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EMPLOYMENT OF SINGLE MOTHERS: CHILD CARE COSTS AND THE EFFECTIVENESS OF THE EITC

Salma Begum

University of Kentucky, salma_begum_nsu@yahoo.com

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Salma Begum, Student

Dr. Christopher Bollinger, Major Professor

Dr. Aaron Yelowitz, Director of Graduate Studies

EMPLOYMENT OF SINGLE MOTHERS: CHILD CARE COSTS AND
THE EFFECTIVENESS OF THE EITC

DISSERTATION

A dissertation submitted in partial fulfillment of the
Requirements for the degree of Doctor of Philosophy in the
College of Business and Economics
at the University of Kentucky

By

Salma Begum

Lexington, KY

Director: Dr. Christopher Bollinger, Gatton Endowed Professor of Economics
And
Director, Center for Business and Economics Research

Co-Director: Dr. Kenneth Troske, Sturgill Endowed Professor of Economics
And
Gatton College of Business and Economics Senior Associate Dean

Lexington, KY

2013

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ABSTRACT OF DISSERTATION

EMPLOYMENT OF SINGLE MOTHERS: CHILD CARE COSTS AND THE EFFECTIVENESS OF THE EITC

This dissertation examines the effect of the Earned Income Tax Credit (EITC) on labor force participation of single mothers by controlling for child care costs. Based on a simple model of utility maximizing households that jointly determine hours worked and hours of non-maternal child care demanded, I estimate the change in the labor force participation rate of single mothers following the EITC expansions of the 1990s. In order to investigate the usage of different modes of childcare services, a multinomial logit model has been estimated. The data source for the study is topical module panels of the Survey of Income and Program Participation (SIPP) for the years 1992, 1993, 1996 and 2001. These panels were selected to reflect the time horizon during which the policy changes of the 1990s took place. The empirical estimation strategy is designed to deal with the problems of both selection bias and simultaneity in choosing hours worked and hours of non-maternal child care demanded. Due attention has been paid to the issue of identification of the empirical equations to be estimated in this paper.

KEY WORDS: Labor Force Participation, Single Mothers,
EITC, Child Care Costs, SIPP

Salma Begum

March 14, 2013

EMPLOYMENT OF SINGLE MOTHERS: CHILD CARE COSTS AND THE
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By

SALMA BEGUM

Dr. Christopher Bollinger
Director of Dissertation

Dr. Kenneth Troske
Co-Director of Dissertation

Dr. Aaron Yelowitz
Director of Graduate Studies

March 14, 2013

To my mother Rowshan Ara, my husband Mushfiqur Rahman, and my daughter Samihat
Rahman

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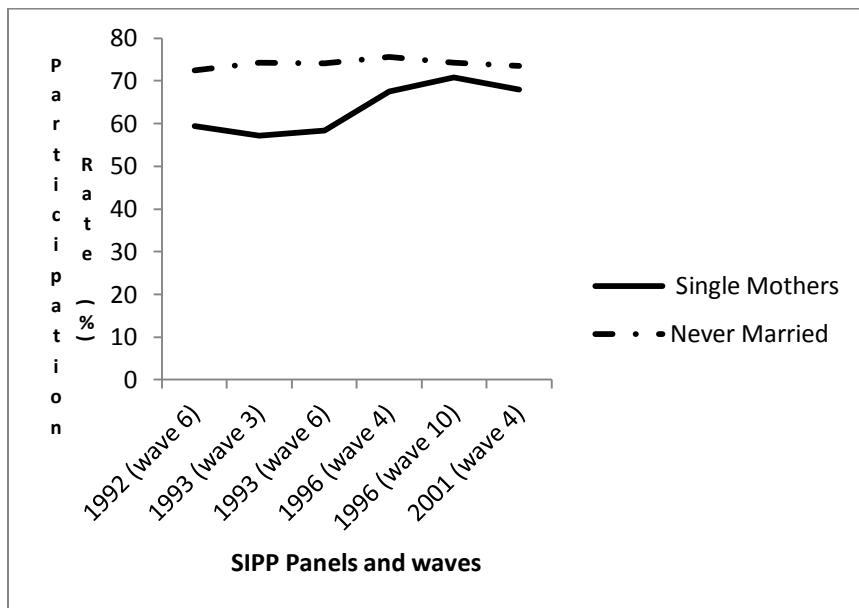
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1 INTRODUCTION

While the dramatic rise in the labor force participation of women in the latter half of the twentieth century is considered as one of the striking labor market developments in the post-World War II era, it is the labor force participation of single mothers that has received considerable attention among policy researchers in recent years. It is well documented that the growth in female labor force participation in the 1990s was largely due to dramatic increases in the employment of single mothers (Blank, 2002; Eissa and Liebman, 1996; Ellwood, 2000; Hotz and Scholz, 2001; Meyer and Rosenbaum, 2001;). Between 1993 and 1999, the employment of single mothers with children increased by more than 12 percentage points, even though never married women (without any children) showed little or no change in their participation rates during the same period (based on my estimates from the SIPP - Survey of Income and Program Participation – panels).

Figure 1.1 Labor Force Participation Rate For Single Mothers And Never Married Women (Ages 18-60)



Source: Author's own tabulations from Survey of Income and Program Participation (SIPP) panels.

Figure 1.1 presents labor force participation rates among single mothers and never married women from SIPP panels' of 1992 to 2001, which refers to the time period 1993 to 2002. Never married women without any children have a high and almost unchanged participation rate during this period. In sharp contrast, single mothers' (with children under 18) labor force participation rate dramatically increased between 1993 and 1999 (SIPP panels 1993 (wave 6) to 1996 (wave 10)).

A large number of studies have investigated this phenomenal growth in the employment of single mothers. The 1990s was an eventful period of time when a number of policy changes took place. It was the time when the welfare reform, tax reform, EITC expansions, Child Care tax credit, etc. were introduced. This time period was also characterized by unusually high and long period of economic growth. Possibly all these factors influenced the observed changes in participation of single mothers. There is a growing consensus from these studies that the policy changes of the 1990s, in particular the 1996 policy reforms of the Personal Responsibility and Work Opportunity Reconciliation Act (PROWRA) and expansions in the Earned Income Tax Credit (EITC) have largely contributed to the dramatic rise in the employment of single mothers. The results from these studies strongly suggest that the EITC expansions of the 1990s can explain a significant part of the changes in the employment of single mothers (Eissa and Liebman, 1996; Meyer and Rosenbaum, 2001; Ellwood, 2000; Hotz and Scholz, 2001).

It is also well-established that labor force participation of women is influenced by the presence of child care costs. A number of studies done in the 1990s consistently estimate a negative relationship between child care costs and mothers' employment (Blau and Robbins, 1991; Ribar, 1992; Connelly and Kimmel, 2003). As these single women move into the workforce, they face additional costs in the form of child care expenditures. Since these women are the sole or primary care-givers for their children, the cost of and access to child care is a significant issue in their decision to join the labor force.

Concerns over childcare issues led to several federal programs in the 1990s. For example, the federal government created the Child Care and Development Fund (CCDF) and substantially increased expenditures on child care subsidies during the 1990s. Federal

legislative changes allowed the States to use a certain portion of their Temporary Assistance for Needy Families (TANF) budget for child care and also expanded the Child Care Tax Credit for low-income families.

This study builds upon and connects these two growing strands of research by examining labor supply effects of the EITC expansions of the 1990s in the presence of child care costs. Even though a large volume of empirical work has been done to investigate and estimate the impact of tax policy changes and child care subsidies on employment of single mothers, none has looked at the joint effect of EITC expansions of the 1990s and child care costs on labor force participation of single mothers. It is quite likely that the EITC-induced labor force participation differs significantly due to child care expenditure.

Difference-in-Difference method is used to examine the changes in labor supply of single mothers (the 'treatment' group) compared to never-married women without any children (the 'control' group). By allowing variations in the cost of childcare to interact with the treatment group and post-EITC expansion era, the impact of child care costs on the efficacy of the EITC program can be identified. The dataset for the study is derived from four panels of the Survey of Income and Program Participation (SIPP): 1992, 1993, 1996 and 2001 designed to capture the period of policy changes of the 1990s particularly the EITC expansions.

I find that while higher child care cost has negative effect on labor force participation, the effectiveness of the EITC expansions has been more pronounced for those single mothers whose face relatively high child care costs. My findings suggest that while EITC expansions increased participation of single mothers as a group, the increase was particularly large for those single mothers who faced higher child care costs. My estimates from the Bivariate Probit model suggest that the labor for participation of the single mothers increased by 3.32% due to the post-EITC expansions of the 1990s, after accounting for child care costs.

To investigate how working mothers choose between various modes of child care, I estimate a multinomial logit model using predicted child care expenses for the various modes as well as a set of socio-economic characteristics. This analysis was performed separately for young and older children. The marginal effects were estimated for formal care. I find that women with some college or college degree are more likely to use formal care compared with relative care. Non-naturalized mothers are less likely to rely on formal day care than native citizens. While presence of young children reduces the likelihood of using formal care, higher non-labor income increases the chances of relying more on formal day care. However, the estimated effects of the (predicted) price variables for the various modes of choice are found to be problematic. Though some of these are estimated to be significant, many of them have incorrect signs. Nevertheless, similar findings have been reported in other studies using SIPP, though in a smaller sample (Connolly and Kimmel, 2003).

It is likely that the demand for child care would increase due to EITC expansions as more single mothers seek to get employment. Assuming less than proportionate increase in the supply of child care facilities, this is going to raise the price of child care for all users. Therefore, it would be interesting to examine the effect of higher labor force participation on child care expenses. My estimates suggest that cost of child care is weakly positively related with labor force participation, meaning child care costs is likely to increase when the rise in participation is taken into consideration.

As mentioned earlier, there are a number of studies that examined either the effectiveness of EITC expansions or the impact of child care costs on labor supply. The main contribution of my work is to allow predicted child care expenses to interact with the EITC expansion era and my treatment group of single mothers and thus estimate child care cost-adjusted effectiveness of EITC expansion. A recent study by Herbst (2010) estimates the employment effects of single mothers by controlling for child care subsidies and EITC. Findings from this study suggest that while child care subsidies generated the largest labor supply response for the single mothers facing high child care costs, the efficacy of the EITC benefits was the largest for single mothers with lower wages.

There are a number of differences between the current study and this paper by Herbst. First, unlike the current study, Herbst does not examine interactions between the EITC era and child care costs. Secondly, his work also differs in terms of the data sources. Herbst uses various panels of the SIPP to predict child care costs and applies the parameter estimates from these child care cost equations to a sample of single mothers drawn from the Current Population Survey (CPS). This process of temporal matching of the SIPP and CPS surveys has drawbacks in terms of econometric considerations. Works by Bollinger and Hirsch (2006) suggest that imputations often lead to biased estimates. My study is similar to recent research on labor supply effects of child care costs by Connelly and Kimmel (2003) and Ribar (1992). However, my study uses more recent panels of the SIPP than these studies and also estimates the heterogeneous effects of the EITC across the distribution of child care expenditures.

This paper also contributes to the recent literature on the EITC and local costs. Even though there has been extensive work done to quantify the effects of the EITC on labor supply, only few studies have attempted to adjust the impact of EITC by cost-of-living in various local areas. The paper by Fitzpatrick and Thompson (2009) investigates how the EITC expansions affect the labor supply response of single mothers due to differences in the cost-of-living in various geographical areas. The authors include housing costs of Metropolitan Statistical Areas (MSA) to analyze the differential effects of the EITC program across geographical areas. Their findings show positive effects of EITC changes on labor force participation of single mothers in the lowest cost areas, but no significant impact in the highest cost areas. As a result, the authors are skeptic about the effectiveness of EITC in addressing unemployment problems in large cities where the cost-of-living is high. Since EITC is administered for the low-income working families, other costs such as transportation and child care costs are likely to affect the effectiveness of the EITC as well. My findings, however, suggest that single mothers living in cities with very high child care costs were more responsive to the expansions of the EITC.

The rest of the paper is organized as follows. An overview of the EITC program and a review of the empirical research literature on the behavioral effects of EITC are discussed in the following two sections. The closing section of the first chapter discusses the theoretical framework, empirical estimation, and identification issues. The description of data with summary statistics on demographics, child care expenses, and EITC credits are provided in chapter two. The third chapter deals with the first-stage reduced-form estimation of labor force participation and use of paid child care as well as selection-corrected wage and child care expenditure. The multinomial logit estimation of the various modes of child care is also discussed in this chapter. The final-stage estimates of labor force participation is presented and discussed in chapter four. The final chapter is a concluding section discussing some of the limitations of this study and future areas of work.

1.1 Overview of the EITC Program

The Earned Income Tax Credit (EITC) is a federal benefit program which began in 1975 and has been expanded several times since then. Currently it is considered as one of the largest anti-poverty programs of the federal government. It has been designed to offset federal income taxes and Social Security payroll taxes, supplement earnings, and encourage and reward work. The benefit structure of the EITC also reflects the reality that larger families face higher living expenses than smaller families. The credit phases in as a family's income rises (at a rate higher for larger families), hits a maximum limit as a family's earnings approach the poverty line, and then phases out at a gradual rate as a family's earnings continues to rise.

According to the design of the EITC, working families with incomes below the federal poverty line receive the largest benefits. Since the credit phases out gradually as income rises, many families with incomes above the poverty line also benefit. Families with three or more children receive larger credits than one- or two-child families, and married couples get more than single parents. For many recipients, especially families just

entering the workforce and those with very low earnings, the EITC more than offsets taxes paid and thus act as a wage supplement. For example, a single mother with one child working full-time at the minimum wage of \$7.25 per hour earns \$15,080 annually. She does not owe any federal income tax, but qualifies for a 2010 EITC of \$3,050. Her tax liability is \$1,154 (for payroll taxes), so the EITC refund completely offsets these taxes and provides an additional \$1,896 as a wage supplement.

Table 1.1 summarizes major developments in the history of the EITC. It was first introduced in 1975 as a ‘work bonus’ for families with children on a temporary basis. It was made permanent in 1978. There was little change in the credit till the Tax Reform Act of 1986 (TRA86). As part of this tax reform package, the maximum credit of the EITC was increased to match up to the level of credit in 1975 as the value of the credit eroded due to lack of indexing. It was also indexed for inflation during this tax reform. The largest expansions of the EITC took place during the 1990 and 1993 tax reform bills.

Table 1.1 Timeline of EITC

1975 Tax Reduction Act	Introduced EITC to the Internal Revenue Code, primarily to offset the Social Security Taxes of low-income working tax-payers with children
1978 Revenue Act	Made EITC a permanent part of the Internal Revenue Code.
1984 The Deficit Reduction Act	Increased the maximum credit amount and renumbered it to its current location in Internal Revenue Code.
1986 Tax Reform Act	Expanded the credit.
1987	Indexed for Inflation
1990 The Omnibus Budget Reconciliation Act (OBRA)	Expanded the supplemental credit amount for families with two or more children.
1993 The Omnibus Budget Reconciliation Act (OBRA)	Expanded the credit further and added a small supplemental credit amount for childless workers.
1997 The Taxpayer Relief Act	Added provisions to improve compliance issues.
2001 Economic Growth and Tax Relief and Reconciliation Act	Made changes to add marriage penalty relief and to simplify.
2009 The American Recovery and Reinvestment Act (ARRA)	Created a new category for families with 3 or more children and expanded the maximum credit for this group and for married couples filing jointly.

Source: Compiled from various sources (the Tax Policy Center, the Brookings Institution, and Hotz and Scholz, 2001).

