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CHILD CARE SUBSIDIES AND THE EMPLOYMENT OF SINGLE MOTHERS

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To Macarena, for all her love, patience and support.

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ABSTRACT

The first chapter examines the effects of child care subsidies on the work effort of single mothers, in the context of the post welfare era in the U.S. (after 1996). To estimate the effects of these subsidies on employment outcomes, this study uses a Full Information Maximum Likelihood approach (FIML) to jointly estimate (1) the program administrators' decision to offer a subsidy to applicant mothers, (2) the mothers' decision to apply for a child care subsidy and (3) an outcome equation (like the decision to work). Given the presence of rationing in the receipt of the subsidies (i.e., not all eligible people who demand a child care subsidy receive one), the mothers' decisions to apply for a subsidy are modeled as a partially strategic model, where mothers consider their probability of being rationed out of the subsidy when they decide whether to apply. The evidence presented is based on data collected in 1999 and 2002 from the National Survey of America's Families (NSAF). The results indicate that the child care subsidies analyzed in this chapter do not help mothers to move into employment in the first place, but they do help mothers to change their work schedule toward more standard hours and to switch from informal to formal child care. These results

suggest that conditioning the access to child care subsidies on having employment at the moment of applying does not help to attract mothers who would benefit the most in terms of employment participation.

The second chapter provides new evidence on the maternal employment effects of the implicit child care subsidy provided by free public kindergarten for five year old children. This chapter aims to document whether the results from Gelbach (2002) can be extended to the context of the post welfare era in the U.S. (after 1996), when access to child care and single mothers' labor force participation have increased substantially since 1980. It also explores whether the impact of this subsidy is heterogeneous across different groups of mothers and groups of states. This study uses data from the 2005, 2006 and 2007 rounds of the American Community Survey (ACS). My results suggest that, twenty six years later, kindergarten access is still a significant source of child care for single mothers with young children. The point estimates are relatively similar to Gelbach's, however, the percentage effects are smaller because the baseline labor supply of single mothers is currently higher compared to 1980. Results from the specifications estimated by ethnicity of mothers and by two group of states suggest a differential impact of public school enrollment across mother and state characteristics.

The third chapter describes the data, the sources of the data and the methodology used to construct the main variables utilized in Chapter 1 and 2.

CHAPTER 1
WORK-RELATED CHILD CARE SUBSIDIES AND THE WORK EFFORT OF SINGLE MOTHERS

1.1 Introduction

The 1996 welfare reform act in the U.S. (Personal Responsibility and Work Opportunity Reconciliation Act of 1996, from now on, PRWORA, 1996) entailed a substantial redesign and increase in work-related child care subsidies.[1] It also consolidated four different child care subsidy programs for low-income families into a single block grant, the Child Care and Development Fund (CCDF). The main goal of the consolidated program is to facilitate the transition from welfare to work and help maintain employment of low-income parents. Other declared goals are to reduce welfare receipt and promote stable child care. As a result, child care subsidies have become of one of the main policy instruments for helping welfare recipients move into the workforce and for keeping other low-income families from becoming welfare dependent.

[1] See a summary of the PRWORA at http://www.acf.dhhs.gov/programs/.

There is little evidence, however, on whether these subsidies have actually contributed to an increase in employment and self-sufficiency among low-income families (Blank, 2002; Grogger and Karoly, 2005). The evidence of the effects of actual subsidy receipt on the employment behavior of mothers of young children is limited, mainly because of lack of data on child care subsidies and selection issues. Also, there is very little evidence of the effect of child care subsidies on child development outcomes (Blau, 2000). It is relevant to know the effects of child care subsidies on employment and child outcomes because child care subsidies are one of several competing policy instruments available to achieve these goals. Moreover, it might be the case that work-related child care subsidies are neither sufficiently increasing the work incentives and economic independence of the targeted group nor improving child outcomes. Also, child care subsidies may affect the mode of care without affecting the total use of non maternal care. Families may just shift from unsubsidized to subsidized child care, in which case the subsidies may be "crowding out" private child care expenditure and have no net effect on the amount of non maternal care (Baker et al., 2005). In this case, most of the effects correspond to economic rents rather than effects on behavior, unless subsidized care improves child outcomes (Grogger, 2004).

This study focuses on one of these issues, namely the effects of child care subsidies on the work effort and child care choices of single mothers, the main target group for welfare reform. The core questions this chapter aims to answer are: (1) What are the effects of child care subsidies on the employment probabilities of single mothers? (2) What are the effects of these subsidies on the probability of working during standard

hours of single mothers (6am-6pm)? (3) What are the effects of these subsidies on the child care choices of single mothers (formal care versus informal care)?

To answer these questions, this chapter uses a Full Information Maximum Likelihood approach (FIML) to jointly estimate (1) the program administrators' decision to offer a subsidy to applicant mothers, (2) the mothers' decision to apply for a child care subsidy and (3) an outcome equation (like the decision to work).[2] Results are compared with univariate probit models of employment outcomes. Given the presence of *rationing* in the receipt of the subsidies (i.e., not all eligible people who demand a child care subsidy receive one), the propensity to receive the subsidy is interpreted as a combined probability of mothers demanding a subsidy (based on utility maximization process, considering the probability of receiving the subsidy) and of program administrators offering a subsidy (based on some maximization or cost-minimization rule). The analysis uses household survey data from the post-PRWORA era coming from the 1999 and 2002 rounds (repeated cross-sections) of the National Survey of America's Families (NSAF), conducted by the Urban Institute.

My work improves on previous studies in the following aspects. First, it provides evidence based on the *post-welfare reform* context (after 1996). Evidence from the pre-1996 period might not be useful to predict the employment responses to current work-related subsidies because of the substantial changes that have been made to the child care system through welfare reform (Blau and Tekin, 2003).

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[2]The outcome equation refers to work, work during the day (6am-6pm) or use formal care as the primary child care arrangement, depending on the outcome analyzed.

Second, this article attempts to estimate the effects of *actual* subsidy receipt rather than focusing on child care price elasticity estimates. It is likely that the presence of rationing imposes substantial non-monetary costs to collecting a subsidy (e.g., time costs to applying or being on a waiting list). This prevents us from using child care (monetary) price elasticity as a guide for estimating the effect of CCDF subsidies on employment or other outcomes.

Third, this article improves on previous attempts to control for *selection bias* by modeling the propensity to receive the subsidy. When estimating the effects of subsidy receipt on employment outcomes, we need to take into account that receiving a subsidy is endogenous to the decision to work. As a result, comparing employment rates of mothers receiving the subsidy versus mothers not receiving the subsidy would likely lead to biased estimates, even after controlling for observable characteristics. As a result, this article specifies a model where the propensity to receive a child care subsidy is jointly modeled with the decision to work.

Fourth, this chapter analyzes the effects of child care subsidies on the *quality of the jobs* obtained by subsidy recipients. It is important to look at other dimensions of employment outcomes, since the subsidy receipt is aimed at increasing not only the probability of participating in the labor market, but also at improving the stability and quality of the jobs obtained by subsidy recipients. In this study, I interpret working during standard hours (6am-6pm) as an indicator of a better job quality. As far as I am aware, Tekin (2004) is the only study that has examined the effect of child care subsidies on the decision to work during standard hours. According to the studies cited

by Tekin, the evidence suggests that workers engaged in nonstandard work schedules are more likely to be assigned to routine jobs, to receive less training and fewer promotions than others, and, consequently, to earn less than standard workers. Also, the evidence indicates that the majority of nonstandard workers work such schedules as an accommodation to labor market needs, not as a personal preference.[3]

Finally, this chapter provides a framework to analyze the mothers' decision to apply for a child care subsidy under rationing on the subsidy receipt. The subsidy rationing implies the propensity to receive a subsidy is no longer determined by the "demand" side only. As a result, the parameter estimates derived from the subsidy equation cannot reflect the underlying mother preferences for child care subsidies, unless more structure is added to the model. This study contributes in this respect, by modeling the mothers' decision to apply for a subsidy as a partially strategic model, where the mothers consider their probability of being rationed out of the subsidy when they decide whether to apply.

