behavioral Problem Index	Motor and Social Development
	(1)	(2)
Expansion in 1993× Single	-0.0519	-0.7064**
	(0.0588)	(0.1764)
Child fixed effect	Yes	Yes
Year and region dummies	Yes	Yes
Controls	Additional	Additional
Number of children	1,995	778
Observations	4,061	1,040
R-squared	0.0303	0.1764

Notes: Sample includes children of mothers with a high school education or less, and with expected household earnings below $30,000 in 1992. Data are from the children of the NLSY79 Child and Young Adults linked to their mothers in the main NLSY79, which ranges from 1990 to 1996. Expansion1993 equals one for 1994, and 1996. Single equals one if mother of child is single in 1992. Additional control variables are on household composition such as ages of the youngest child in the household, number of family members (adults, children, children in certain age groups, adults who worked), and a dummy variable for living with grandparents. I use nonwage income in terms of quadruple root instead of log to include samples with zero amounts. Robust standard errors in parentheses and clustered at the child level.***p <0.01, ** p <0.05, $*p$ <0.1

Table B3
DID Regression Results of Children's Cognitive Achievements (By Age)

Dependent variables:	PIAT Math+Reading		
Samples:	All	5-12 years	Older than 12 years old
		(1)	(2)
Expansion in 1993 × Single	-0.1361***	-0.1429***	-0.0662
	(0.0470)	(0.0502)	(0.1200)
Child fixed effect	Yes	Yes	Yes
Year and region dummies	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Number of children	1,829	1,353	477
Observations	3,753	2,981	773
R-squared	0.0201	0.023	0.0284

Notes: Sample includes children of mothers with a high school education or less, and with expected household earnings below $30,000 in 1992. Data are from the children of the NLSY79 Child and Young Adults linked to their mothers in the main NLSY79, which ranges from 1990 to 1996. Expansion1993 equals one for 1994, and 1996. Single equals one if mother of child is single in 1992. The control variables include child characteristics (ages of children), mother characteristics (ages of mothers), nonwage income, and region dummies. I use nonwage income in terms of quadruple root instead of log to include samples with zero amounts. Robust standard errors in parentheses and clustered at the child level.$^{***}p<0.01$, ** $p<0.05$, $*p<0.1$

Table B4
DID Regression Results of Children's Cognitive Achievements (By Ethnicity)

Dependent variables:	PIAT Math+Reading		
Samples:	All	Non-White	White
		(2)	(3)
Expansion in 1993 × Single	-0.1361***	-0.1356**	0.0306
	(0.0470)	(0.0550)	(0.1028)
Child fixed effect	Yes	Yes	Yes
Year and region dummies	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Number of children	1,829	1,349	480
Observations	3,753	2,716	1,037
R-squared	0.0256	0.0280	0.0395

Notes: Sample includes children of mothers with a high school education or less, and with expected household earnings below $30,000 in 1992. Data are from the children of the NLSY79 Child and Young Adults linked to their mothers in the main NLSY79, which ranges from 1990 to 1996. Expansion1993 equals one for 1994, and 1996. Single equals one if mother of child is single in 1992. The control variables include child characteristics (ages of children), mother characteristics (ages of mothers), nonwage income, and region dummies. I use nonwage income in terms of quadruple root instead of log to include samples with zero amounts. Robust standard errors in parentheses and clustered at the child level.$^{***}p<0.01$, ** $p<0.05$, $*p<0.1$

Table B5
DID Regression Results of Children's Non-cognitive Achievement (By Ethnicity)

Dependent variables:	Motor Social Development		
Samples:	All	Non-White	White
		(2)	(3)
Expansion in 1993 × Single	-0.6820**	-0.6898*	-0.4828
	(0.2780)	(0.3928)	(0.6053)
Child fixed effect	Yes	Yes	Yes
Year and region dummies	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Number of children	798	489	309
Observations	1,081	646	435
R-squared	0.0767	0.1129	0.1371

Notes: Sample includes children of mothers with a high school education or less, and with expected household earnings below $30,000 in 1992. Data are from the children of the NLSY79 Child and Young Adults linked to their mothers in the main NLSY79, which ranges from 1990 to 1996. Expansion1993 equals one for 1994, and 1996. Single equals one if mother of child is single in 1992. The control variables include child characteristics (ages of children), mother characteristics (ages of mothers), nonwage income, and region dummies. I use nonwage income in terms of quadruple root instead of log to include samples with zero amounts. Robust standard errors in parentheses and clustered at the child level.$^{***}p<0.01$, ** $p<0.05$, $*p<0.1$