The current EITC structure follows eight different schedules for workers based on their marital status and number of children –single/married worker with no qualifying children, those with one child, those with two children, and those with three or more children. Each schedule has three ranges:

- Phase-in (or subsidy) Range
- Stationary Range
- Phase-out Range

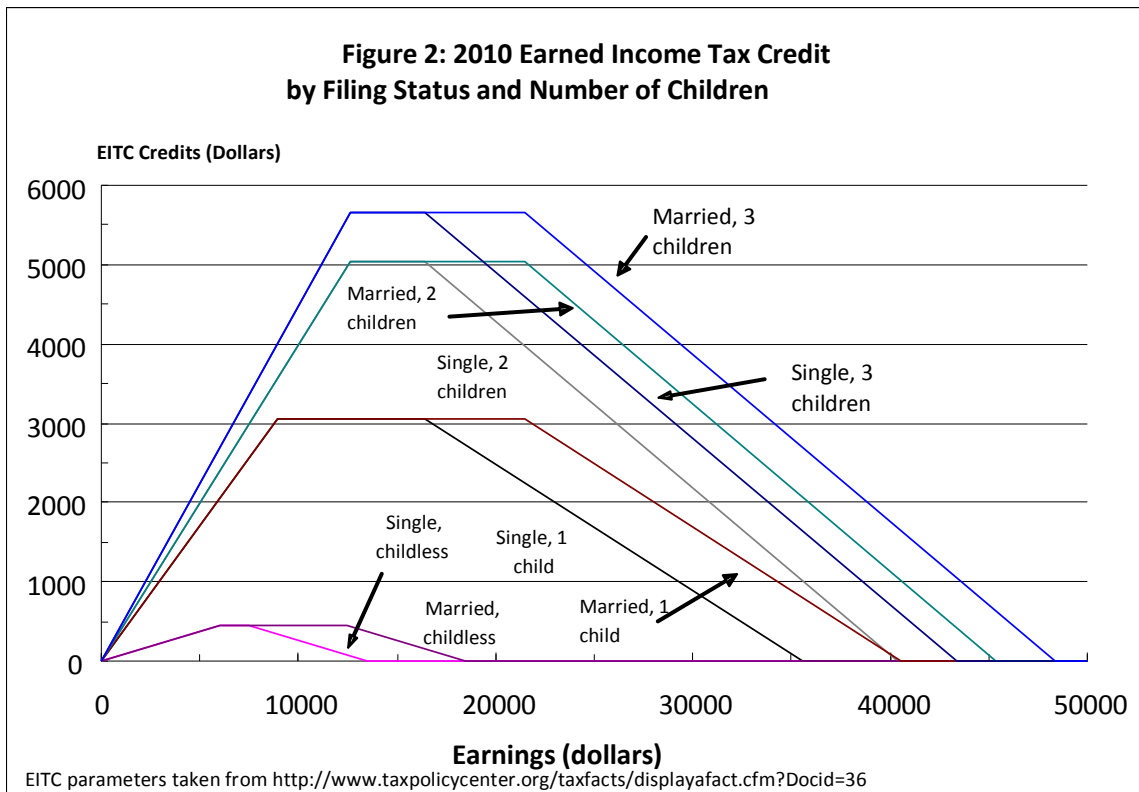
The 2010 Federal EITC structure is presented in Figure 1.2 (Source: <http://www.taxpolicycenter.org/briefing-book/key-elements/family/eitc.cfm>). The upward-sloping segment of the schedule is the phase-in range where the EITC increases with additional earnings. In the plateau or the stationary range, the EITC itself provides no additional compensation as income rises. The phase-out range is the downward-sloping segment of the schedule where the amount of credit falls with each additional dollar earned. The phase-out rate is slower than the phase-in rate, which is reflected in the flatter slope of the phase-out range.

Based on the 2010 schedule, a single parent with 3 or more qualifying children is entitled to claim a maximum credit of \$5,666. The credit is computed as 45% of the first \$12,590 of earned income. This subsidy offsets federal income tax obligations (including taxes that fund the Social Security and Medicaid programs) and surplus credits are refunded for workers whose EITC subsidy is greater than their tax obligations. The credit amount remains constant at this maximum level for income range \$12,590-\$16,450. Beyond this income level of \$16,450, it is the phase-out range where the maximum credit is reduced at a rate of 21.06% of additional earned income. The subsidy is completely phased out at \$43,998 of income.

A single parent with 2 children is entitled to a phase-in credit rate of 40%, which is lower than the rate for a single parent with 3 or more children, leading to a lower maximum credit. However, the stationary plateau range is the same for these two groups of parents.

Their phase-out rate is also same at 21.06%, but the subsidy is entirely phased out earlier at an income level of \$40,964.

Figure 1.2 2010 Earned Income Tax Credit by Filing Status and Number of Children



Source: <http://www.taxpolicycenter.org/briefing-book/key-elements/family/eitc.cfm>

Similarly, a single parent with one child can receive a maximum credit of up to \$3,050, which is computed as 34% of the first \$8,950 of earned income. The stationary range extends from \$8,950 to \$16,420. The phase-out credit rate is 15.98% and is completely phased out at an income level of \$35,463.

A single worker with no qualifying child is also entitled to a small maximum credit of \$457, which is 7.65% of the first \$5,970 of income. The stationary range is shorter than those with children (\$5,970-\$7,160). The phase-out rate is also lower (7.16%). The maximum credit is completely phased out at \$13,440 of income.

For married couples filing jointly, the maximum credit is the same as the single parents for a given number of children. However, the beginning and ending points of the phase-out range are \$5,010 higher than those of the single, head of household or qualifying widow(er). This means the plateaus extend by \$5,010 for married couples in each one of the four schedules for no children, one child, two children, and three or more children.

In brief, the EITC structure provides lower phase-in and phase-out credit rates as well as lower maximum credits for families with fewer numbers of children. However, the phase-out range begins at the same income level for families with one/ two/three or more children for a given marital status. The maximum credit is completely exhausted at earlier income levels for families with fewer children. While married couples enjoy the same maximum credit as the single families, their stationary range extends further than the single parents.

The current schedule of the EITC went through a number of large expansions during 1984-1994. The expansions of the 1990 tax bill were phased in over three years. The EITC parameters are shown in Table 1.2. For the first time, the taxpayers with two or more children were entitled to a higher credit rate than those with one child in 1991, though the increment was small until 1993. The requirements for qualifying children were also changed in a way in 1991 that encouraged participation in the EITC. The budget bill of 1993 raised the EITC benefits again and particularly for families with two or more children.

A small amount of credit was made available in 1994 for families without any children. Since 1994, the difference in credit for families with two or more children began to rise sharply; it rose to \$2,528 in 1994 from \$1,511 in 1993 (in nominal dollars) and further increased to \$3,556 in 1996. The 1993 tax bills also significantly increased work incentives for very low income women as both the credit rate and the maximum credit experienced large increases. Another round of expansions took place in 2009 and a new category for families with three or more children was introduced.

A number of states have also enacted state-level EITC as a fraction of the federal EITC – though small in size – through the State income tax codes. In 1994 seven states had their own EITCs. In 2010, 23 states and the District of Columbia were administering their own state-EITC programs. Since all of the state EITCs were set as a fraction of the Federal EITC, these also increased when the Federal rates were expanded (not shown in Table 1.2).

Table 1.2 EITC Parameters, 1975-1999 (in nominal dollars)

Year	Phase-in Rate (%)	Phase-in Range	Maximum Credit	Phase-out Rate (%)	Phase-out Range
1975-78	10	\$0-\$4,000	\$400	10	\$4,000 - \$8,000
1979-84	10	0-5,000	500	12.5	6,000 - 10,000
1985-86	11	0-5,000	550	12.22	6,500 - 11,000
1987	14	0-6,080	851	10	6,920 - 15,432
1988	14	0-6,240	874	10	9,840 - 18,576
1989	14	0-6,500	910	10	10,240 - 19,340
1990	14	0-6,810	953	10	10,730 - 20,264
1991^a	16.7¹	0-7,140	1,192	11.93	11,250 - 21,250
	17.3²		1,235	12.36	11,250 - 21,250
1992^a	17.6¹	0-7,520	1,324	12.57	11,840 - 22,370
	18.4²		1,384	13.14	11,840 - 22,370
1993^a	18.5¹	0-7,750	1,434	13.21	12,200 - 23,050
	19.5²		1,511	13.93	12,200 - 23,050
1994	23.6¹	0-7,750	2,038	15.98	11,000 - 23,755
	30²	0-8,245	2,528	17.68	11,000 - 25,296
	7.65³	0-4,000	306	7.65	5,000 - 9,000
1995	34¹	0-6,160	2,094	15.98	11,290 - 24,396
	36²	0-8,640	3,110	20.22	11,290 - 26,673
	7.65³	0-4,100	314	7.65	5,130 - 9,230
1996	34¹	0-6,330	2,152	15.98	11,610 - 25,078
	40²	0-8,890	3,556	21.06	11,610 - 28,495
	7.65³	0-4,220	323	7.65	5,280 - 9,500
1997	34 ¹	0-6,500	2,210	15.98	11,930 - 25,750
	40 ²	0-9,140	3,656	21.06	11,930 - 29,290
	7.65 ³	0-4,340	332	7.65	5,430 - 9,770
1998	34 ¹	0-6,680	2,271	15.98	12,260 - 26,473
	40 ²	0-9,390	3,756	21.06	12,260 - 30,095
	7.65 ³	0-4,460	341	7.65	5,570 - 10,030
1999	34 ¹	0-6,800	2,312	15.98	12,460 - 26,928
	40 ²	0-9,540	3,816	21.06	12,460 - 30,580
	7.65 ³	0-4,530	347	7.65	5,670 - 10,200

Source: 1998 Green Book, Committee on Ways and Means, U.S. House of Representatives, U.S. Government Printing Office,

page 867. 1998 and 1999 parameters come from Publication 596, Internal Revenue Service

^aBasic credit only. Does not include supplemental young child or health insurance credits.

¹Taxpayers with one qualifying child.

²Taxpayers with more than one qualifying child.

³Childless taxpayers.

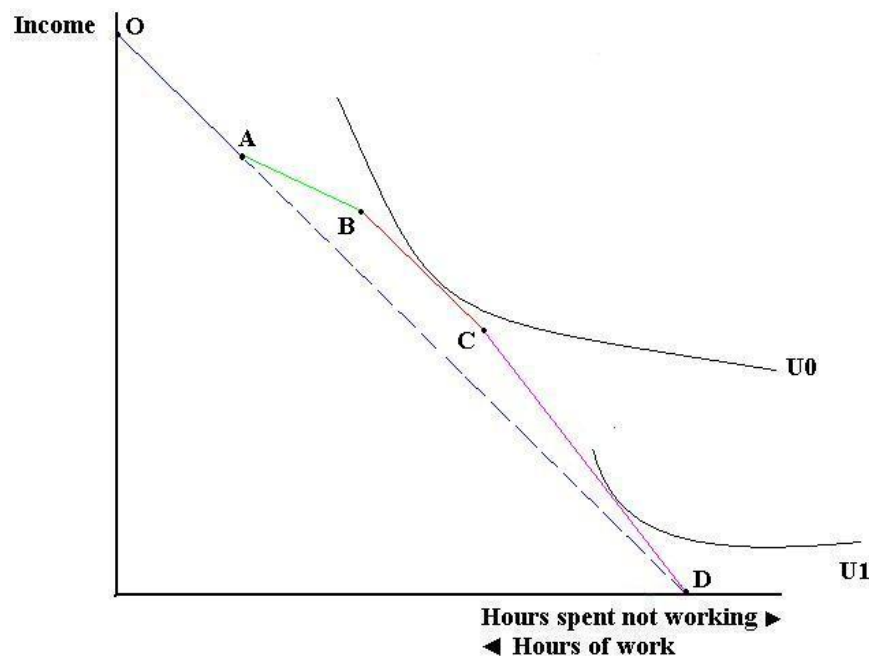
As noted above, one of the policy goals of the EITC program is to encourage and reward work. Since the credit acts as a wage supplement, there are important economic implications, particularly for labor force participation. The theoretical effects of the EITC on labor force participation can be traced out by looking at a model of labor supply based on indifference curve analysis. A representative household is assumed to be maximizing utility over a market good (C) and non-market time, leisure (L) subject to a budget constraint. Household preference is represented by strictly concave utility function, $U = U(C, L)$. It is assumed that utility is increasing in C and L ($U_C > 0, U_L > 0$). Since the maximum available time is T, the time constraint must satisfy that hours spent for the consumption (C) and leisure (L) must equal total time (T):

$$(1) \quad T = C + L$$

The budget constraint of a representative individual maximizing utility from leisure and consumption is illustrated in the Figure 1.3 below. The budget constraint for a typical worker (assuming zero non-labor income) without the EITC benefit is shown by the line OD. The introduction of the EITC alters the budget line from a linear OD to a non-linear OABCD, where DC is the phase-in range, CB is the stationary range, and BA is the phase-out range. Since the maximum credit is completely phased out beyond A, it follows the original budget line after the phase-out range. It is assumed that initially the individual is located at point D, supplying zero hours of labor; the reservation wage (the slope of the indifference curve (not shown in the diagram) at point D) exceeds the wage rate (the slope of the OD income budget line). Because of EITC, the new income budget line rotates upwards from OD to OABCD as the wage rate is being supplemented with a subsidy in the phase-in range. Given this new higher wage rate and new higher income budget line, the individual can reach a higher indifference curve U_1 ; the optimal position is now where the indifference curve U_1 is tangent with the new budget line OABCD. The individual now participates in the labor force and supplies positive hours of work. As a result, the labor force participation rate is predicted to increase for people who were not in the labor force when the wage rate rises due to expansions in the EITC phase-in credit rates.

According to standard labor market theory in economics, EITC, therefore, unambiguously makes joining the labor force (extensive margin) more attractive in the phase-in range because it increases the market wage by the phase-in credit rate. However, the effect of EITC on hours of work for those already in the labor force (intensive margin) is ambiguous due to offsetting impacts of substitution and income effects in the phase-in range and depends on their initial position (before the expansion) on the budget line.

Figure 1.3 : Effect of the EITC on Household Budget Constraint



When the wage increases, the income effect makes workers feel wealthier and therefore makes them want more of both leisure and consumption. The substitution effect, however, makes leisure relatively expensive (since the worker would have to give up higher wages to have free time or leisure); so workers will want more consumption and less leisure. Because labor is inversely related to leisure, this means that an increase in wages will cause labor to both increase (due to substitution effect) and decrease (due to income effect). Therefore, when wages increase, the combined effect of the substitution and income effect on the level of labor and leisure is uncertain for those already in the

labor force and operating in the phase-in range. If we assume that the substitution effect is stronger, then workers will choose to work more in the phase-in range. In contrast, economic theory predicts that the effect of EITC would be to decrease labor supply (intensive margin) for families in the stationary range due to negative income effect (and no offsetting substitution effect). Economic theory also predicts that EITC would reduce labor supply for earners in the phase-out range because of reinforcing negative substitution effects and negative income effects. Therefore, EITC is clearly likely to increase labor force participation (for those who are not working) because of positive substitution effect, and decrease hours of work for those already in the labor force and operating in the stationary range (due to negative income effects) or in the phase-out range (because of reinforcing substitution and income effects). However, it has ambiguous effects on hours of work for those who are working in the phase-in range due to offsetting substitution and income effects.

Since the EITC phase-in schedule is steeper for families with more children (because of higher credit rates), one expects the labor force participation effects to be stronger as number of children increases. Similarly, a steeper phase-out schedule for families with two or more children implies that the negative substitution and income effects in the phase-out range would also be larger for these larger families than those with one or no child. As discussed earlier, the stationary range is wider for families with one or more children than those with no child. This would result in larger negative income effect for hours of work for families with children in the stationary range. The same could be said about married couples operating in the stationary range since their plateau also extends wider than single families for a given number of children. There are also important consequences for secondary earners of married couples. It can be argued that couples filing tax returns as 'married jointly' may face reduced EITC credits and higher tax liabilities than couples who file as 'separated' for the same amount of total income. This is known as the 'marriage penalty' of EITC in the literature. The benefit structure of EITC that rewards higher credit for families with children may also have impacts on fertility decisions of households. I attempt to evaluate the effectiveness of the expansions in the EITC benefits in encouraging work among single mothers.