The overall strategy in constructing covariates assumes that a mother's observed demographic characteristics (like marital status and the ages and number of children), the state-level demographic characteristics, the child care and welfare policy rules she faces, and the economic environment in her state are all exogenous. As a result,

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[3]Even though it is assumed that nonstandard-schedule jobs are of inferior quality than standard-schedule jobs, evidently there are exceptions, either with respect to the quality of the nonstandard jobs themselves, or with respect to preferences for working during nonstandard schedules of the workers. Nevertheless, it is likely that single mothers trade-off working during nights for receiving better paid or getting access to informal child care from a relative, compared to working during standard hours.

the model is a semi-reduced specification, with a fully-reduced demand for subsidy equation and a semi-reduced outcome equation, since the subsidy receipt is an endogenous variable in the outcome equation.

As exclusion restrictions to help in identifying the model, I use the variation across states in some plausibly exogenous determinants of the probability of being rationed out of the subsidy, such as the amount of pre-determined child care funding, scaled by the number of young children living with a female householder in each state. The exclusion restrictions are assumed to affect the probability of being rationed out of the subsidy, but not the probability of being employed, conditional on subsidy status. To avoid correlation between the exclusion restrictions and the unobservables of the employment equation, I use a set of state welfare policy variables constructed by Fang and Keane (2004) and Bernal and Keane (2006) to control for differences in welfare regulation across states that might influence both exogenous determinants of the probability of being rationed out of the subsidy and employment decisions.[4] These welfare policy variables are also interacted with demographic characteristics at the individual level.

This chapter also examines the effects of child care subsidies on part-time employment, full-time employment, and labor force participation.

Using both 1999 and 2002 rounds of the NSAF, I select a sample from the 13 over-sampled states of 2131 unmarried mothers between 19 and 44 years old with at least one child under age 5, and with family income below 200 percent of the federal

[4]I am grateful to these authors for giving me their state-level welfare policy data.

poverty line (FPL).[5] This study focuses on single mothers because they are the main target group for welfare reform. Furthermore, single parent-headed families account for about 80 percent of all CCDF beneficiaries (according to CCDF administrative data of FY 2002).[6]

Controlling for selection into the subsidy receipt, the results from the FIML models indicate that child care subsidy receipt is not considerably associated with an increase on the employment participation of the mean single mother whose youngest child is under 5 years old. According to these models, the observed differences in employment rates and labor force participation between subsidy recipients and non-recipients can be explained for the most part by the observed and unobserved differences between both groups and not because of the subsidy receipt. A different conclusion arises when looking at the effect of subsidy receipt on the probability of working during standard hours (6am-6pm). Controlling for selection, the results from the FIML models show a positive and significant effect of subsidy receipt, especially on the probability of working part-time during standard hours, which approximately rises from 0.39 to

[5]The 13 over-sampled states are Alabama, California, Colorado, Florida, Massachusetts, Michigan, Minnesota, Mississipi, New Jersey, New York, Texas, Washington and Wisconsin. The income limit threshold of 200 percent of the FPL is selected for convenience, since the NSAF survey only asks about rationing issues to persons with family income below this threshold because it (informally) defines the potential population that could demand these kinds of subsidies.

[6]A potential criticism is the implicit exogeneity assumption of marriage to the subsidy receipt. However, the evidence on the effects of welfare policies on marriage is inconclusive, making the exogeneity assumption more plausible. See more details in Section 1.4. See Grogger (2001) for an analysis of the potential sample selection bias arising from restricting the sample to single mothers, in the context of his study of the effects of time limits and other welfare changes on work participation of female-headed families.

0.63 because of the subsidy. Also, the models of child care arrangement outcomes show a large and significant effect of the subsidy receipt on the probability of using a subsidized-type care as the primary care arrangement for the focal child. According to these models, the probability of using formal care as the primary arrangement rises from 0.32 to 0.69 because of the subsidy receipt. Overall, the evidence from the different outcomes points in one direction: the child care subsidies analyzed in this chapter do not help mothers to move into employment in the first place, but they do help mothers to change their work schedule toward more standard hours and to switch from informal to formal child care.

This chapter is organized in the following way. Section 1.2 describes the CCDF subsidies. Section 1.3 reviews the previous literature on the effects of child care subsidies on employment. Section 1.4 presents a conceptual model that serves as a basis for the econometric specification. Section 1.5 explains the main econometric model and its empirical implementation. Section 1.6 discusses the data from the NSAF used in this chapter and shows descriptive statistics of the main variables used in the estimations. Section 1.7 shows the empirical results. Section 1.8 concludes.

1.2 Child Care Subsidy Programs

The child care subsidy programs described in this section, and that are the focus of this article, are for work-related child care expenses of children in low-income families[7].

[7]The empirical analysis, however, does not distinguish between work-related and non-work-related child care subsidies. Nonetheless, the majority of the child care subsidies in the post-welfare reform era have an employment requirement, either

Before welfare reform, there were four main child care subsidy programs with different rules and target populations[8]. PRWORA restructured these four programs into a single child care block grant program called the Child Care and Development Fund (CCDF). As a result, this block grant has become the most important source of funding for work-related child care subsidies[9]. The main goal of the consolidated program is to assist low-income families, families receiving welfare and those transitioning off welfare in obtaining child care so they can work or attend training/education.

Within the general federal requirements, states have broad flexibility in administering their CCDF programs and in determining their main parameters. They can define income eligibility limit (within the federal limit of 85 percent of the state median income), set the parent co-payment schedule, determine reimbursement rates to providers (the amount of the subsidy), establish work requirements and define the target population served (see Table 1.1). States authorize payments for either 6 or 12 months, after which there is a recertification process. Child care providers' quality is regulated by states. CCDF subsidies can be used only in arrangements that satisfy state licensing standards or are legally exempt from such standards.

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directly or indirectly through the post-welfare reform rules. One exception is the Head Start program. For that reason, the empirical analysis checks the robustness of the results to re-classify subsidy recipients that have a child in Head Start as non-recipients.

[8]These were the Child Care and Development Block Grant (CCDBG), for low-income families, and three AFDC-related child care programs with differing rules: AFDC/JOBS Child Care (AFDC-CC), Transitional Child Care (TCC) and At-Risk Child Care (ARCC). See more details in Besharov and Higney (2006).

[9]According to CCDF administrative data from FY 2002, the percentage of child care funds that are provided by the CCDF averaged 84 percent across states.

Table 1.1. CCDF Regulation

	Federal Law	**States Guidelines**
Eligibility Criteria		
1) child age	under 13 (<19 if disabilities)	under 13 (<19 if disabilities)
2) income limit	85% of SMI	Initial limit: 68% of SMI on average in 1999 Continuing limit:71% of SMI on average in 2002
3) work requirement	Acceptable work activity: parent(s) working or attending a job training or educational program	Minimum number of hours working: TANF, 17 states; Non-TANF, 18 states. Job search is acceptable: TANF, 51 states; Non-TANF, 16 states.
Priority Groups	Low-income families, families receiving welfare (TANF), families transiting off welfare.	Usually those leaving welfare for work have priority
Administration	Dep of Health and Human Services	State child care lead agency

Sources: CCDF fact sheet (www.acf.hhs.gov/programs/ccb/ccdf/factsheet.htm), Schulman, K., Blank, H., and Ewan, D. (2001), Herbst (2006).

Families must contribute to the cost of care on a sliding fee scale, with co-payments rising with family income. States are allowed to waive these co-payments for families with income below the poverty line and there is substantial disparity across states in use of this prerogative. The co-payments can be determined in several ways, including flat rates, percent of cost, percent of income, and combinations of these.