1.2 Review of Literature

The policy changes of the 1990s have been among the most widely and thoroughly studied public policies in recent history as seen by the extensive volume of work done by researchers from various disciplines. Hotz and Scholz (2001) provide a discussion of the pros and cons of the different types of empirical approaches used to study the labor market effects of the EITC changes. According to their discussion, three of the most common approaches are:

- “reduced form” effects, which examine the net effects of policy through observed changes in the policy;
- “quasi-structural” models, which simulates how the EITC affects the after-tax wage and thus labor supply; and
- “structural models” which posit and estimate specific models of preferences (e.g. specific utility functions) and constraints (e.g. kinks and other features of the budget line) facing consumers;

My estimation technique is of the first category where reduced form effects of labor for participation is estimated after taking into consideration selection-corrected wage and child care costs. It is important to note that there is effectively no cross-state variation in the overall nature of the federal EITC program due to its uniform national eligibility and benefit structure. The State-EITC programs provide some cross-state variation. As a result, difference-in-difference methods have been generally used to evaluate the effects of the EITC. The main sources of identification are variations in the program parameters in two dimensions: time and family structure. These methods rely on explicit comparisons between groups that are and are not affected by the changes in EITC benefits. The commonly used “control” group is single women without children while the “treatment” group is single women with children. This analysis is based on two observations. Firstly, while the participation rates of single mothers have dramatically increased between 1994 and 1999, there is no such trend in the participation rate of the single women without children (refer to Figure 1). Secondly, as discussed above (refer to

Table 2) the budget bill of 1993 raised the EITC benefits significantly for families with two or more children during this period while only a small amount of credit was made available in 1994 for families without any children. The timing of the rapid expansions in the EITC, changes in welfare reforms, and the fact that these changes did not affect all persons equally, creates a natural experiment-type situation. The difference-in-difference methodology exploits this argument of natural experiment and attempts to investigate whether a *causal* relationship exists between the policy changes of the 1990s, including EITC expansions, and the changes in the participation rates.

There is a large volume of work done examining the effects of the EITC on a range of behavioral issues: labor supply, income, poverty, human capital development, consumption decisions, marriage and fertility, health outcomes, and child achievements. Since the research objective in this study is to estimate effects of EITC on labor supply in the presence of child care costs, the discussion focuses on literature of these strands.

1.2.1 Labor Force Participation of Single Mothers

There is considerable evidence from a number of important studies using a variety of empirical methods that the EITC expansions increased the employment of single mothers. In one of the earliest studies, Eissa and Liebman (1996) analyzed data from the March Current Population Surveys (CPS) from 1985 to 1987 and 1989 to 1991, and found that the EITC had important effects on the employment of single women. According to their difference-in-difference estimates, the labor force participation of single mothers increased by up to 2.8 percentage points between 1984-86 and 1988-1990. While there were other policy and economic changes taking place during this period, Eissa and Liebman (1996) argued that the changes in the EITC benefit was likely to be the main reason for the estimated observed effect on labor supply of single mothers. Ellwood (2000) also uses the difference-in-difference approach and finds evidence of expanded work by single mothers, particularly for the least skilled group (constructed on the basis of predicted wage quartiles), due to the EITC expansion. An important study by Meyer and Rosenbaum (2001) estimated a large share of the EITC and other tax changes for the

unprecedented increases in the employment of single mothers. Their results suggest smaller shares for welfare reforms such as lower benefit, welfare waivers, training programs and child care programs. According to their estimates based on the analysis of the March CPS files and the merged Outgoing Rotation Group (ORG) data, EITC and other tax changes accounted for over 60 percent of the 1984 to 1996 increase in weekly and annual employment of single mothers relative to single women with without children. Changes in welfare reforms were found to be less important, but still accounted for a substantial part of the employment increases while contributions of other policy changes such as Medicaid, training, and child care programs were found to be considerably lower.

A number of other studies, using recent panel data from the Survey of Income and Program Participation (SIPP), also found substantial effects of the EITC expansions on labor force participation of women. Looney (2005) and Fitzgerald and Ribar (2004) are two recent studies that use the SIPP panels and conclude that the EITC expansions lead to less welfare use and increased work among single mothers. Grogger (2004) found that the expansion of the EITC was important in encouraging entry into work. EITC was also identified as a particularly important factor in explaining both the decrease in welfare use and the increase in employment, as well as earnings among female-headed families by Grogger (2003) where he relied on the March CPS data from 1979 to 2000. A general finding from these studies has been that the EITC expansions and the welfare reforms alone cannot explain all the changes in caseloads and employment in the 1990s. A recent study by Fang and Keane (2004), based on March CPS data from 1980 to 2002, attempted to completely account for the observed changes in caseloads and employment over the 1990s by a large set of economic and policy variables. According to their simulations, the EITC was the main policy variable contributing 33 percent of the increase in participation of single mothers, while work requirement component of the welfare reform accounted for an overwhelming 57 percent of the drop in welfare participation rate of single mothers. However, their reliance on a complex set of interaction terms and interpretations have been subject to criticisms (Blank, 2009).

Hotz, Mullin, and Scholz (2005) created an exclusive dataset by matching administrative data from public assistance records, unemployment insurance records, and federal tax returns for a sample of California residents to examine the employment effects of the EITC. They compare employment rates of families with two or more children relative to one-child families for those who file tax returns (and claim the EITC credits) versus those who don't file tax returns (hence don't claim the EITC credits). The reason for comparing these two groups was due to the fact that the budget bill of 1993 raised the EITC benefits significantly for families with two or more children. Comparing those who file (and hence claim the credit) with those who do not, allows the authors to estimate the effect of EITC expansions on the participation of families with two or more children relative to one-child families. Their estimates suggest that the EITC expansions had substantial positive effect on the employment of families with two or more children compared to single-child families.

In contrast, several other studies estimate that the changes in the EITC had little effect on labor supply of single mothers. Cancian and Levinson (2006) examine the effect of EITC on labor supply by comparing families with three children to families with two children in Wisconsin (which supplements the federal EITC for families with three children by \$1,107) versus states that do not supplement the federal EITC for three children. Their cross-state comparison found no effect of the EITC on labor force participation of single mothers with three children relative to single mothers with two children in Wisconsin. While their findings seem to differ from previous estimates, the authors argue that there might be less unmeasured differences between their comparison groups (single mothers with three children versus single mothers with two children) as opposed to those of previous studies - single mothers versus single women with no children - and hence their estimates might be correctly measuring the impact of EITC on participation and hours of work. They also state that Meyer and Rosenbaum (2001) found similar (small or no effects) results when they compared mothers with different number of children. However, the authors note that employment decisions of larger families might be more influenced by non-pecuniary costs and benefits of employment leading to less sensitivity towards EITC. Furthermore, since Wisconsin already had high employment rates prior to the

EITC expansions, there was little room for increasing employment further by these expansions.

In another study, Fitzpatrick and Thompson (2009) examined how the labor force participation of single mothers is affected when the federal EITC interacts with the cost-of-living. Their findings showed positive effects of EITC changes on labor force participation of single mothers in the lowest housing cost areas, but no significant impact in the highest housing cost areas. As a result, the authors raised questions about the effectiveness of EITC in addressing unemployment problems in large cities where the cost-of-living (in terms of housing cost) is high. Findings from my estimation indicate a different phenomenon where single mothers facing higher child care costs experienced significant increase in participation relative to those facing lower child care costs.

Most of these studies have also examined the magnitude and consequences of the implied elasticity of employment due to effects of EITC with respect to a household's net income and/or net wage. Hotz and Scholz (2003) report that the range of the implied participation elasticity for single mothers across studies of EITC using difference-in-difference method is from 0.97 to 1.69, and 0.69 to 0.96 using structural models. In a review of recent literature on labor supply elasticity, McClelland (2012) report that the EIC literature's estimate of participation elasticity is higher than those of other general studies. One probable explanation for this finding is that low-income women with children have low initial participation and hence when EITC credit limits expand, there is room for large increases in their participation. However, this analysis does not consider the effects of child care costs. Findings from my research suggest that there is variation in the participation elasticity across the distribution of child care costs. My estimates show that the increase in participation in the post-expansion period of EITC mostly came from those women facing high child care costs and hence indicating relatively high elasticity of participation for women facing high child care costs

1.2.2 Labor Supply of Married Couples

It has discussed earlier that there are important consequences of EITC for secondary earners of married couples. It has been argued that EITC has a 'marriage penalty' since

couples filing tax returns as ‘married jointly’ may face reduced EITC credits and higher tax liabilities than couples who file as ‘separated’ for the same amount of total income. This phenomenon is likely to have negative participation effects for secondary earners for married couples.

Eissa and Hoynes (1998) find modest negative effects of the EITC on labor market participation of married women. Eissa and Hoynes (2004) examine the labor force participation response of married couples between 1984 and 1996 using quasi-experimental and traditional reduced-form labor supply models. Their estimated results suggest that the EITC expansions reduced total family labor supply of married couples. Bar and Oksana (2009) examine a model of heterogeneous households and also find similar negative effect of EITC participation, especially among married couples with low-earning husbands. Results from Ellwood (2000) suggest reductions in work by married mothers as well.

My study design involves estimating participation effects for single mothers, as opposed to married women. The reasons are clear. Even though the participation of women was on the rise during most of the 1990s, married women’s labor force participation declined during this period as the findings of the above studies indicate. It is the single mothers who experienced the most dramatic increase in participation in the 1990s (Mosissa and Hipple, 2006). As a result, I decided to work with single mothers and investigate the causes behind this phenomenon.

1.2.3 Hours of Work

As discussed earlier, a wider stationary range for married couples would, in theory, result in larger negative income effect for hours of work for families with children in the stationary range. A limited number of studies have looked at the effect of EITC on those already working in the labor force, namely on hours of work. Most of the studies find no or little negative effect. Eissa and Liebman (1996) found no change in the relative hours worked by low-educated single mothers, conditional on working. Meyer and Rosenbaum (1999) find mixed, but insignificant impacts on hours worked. Focusing on the phase-out range of the EITC in the Current Population Survey Data cases, a recent study by Trampe

(2007) show a small negative effect on hours worked for the population in the phase-out range. However, some studies indicate that the aggregate effect of the EITC on hours worked could be positive, once we account for the participation effects (Dickert, Houser and Scholz, 1995; Keane and Moffitt, 1998; and Meyer and Rosenbaum, 2001). Thus I focus on participation effects of the EITC and examine labor supply at the extensive margin for single mothers.

1.2.4 Labor Supply and Child Care Costs

There are also a number of studies that provide estimates of the effect of the price of child care on labor supply. Considering access to child care as one of the determinants of female labor supply, this literature has focused on estimating the impact of child care costs on the labor supply of women. However, none of these studies are in the context of the EITC, particularly the interaction between EITC and child care costs and the resulting impacts on labor supply.

This literature has been reviewed extensively in Anderson and Levine (2000), Blau (2003b), Connelly (1991), and Ross (1998). Chaplin et al. (1999) provide a review of the literature on the effect of the price of child care on various modes of child care choice. These studies almost uniformly show negative price effects on employment (i.e. maternal labor force participation increases when the price of child care falls), implying that child care subsidies will indeed increase employment (see Connelly and Kimmel, 2003. Riber, 1992; Michalopoulos et.al, 1992; Blau and Robins (1991)). Anderson and Levine (2000) discuss that the estimated employment elasticities with respect to a change in the cost of child care across studies range from just over zero to almost one, with some clustering around -0.3 to -0.4. They argue that the lack of low cost child care may be a crucial determinant for the employment decisions of the less-skilled women. Using the SIPP data, they examine child care decisions of women who differ by their level of skill, as measured by their level of education, and the role of child care costs on their labor force participation. They find elasticity of labor force participation with respect to child care costs in the range of -0.05 and -0.35 for women with children under 13, with this elasticity declining with the skill level. In other words, labor force participation of high

educated mothers is less sensitive to increases in child care costs according to their findings. Blau and Currie (2006) summarize results from twenty studies estimated the effect of paid child care on employment of mothers. They show that while in all studies, lowering the price of childcare increases mother's labor force participation, estimates of this elasticity vary significantly even within studies using the same source of data. In their view, specification and estimation issues are the main reasons behind the wide range of estimates for elasticity. Nevertheless, based on studies that modeled for unpaid child care in accordance with the existence of an informal care option, the authors suspect that the true elasticity may be small.

A second strain of the child care literature investigates the impact on the labor supply and welfare dependence of single mothers (Garfinkel et al. 1990; Michalopoulos et al. 1992; Connelly 1990; Berger and Black 1992; Kimmel 1995). The majority of these studies indicate that lower child care costs not only significantly increase women's labor supply, but also reduce welfare caseloads.

In brief, investigation of the large research literature on labor supply provides evidence that the EITC encourages labor force participation, particularly among single mothers. There is also evidence that it has a modest negative effect on labor supply of married couples or secondary earners. Most of the evidence on hours of work suggests that the EITC has a small negative or no effect, but there are mixed results as well. The participation effect of the EITC is also substantial in terms of explaining the observed changes in labor force participation of single mothers, as suggested by the estimated results of the studies. A number of studies estimate that the EITC was more important than the welfare reform in explaining the increase in participation of single mothers during the 1990s. The literature on child care costs finds negative impact on female labor supply indicating lower child care costs increase women's labor supply. This literature also suggests that lower child care costs reduce welfare dependence. However, the best available estimates suggest that the effects of the price of paid child care on labor force participation, hours of work, and welfare use are small.

Even though the effect of child care costs on labor supply, and the effect of EITC on labor supply have been well researched as separate strands of research, the interaction between the EITC and child care costs have not been investigated in the literature. An attempt has been made in this study to estimate the labor force participation effects of the EITC by explicitly incorporating child care costs in the decision to work.

1.3 Theoretical Framework, Empirical Estimation, and Identification Issues

A number of approaches have been applied in modeling the effect of child care costs as fixed costs on labor supply. The following simple model adapted from Ribar (1992) where the hours of non-market/market child care demanded and hours worked are results of utility maximizing behaviors by representative households.

1.3.1 Theoretical Framework

The representative household is assumed to be maximizing utility over a market good and leisure, a fixed portion of which is devoted to maternal care.

Suppose, a representative single mother with N children has preferences over leisure (L), market goods (C) and average quality of child care (Q/N) where Q is a measure of quality of child care and N is the number of children. Household preference is represented by strictly concave utility function, $U = U(C, Q/N, L)$. It is assumed that caring for children yields utility and utility is increasing in C , L and Q/L ($U_C > 0, U_L > 0, U_{Q/N} > 0$).

Mothers are assumed to spend working in the market by H hours. Since the maximum available time is T , the time constraint is

$$(1) \quad T = H + L$$

Since information on maternal child care is unavailable, it is assumed to be a proportion of L . The children can also receive non-maternal care (paid or unpaid) outside the home. Let F denote total hours of paid market child care demanded. Total hours of non-maternal

unpaid care are denoted by I . The total quality of care provided to child j can be expressed as:

$$(2) \quad Q_j = \alpha_F F_j + \alpha_I I_j + \alpha_T \frac{L}{N}$$

where α_F , α_I , α_T are productivity coefficients of paid non-maternal care, unpaid non-maternal care and maternal care, respectively. The linear specification assumes that quality of a non-maternal care does not depend on utilization of that mode.

Given W as the mother's hourly wage rate, the convex budget set, in terms of the market goods, could be written as

$$(3a) \quad C = WH + V - p = Y - pF - sI$$

where V is non-labor income, Y is total income, p represents the cost of hourly child care (assumed to be given for the household) and s is the shadow price of unpaid non-maternal care. Earnings of all other members of household are included in V and assumed to be exogenous for the mother. This is the budget constraint faced by each household with children in the absence of any EITC benefit.

We can incorporate the EITC credit in this model as a supplement to the wage income since it is effectively like a wage subsidy. Since the amount of the EITC benefit varies based on the three ranges, the budget set takes the following forms for a single parent with two qualifying children ($N = 2$) based on the 2010 schedule:

$$(3b) \quad \text{Phase-in range:} \quad C = WH + V + 0.4(WH) - pF - sI$$

$$(3c) \quad \text{Stationary range:} \quad C = WH + V + 5,036 - pF - sI$$

$$(3d) \quad \text{Phase-out range:} \quad C = WH + V + [5,036 - 0.2106(WH - 16,450)] - pF - sI$$

In general, the budget constraint could be written as

$$(4) \quad C = WH + V + E - pF = Y + E - pF - sI$$

where E is the amount of the EITC credit, which is a function of labor-income (WH), number of children (N), and filing (or marital) status.

The objective of the household is to

$$(5) \quad \underset{H, F/N, I/N}{\text{Max}} U(C, L) = \quad =$$

$$\underset{H, F/N, I/N}{\text{Max}} U(WH + V + E - pF - sI, \alpha_F \frac{F}{N} + \alpha_I \frac{I}{N} + \alpha_T T - \frac{H}{N}, T - H)$$

subject to non-negativity constraints for the choice variables: H , F/N and I/N . First order conditions of this maximization problem will yield demand functions for H (employment) and F/N (non-maternal paid care). Setting $H=0$ and $F/N=0$ in the first order conditions will lead to expressions for mother's reservation wage as well as reservation marginal price of child care. These are as follows:

$$(6) W_R = \left(\frac{U_L}{U_C} \Big|_{H=0} \right) + \left(\frac{\alpha_T U_Q}{N U_C} \Big|_{H=0} \right)$$

$$(7) P_R = \left(\frac{\alpha_F U_Q}{N U_C} \Big|_{F/N=0} \right)$$

The predictions of this model suggest that wages and labor force participation are positively related, while an increase in the marginal price of child care leads to a decrease in the demand for paid non-maternal care. Similarly, an increase in the shadow price of unpaid non-maternal care is expected to reduce the demand for such services.

1.3.2 Empirical Estimation and Identification

The solution to the maximization problem would generate mothers' labor force participation (H) as a function of wages (W), the EITC benefit (E), number of children (N), unearned income (V), and cost of paid non-maternal child care (P). It would also yield a demand function for non-maternal child care as a function of these variables. The reduced form solutions are:

$$(8) \quad H = f(W, E, N, V, P, Z, \omega);$$

$$(9) \quad F = g(E, N, V, P, Z, \varepsilon);$$

where Z is a vector of observed characteristics of the mother, and ω and ε are unobserved determinants.

The specific employment and child care usage decisions are represented by

$$(10a) \quad H^* = f(W, E, N, V, P, Z, \omega)$$

$$(10b) \quad H = \begin{cases} 1 & \text{(works), if } H^* > 0 \\ 0 & \text{(doesn't work), otherwise.} \end{cases}$$

Also,

$$(11a) \quad F^* = g(H, E, N, V, P, Z, \varepsilon)$$

$$(11b) \quad F = \begin{cases} F^* & \text{(uses non-parental care), if } F^* > 0 \\ 0 & \text{(doesn't use non-parental care), otherwise.} \end{cases}$$

The joint distribution of the ω and ε are assumed to be given by

$$(12) \quad \begin{bmatrix} \omega \\ \varepsilon \end{bmatrix} \sim N[0, \Omega]$$

The ultimate goal is to estimate probability of labor force participation as a function of EITC credit expansions, wages, child care costs and demographic variables. To do that, data on wages and child care costs for all women, regardless of their employment or child care payment status, is required. However, both wages and child care costs are endogenous since observed wages and child care costs do not fully capture all of the relevant demand information and may be correlated with unobservable characteristics included in the error terms (ω, ε) . Additionally, wages are not observed for mothers who do not work, and cost of non-maternal child care is not observed for those mothers who do not use these services. Child care costs are not observed for unemployed mothers in earlier panels of SIPP, particularly for samples before 1996.

The presence of the above two phenomenon mean that there is endogeneity problem and sample selection bias. Therefore, I approach the analysis in several approaches. First, using the exogenous determinants of participation and use of paid child care, a reduced form specification for joint labor force participation and child care model is estimated. Second, selection corrected wages and costs of child care equations are estimated. Finally, using the selection corrected wage and cost estimates as instruments, a structural equation for labor force participation is estimated to obtain the effects of these variables (as well as EITC) on participation. Table 1.3 provides a summary of the three-step estimation approach with exclusion variables.

Table 1.3 Variables included in various stages of the estimation

First Stage Bivariate Probit Model		Second Stage Selection-corrected Model		Final Stage Probit
<i>Employment</i>	<i>Usage of Paid Care</i>	<i>Hourly wage</i>	<i>Weekly Cost of Care</i>	<i>Employment</i>
Age	Age	Age	Age	-
Age squared	Age squared	Age-squared	-	-
Disabled	-	Disabled	-	Disabled
High School	High School	High school	High school	-
Some college	Some college	Some college	Some college	-
College	College	College	College	-
Post college	Post college	Post-college	Post-college	-
Naturalized	Naturalized	Naturalized	Naturalized	Naturalized
Not naturalized	Not naturalized	Not naturalized	Not naturalized	Not naturalized
Married (sps ab.)	Married (sps ab.)	Married (sps ab.)	Married (sps ab.)	Married (sps ab.)
Widowed	Widowed	Widowed	Widowed	Widowed
Divorced	Divorced	Divorced	Divorced	Divorced
Separated	Separated	Separated	Separated	Separated
Never married	Never married	Never married	Never married	-

Table 1.3 Variables included in various stages of the estimation (Continued)

First Stage Bivariate Probit Model		Second Stage Selection-corrected Model		Final Stage Probit
<i>Employment</i>	<i>Usage of Paid Care</i>	<i>Hourly wage</i>	<i>Weekly Cost of Care</i>	<i>Employment</i>
Black	Black	Black	Black	Black
Hispanic	Hispanic	Hispanic	Hispanic	Hispanic
Other race	Other race	Other race	Other race	Other race
Other adults	Other adults	-	-	-
-	-	Metro	Metro	-
No. of own kids	No. of own kids	-	-	No. of own kids
No. of infants	No. of infants	-	No. of infants	No. of infants
No of kids below 5	No of kids below 5	-	No. of kids below 5	No of kids below 5
-	No. of kids 6-12	-	-	-
-	No. of kids 13-17	-	No. of kids 13-17	-
No-labor income	No-labor income	-	-	No-labor income
Property income	Property income	-	-	Property income
State EITC	-			
Workers compensation	Workers compensation	-	-	-
State unemployment rate	State unemployment rate	-	-	State unemployment rate
AFDC benefit (2person)	AFDC benefit (2person)	-	-	AFDC benefit (2person)
AFDC benefit (3person)	AFDC benefit (3person)	-	-	AFDC benefit (3person)
-	-	-	-	Predicted wage (hr)
-	-	-	-	Predicted cost (wk)
-	-	-	-	treatment
-	-	-	-	post96
-	-	-	-	treatment*post96
-	-	-	-	treatment*cost
-	-	-	-	cost*post96
-	-	-	-	treatment*cost*post96

In particular, the following equations are going to be estimated to investigate the effects of the EITC expansions on labor supply in the presence of child care costs.

First stage Equations:

(13a) *Reduced Form Participation:* $Pr[(H = 1)|M, V]$

where M includes observed variables such as age, age squared, education, race, etc. The suggested identifiers for this equation of probability of employment are: non-labor income, young children of various age groups, presence of other adults in the house and, state variables regarding AFDC/TANF benefits, estimated workers' compensation (a state policy variable), unemployment rate and presence of state EITC. These variables do not appear in the wage equation (14a).

(13b) Reduced Form Usage of Paid Child Care: $Pr(F^ > 0) | D$, Family characteristics)*

where D is the vector of observed variables affecting the probability of using non-maternal childcare such as age, years of education, non-labor income, race, number of kids in various age groups, presence of other adults, health status of the mother, state variables regarding AFDC benefits. The childcare expenses equation is identified by the presence of other adults and teens in the house. These two variables do not appear in the cost of childcare equation (14b).

These two equations in the first-stage are going to be jointly estimated using a bi-variate probit model to jointly estimate the decision equations since it is likely that mothers make the two decisions simultaneously. Based on the Mills Ratios constructed from this first stage bi-variate probit estimate, correction terms are generated for the hourly wage and weekly expenses of childcare so that a selection-corrected wage equation and a demand equation for paid child care could be estimated in the second-stage.

Second Stage Equations:

(14a) Selection Corrected Wage: $W = \Gamma S + \nu$

where S is the set of variables that affects wage and is a subset of M (from 13a) in order to identify this equation. For example, it includes variables such as education, age, age squared, marital status, citizenship status, race, health status, metro residence, and inverse mills ratio (computed from the first stage bi-variate estimates). ν represents unobserved determinants of wages.

(14b) Selection Corrected Cost of Child Care: $p = \Lambda K + \eta$

where K is a vector of variables affecting childcare expenses and similarly is a subset of D (from 13b) in order to identify the equation for childcare expenses. In particular, we exclude presence of other adults and teens in the house from this equation. The control variables included in this equation are age, education, citizenship status, marital status, race, number of infants, number of children in various age groups, metro residence, and inverse mills ratio. η is the set of unobserved factors that affects the cost of childcare.

Final Stage Equation:

(15) Structural Equation for Participation: $Pr(H = 1)$

$$(\lambda + \theta Q + \rho_0 \hat{W} + \rho_1 \hat{p} + \rho_2 Treatment + \rho_3 Post96 + \rho_4 (Treatment * Post96) + \rho_5 (Treatment * Post96 * \hat{p}))$$

In the final step, a Probit model is used to estimate the probability of employment utilizing the predicted wage and predicted childcare expenses, among others, from the second-stage results. I attempt to capture the EITC expansions included in the Omnibus Budget Reconciliation Act of 1993 (OBRA93) through the dichotomous variable, $Post96$ where $Post96 = 1$ if the reference time period is after 1996 and 0 otherwise. Recall that the expansions of the EITC were implemented in phases in 1994, 1995 and 1996. As a result, the dichotomous variable, $Post96$ reflects the period *before* and *after* EITC expansions.

Here, Q is a set of variables that affect the probability of labor force participation. It excludes some variables that arguably affect either the probability of using non-parental childcare, or wages, or the cost of childcare, but does not affect the probability of employment. Following Connelly and Kimmel (2003), the following variables are excluded from this final equation due to identification requirements: presence of other adults, education, state regulations regarding employers estimated workers' compensation. While many of these are also suggested in other studies, the exclusion of age, age squared, and education from the final equation may be arguable.

The *treatment* group is single mothers with at least one child under 18 and this group is compared with the *control* group – never married women without children. There are two groups of women who constitute the ‘usual’ control groups in existing literature: single women with no children, single women who dropped out of high school and have no children. These groups included women who are either widowed or separated or divorced or never married. All these groups of women tend to show little change in their labor force participation during the 1990s. However, assets and non-labor resources of widowed/separated/divorced women may differ from those of never married women. Furthermore, the widowed/separated/divorced women may represent different choices regarding having children than the never married women. As a result, I have chosen the never married women without any children as the ‘control’ group whose labor force participation would be compared with that of the single mothers. However, some analysis has been done using the other control groups for purposes of comparison.

Though my primary interest are the difference-in-difference estimators ρ_4 and ρ_5 , due to the presence of several interaction terms we need to consider the partial derivative of the dependent variable (labor force participation) with respect to the treatment group, evaluated at the average predicted childcare expenses, to find out how single mothers change their labor force participation relative to never married women without children after the EITC expansions till 1996. Everything else being the same, we expect higher costs of childcare to reduce the effectiveness of the EITC program on labor force participation of single mothers, i.e. dampen the increase in labor force participation of single mothers.

2 DATA DESCRIPTION

The sample of women for my research comes from the Survey of Income and Program Participation (SIPP). This dataset has been selected primarily because it collects detail information on the variables of my interest, particularly on child care expenses, labor force participation and taxes including EITC claims. Current Population Survey (CPS) does not have information about child care modes and expenses. As a result, I have selected SIPP panels of 1992, 1993, 1996 and 2001 to cover the policy period under consideration when maximum credits of EITC were increased substantially in 1993 and implemented in phases till 1996 (described above in Section 1.1, Table 1.2). In particular, the following panels and waves of the Survey of Income and Program Participation (SIPP) were drawn:

Table 2.1 SIPP Panels Covered

Panel	Wave	Reference Time Period	Topical Module
1992	6	Sept 93 – Dec 93	Child care
1992	8 (Research)	May 94 – Aug 94	Taxes
1993	3	Sept 93 – Dec 93	Child Care
1993	5 (Research)	May 94 – Aug 94	Taxes
1993	6	Sept 94 – Dec 95	Child Care
1993	8 (Research)	May 95 – Aug 95	Taxes
1996	4	March 97 – June 97	Taxes, Child Care
1996	10	March 99 – June 99	Taxes, Child Care
2001	4	Jan 02 – Apr 02	Taxes, Child Care

The programs for cleaning and pulling these panels have been downloaded from the website of the Center for Economic and Policy Research (CEPR) (http://www.ceprdata.org/sipp/sipp_data.php) while the raw data was downloaded from the National Bureau of Economic Research (NBER) (<http://www.nber.org/data/sipp.html>)

website. Using the programs from CEPR, I matched information from the ‘topical’ modules on childcare with the detail labor force, income and demographic information from the ‘core’ modules. Since the CEPR programs do not cover the tax modules, the ‘topical’ modules relating to ‘taxes’ were match-merged with the rest of the data to provide a complete set of information relating to demographics, childcare and EITC variables. In addition, a set of state-level policy variables relating to economic and program transfer information (from the website of UKCPR) was merged with these files as a final step in data preparation.

The SIPP is a multistage-stratified sample covering the U.S. civilian non-institutionalized population. Interviews are attempted for all household members 15 years of age and older, with the option of proxy responses when household members are unavailable for interviewing. The survey design consists of a continuous series of national panels, with new panels (having a new set of sample households) being introduced periodically. The sample size in a panel ranges from approximately 14,000 to 36,700 interviewed households. The duration of each panel varies from thirty-two (32) months to forty-eight (48) months. More information on SIPP is available at the website of the Census Bureau (<http://www.census.gov/sipp/overview.html>).

The SIPP has two modules: Core and Topical. The “core modules” ask questions relating to labor force, program participation, and income with an objective to measure economic conditions of people. The "topical modules" are additional questions on a variety of topics not covered in the core section and are assigned to particular interviewing waves of the survey only. Topics covered by the topical modules include personal history, child care, wealth, program eligibility, child support, utilization and cost of health care, disability, school enrollment, taxes, and annual income.

The SIPP survey uses a 4-month recall period (called a ‘wave’), with approximately the same number of random subsamples being interviewed in each month of the 4-month period of each wave. Thus, each sample member is interviewed every 4 months for the duration of a panel, with information about the previous 4-month period collected in each interview. Due to this interview structure, data from only the fourth month of each

relevant wave_was analyzed. The topical modules of child care questions refer to childcare arrangements of the “last month”. The User Guide of SIPP recommends using the fourth reference month of current wave when the survey questions refer to arrangements in the previous month (<https://www.census.gov/sipp/usrguide/sipp2001.pdf> , page 273).

2.1 Demographic Summary Statistics of Single Mothers and Single Women

Since the research topic is to analyze labor force participation of single mothers as compared to single women, the sample consists of only females, within the age group of 18-60 years. The choice of this age group is to consider the working age women. My treatment group is single women (either married but spouse absent, single, divorced, or never married) with at least one child below age 18. The control group consists of single women (never married) who do not have any child (below age 18) of their own.