The process of getting into the subsidy system varies across sites, but the usual steps are the application process, finding a child care provider, and provider approval[10]. Parents need to contact the subsidy agency (by phone, by mail or in person), complete

[10]This description is based on Adams et. al. (2002). See a detailed description of the process to gaining and retaining child care assistance in this study.

an application, and provide paperwork to prove they are eligible for the subsidies. The paperwork might include documentation certifying that they are involved in acceptable work activities. There is substantial variation in the types of work activities that are considered acceptable and the number of participation hours per week required. In general, states accept formal employment as well as enrollment in post-secondary education and job training programs. Job search activities are accepted as acceptable activity in all states if the applicant is a TANF recipient, but only in sixteen states if the applicant does not receive TANF benefits. Usually, if the parents are found eligible and funding is available, they need to find child care provider, with assistance from their caseworker. However, the order of the steps varies in some cases.

Under the CCDF, federal funding is provided to the states in four main categories: Mandatory Funds, Discretionary Funds, Maintenance-of-Effort (MOE) Funds, and Matching Funds. Mandatory Funds supply a guaranteed level of federal child care funding to states, for which no state matching funds are required. Each state receives a fixed amount each year, equal to the funding it received under the AFDC child care programs in either FY 1994, FY 1995, or the average of FY 1992–1994, whichever is highest[11]. Like Mandatory Funds, Discretionary Funds are federal funds that do not require state matching funds. TANF transfers to the CCDF are treated as Discretionary Funds[12]. MOE funds are the money that states must spend on child care in order to

[11]Unused funds may be carried over into future years (with no fiscal year limitation). See Besharov and Higney (2006) for further details.

[12]States are allowed to transfer up to 30 percent of their TANF block grant funds to the CCDF to be used for child care. They can also use TANF funds directly for child care services without transferring the funds to CCDF.

become eligible for federal Matching Funds. State MOE requirements are set at the level of each state's FY 1994 or FY 1995 spending levels (whichever is larger) in the Title IV-A child care programs (Besharov and Higney, 2006).

There has been a substantial increase in CCDF funding, however it is not enough to meet increasing demand for subsidies. CCDF subsidies are a capped entitlement with no obligation to serve all eligible families. As a result, nearly half of all states have placed eligible families on waiting lists or simply have imposed a freeze in their intake at some point in time. This indicates the presence of rationing (i.e., when not all eligible people who demand a child care subsidy receive one)[13].

States determine (explicitly or implicitly) the degree of rationing they are willing to tolerate by adjusting the eligibility limits, the "generosity" of the subsidy and/or varying the state funds allocated to this program. For example, states might reduce the level of rationing by increasing their state Matching Funds and, therefore, claiming additional federal matching funds. They might also decide to eliminate waiting lists by reducing the income eligibility limit such that all eligible applicants are served. In fact, most of the states have set the income eligibility limit below the 85 percent of state median income (42 states in 1999, 49 states in 2002) and some have even put it at less than 50 percent of median income (5 states in 1999, 8 states in 2002). In other words, states

[13]There is no systematic information on the degree of rationing among different states. It is estimated that the CCDF served only 12-15 percent of eligible children (Administration for Children and Families, 1999). However we do not know how many of these eligible children were in families that demanded the subsidy and were rationed out and how many just did not apply for it. For an estimation of take-up rates among eligible families, see Herbst (2006).

choose their preferred combination of child care policy variables (including the degree of rationing they are willing to tolerate) given the federal rules and the endogenous and exogenous budget constraints.

1.3 Previous Literature

1.3.1 Effects of child care subsidies on employment outcomes

There are four broad types of studies that provide evidence on the effects of child care subsidies on employment in the U.S.[14]: (1) evaluation of actual subsidy receipt effects, (2) welfare demonstration projects that include a child care component, (3) studies on the effects of the price of child care and (4) studies on the effects of state-level child care expenditures on employment outcomes. The three main difficulties encountered in research on this issue are finding appropriate control groups, accounting for the wide prevalence of unpaid child care arrangements, and identification of the effect of the price of child care (Blau, 2000).

This study falls into the first category. Studies of the first type compare employment rates of mothers receiving the subsidy versus mothers not receiving the subsidy, after controlling for observable characteristics. To deal with selection issues, these studies attempt to construct appropriate control groups or, alternatively, to find reasonable instruments. Three papers have estimated the effects of actual child care subsidies on employment in the U.S. using data from pre-welfare reform period (Berger and

[14]See an extensive survey in Blau (2000).

Black,1992; Gelbach, 2002; Meyers, Heintze and Wolf, 2002) and two studies have used data from post-welfare reform (Blau and Tekin, 2003 and Tekin 2005).

Berger and Black evaluate the effect of child care programs in Kentucky in 1989 on the employment of single mothers. They use mothers on the waiting list for a subsidy as a control group. Meyers, Heintze and Wolf (2002) use data from a sample of low-income single mothers in four counties in California during 1992-1995 to analyze the impact of subsidy receipt on labor market activity (employment or job preparation activity). Gelbach (2002) estimates the impact on employment of the implicit child care subsidy provided by free public kindergarten for five year old children, using data from the 1980 Census on single mothers.

As pointed out by Blau and Tekin (2003), evidence from the pre-reform period might not be informative to the case of the effects of current CCDF subsidies on the employment. Such results thus may not be useful to predict the employment responses to current work-related subsidies because of the substantial changes that have been made to the child care system through welfare reform. Blau and Tekin use data from the 1999 round (post-reform) of the NSAF (the same survey used in this article). They implement a 2SLS approach based on linear probability models for the employment outcomes and the subsidy equations. They use county dummies as identifying instruments, assuming that they are good proxies of factors that determine how subsidies are rationed at the county level. However, as the authors show, there is evidence indicating that county dummies might not be valid instruments. In fact, even

controlling for county-level demographic and labor market characteristics, it is likely that county dummies should not be excluded from the employment equation.

Tekin (2005) examines the impact of actual subsidy receipt of single mothers on their joint employment and child care mode decisions in the post-welfare reform environment. Like Blau and Tekin (2003), he uses data from the 1999 NSAF, but restricts the sample to single mothers with at least one child under the age of 6. He estimates a multinomial choice model of employment and care mode decisions. A subsidy receipt equation is estimated jointly with the multinomial choice equation. As identifying instruments, he includes the average amount of CCDF funds spent per child in the state, the percentage of eligible children served by subsidies in the state, and a binary variable indicating whether the state uses mass media as a consumer education strategy for the child care subsidies. These variables are assumed to capture the state's generosity in providing child care subsidies. His results indicate that child care subsidy receipt increases the probability of choosing alternatives in which the mother is employed by a total of 15.3 percent.

The second type of studies that provide evidence on the effect of child care subsidies use randomized experiments from welfare demonstration programs conducted prior to the PRWORA. It is difficult, however, to determine how much of the effect is due to child care subsidy receipt per se, since in each case child care was only one of several components of the benefits and services provided to help low income families to achieve economic independence[15].

[15]See Blau (2000) and Blau and Tekin (2003) for a comprehensive list of those

The third type of studies infers the impact of subsidies indirectly by estimating price effects of child care. Usually, the costs of child care are predicted using child care cost equations estimated from a sample of working mothers[16]. Inferences about the effects of the CCDF subsidies drawn from this type of study might not be useful if there are substantial costs to collecting a subsidy (Blau and Tekin, 2003). This is the case when there are psychic costs ("stigma"), or time costs to applying or being on a waiting list. In fact, the presence of rationing in the CCDF subsidies - i.e., not all eligible mothers who demand a child care subsidy receive one - suggests that the non-monetary costs of take-up for the CCDF subsidies are likely substantial. This prevents us from using child care (monetary) price elasticity as a guide for estimating the effect of CCDF subsidies on employment.