In order to get robust estimates of the predicted wage and price of childcare from a larger sample, the first-stage bi-variate probit equations (joint reduced form labor force participation and use of paid child care) as well as the second-stage selection-corrected equations (on wage and cost of child care) have been run on a sample consisting of married women, single mothers and never married women (with no children). As a result, married women with spouses present were also included in the initial sample. The final-stage analysis of labor force participation was conducted on only the treatment and control group of women.

Table 2.2 presents the mean values of the variables included in the analysis for the three categories of women between the ages 18 to 60 years as described above: single mothers, single women, and all women (including married women with spouse present) for all the panels. The summary statistics show that 57.67% of the sample is married women with spouses present, while 18.34% are women without spouse or widowed or divorced or separated and, 23.99% are never married women. Out of the total sample of 109,935

women, 16,626 are single mothers (treatment group) and 17,364 are single women (control group).

Table 2.2 Demographic Statistics of Single Mothers and Never Married Women: All Panels

Variables	All Women (including married, spouse present)		Single Mothers		Never Married	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Demographics						
age	37.76	11.5213	31.22	10.0462	28.84	9.9465
Number of other adults	2.15	0.9596	1.83	1.1387	2.15	1.3331
No of own children	0.90	1.1593	1.75	0.9921	0.00	0.0000
Family's other income (1997 \$)	285.12	847.8093	270.52	560.5762	293.22	882.3908
Family's property income (1997 \$)	98.33	425.4070	36.57	243.1879	79.31	381.3848
Disabled	0.09	0.0009	0.09	0.0022	0.09	0.0022
Less than high school	0.14	0.0010	0.23	0.0033	0.11	0.0024
High school	0.32	0.0014	0.33	0.0036	0.24	0.0033
Some college	0.32	0.0014	0.35	0.0037	0.36	0.0036
College	0.19	0.0012	0.08	0.0021	0.24	0.0032
Post-college	0.04	0.0006	0.01	0.0009	0.04	0.0015
Native	0.85	0.0011	0.86	0.0027	0.85	0.0027
Naturalized	0.04	0.0006	0.03	0.0013	0.02	0.0012
Not-naturalized	0.07	0.0007	0.07	0.0020	0.05	0.0016
Married, spouse present	0.58	0.0015	0.00	0.0000	0.00	0.0000
Married, spouse absent	0.01	0.0003	0.03	0.0013	0.00	0.0000
Widowed	0.02	0.0005	0.04	0.0015	0.00	0.0000
Divorced	0.12	0.0010	0.30	0.0036	0.00	0.0000
Separated	0.03	0.0005	0.12	0.0025	0.00	0.0000
Never married	0.24	0.0013	0.51	0.0039	1.00	0.0000
White	0.73	0.0013	0.54	0.0039	0.70	0.0035
Black	0.12	0.0010	0.26	0.0034	0.16	0.0028
Hispanic	0.11	0.0009	0.17	0.0029	0.09	0.0021
Otherace	0.04	0.0006	0.04	0.0015	0.05	0.0016
Metro	0.78	0.0012	0.79	0.0031	0.83	0.0029
Employment						
Proportion in labor force	0.67	0.0014	0.64	0.0037	0.74	0.0033
Wage per hour (1997 \$)	11.86	12.1056	9.56	8.9661	10.77	9.3616
Hours worked per week	24.00	19.1988	21.97	18.7666	26.43	18.5702
Full-time work	0.63	0.4827	0.57	--	0.62	--

Table 2.2 Demographic Statistics of Single Mothers and Never Married Women: All Panels (Continued)

Variables	All Women (including married, spouse present)		Single Mothers		Never Married	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Child Care						
Total cost per week((1997 \$)	79.27	68.5918	67.20	57.2653		
(Observations)	8832					
Proportion paying for care	0.08	0.0008	0.12	0.0025		
No. of Observations	109935		16626		17364	

Values are in constant 1997 dollars.

It is seen that approximately 67% of the 109,935 women in the full sample have a job. About 64% of the treatment group (single mothers) has a job, while 74% of the control group (single women) are working. This is consistent with overall trends in participation of single mothers and never married women. In general, participation rate of never married women is found to be higher than that of single mothers. Average weekly working hours for the full sample of women is 24 hours. However, the single mothers work fewer hours than the single women (22 hours vs. 26 hours) and hence a smaller proportion of the single mothers work full-time (40 or more hours per week). Additionally, they (single mothers) earn a lower average hourly wage than the single women (\$9.56 vs. \$10.77) in constant 1997 dollars.

Single mothers are 31 years of age on average, and most likely to have some college education (35%) while a third of them are high school graduates. Single women are younger in age (29 years) and also most like to hold some college education (36%). However, they are approximately three times more likely than single mothers to have completed college (24% vs 8%) and four times more likely to have post-college education (4% vs. 1%).

A higher proportion of single women are likely to be White (70% vs. 54%). A higher proportion of single mothers are, however, likely to be Black or of Hispanic origin. Single mothers and single women predominantly live in a metro (79% and 83%, respectively) and, are mostly native-born (86% and 85% respectively). A higher

proportion of the single mothers (7% vs. 5%) are immigrants who have not become citizens.

Both single mothers and single women have about two other adults present in their family. This may be due to the presence of other family members or sharing of a rental unit with other adults. Single women have higher average monthly real non-labor income than single mothers (\$293.22 vs. \$270.52). Additionally, they have higher stream of monthly property income (\$79.31 vs. \$36.57). However, there is substantial variation in both of these categories of income (non-labor and property income) as evidenced by the high standard deviation. It is worth noting that SIPP divides household cash-income into four categories: earned, property, transfers and other. Non-cash income includes food stamp, WIC, and energy assistance.

2.2 Summary Statistics of Modes of Childcare Usage and Expenditures

Looking at the child-related variables, it is seen that single mothers have on average about two children less than 18 years of age. Out of the single mothers, 12.14% are making out-of-pocket payments for the usage of childcare services. This may reflect the usage of informal and subsidized childcare services as well as assistance from other sources.

Broadly, there are six different types of childcare arrangements that have been created by out of the responses for the childcare questions in SIPP. These, as described in user notes for the childcare module, are:

Family Care: This includes non-relative care outside the child's home; for instance, family daycare and informal care facilities in someone's home.

Formal Day Care: This type refers to formal day care centers and is not situated in a home. For example, it includes daycare, nursery school, and Head Start/ pre-school for young children; for older children, it includes daycare, sports, lessons, clubs, and after-school care.

Nanny/Sitter: This is for non-relative care inside a child's home.

Relative: This category refers to siblings over age 15 years, grandparents, or other relatives taking care of a child either inside the home or outside the home.

Parent/Guardian: This is either parent/guardian respondent of a child or other parent/guardian caring the child at home or at workplace of the parent/guardian.

Self Care: This means the child is taking care of himself/herself or is cared for by siblings 15 years or younger.

My analysis of the SIPP data on childcare arrangement refers to only the primary mode of arrangement (i.e. the childcare arrangement with the maximum number of hours for a child) for the three youngest children, broken down into two age groups: children under 6 years of age and children 6 years or older. Even though recent panels (since 1996) expand the childcare arrangement questions to more children/more types of arrangements, I was unable to utilize this additional information due to lack of consistency/availability in the earlier panels (1992, 1993). With respect to the payment variables, the amounts show the total amount paid by a parent (in constant 1997 dollars), on average, for a particular mode of child care arrangement, which is broken down along the two age groups: all children under the age of six (for a parent), and all children six years of age or older (for a parent).

Table 2.3 provides detail information regarding childcare usage and expenditures by various modes for all the single mothers, further disaggregated by their employment status. In general, it is seen that working single mothers are more likely to use child care arrangements relative to non-working single mothers. It is observed that relative care is the primary mode of arrangement for single mothers, both employed and unemployed regardless of the age of children. Similar findings are reported by Connelly and Kimmel (2002). They comment that this pattern of choice is consistent with the employment pattern of single mothers, who typically work part-time (as seen by their average work hours in Table 2). In addition, it provides greater flexibility to meet non-traditional work hours. According to Washington State Department of Early Learning, family, friend and neighbor providers – commonly known as FFN care – is the most common type of care

around the nation for infants, toddlers and school-age children before and after school. People choose FFN care for a variety of reasons such as existing bonds of love, shared language, culture, religion and values, presence of a special- needs child, cost etc. Their research also suggest that FFN providers do this work primarily because they enjoy being with children and they like helping the parents. This explains why only 23.52% of single mothers, who use relative care for a child under six years of age, make a payment for such services. This proportion is slightly higher for the working single mothers (27.37%), nevertheless still small compared to Family Care, Formal Care or Care by a Nanny/Baby Sitter.

For children under six years of age, formal day care is the second major mode of childcare arrangement for single mothers (whether working or not), followed by family care. However, this is not the case for children six or older; for this group of children, self-care is the second major mode for both working and non-working single mothers.

Table 2.3 Childcare Arrangements of Single Mothers (All Panels)

	Single Mothers (All)				Single Mothers (working)				Single Mothers (not working)			
	Child Under 6		Child 6 or older		Child Under 6		Child 6 or older		Child Under 6		Child 6 or older	
	Mean	St Dev	Mean	St Dev	Mean	St Dev	Mean	St Dev	Mean	St Dev	Mean	St Dev
Usage of Modes (proportion):												
Family Care	0.1236	0.0052	0.0684	0.0034	0.1592	0.0070	0.0828	0.0044	0.0501	0.0059	0.0279	0.0043
Formal Day Care	0.2688	0.0069	0.1394	0.0047	0.3138	0.0089	0.1560	0.0058	0.1759	0.0102	0.0930	0.0076
Nanny/Sitter	0.0319	0.0027	0.0348	0.0025	0.0370	0.0036	0.0400	0.0031	0.0213	0.0039	0.0203	0.0037
Relative care	0.3509	0.0075	0.3047	0.0063	0.3704	0.0093	0.3417	0.0076	0.3107	0.0124	0.2008	0.0105
Parent/Guardian	0.0716	0.0040	0.0762	0.0036	0.0844	0.0054	0.0947	0.0047	0.0450	0.0056	0.0243	0.0040
Self care	0.0065	0.0013	0.1694	0.0051	0.0061	0.0015	0.1885	0.0062	0.0072	0.0023	0.1160	0.0084
No of Observations	4081		5402		2698		3935		1383		1467	
Pay for care of those who use (proportion):												
Family Care	0.8301	0.0170	0.7321	0.0236	0.8666	0.0164	0.7600	0.0240	0.5905	0.0646	0.5000	0.0845
(No of Observations)	490		353		431		317		59		36	
Formal Day Care	0.7199	0.0141	0.6626	0.0173	0.7901	0.0143	0.6902	0.0187	0.4614	0.0353	0.5328	0.0438
(No of Observations)	1016		746		815		615		201		131	
Nanny/Sitter	0.5100	0.0437	0.4598	0.0378	0.5306	0.0480	0.4820	0.0404	0.4358	0.1057	0.3374	0.1057
(No of Observations)	132		175		109		154		23		21	
Relative care	0.2352	0.0114	0.1325	0.0084	0.2737	0.0142	0.1449	0.0097	0.1405	0.0173	0.0732	0.0152
(No of Observations)	1395		1623		990		1330		405		293	
Weekly expenditure of those who pay (1997 \$)												
Family Care	65.46	45.90	56.33	52.85	66.47	43.62	59.26	54.98	56.89	62.67	32.62	18.10
(No of Observations)	236		148		214		134		22		14	
Formal Day Care	72.91	59.49	49.39	45.23	75.78	61.20	51.44	45.80	54.70	43.18	37.01	39.68
(No of Observations)	726		482		634		417		92		65	
Nanny/Sitter	97.51	78.46	79.17	60.49	90.68	75.10	79.28	61.58	125.82	89.67	76.91	39.61
(No of Observations)	67		72		57		69		10		3	
Relative care	53.39	50.38	48.30	37.74	57.20	56.69	49.40	38.14	37.22	27.26	38.41	33.08
(No of Observations)	314		201		264		181		50		20	
Total Weekly Expenditure (1997 \$)	68.61	57.46	53.18	47.53	70.83	58.19	55.27	48.52	54.98	50.84	37.89	36.19
(No of Observations)	1333		895		1161		793		172		102	

Note: all dollar figures have been adjusted for inflation and are in 1997 dollars.

Nanny/sitter care is the least used/preferred arrangement for single mothers whether working or not. This pattern is also consistent with common findings as this mode is relatively more expensive.

Looking at the proportion of parents making payments (out of those who used a given childcare mode), it is seen that working single mothers, overall, are more likely to make a payment compared to the unemployed single mothers. As mentioned above, neither group of mothers is very likely to pay for relative care. However, this may ignore presence of other indirect forms of (cash or non-cash) payments for such informal care services. For example, there might possibly be trading among parents and caregivers and sometimes parents may pay for particular family needs of the caregivers (e.g., food or clothing) rather than cash payments for their services. This would imply that our child care expenditure is under-estimated and would be higher if we were able to measure and include such indirect payments to the relative care providers.

Regarding care for a child under six, 87% of the working mothers are likely to pay for family care, whereas only 59% of the unemployed mothers are likely to pay for family care. Similarly, a high proportion of the working single mothers pay for formal day care (79%) relative to unemployed single mothers (46%). As mentioned earlier, only 27% of working single mothers pay for relative care, the mode least likely to make a payment for. The unemployed single mothers are half as likely (14%) to pay for relative care.

We observe similar differences between the two (working vs. not-working) groups of single mothers in terms of likelihood of paying for children six and over. 76% (out of those who use the mode) of the working single mothers are likely to pay for family care compared to only 50% of those single mothers who are not working. Regarding formal care, the proportions are 69% vs. 53%, respectively. Again, we find that working single mothers are twice as likely to pay for relative care (14.49% vs. 7.32%) than the unemployed single mothers for children six and over.

In summary, working single mothers are more likely to pay for family care, followed by formal care, nanny care, and finally relative care respectively for both younger and older children. Similar pattern is observed for unemployed single mothers regarding children less than six years of age. However, the order (in terms of likelihood of payment) changes to formal care, family care, nanny care and lastly relative care for older children for this group of mothers.

When we compare the average weekly expenditures in real terms, we find that the working single mothers' payment is consistently higher than those who are not working, for all modes of childcare arrangement. Nanny/sitter care is found to be the most expensive one with average weekly expenses of \$90.68 for a child under six, and \$79.28 for a child six or over. It seems that single mothers without work incur higher costs on average for nanny services for young children (\$125.82 vs. \$90.68).

However, we only have 10 unemployed single mothers with children under six years of age and 3 unemployed single mothers with children six or older in this category (nanny/sitter care), which is a sample size too small to draw any meaningful statistical comparison. Apart from nanny/sitter care, formal day care for children under six is the most expensive mode (\$75.78) for working single mothers, while family care is the most expensive for the older children for this group of mothers (\$59.26). We observe opposite patterns for the unemployed single mothers, as they spend most for family care for the younger children (\$56.89) and formal care for the older children (\$37.01). However, the differences in the payments are small.

For a single mother, the average weekly expenditure is \$68.61 for all children under six and, \$53.18 for all children six or older. The working single mothers make higher payments on average per week than the non-working single mothers for children of both age groups. In order to depict the relative magnitude, expenses for a child under six is 33.68% of a typical single mother's weekly wage income (calculated based on real wage [\$9.56/hour] and hours worked per week [22 hours] from section 2.1). This is by no means small considering that these women are likely to be the sole earners in their family. However, the EITC expansion is likely to reduce the magnitude of this proportion. As discussed earlier, the EITC is a supplement to wage income, especially in the phase-in range. When we consider the after-EITC wage of the single mothers, the relative magnitude of child care costs as a proportion of wage income is likely to go down. This is likely to be the case as long as the cost or price of child care does not increase faster than the increase in the phase-in credit rate of the EITC.

2.3 Summary Statistics of EITC-related Variables

In the tax modules of the SIPP, respondents are asked questions regarding whether they filed federal tax returns, whether they claimed EITC benefits and if so, the amount claimed and other matters. Summaries of the tax-related variables from the sample of the study are presented in Table 2.4.

Table 2.4 Tax Filing and EITC Claims (All Panels)

Variables	All Women	Single Mothers	Never Married Women (no kids)
	Mean	Mean	Mean
Tax filed (%)	48.16	53.28	58.96
(Observations)	109935	16626	17364
Of those who filed:			
Has tax copy (%)	25.49	21.31	24.07
Filed as Single (%)	35.42	34.85	93.22
Filed as Married (joint) (%)	45.89	04.15	00.72
Filed as Married (Sep) (%)	03.41	02.73	00.04
Filed as Unmarried Head (%)	12.83	55.09	04.06
Filed for EITC (%)	12.16	36.18	04.24
(Observations)	53550	8945	10067
EITC amount claimed (1997 \$)	1534.94	1613.56	1060.14
(standard deviation)	1084.99	1099.19	1084.15
Observations for EITC claim	3502	1721	224

It is observed that 48.16% of the full sample (consisting of married and single women), 53.28% of the single mothers and 58.96% of never-married no-children women said that they filed the federal tax return. However, less than one-quarter of these women have tax copies. The majority of the single mothers file taxes as unmarried head of household followed by single filing status. 93.22% of the never-married women file taxes as single.

Out of those who filed a federal tax return, 36.18% of the single mothers claimed EITC and the average claimed amount is \$1,613.56 (in constant 1997 dollars). About 4.24% of the never-married women claimed EITC when they filed federal tax returns, with an average amount of \$1,060.14 (in constant 1997 dollars).

Often times these variables are considered of limited value because a large proportion of the households tend not to respond these questions. Non-response is a major issue for these questions (Karl Scholz, 1993). Sometimes many households are not even asked these questions if the interviews take too long or if there is a danger of non-cooperation on the part of the respondents. Scholz also points out that households relying on paid tax preparers (a significant proportion of the EITC claimants) might not be aware of or remember whether they received the EITC. As a result, he argues that the population of households, who reported to have referred to the tax copy while answering the tax module questions, would be a more reliable sample to estimate participation and amount of EITC claimed.

2.4 Summary Statistics across the Panels

In order to capture snapshots of the key variables over time, I summarized some of the variables across the four panels. The summary statistics are presented in Table 2.5.

It is evident that both of these groups of women experienced substantial fluctuations in their 'other' income over the duration of the sample. Single mothers experiences decreases in their property income during fall of 1993 and 1994. After remaining stable during the summer 1997-summer 1999 periods, it rose slightly in 2001. The proportion of single mothers with a job has been gradually on the rise over the sample period (except for Panel 1993, wave 3). However, their hourly wage (in constant 1997 dollars) has remained remarkably stagnant with very small increments, especially during fall 1993-summer 1999. Their hours worked increased during fall 1993-1994, but continued to fall since then. Though there is also fluctuations in childcare expenses (in constant 1997 dollars), it seems single mothers incurred lower amounts of these expenses in 2001 than they did in fall of 1993. This may reflect lower demand for childcare as they work fewer hours. These are expenses incurred by single mothers and do not reflect the market price of providing for childcare services. The proportion of single mothers paying for care dipped in the fall-1994, but has been hovering around 14% since then. It seems that the

proportion of single mothers who filed federal tax return hovers around 54-57%, except for the year 2001, when it is 46%.

Table 2.5 Panel-wise Summary Statistics of Single Mothers and Single Women without children

Variables	Single Mothers					
	1992 (wave 6 & tm 8)	1993 (wave 3 & tm 5)	1993 (wave 6 & tm 8)	1996 (wave 4)	1996 (wave 10)	2001 (wave 4)
Monthly non-labor income (1997 \$)	265.21	283.38	269.35	244.88	283.97	276.31
(standard deviation)	577.35	603.18	587.56	491.11	574.00	530.74
Monthly property income (1997 \$)	41.63	33.31	28.65	37.93	40.01	37.57
(standard deviation)	223.71	173.17	153.76	210.29	220.70	386.03
Proportion working (%)	59.36	57.17	58.45	67.56	70.82	67.96
Hourly wage (1997 \$)	9.20	9.24	9.31	9.31	10.13	9.94
(standard deviation)	5.87	5.36	6.23	7.57	14.83	8.07
Weekly work hours	20.53	19.62	20.22	23.14	24.42	23.31
(standard deviation)	18.92	18.85	19.03	18.64	18.19	18.53
Proportion paying for childcare (%)	10.62	10.44	09.92	14.06	13.56	13.68
Weekly expenditure on childcare (1997 \$)	71.37	69.48	71.18	63.25	64.68	66.70
(standard deviation)	50.16	46.89	68.19	50.67	59.67	63.67
Observations (Childcare)	203	213	192	575	435	451
Proportion filed for tax (%)	55.05	52.27	53.56	56.27	57.00	45.88
Proportion claimed EITC (%)	18.00	17.66	19.65	17.52	21.98	20.91
EITC amount claimed (1997 \$)	1094.24	1021.20	1834.70	1737.54	1761.99	2094.2
(standard deviation)	594.64	577.42	1066.14	1035.67	1025.15	1489.6
Observations (EITC)	202	212	231	323	400	353
Reference time period:						
Childcare	Fall of 1993	Fall of 1993	Fall of 1994	Summer of 1997	Summer of 1999	Spring 2002
Tax year	1993	1993	1994	1996	1998	2001
No. of Observations	1942	2052	1941	4070	3315	3306

Table 2.5 Panel-wise Summary Statistics of Single Mothers and Single Women without children (Continued)

Variables	Never married women (without children)					
	1992 (wave 6 & tm 8)	1993 (wave 3 & tm 5)	1993 (wave 6 & tm 8)	1996 (wave 4)	1996 (wave 10)	2001 (wave 4)
Monthly nonlabor income (1997 \$)	309.08	323.89	333.81	276.72	276.66	252.98
(standard deviation)	845.67	1058.83	1035.13	885.01	720.87	745.15
Monthly property income (1997 \$)	95.10	103.93	92.08	68.15	76.98	48.61
(standard deviation)	505.42	469.47	393.81	261.10	321.75	301.57
Proportion working (%)	72.45	74.25	74.16	75.67	74.23	73.48
Hourly wage (1997 \$)	10.24	10.55	10.33	10.39	11.00	11.85
(standard deviation)	7.35	7.36	6.59	11.94	9.65	11.05
Weekly work hours	25.76	27.17	26.92	26.77	26.12	25.97
(standard deviation)	18.56	18.60	18.64	18.32	18.58	18.69
Proportion filed for tax (%)	62.48	66.55	63.70	63.03	58.56	43.15
Proportion claimed EITC (%)	02.59	01.72	01.94	02.92	02.55	03.09
EITC amount claimed (1997 \$)	826.71	1030.10	793.17	758.26	1229.57	1518.45
(standard deviation)	553.32	651.93	936.35	738.00	1070.69	1613.30
Observations (EITC)	32	17	22	51	48	54
Tax year	1993	1993	1994	1996	1998	2001
No. of Observations	2209	2073	2029	4074	3434	3545

One possible reason for the lower percentage in 2001 may be due to the timing of the survey. This wave was conducted in spring 2001 and hence may have been too early for a lot of the respondents to file tax returns. The proportion of EITC claims have been gradually on the rise, so has been the claimed amount which increased from \$1094 in fall-1993 to \$2094 (1997 dollars). This is consistent with the expansions of the EITC benefits since mid-1990s.

Never-married women with no children also experienced substantial drops in their ‘other’ income and property income during the sample period. Their wage rate remained

stagnant during most part of the sample period, but it increased in 1999 and 2001. They seem to working similar hours in 2001 as in 1993, though there were periodic rises in hours worked between these years. Proportion of these women who are working is slightly higher in 2001 than their 1993 shares.

Increasing proportion of these women are filing tax returns, though it dropped a little in 1999. As stated above, the figures for 2001 may have been affected by premature timing of the survey for tax returns. Though the proportion of EITC claims shows a rising trend over the panels, only a small proportion of these women claim EITC. There is significant increases in the amount of EITC claimed, especially during 1999 and 2001. One might argue that the control group of women is ‘contaminated’ in the sense that they are also eligible for the EITC benefits since 1994. However, as seen from Table 2.5, the proportion of never married women (with no children) claiming EITC is very small. Furthermore, these are ‘claimed’, not ‘actual’ statistics and recall that there are serious concerns regarding the credibility of these ‘claimed’ amounts (Karl Scholz, 1993).

3 SELECTION-CORRECTED WAGE AND CHILDCARE EXPENDITURE

I approached the empirical estimation process in several steps, as discussed in detail in Section 1.3. The first step of the process is to estimate a bivariate model of probability of participation and probability of using paid care. The inverse-mills-ratio constructed from this first-stage model is then used to estimate selection-corrected wage and costs of care. The need for estimating a joint reduced form participation and usage of paid care arises because of the presence of endogeneity, simultaneity, and potential selection issues in directly estimating wages and costs of care. The predicted wage and cost of care enter the final-stage model of participation as regressors. Estimates of the first-stage bivariate model and second-stage selection-corrected wage and costs of care are presented and discussed below.

3.1 Results from Reduced-form Models of Labor- force Participation and Use of Paid Childcare

I estimate the following reduced-form bivariate probit equation using the full sample of married women (with spouses present) as well as all single women (with or without children). The results are produced in Table 3.1. The dependent variables are probability of employment and probability of using paid care services. The regressors include a set of demographic characteristics of the women, a set of household composition variables, and a set of structural variables. The demographic variables are age, non-labor income, and a set of dichotomous variables for education levels, race, citizenship status and disability. The household composition variables include presence of other adults, number of own children, number of infants, number of children under 5, number of children between 6-12, number of children between 13-17, marital status etc. Variables such as state EITC (a dichotomous variable), state's AFDC/TANF benefit levels for 2 and 3 persons' family, the estimated employer costs of workers compensation insurance payments by the state, state's unemployment rate, etc. are the structural variables.

Table 3.1 Bi-variate Probit Estimation of Probability of Participation and Probability of Using Paid Child care

	Employment			Pay for Care		
	Coef.	Robust Std. Error	z	Coef.	Robust Std. Error	z
Age	0.0803	0.0028	28.17	0.1322	0.0064	20.73
Age squared	-0.0011	0.0000	-31.09	-0.0021	0.0001	-23.88
Disabled	-1.0080	0.0146	-69.13	-	-	-
High School	0.3972	0.0134	29.63	0.2826	0.0267	10.59
Some college	0.5052	0.0137	36.88	0.4372	0.0265	16.48
College	0.6560	0.0159	41.37	0.5555	0.0281	19.77
Post college	0.7538	0.0255	29.57	0.7684	0.0367	20.92
Naturalized	-0.0497	0.0235	-2.12	0.0437	0.0369	1.19
Not naturalized	-0.3068	0.0191	-16.08	-0.0824	0.0308	-2.68
Married (sp ab.)	0.0131	0.0398	0.33	-0.2518	0.0648	-3.88
Widowed	0.0865	0.0267	3.24	-0.2152	0.0670	-3.21
Divorced	0.2891	0.0145	19.95	-0.0985	0.0230	-4.29
Separated	0.1820	0.0236	7.70	-0.1093	0.0356	-3.07
Never married	0.0818	0.0133	6.16	-0.5121	0.0222	-23.08
Black	-0.0005	0.0134	-0.03	0.1122	0.0211	5.31
Hispanic	-0.0021	0.0156	-0.13	0.1125	0.0241	4.66
Other race	-0.1131	0.0220	-5.15	-0.0381	0.0357	-1.07
Other adults	-0.0346	0.0048	-7.28	-0.1670	0.0113	-14.72
No. of own kids	-0.1095	0.0045	-24.09	0.0419	0.0210	1.99
No. of infants	-0.1103	0.0229	-4.83	-0.2807	0.0284	-9.89
No of kids below 5	-0.2520	0.0089	-28.39	0.5510	0.0216	25.48
No. of kids 6-12	-	-	-	0.1756	0.0220	8.00
No. of kids 13-17	-	-	-	-0.1025	0.0244	-4.19
No-labor income	-0.0002	0.0000	-11.81	0.0001	0.00001	-0.97
Property income	-0.0002	0.0000	-13.30	0.00002	0.00003	0.96
Workers compensation	0.0000	0.0000	-7.57	0.00001	0.0000	-0.16
State unemploy. rate	-0.0472	0.0032	-14.84	-0.0603	0.0046	-13.01
AFDC (2person)	0.0012	0.0003	4.06	-0.0006	0.0004	-1.45
AFDC (3person)	-0.0006	0.0002	-2.53	0.0005	0.0004	1.55
State EITC	-0.0085	0.0162	-0.52	-	-	-
Constant	-0.7074	0.0598	-11.83	-3.2931	0.1220	-26.9900
Observations	109190					
Rho				0.3828		0.0083
Wald test of	rho=0:	chi2(1) =1713.91		Prob > chi2 = 0.0000		

Results from the employment equation are consistent with prior expectations. First, we find that age is positively related with labor force participation, but the relationship becomes negative at some point indicating older people (beyond 36.5 years) are less likely to be employed as they approach the retirement age. Disability also negatively affects employment as expected. The effect of education on employment is positive. Education signals ability of the individual and also increases the stock of human resources of the individual, thus enhancing chances of employment. The findings suggest that native citizens are more likely to be employed. This might be due to strict immigration regulations, which is part of the reason why whites are more likely to be employed. Single women (with or without children) are more likely to be working relative to married women (with spouses present) as these women are most often the sole earners in their families. Presence of other adults in the house might imply alternative sources of income and hence negatively affects employment. Presence of children (especially young children) also negatively affects labor force participation as they need to be cared for. Due to negative income effect, non-labor income is inversely related with participation, an expected prediction from the labor supply model. State policies relating to workers' compensation and AFDC benefit level for 3-person family also reduce participation likelihood.

Findings from the use of non-parental childcare equation show that though age is positively related with use of non-parental childcare, it becomes negative beyond 31.5 years of age. This is expected because as children get older, the need for child care obviously falls. Higher educated women are more likely to demand child care services. Native citizens are also more likely than non-naturalized citizens to seek paid non-parental child care services. While married women (with spouses present) are more likely to use paid non-parental child care services, white women are less likely to use do so. Presence of other adult family members reduces the probability of using paid care. Presence of young children increases the likelihood of using paid care. However, presence of teenage children reduces the likelihood of using paid care. Non-labor and property income do not affect likelihood of using paid care. Lastly, higher state

unemployment rate and AFDC/TANF benefit reduce the likelihood of using paid childcare.

The jointly estimated bivariate probit model accounts for the correlation between employment participation and usage of paid childcare services. The justification for using a bivariate model is that the two decisions of employment and usage of paid care are interrelated. A standard bivariate model is where:

$$(16) \textit{Participation Equation: } Y_{1i}^* = X_{1i}\beta_1 + u_{1i}$$

$$Y_{1i} = 1 \textit{ if } Y_{1i}^* > 0$$

$$Y_{1i} = 0 \textit{ otherwise, and}$$

$$(17) \textit{Usage of Paid Care Equation: } Y_{2i}^* = X_{2i}\beta_2 + u_{2i}$$

$$Y_{2i} = 1 \textit{ if } Y_{2i}^* > 0$$

$$Y_{2i} = 0 \textit{ otherwise}$$

The error terms consist of a common term and a second term that is unique to each model and hence the two equations are related through correlated error terms. As expected, the estimated correlation coefficient is positive and significant ($\rho=0.3828$). This means that unobserved factors that increase the probability of employment also increase the probability of using paid non-parental care. We can test the hypothesis that the bivariate probit model fits the data better than separate models, using a simple Wald test. The Wald test statistic for the hypothesis that the two decisions are independent (i.e. uncorrelated error terms or $\rho=0$) is 1713.91 and is significant. This means that the probability of employment will be dependent on the value/probability of using paid care.