The fourth type of studies also infers the effects of child care subsidies indirectly. These studies estimate the effect of different state-level welfare policies on employment outcomes, such as Earned Income Tax Credit expansions, Medicaid, welfare time limits, work requirements and other tax changes. They also include state-level child care expenditures as one of the determinants of employment decisions[17]. The advantage of this approach is that they do not need to deal with selection issues concerning the subsidy receipt. These studies, however, do not model the self selection into the

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projects.

[16]Examples of these studies are Heckman (1974), Cogan (1980), Blau and Robins (1988), Connelly (1992), Ribar (1992) and (1995), Kimmel (1998), Anderson and Levine (2000). Reviews of this literature can be found in Anderson and Levine (2000) and Blau (2000).

[17]See, for example Meyer and Rosenbaum (2001) and Fang and Keane (2004).

subsidy receipt and therefore, they do not allow to separate out the effect of child care expenditures on child care subsidy's take up rates from the effect of the child care subsidy on employment rates. It is useful to distinguish these effects for budgetary and policy evaluation purposes.

To my knowledge, Tekin (2004) is the only paper that has examined the effect of child care subsidies on the decision to work during standard hours (6am-6pm). Using data from the 1999 NSAF, he estimates a binary model of standard-nonstandard employment jointly with binary models of subsidy receipt and labor force participation. He uses the same instruments as in Tekin (2005). He finds that child care subsidies are associated with a 6 percentage point increase in the probability of single mothers working at standard jobs, with a greater effect among welfare recipients (14 percentage points).

1.3.2 Effects of child care subsidies on child care arrangements

As previously mentioned, child care subsidies may affect the mode of care without affecting the total use of non-maternal care. Families may simply shift from unsubsidized to subsidized child care, in which case the subsidies may be "crowding out" private child care expenditure and have no net effect on the amount of non-maternal care. Previous studies usually address this issue indirectly, by estimating own and cross-price elasticities for child care.

Among U.S. studies estimating the own price elasticity, the smaller estimates are from Blau and Hagy (1998) (-.0.34) and Chaplin et. al (1999) (-0.405 for center care).

On the other side, Powell (2002) and Connely and Kimmel (2003) all report estimates larger than -1.0. These studies also report separate elasticities for different mode of care. For example, Blau and Hagy (1998) report estimates for different modes of care than range from -0.07 to -0.34, the largest for family home based child care. Likewise, Michalopoulos and Robins (2000) find that tax subsidies have the largest effect on non-relative, non-center based care.

Among estimates of cross-price elasticities of child care demand, Michalopoulos and Robins (2000) find that center based care prices have statistically significant effects on the use of relative and non-relative care. Powell (2002) estimates a cross price elasticity of center care on either relative or based care of nearly 1. Blau and Hagy (1998) report significant cross price effects among all competing type of care.

Tekin (2005) also provides evidence on the effect of actual subsidy receipt on child care choices of single mothers with at least one child under the age of 6. He finds a substantial move away from parental and relative care toward center-based care due to receipt of child care subsidies. Subsidy receipt increases the probability of working and using center care by 33.2 percent, while decreasing the probability of working and using relative care by 16.2 percent.

Using data from Canada, Baker et al. (2005) study the introduction of Quebec's universal and highly subsidized "$5 per day child care" program. They find that nearly one third of the newly reported subsidized child care use appears to come from women who previously worked with the aid of informal arrangements.

As pointed out by Baker et al. (2005), cross-price elasticities are usually estimated from variation in the child care prices individuals report paying. Given the great flexibility of the child care modes available, these observed prices are endogenous, and prices must be predicted for those not using care.

This study offers and advantage in studying the potential "crowding effect" of subsidized child care with respect to previous studies that base their estimations on child care price elasticities. As mentioned previously, inferences about the effect of child care subsidies on child care choices draw from child care price elasticities are not informative if there are substantial costs to collecting a subsidy. The presence of rationing in the CCDF subsidies -i.e., not all eligible mothers who demand a child care subsidy receive one - suggests that the costs of take-up for the CCDF subsidies are likely substantial. This prevents us from using child care price elasticities as a guide for estimating the effect of CCDF subsidies on child care choice.

1.4 Conceptual Model

I develop a simple static one-period model of behavior as a basis for the econometric specification. The basic model serves to analyze the basic trade-offs that the mother faces between working and not working and taking or not taking the subsidy. The Appendix presents an extension to the basic model by subdividing the non maternal care into formal care and informal care. This allows one to explain why some fraction of working and eligible mothers decide to pass-up the subsidy and also to explain the

crowding out effect from informal to formal care that we might expect as a consequence of the subsidy.

The single mother has preferences over a composite market good, C, non-market time, L, and the quality of care extended to her child, Q (assuming on child per mother, for simplicity). Let these preferences be represented by a strictly concave utility function, increasing in all its arguments

$$U = U(C, L, Q, \alpha_u) \tag{1.1}$$

where α_u represents the parameters of the utility function. Following Michalopoulos et. al. (1992), the quality of child care represents the subjective assessment by the mother of the child's well-being while in care. The quality of care Q is assumed to depend on the number of hours of maternal care provided by the mother in her non-market time, L and the number of hours of (paid) non maternal care used, N.[18]

$$Q = Q(L, N, \alpha_q) \tag{1.2}$$

where α_q represents the parameters of the production function. This static framework implicitly treats marriage, fertility, education and saving decisions as exogenous variables. These choices are treated as exogenously determined in the econometric framework as well.[19]

Suppose that non maternal care N is homogeneous in quality and commands a market price of p dollars per hour of care, taken as given by the mother[20]. There is

[18]For the moment, N is the only non-maternal care option available. See Appendix I for an extension that includes formal and informal non-maternal care into the analysis.

[19]See further discussion about these assumptions in Section 1.5.

[20]For simplicity in the exposition, I am assuming no restrictions in the quality of

an additive subsidy s per hour of non maternal care used that reduces the hourly price of non maternal care to $p - s$ in case the subsidy is taken ($D = 1$). The subsidy rate s is assumed to be independent from the level of income.[21] The mother can receive the subsidy if her total income is less than the income eligibility E and if she works a minimum amount of hours (say $H > 0$, for simplicity).

The mother maximizes $U(C, L, Q(L, N))$ with respect to the choice of optimal quantities of $C, L, N,$ and with respect to the decision to take or not the subsidy ($D = 1$ if the subsidy is taken, $D = 0$ otherwise), subject to the following constraints:

$$\text{Budget constraint} \quad : \quad C + (p - sD)N = wH + A \tag{1.3}$$

$$\text{Mother's time} \quad : \quad L + H = 1 \tag{1.4}$$

$$\text{Child's time} \quad : \quad L + N = 1 \tag{1.5}$$

$$\text{Eligibility limit} \quad : \quad (wH + A)D \leqslant E \tag{1.6}$$

$$C, L, H, N \quad \geq \quad 0 \tag{1.7}$$

The budget constraint indicates that the total consumption of the composite market good C (with its price normalized to one) plus child care expenditures equal total income. The mother's time can be divided among non-market time L and working time H. All non-market time L is devoted to take care of the child at home. This

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formal care that the mother can purchase when she gets the subsidy. With restriction like this, there would be an additional trade off in choosing whether to demand the subsidy or not. In practice, CCDF subsidies can be thought of being subject to a quality threshold (given by state licensing standards) but independent of quality beyond the threshold (Blau, 2000).

[21] CCDF subsidies have a sliding fee structure, with fees increasing with family income. Assuming a constant subsidy rate simplifies the analysis, since the budget constraint has just one kink in this case (at the income eligibility limit).

assumption removes the necessity to distinguish between "pure" leisure and home production of child care, which would excessively complicate the analysis. The mother's time constraint is binding (which is guaranteed if the marginal utility of L is always positive). The child requires continuous care by an adult ($L + N = 1$). Hence, paid child care is required for every hour the mother works ($N = H = 1 - L$).[22]

The eligibility limit constraint captures that in case the subsidy is taken ($D = 1$), total income must be no greater than the income eligibility limit ($wH + A \leqslant E$). The limit E introduces a kink in the budget constraint under the subsidy regime. The subsidy s does not cover all the hourly child care cost p and hence, $s < p$, so $w - p + s < w$[23]. The cost (market price) of non maternal care is the same regardless the age of the child.

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[22]Assuming that the child requires continuous care by an adult implies that the child's time constraint is binding at the optimum. The mother's time constraint is likely binding as well (which is guaranteed if the marginal utility of L is always positive). Therefore, at the optimal solution $N = H$ always, which means that every hour the mother chooses not to take care of her child must be offset with an hour of non-maternal care. This implicitly assumes, a priori, a minimum amount of child care quality consumed. Heckman (1974) argues that the fact that children only rarely go unsupervised when a mother works is a statement about consumer preferences and not one about the need to consume a minimum amount of child-care quality. However, I make this assumption to focus on the analysis on work-related subsidies, which imply hiring non-maternal care while working positive hours. Relaxing this assumption would only imply considering more scenarios in which the child is gone unsupervised a fraction of time and hence $L + N < 1$ in that case. Moreover, previous studies usually assume that the child is supervised by an adult at all times (e.g., Blau and Robins, 1988; Michalopoulos et al, 1992, Blau and Tekin, 2003).

[23]This is consistent with the existence of copayments under the CCDF subsidy's regime.

Non labor income, A, is assumed predetermined.[24] Assume $A < E$. The hourly wage rate w is independent of the number of hours worked. It only depends on the human capital and experience of the mother (which are assumed to be pre-determined). There is complete flexibility in choosing the hours to work. These assumptions imply that the mother chooses to be eligible for the subsidy based on her decision about the number of hours worked so that $wH^* + A \lesseqgtr E$, where H^* is the optimal number of hours worked.

Let the choice variables be C and L, conditional on D. Substituting the constraints into the utility specification, the program and the FOCs become (omitting the arguments for simplicity)

$$\begin{aligned} \underset{C,L,\theta_1,\theta_2/D}{Max} \pounds &= U(C, L, Q(L, 1-L)) - \theta_1[C - (w - p + sD)(1-L) \quad (1.8) \\ &\quad -A] - \theta_2[(w(1-L) + A)D - E] \end{aligned}$$

[24]This is a strong assumption, since we could argue that A should include welfare transfers, at least for some fraction of the relevant population (single mothers). Indeed, welfare transfers are likely to be decreasing with earnings, and hence, with number of hours worked, H, one of the choice variables of the model. This will create non linearities in the budget constraint, which is non fundamental for the exposition but is relevant for the choice of number of hours worked. However, the main point of the study is neither to explain the decision to enter or leave welfare nor the effects of subsidy receipt on welfare participation. As a result, I do not model the welfare participation explicitly. However, in the econometric specifications I do consider the main incentives to work created by the welfare scheme. See further discussion in Section 1.5.

$$[C] \quad : \quad U_C = \theta_1 \tag{1.9}$$

$$[L] \quad : \quad U_L + U_Q[Q_L - Q_N] \gtrless \theta_1[w - p + sD] - \theta_2 wD \tag{1.10}$$

$$[\theta_1] \quad : \quad C = [w - p + sD][1 - L] + A \tag{1.11}$$

$$[\theta_2] \quad : \quad \theta_2[(w(1 - L) + A)D - E] = 0 \tag{1.12}$$

$$\theta_1, \theta_2 \quad \geq \quad 0,\ C, L \geq 0,\ L \leq 1,\ [w[1 - L] + A]D \leq E \tag{1.13}$$

From the FOC $[L]$, we can see that, unlike standard models, the marginal utility of leisure has two components. The first one corresponds to the marginal utility that is derived directly from the non-market time, U_L. The second component reflects the additional utility (or disutility) derived from devoting an additional hour of non-market time to maternal care, $U_Q[Q_L - Q_N]$. This term is positive if the maternal care productivity is greater than the non maternal care productivity ($Q_L > Q_N$), and negative otherwise. Therefore, the mother must take into account the utility lost (or gained) from not providing care for her child when she works. She is more likely to consume more leisure and hence, less willing to work, if she perceives that her productivity as a caregiver, Q_L, is higher than the non-maternal productivity Q_N.

From the system of equations, we can derive the optimal solution as functions of the exogenous parameters of the model $w, p, s, A, E, \alpha_u, \alpha_q$ conditional on the choice of D. For the moment, assume there is no rationing in the subsidy receipt. Hence, if the mother is eligible and decides to apply for the subsidy, she will certainly get one[25]. Also for the moment, assume there is no fixed cost to apply for the subsidy. As a result,

[25]This assumption is relaxed below.

the mother chooses to receive the subsidy, $D = 1$, (and hence to become eligible) if the indirect utility under the subsidy regime is greater than the indirect utility without the subsidy.

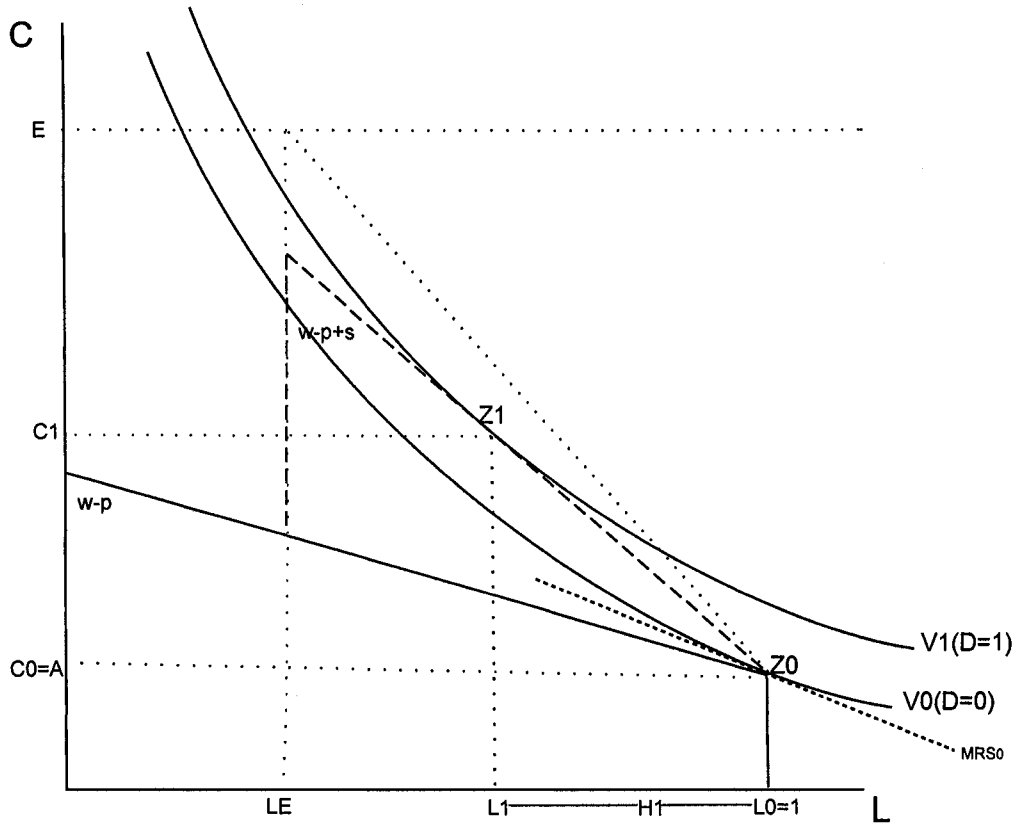
To characterize the optimal solution graphically, Figure 1 depicts the optimal choice of C and L with and without the subsidy, for a given set of exogenous parameters. In this particular example, the mother is induced to work due to the subsidy (this corresponds to Case II, analyzed below). Without the subsidy, the optimal choice is not working at all (point Z_0). The subsidy raises the net wages, making the budget line steeper and thereby increases the likelihood of work. The mother is induced to work H_1 hours due to the subsidy (point Z_1). Since the utility of taking the subsidy is greater than the utility of not taking it, this mother would choose to receive the subsidy.