3.2 Selection-corrected Wage and Childcare Expenditure

Estimation of reduced form bivariate model was the first-stage of the three-step estimation process. Presence of potential selection issues require us to estimate selection –corrected wage and costs of paid care so that these could be used as regressors in the final-stage estimation of participation. Therefore, inverse mills’ ratio was constructed from the first-stage estimates to estimate selection-corrected equations of wage and cost of child care. The resulting coefficients from these two estimated equations were used to construct predicted unconditional hourly wage and predicted unconditional weekly price or cost of childcare. Again, these results were generated utilizing the full sample of married women (with spouses) as well as single women (with or without children) to obtain robust estimates.

I omitted the following variables in the wage equation: non-labor income, number of children, young children of various age groups, presence of other adults in the house and, state variables regarding AFDC benefits, workers’ compensation, unemployment rate and presence of state EITC. The variables that are included in the first-stage bivariate probit model, but do not appear in the second-stage model of cost of childcare equation are: age squared, number of own children, other adults in the family, presence of teenage children, non-labor income, state variables regarding AFDC benefits, workers’ compensation and, unemployment rate.

The results are produced in Table 3.2 and 3.3. The coefficients of the wage equation have expected signs. It is found that age positively affects wage; however beyond a certain level, wage falls with age. Higher educated women have higher wages. Additionally, married women (with spouse present) have higher wage than single women (with or without children). It might reflect the phenomenon that married women require a higher wage than single women due to the presence of another earning member in the family. Women living in the metro areas also have higher wage, which to a large extent is reflecting the higher cost of living in the metro areas. The results also show that non-white as well as disabled women have lower wage. Other studies (e.g. Connelly and Kimmel, 2003) report similar findings.

Table 3.2 Selection-corrected Wage Equation

Wage	Coef.	Std. Err.	t	P>t
Age	0.4113	0.0211	19.49	0.0000
Age-squared	-0.0043	0.0003	-16.00	0.0000
High school	1.1302	0.1218	9.28	0.0000
Some college	2.3072	0.1279	18.04	0.0000
College	5.2430	0.1425	36.79	0.0000
Post-college	8.0119	0.1854	43.22	0.0000
Naturalized	0.7147	0.1635	4.37	0.0000
Not naturalized	-1.1620	0.1536	-7.57	0.0000
Married (spouse absent)	-0.5940	0.2909	-2.04	0.0410
Widowed	-0.6514	0.1989	-3.27	0.0010
Divorced	0.0344	0.0945	0.36	0.7160
Separated	-0.5324	0.1616	-3.29	0.0010
Never married	-0.1471	0.0878	-1.67	0.0940
Black	-0.3478	0.0906	-3.84	0.0000
Hispanic	-0.6351	0.1118	-5.68	0.0000
Other race	-0.0080	0.1565	-0.05	0.9590
Metro	1.2879	0.0702	18.34	0.0000
Disabled	-1.8812	0.1926	-9.77	0.0000
Inverse Mills Ratio	1.3770	0.2243	6.14	0.0000
Constant	-5.4981	0.4957	-11.09	0.0000
Adjusted R-Squared	0.1002			
Observations	71524			

Regarding weekly cost of childcare (shown in Table 3.3), I find that age has positive impact on cost of childcare. Higher educated women pay a higher price for childcare. Non-naturalized citizens pay a lower price than natives while naturalized citizens incur higher costs. Married women pay a higher price than single women. White women tend to pay more than others. Presence of young children raises the cost of childcare, while presence of teenage children lowers the cost. Finally, women living in the metro areas experience higher costs for childcare. It is important to note that I haven't controlled for quality of child care or income and hence some of these estimates may be affected by these omissions.

Table 3.3 Selection-corrected Weekly Price of Childcare (constant 1982-84 dollars)

Weekly Cost of Childcare	Coef.	Std. Err.	t	P>t
Age	-0.0226	0.0166	-1.3600	0.1730
High school	1.5075	0.3477	4.3400	0.0000
Some college	3.2938	0.3645	9.0400	0.0000
College	8.0453	0.4297	18.7200	0.0000
Post-college	12.8104	0.6601	19.4100	0.0000
Naturalized	0.5708	0.5612	1.0200	0.3090
Not naturalized	-1.6628	0.4326	-3.8400	0.0000
Married (spouse absent)	-1.5875	1.0144	-1.5600	0.1180
Widowed	0.5196	0.9175	0.5700	0.5710
Divorced	0.2429	0.3501	0.6900	0.4880
Separated	-0.3870	0.5411	-0.7200	0.4740
Never married	-0.5016	0.4308	-1.1600	0.2440
Black	-0.7267	0.3408	-2.1300	0.0330
Hispanic	-0.1796	0.3618	-0.5000	0.6200
Other race	-0.2962	0.5273	-0.5600	0.5740
Number of infants	-5.1825	0.4188	-12.3700	0.0000
Number of kids below 5	6.3820	0.2246	28.4200	0.0000
No. of kids between 13-17	-2.0187	0.1667	-12.1100	0.0000
Metro	1.7540	0.2505	7.0000	0.0000
Inverse Mills Ratio	-2.9218	0.3451	-8.4700	0.0000
Constant	7.3850	0.8927	8.2700	0.0000
Adjusted R-Squared	0.1011			
Observations	52,308			

The estimates of the standard errors from the bivariate model are incorrect. As a result, I estimated Heckman selection-corrected equations for wage and costs of paid care, which was utilized to predict wages and costs of care to be included in the final-stage model of participation.

3.3 Results from Multinomial Logit Model of Modes of Childcare

The main focus of my study is to estimate effects of EITC expansions and child care costs on participation. However, access to child care services is also key aspect in

decision to work. As a result, I investigate the demand for child care services for working mothers by applying a multinomial logit model and a sample selection model to augment and enrich my analysis. My interest is in the analysis of factors, including the role of child care expenditure, that influence the choice of child care services.

I consider five categories of choice for child care – family care, formal day care, nanny care, relative care (including self-care), and parental care. The relative care has been designated as the reference category since it is the most frequently used mode. This requires estimating 4 (5-1) equations, one for each category relative to the reference category to predict the probabilities of choosing the various modes of child care given the independent variables.

Based on utility theory, we can argue that parents evaluate the different types of child care services to choose the one that maximizes their utility, given the constraints of prices and income. Suppose, a parent makes decision on which one of the modes of child care to use from a set of $M=\{0,1,\dots,m\}$. Let p_{im} denote the vector of prices for each of the alternatives, Y_i to represent individual parental income, and X_i to be a vector of socio-economic characteristics that affect choice of modes of child care. Given this set up, each individual parent i chooses child care service m^* that maximizes the conditional indirect utility function:

$$(18)U_{im} = V(Y_i - P_{im}, X_i) + \varepsilon_{im}$$

where $V(\cdot)$ is the deterministic part of the utility function and ε_{im} is an independently and identically distributed error term representing unobserved heterogeneity among individuals and various modes of care. The probability that a parent i chooses m^* out of the set of alternatives can be written as:

$$(19)Pr_{im^*} = \Pr(U_{im^*} > U_{im}) = \frac{\exp(V_{im^*})}{\sum_{m=0}^m \exp(V_{im})} \text{ for } m \neq m^* = 0,1, \dots, M$$

Substituting the expression for the indirect utility function into the above equation and by normalization, we get:

$$(20) Pr_{im^*} = \frac{\exp(Y_i - P_{im^*}, X_i)}{1 + \sum_{M=1}^m \exp(Y_i - P_{im}, X_i)} \text{ where } m=0 \text{ is the base/reference category.}$$

The coefficients of a multinomial logit model are of limited value for analysis. As a result, marginal effects need to be computed from the estimated coefficients. These effects measure the impact of a unit change in the continuous explanatory variable (or from 0 to 1 for dichotomous variables) on the probability of observing a specific mode of care, evaluated at the mean of the explanatory variable.

I estimate separate multinomial logit models for modes of choice for young children (below six) and older children (six and above) utilizing the sample of working mothers (married or otherwise). The estimation process involves a number of steps. First, I use the first-stage bivariate model (presented earlier) to construct inverse-mills-ratio, which is later used in the second-stage to estimate selection-corrected price equations. Next, I predict prices for each individual mode of care for those women who have children. These predicted prices, together with socio-economic characteristics, are used in the final-stage multinomial logit model. As stated, these steps have been applied first to estimate choice of mode for young children, and later for older children. The marginal effects from the multinomial logit model are presented in Table 3.4 for the formal day care services.

Table 3.4 Marginal Effects from Multinomial Logit Model for Formal Day Care

variable	Children Under 6			Children 6 and over		
	dy/dx	Std. Err.	P>z	dy/dx	Std. Err.	P>z
	Pr(formal care)= 0.3027			Pr(formal care)= 0.1740		
Age	0.0013	0.0036	0.7080	0.0046	0.0063	0.4590
High school	0.0190	0.0298	0.5240	-0.0076	0.1274	0.9520
Some college	0.0633	0.0300	0.0350	0.0148	0.1378	0.9140
College	0.0963	0.0423	0.0230	-0.0358	0.1799	0.8420
Post-college	-0.0925	0.0781	0.2360	-0.0710	0.1011	0.4820
Naturalized	-0.1574	0.0285	0.0000	-0.0349	0.0689	0.6120
Not naturalized	-0.1585	0.0214	0.0000	-0.1274	0.0572	0.0260
Married (sps ab.)	-0.0228	0.0555	0.6810	-0.0244	0.0554	0.6600
Widowed	-0.1687	0.1355	0.2130	-0.0834	0.0654	0.2030
Divorced	0.0028	0.0440	0.9480	-0.0810	0.0719	0.2600
Separated	0.0022	0.0748	0.9770	-0.0518	0.0173	0.0030
Never married	0.0649	0.0415	0.1180	0.0165	0.0589	0.7790
Black	0.0583	0.0667	0.3830	-0.0295	0.0141	0.0370
Hispanic	-0.1001	0.0280	0.0000	-0.0156	0.0809	0.8470
Other race	0.0073	0.0503	0.8840	-0.0598	0.0332	0.0720
fam_ads	-0.0234	0.0214	0.2750	-0.0213	0.0079	0.0070
No. of infants	-0.1169	0.0205	0.0000	-0.0073	0.0164	0.6560
No. of kids 0-5	0.0261	0.0183	0.1530	-0.0270	0.1345	0.8410
No. of kids 6-12	-0.0387	0.0069	0.0000	-0.0235	0.0056	0.0000
No. of kids 13-17	0.0522	0.0266	0.0500	-0.0557	0.0867	0.5200
Real other income	0.0001	0.0000	0.0030	0.0000	0.0000	0.0950
Real property income	0.0001	0.0000	0.1280	0.0000	0.0000	0.4820
Predicted price of family care	-0.0266	0.0045	0.0000	-0.0005	0.0030	0.8620
Predicted price of formal care	0.0126	0.0058	0.0310	0.0044	0.0096	0.6500
Predicted price of nanny care	-0.0005	0.0011	0.6400	0.0018	0.0040	0.6610
Predicted price of relative care	0.0164	0.0127	0.1960	-0.0033	0.0062	0.5960
Poverty rate	0.0055	0.0017	0.0010	-0.0007	0.0011	0.5530

These marginal effects presented in Table 12 measure the impact of a unit change in the continuous explanatory variables (from 0 to 1 for dichotomous variables) on the probability of choosing formal day care compared to relative care, evaluated at the mean of the explanatory variables. We find that only a handful of the variables are statistically significant. Regarding modes of choice for young children, women with some college or

college degree are more likely to use formal care compared with relative care. Both naturalized and non-naturalized mothers are less likely to rely on formal day care than native citizens. Similarly, being of Hispanic race as well as having young children reduces the likelihood of using formal care. Higher non-labor income increases the chances of relying more on formal day care. However, the estimated effects of the (predicted) price variables for the various modes of choice are problematic. Though some of these are significant, but many of them have incorrect signs. I tried several alternative methods to obtain better estimates. Unfortunately, those results were also similar. While these results are problematic, nevertheless such findings are not uncommon in the literature. Connelly and Kimmel (2003) report similar findings using SIPP 1992 and 1993 panels. One probable reason for such inaccurate estimates might be due to poor price/costs of care information. A large number of mothers in the sample rely on relative care, for which they seldom make payments. This leads to limited information as well as variation in the price data. The problem of data quality is accentuated by lack of information on non-cash forms of payment. Furthermore, there are important differences in choice sets regarding availability of various modes of child care services. For example, child care options are different in metro areas compared to non-metro areas (Walker et al. 2011). In the absence of information regarding what choices people face, estimates are likely to be poor.

4 FINAL-STAGE ESTIMATION OF LABOR-FORCE PARTICIPATION

The primary objective of my dissertation is to estimate probability of labor force participation as a function of EITC expansions, wages, child care costs and demographic variables. As discussed earlier in detail, multiple equations are needed in several steps to estimate this ultimate model. As part of the three-step approach, I estimated a bivariate model of participation and usage of paid care services in the first stage. The second stage involved estimating selection-corrected wage and costs of care equations based on the inverse-mills-ratios from the first-stage bivariate model. Having corrected for the endogeneity and selection issues, the final stage strategy is to estimate a probit model of participation using the selection-corrected wage and costs of care as regressors together with a set of socio-economic characteristics of the single mothers and single women (no children).

4.1 Results from the Final-stage Probit Model of Labor-force Participation

The dependent variable in the final stage probit equation is labor force participation. The treatment group of women is single mothers who were the primary target group of the EITC expansions of the 1990s. The control group is the never married women with no children. The before/after period of the EITC expansions is captured by a dummy variable *'post96'*.

The following Table (Table 4.1) provides marginal effects from the final-stage probit regression. Though my primary interest are the difference-in-difference estimators *'treat*post96'* and *'treat*cost*post96'*, the presence of several interaction terms require us to consider the partial derivative of the dependent variable (labor force participation) with respect to the treatment group, evaluated at the average predicted childcare expenses, to find out how single mothers change their labor force participation relative to never married women (without children) after the EITC expansions of the 1990s that

were implemented till 1996. The results show that labor force participation of the treatment group was higher in post 1996 (coefficient on ‘*treat*post96*’ is positive), but it is not statistically significant. This outcome is not surprising since there was a trend of overall decline in women’s labor force participation since 2000 (Monthly Labor Review, October 2006).

Table 4.1 Final Estimates of Participation

Probit regression, reporting marginal effects	
Number of obs	33997
LR chi2(28)	5862.00
Prob > chi2	0.00
Pseudo R2	0.1403
Log likelihood	-17953.723

hasjob1	dF/dx	Std. Err.	z	P>z
disabled*	-0.33294	0.0118	-28.6400	0.0000
naturalized	-0.02484	0.0178	-1.4200	0.1560
not-naturalized*	-0.02708	0.0121	-2.2900	0.0220
married/spouse absent	-0.03272	0.0213	-1.5700	0.1160
widowed*	-0.07067	0.0228	-3.2400	0.0010
divorced*	0.04218	0.0092	4.4400	0.0000
separated*	0.04373	0.0114	3.6900	0.0000
black*	-0.08538	0.0091	-9.7200	0.0000
hispanic *	-0.04055	0.0092	-4.5000	0.0000
otherace*	-0.10828	0.0148	-7.7200	0.0000
metro	-0.01729	0.0094	-1.8300	0.0670
rfoklt18 *	-0.02546	0.0041	-6.2000	0.0000
No of Infants*	-0.08935	0.0153	-5.8300	0.0000
No if kids (0-5)	-0.02843	0.0225	-1.2600	0.2070
real other income*	-0.00005	0.0000	-9.1100	0.0000
real property income*	-0.00009	0.0000	-6.8000	0.0000
unemployment rate *	-0.02025	0.0025	-8.2300	0.0000
AFDC benefit (2 person family) *	0.00048	0.0002	2.8000	0.0050
AFDC benefit (3 person family)*	-0.00038	0.0001	-2.6500	0.0080
State EITC *	-0.09197	0.0318	-2.8900	0.0040

Table 4.1 Final Estimates of Participation (Continued)

hasjob1	dF/dx	Std. Err.	z	P>z
realwage *	0.04813	0.0031	15.7300	0.0000
real total cost (wk)*	-0.00260	0.0013	-2.0400	0.0410
treatment*	-0.05170	0.0244	-2.1200	0.0340
post96	-0.03298	0.0236	-1.3900	0.1650
treat*post96	0.01366	0.0281	0.4800	0.6290
treat*cost	0.00001	0.0008	0.0100	0.9900
cost*post96	-0.00009	0.0008	-0.1100	0.9140
treat*cost*post96*	0.00236	0.0010	2.4700	0.0130

* statistically significant at 5% or less.