We also can characterize the optimal solution conditional on the choice of D by combining $[L]$ and $[C]$ to create the Marginal Rate of Substitution (MRS_D) between leisure and consumption, as follows

$$\underbrace{\frac{U_L + U_Q[Q_L - Q_N]}{U_C}}_{=MRS_D} \gtrless w - p + sD - \frac{\theta_2 w D}{\theta_1} \tag{1.14}$$

where the subscript D in the MRS indicates that the solution of the program is conditional on the choice of the subsidy (i.e., D may be equal to 1 or 0). There are five possible cases. In Case I, the mother does not work at all and the subsidy is not high enough to induce her to start working, then $MRS_0 > w - p$ and the mother decides to pass up the subsidy, so $D = 0$ (Figure 2). In Case II, the mother is induced to work due to the subsidy, which corresponds to the case analyzed previously (Figure 1). In

Figure 1. Effect of a Child Care Subsidy on Work Effort- Mother Induced to Work

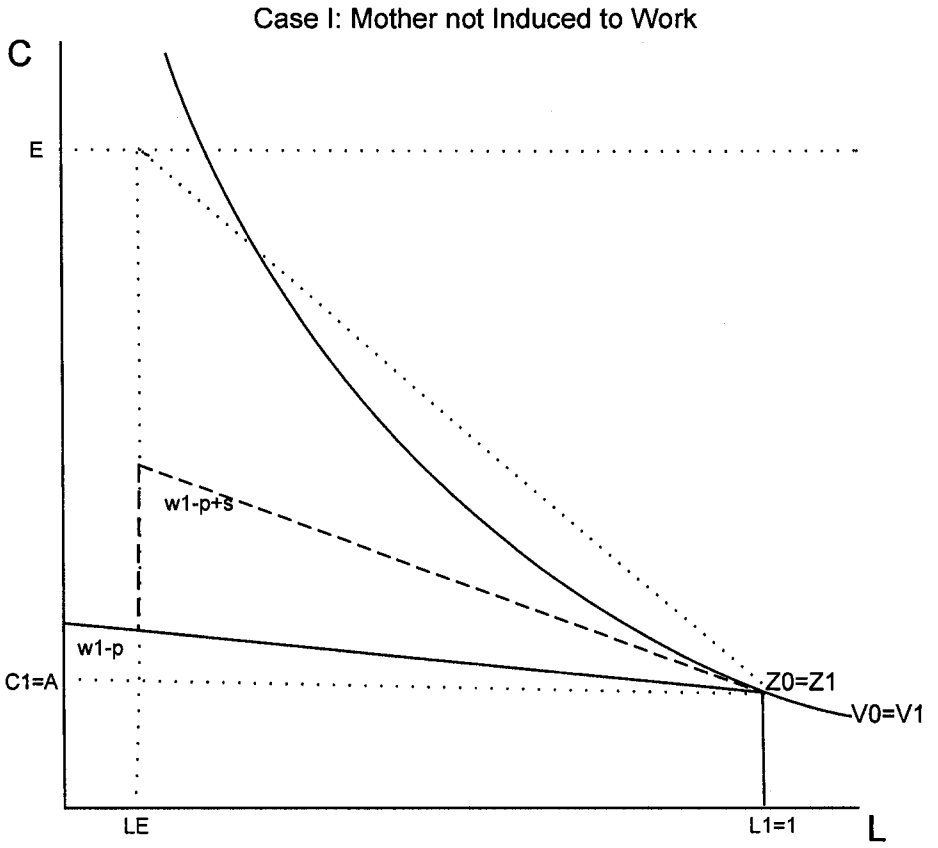


Note: This graph corresponds to Case 2.

Case III, the mother that works (with and without the subsidy), takes the subsidy up, and the eligibility limit is not binding at the optimum, then $MRS_1 = w - p + s$ (Figure 3). Case IV describes the optimum when the income limit is binding, then $\theta_2 > 0$ and hence $MRS_1 < w - p + s$. In this case, the optimum will be at the notch in L_E and the mother reduces the hours worked to keep being eligible for the subsidy (Figure 4). Case V shows when the eligibility limit is too restrictive, leading to mother reducing

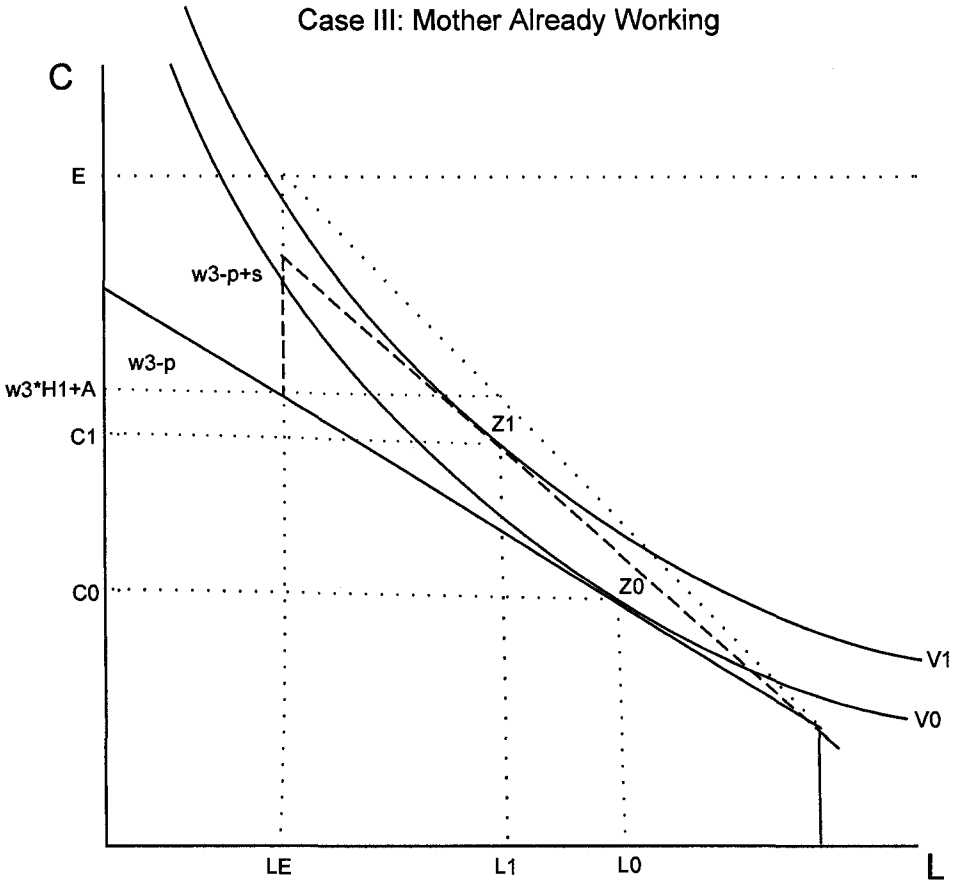
the hours worked so she remains eligible. As a result, it is an optimum choice for her to pass up the subsidy (Figure 5).

Figure 2. Effect of a Child Care Subsidy on Work Effort- Case I



Overall, the predictions of the model are the following. A linear subsidy *s* per hour of non maternal care used is expected to increase the likelihood of work among mothers. For given tastes and productivities, the effect of the subsidy on employment participation should be concentrated among "middle-wage" mothers, since the

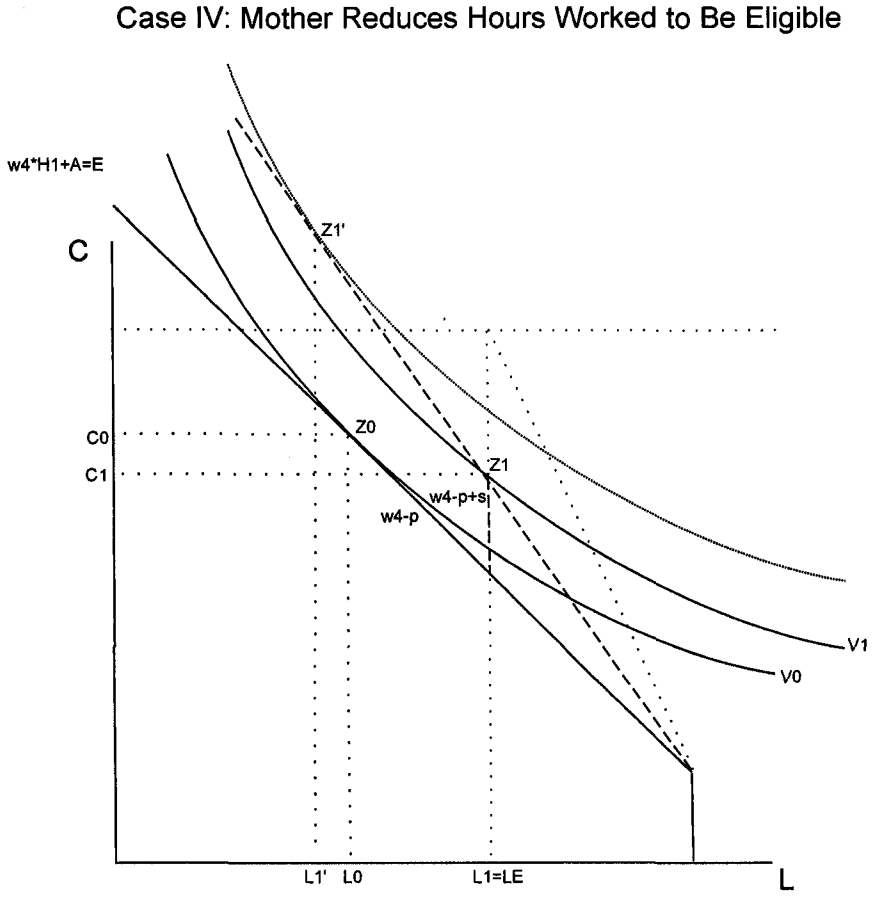
Figure 3. Effect of a Child Care Subsidy on Work Effort- Case III



high-wage mothers were already working before the subsidy and low-wage mothers will not be induced to work due to their low productivity in the labor market.[26] The effect of such a subsidy on hours of work conditional on employment is indeterminate because the increase in the effective wage due to the subsidy has a positive substitution effect and a negative income effect on hours of work. The subsidy could induce

[26]Low, middle and high wage categories are meant to simply describe relative position within the wage distribution of the target population of the subsidy, and not an absolute position. Hence, "high-wage" mothers represent mothers nearby the eligibility limit of the subsidy.

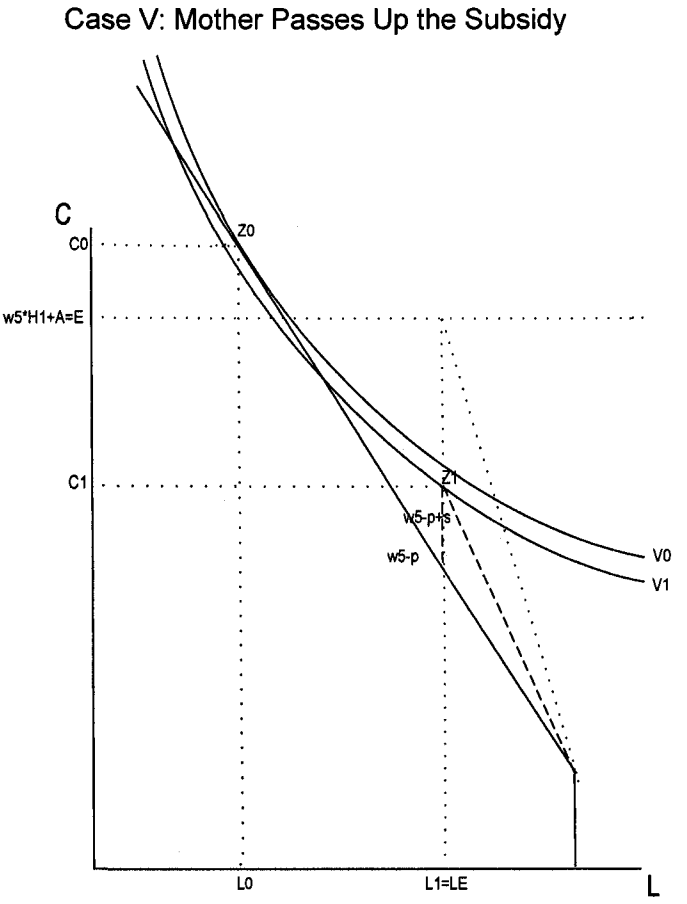
Figure 4. Effect of a Child Care Subsidy on Work Effort- Case IV



some high-wage mothers to reduce hours worked in order to be eligible. Also, some proportion of high-wage mothers will prefer to be non-eligible and thus will pass up the subsidy.

Let us look now at the hours worked function that serves as the basis for the econometric specification presented in the next section. The optimality condition arisen from (1.14) indicates that MRS_D equals $w - p + sD - \frac{\theta_2 wD}{\theta_1}$ at the optimum. The MRS_D can be expressed as a function of hours worked

Figure 5. Effect of a Child Care Subsidy on Work Effort- Case V



conditional on D (H_D) and all the exogenous parameters of the model, such that $MRS_D(\mathbf{H}_D, w, p, A, sD, ED, \alpha_u, \alpha_q) = w - p + sD - \frac{\theta_2(E,.)wD}{\theta_1(.)}$, where the subsidy s and the eligibility limit E affect hours worked only if $D = 1$. Note that θ_1 and θ_2 are function of all the exogenous parameters of the model as well. In particular, the multiplier of the eligibility constraint, θ_2, increases as the eligibility limit E decrease, but only when w and A are high enough. This implies that the effect of E on hours worked depends on the interaction between w and A, as shown below. Solving (1.14)

for hours worked conditional on D (H_D) as a function of all the exogenous parameters of the model and the subsidy dummy D, we get

$$H_D = H_D(w, p, A, sD, ED, EwD, EAD, \alpha_u, \alpha_q) \tag{1.15}$$

where the subsidy s and the eligibility limit E affect hours worked only if $D = 1$. In the case of E, its effect on hours worked varies according to w and A. Therefore, the potential hours worked for the participation state ($D = 1$) are described by $H_1 = H_1(w, p, A, s, E, Ew, EA, \alpha_u, \alpha_q)$ and the potential hours worked for the non-participation state ($D = 0$) are $H_0 = H_0(w, p, A, \alpha_u, \alpha_q)$. Denote the best attainable utility under the subsidy scheme by V_1 and the best attainable utility without the subsidy by V_0. Without loss of generality, these functions can be expressed in terms of H_1 and H_0 solely. As a result, the net utility of receiving the subsidy is given by the following latent index function

$$\begin{aligned} Y_s^* &= V_1 - V_0 \\ &= V_1(C(H_1), L(H_1), Q(L(H_1), 1 - L(H_1)) - \\ &\quad V_0(C(H_0), L(H_0), Q(L(H_0), 1 - L(H_0)) \qquad (1.16) \\ &= Y_s^*(w, p, A, s, E, Ew, EA, \alpha_u, \alpha_q) \qquad (1.17) \end{aligned}$$

where H_1 and H_0 have been substituted by their determinants when going from (1.16) to (1.17). Assuming no rationing in the subsidy receipt for the moment, the mother demands the subsidy if $Y_s^* > 0$. In other words, when there is no rationing, the propensity to receive a subsidy is determined by the "demand side" only. Note the joint nature of the decision to work and to demand a subsidy. This is reflected in

equations (1.15) and (1.17), since the same variables appear in both equations. For example, the eligibility limit not only affects the propensity to receive the subsidy, but also the number of hours worked under the subsidy scheme and thus, the value of being employed and receiving a subsidy. The presence of rationing however, make it possible to come up with potential exclusion restrictions to help identifying the effect of the subsidy receipt on employment outcomes. This is explained in the next section.