Higher cost for childcare reduces labor force participation on average since the coefficient on ‘*real total cost (wk)*’ is negative and significant. In contrast, higher wage increases participation on average (the coefficient on ‘*real wage*’ is both positive and significant).

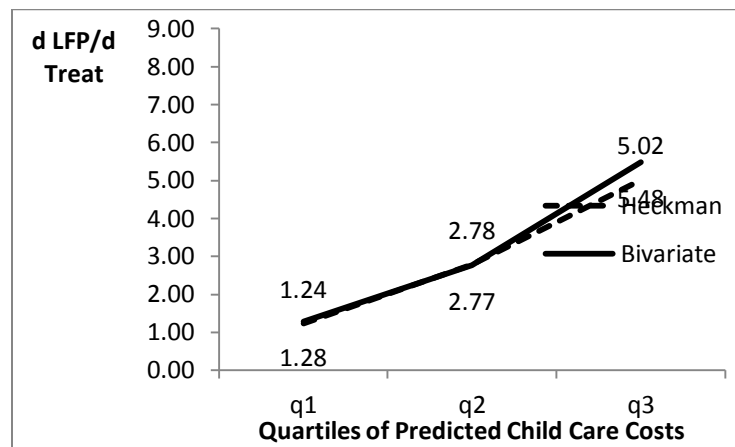
I evaluated the derivative of the dependent variable (labor force participation) with respect to the ‘*treatment*’ variable at the mean of the predicted expenditure for child care. This exercise indicates a 3.32% increase in the participation of single mothers in the post-1996 era relative to never-married women without any children. This estimate is similar to the roughly 3% participation increase estimated by Meyer and Rosenbaum (2001), or 4.7% increase found by Fitzpatrick and Thompson (2010) for the 1993 expansion. There are a number of differences with respect to these studies. First, both of these studies used CPS data to estimate the impact whereas I’ve used SIPP. Secondly, none of these studies explicitly controlled for child care expenses. Moreover, their sample selection criterion, the definition of treatment and control groups are different from this study. However, I re-estimated the model using their definition of a control group (widowed/separated/divorced/never married women without children) and found that participation of single mothers increased by an estimated amount of 4.46% in the post-1996 era relative to single women without any children. The size of the estimated effect is larger when estimated using the ‘usual’ control group, but still within the range commonly found in the literature.

Taking derivative of the dependent variable (labor force participation) with respect to the ‘cost’ of child care variable yields a negative impact on participation for single mothers in both pre and post 1996 period. This exercise reveals an estimated reduction in labor force participation of single mothers by 0.259% in the pre-1996 period and 0.028% in the post-1996 period relative to single women due to increase in the weekly cost of care. This result implies that the cost of child care had smaller impact on participation in post-1996 than before 1996. Controls for immigration status, marital status, race and other coefficients have the expected signs.

I evaluate the derivative of the dependent variable (labor force participation) with respect to the ‘treatment’ variable at the respective quartiles of the predicted child care cost for two alternative specifications. The first specification uses a reduced form bivariate probit model in the first stage of estimation to create selection terms to be utilized for second stage wage and cost of care equations. The predicted wage and cost of care from the second stage is then used to estimate the final probit model of participation. The alternative specification relies on Heckman selection corrected wage and cost of care equations to estimate the final participation model.

The results of the derivative are presented below in Figure 4.1. As expected, it is seen that the two methods of estimated results yield similar estimates for the effectiveness of the EITC expansions of the 1990s.

Figure 4.1 Heckman and Bivariate Estimates of Labor Force Participation



I predict participation from the final probit estimates and compared before and after policy changes for high school educated women. The findings are summarized in the following table (Table 4.2). It shows that though there were across the board increases in labor force participation for single mothers of this educational group, it was those women facing the highest childcare costs (fifth quintile) had the largest and the most dramatic increase in labor market participation. Also, the increase in participation increases as we gradually move to higher quintiles. This indicates higher responsiveness of women facing high child care costs in the post-EITC expansion period.

Table 4.2 Predicted Labor Force Participation of High School Grad Single Mothers

Distribution of Predicted Cost of Care	Predicted Participation		
	Pre 1996	Post 1996	Change (Post-Pre)
Quintile 1	0.6124	0.6440	0.0316
Quintile 2	0.6398	0.7026	0.0628
Quintile 3	0.6611	0.7354	0.0743
Quintile 4	0.5709	0.6607	0.0898
Quintile 5	0.4704	0.6209	0.1505

4.2 Demand for Child care Post-Increase in Labor Force Participation

One can argue that there would be a feedback effect from the labor market to the cost of child care. With limited expansions of supply of child care, the increase in labor force participation is likely to increase the cost of child care. In order to capture the distribution of cost at the MSA levels, I run a simple probit model of participation and predict probability of working which is collapsed at the MSA level. Later, I regress the cost of care on a set of demographic variables and the MSA-level predicted participation as control variables. The estimates from this model are produced below in Table 4.3.

Table 4.3 Cost of care and Predicted Participation

Real total weekly Cost	Coefficient	Std. Err.	T-stat
Age	-0.0683	0.0157	-4.34
High school	2.2962	0.3348	6.86
Some college	4.4461	0.3380	13.15
College	9.5109	0.3926	24.23
Post-college	14.7509	0.6181	23.86
Naturalized	0.6586	0.5623	1.17
Not naturalized	-1.8607	0.4333	-4.29
Married (sps ab.)	-2.1167	1.0131	-2.09
Widowed	-0.2857	0.9131	-0.31
Divorced	0.2986	0.3502	0.85
Separated	-0.3744	0.5415	-0.69
Never married	-2.5572	0.3562	-7.18
Black	-0.1986	0.3354	-0.59
Hispanic	0.1976	0.3685	0.54
Other race	-0.5240	0.5271	-0.99
No. of infants	-6.0432	0.4066	-14.86
No. of kids 0-5	7.6653	0.1657	46.26
No. of kids 13-17	-2.4459	0.1590	-15.39
Metro	1.7185	0.2506	6.86
Predicted participation	6.0655	3.4404	1.76
Constant	-1.5470	2.4212	-0.64
R-squared	0.1002		
Number of observations	52,308		

As expected, the estimated coefficient on predicted participation is positive. This means that as employment increases, demand for child care increases and as a result, the cost of care also increases. The estimated coefficient is weakly significant.

4.3 Hours Worked and EITC Expansions

I estimated a simple regression model of hours worked using the full sample conditional on working. It is observed from Table 4.4 that married women with spouse absent, widowed, divorced and separated women work longer hours than married women with

spouse present. Only never married women tend to work fewer hours than married women (spouse present). I also find Black, Hispanic and women from other race work longer than White women. Number of children, presence of young children, non-labor income, and availability of state EITC make women work fewer hours. It is also seen that predicted child care costs has negative impact on hours worked and is significant.

Table 4.4 Effect of EITC Expansions on Hours Worked

Hours worked	Coef.	Std. Err.	t	P>t
disabled*	-1.4724	0.2081	-7.0800	0.0000
naturalized	-0.0104	0.2318	-0.0400	0.9640
not naturalized*	1.5808	0.2082	7.5900	0.0000
married, spouse absent*	1.2329	0.4161	2.9600	0.0030
widowed*	2.0232	0.3036	6.6600	0.0000
divorced*	2.5067	0.1214	20.6400	0.0000
separated*	1.8882	0.2246	8.4100	0.0000
never married*	-1.2755	0.1123	-11.3600	0.0000
black*	1.0804	0.1456	7.4200	0.0000
hispanic*	1.9375	0.1590	12.1900	0.0000
otherace*	1.1283	0.2218	5.0900	0.0000
metro	-0.1041	0.1367	-0.7600	0.4460
No of own kids*	-1.5153	0.0561	-27.0300	0.0000
No of infants*	-1.1267	0.2567	-4.3900	0.0000
No of kids below 5 years*	1.6850	0.3200	5.2700	0.0000
Other Income (real)*	-0.0006	0.0001	-6.9900	0.0000
Property income (real)*	-0.0022	0.0002	-13.0100	0.0000
unemployment rate	-0.0542	0.0367	-1.4800	0.1400
AFDC benefit (2 person family) *			2.1000	0.0350
AFDC benefit (3 person family)*	-0.0082	0.0022	-3.7700	0.0000
State EITC *	-1.2342	0.4955	-2.4900	0.0130
realwage (predicted)*	1.1240	0.0407	27.6000	0.0000
total weekly cost of care (real)*	-0.0990	0.0147	-6.7600	0.0000
post96*	-0.6077	0.2371	-2.5600	0.0100
cost_post	0.0006	0.0062	0.1000	0.9220
constant*	34.6909	0.3389	102.3600	0.0000
No of Observations	73726			
Adjusted R-square	0.0777			

* statistically significant at 5% or less.

Interestingly, the coefficient of the dichotomous variable *post96* (capturing the EITC expansions) is negative and statistically significant, implying overall reduction in hours worked by those women who were already in the work force after the EITC expansions. The literature on hours worked tend to find little or no change in hours worked after the expansions of the EITC benefits. Meyer and Rosenbaum (2001) found mixed, but insignificant impacts on hours worked. However, my findings are consistent with economic predictions that EITC expansions can reduce labor supply, particularly for those working in the stationary or phase-out range. It may be mentioned that nature of employment (full-time vs. part-time) also has impact on hours worked, which hasn't been controlled for here.

5 CONCLUSION

This dissertation has investigated the relationship between the EITC-induced labor force participation of single mothers and the role of child care costs. A difference-in-difference approach based on child care modules of SIPP panels has been presented. This exercise differs from the existing research on the effects of EITC on labor supply as well as from the effects of child care costs on labor supply by considering the interaction between the effects of EITC and child care costs on employment.

The expansions of the EITC benefits significantly increased incentives for work, particularly for low-income families with children. Existing research confirms that single mothers significantly increased participation in the post-EITC expansion era. As the single mothers seek employment, it has implications in terms of caring for their children. The purpose of this dissertation was to estimate the effects of child care costs on labor force participation of these women before and after the EITC expansions.

My findings suggest that participation of single mothers increased post-expansion of the EITC benefits across the distribution of child care costs. However, the increase in participation is not homogenous for all single mothers. I find that single mothers facing low child care costs increased participation by an estimated 3.16% after the EITC expansions, while those women facing high costs increased participation by remarkable 15.05%. This emerges as a new finding that has not been investigated earlier. As expected because of the inverse relationship between participation and child care costs, single mothers with high child care costs had low labor force participation before the EITC expansions. When after-tax wage of single mothers increased after the expansions particularly for those in the phase-in range, this resulted in increased participation. However, this finding is likely to be applicable for metro areas since majority of the sample live in metro areas. Studies find substantial differences between metro and non-metro areas regarding responses to policy changes such as the EITC expansions (CARSEY Fact Sheet, 2007). There are also important differences among the non-metro tax files depending on state, race, education, family size etc. (Mammen et al. 2009).

A multinomial logit model was estimated to investigate how working mothers make choices regarding the mode of child care. Unfortunately, this exercise did not produce reliable estimate of how choice of mode is affected by child care costs. However, this result is not uncommon in the literature and raises concerns regarding the quality of the data on cost of care.

The evidence from this dissertation suggests that the EITC expansions might have led to large-scale increases in the labor force participation of single mothers living in high-cost cities. While some previous investigations have suggested that the EITC expansion may have been ineffective in increasing participation in large cities where cost-of-living (in terms of housing cost) is high (Fitzpatrick and Thompson, 2009), the results from this dissertation suggest a different phenomenon. The EITC expansion is found to be effective for single mothers living in large cities such as Boston, Phoenix, San Francisco, Washington, Seattle, San Diego etc. where child care costs are predicted to be the highest.

A number of issues, however, need to be considered to rationalize these findings. First, the 1990s was an eventful period of time when a host of changes took place. It was the time when the welfare reform, tax reform, EITC expansions, Child Care subsidies etc. were implemented. It was also characterized by unusually high and long period of economic growth. It is reasonable to argue that all of these factors --- the welfare reform, tax reform, EITC, Child care subsidies, macro-economy --- influenced the observed changes in participation of single mothers. Disintegrating the effects of EITC and child care costs on participation is, therefore, a complex and challenging task. I attempted, albeit in a limited way, to account for some of these changes taking place during 1990s by including variables such as states' unemployment rate, AFDC/TANF benefit levels for two and three-person families. Inclusion of a broader set of measures for these policy changes would certainly strengthen the findings of this dissertation.

Notwithstanding these limitations, however it could be said that this finding is not unusual in the existing literature where there is evidence of substantial positive effect of

EITC on participation of single mothers based on a variety of techniques and data. The findings from this dissertation have raised a number of questions regarding possible interaction between EITC and child care costs and their impact on labor supply. It is the first of this kind of study and further work needs to be done to consolidate the findings from this research. Future work could assess the interaction between EITC and child care costs by including a broader set of measures for the policy changes of the 1990s as well as working with different datasets to investigate consistency of my findings. As an extension of this analysis to a different context, it would be interesting to compare experiences of other developed countries that implemented similar EITC-type tax policies.

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Vita

Salma Begum

Birth place: Dhaka, Bangladesh

Education

Master of Social Sciences (Economics), National University of Singapore, Singapore, 2002

Bachelor of Economics (Hons), Monash University, Melbourne, Australia, 1997

Professional and Research Experience

Instructor, Economics and Business Statistics, University of Kentucky, Fall 2010 - Fall 2012

Instructor, Principles of Microeconomics, University of Kentucky, Fall 2008 - Spring 2010

Short-term Consultant, World Fish Center, Dhaka, Bangladesh, December 2006

Short-term Consultant, World Fish Center, Dhaka, Bangladesh, June - September 2005

Short-term Consultant, German Technical Assistance, Dhaka, Bangladesh, January - April 2005

Short-term Consultant, International Labor Office, Dhaka, Bangladesh, April - June 2004

Short-term Consultant, Govt. of Bangladesh and UNICEF, Dhaka, Bangladesh, Jan-March 2004

Consultant, Action Aid Bangladesh, Dhaka, Bangladesh, April 1998 - April 1999

Academic Awards and Honors

Research Challenge Trust Fund II Gatton Doctoral Fellowship, Department of Economics, University of Kentucky, 2009

Teaching Assistantship for Doctoral program, Department of Economics, University of Kentucky, Fall 2007

Teaching Assistantship, Department of Economics, National University of Singapore, 2002

Tuition Fee Grant, Department of Economics, National University of Singapore, 2002

Golden Key National Honor Society, Monash Chapter, Australia, 1996

Undergraduate Scholarship, Australian International Development Assistance, 1993-1997

Higher Secondary Scholarship, Government of Bangladesh, 1992

Secondary School Scholarship, Government of Bangladesh, 1990

Publications

Begum, Salma, and Siddique Kaniz, Chapter on Industrial Sector in “Emerging Issues in Bangladesh Economy: A Review of Bangladesh’s Development 2005-06”, Center for Policy Dialogue and University Press Limited, Bangladesh, 2008

Ahmed, Muzaffar, and Begum Salma, Introductory Chapter in “Who gets what: A gender analysis of public expenditure in Bangladesh”, Barbara Evers and Kaniz Siddique (eds.), University Press Limited, Bangladesh, 2006