1.5 Econometric Model

1.5.1 Econometric Specification

The econometric specification is based on a latent-index framework inspired in the conceptual model presented in the previous section, but introducing several modifications. First, exogenous determinants of wages w, prices of non maternal care p, and tastes and productivities α_u and α_q are substituted into the model, and hence, a semi-reduced form specification is estimated.[27] Second, we need to include the presence of rationing into the model. Given the existence of rationing in the CCDF subsidies (i.e., not all eligible people who demand a child care subsidy receive one), the

[27] See next section for an explanation of the semi-reduced interpretation. Alternatively, I could have estimated wages and prices of care using selection methods to account for the non observability of wages and care expenditures. However, wage effect on employment is not the focus of this study. Also, this study is aimed at estimating the effect of actual subsidy receipt on employment outcomes, and not child care price elasticities on employment. As mentioned before, inferences about the effects of the CCDF subsidies drawn from price elasticities might not be useful if there are substantial costs to collecting a subsidy, which is likely the case when there is rationing.

propensity to receive a subsidy is determined by both the mother's choice to demand the subsidy and the agency's decision to award it. The mother's decision to apply for a subsidy is modeled as a partially strategic model, where the mother considers her probability of being rationed out of the subsidy when she decides whether to apply.

The subsidy rationing implies the propensity to receive a subsidy is no longer determined by the "demand" side only. This situation, however, gives us the opportunity to look at supply-side determinants of the degree rationing as a source of potentially valid exclusion restrictions to help identifying the effect of subsidy receipt on employment outcomes. See below the assumptions needed for this to be true.

The econometric specifications basically consist of joint modeling the propensity to receive a child care subsidy and an outcome equation (like the decision to work), where a subsidy indicator acts as an endogenous explanatory variable in the outcome equation. For clarity in the exposition, the explanation that follows consider the decision to work as the outcome equation, but the analysis can be easily extended to the other outcomes.[28] As a result, the econometric model consists on the following equations: (1) the mother's decision to work and (2) the propensity to receive a subsidy. The propensity to receive a subsidy, in turn, consists on (a) the mother's decision to apply for a subsidy and (b) the decision of the subsidy agency to offer a subsidy for the applicant mother.

[28]In particular, the outcome equations refer to (1) work, (2) work during the day (6am-6pm) and (3) use formal care as the primary child care arrangement.

1.5.1.1 Mother's decision to work (outcome equation)

The mother's decision to work is essentially based on equation (1.15) of the conceptual model, that is, $H_D = H_D(w, p, A, sD, EwD, EAD, \alpha_u, \alpha_q)$. Assuming that there exists a suitable monotonic transformation such that (1.15) may be expressed as a linear function of the subsidy and of its independent variables, equation (1.15) may be written as

$$H_D = \widetilde{\beta}_0 + \widetilde{\beta}_1 w + \widetilde{\beta}_2 p + \widetilde{\beta}_3 A + \widetilde{\beta}_4 sD + \widetilde{\beta}_5 EwD + \widetilde{\beta}_6 EAD + \widetilde{U}$$

where $\widetilde{U}$ combine the preferences and productivities parameters α_u and α_q. To estimate the model, this equation is modified in the following ways. First, exogenous determinants of wages w and prices of non maternal care p are substituted into the model. This approach allows us to avoid the difficult problems of estimating wages and prices of nonworkers and non-payers respectively. Second, the total effect of subsidy receipt on the decision to work is captured by a dummy variable D only. This allows us to keep the model simple by avoiding having interactions of the endogenous dummy D with other variables, which would be more demanding in terms of the identification and estimation of the model. Thus the income eligibility limit E is included with no interactions, capturing differences across states in the access to the subsidy (along with other state covariates included as well).

Let Y_{Hi} be an indicator variable that takes the value 1 if the mother i works positive hours and 0 if not. As a result, the decision to work positive hours for mother i is given

by

$$H_i^* = X_i\beta + \psi_s \mathbf{D}_i + U_i \tag{1.18}$$

$$Y_{Hi} = 1 \text{ if } H_i^* > 0;\ Y_{Hi} = 0 \text{ otherwise}$$

The (common treatment) effect parameter of the subsidy receipt is then ψ_s. In this model, the average effect of D on the probability of being employed (for a given value of covariates X_i) is $F(X_i\beta + \psi_s) - F(X_i\beta)$, where F represents a cumulative distribution.

1.5.1.2 The propensity to receive a subsidy

The propensity to receive a subsidy is modeled as a (partially) strategic model that can be solved by backwards induction.[29] The game is only partially strategic because only one player (the mother) conditions her behavior on the expected behavior of the other player (the agency). The mother's decision to apply is assumed to be dependant on what she thinks the subsidy agency will do. Thus, the mother considers her probability of being offered a subsidy by the subsidy agency when she decides whether to apply[30].

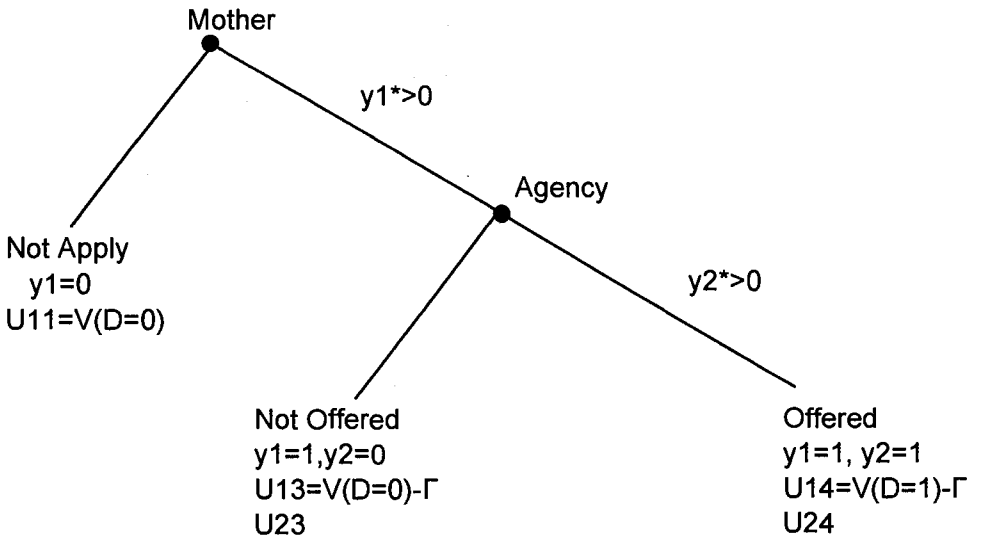
The partially strategic feature of the game is reflected in the fact that there is no need to specify U_{21} in Figure 6. The probability of applying for the subsidy and the probability of offering the subsidy are therefore considered equilibrium choice

[29] See Bas, Signorino and Walker (2007) for an explanation of recursive extensive-form games in a statistical context.

[30] This is consistent with the way that the information about these programs is usually transmitted between potential beneficiaries. Normally mothers learn about these subsidies through the previous experience of a relative, a friend or a neighbor. In that case, subjective information about the length of the waiting list, for example, may influence the mother's decision whether to apply for the subsidy.

probabilities. As a result, the propensity to receive a subsidy is determined by both the mother's choice to apply for a subsidy and the agency's decision to award it.

Figure 6. Mother's Decision to Apply for the Subsidy



Note: In the above model, the eligible mother chooses whether to apply for the subsidy. If she applies, the agency must then choose between offering the subsidy to her or rationing her out.

To derive the choice probabilities we will work "up the tree" (see Figure 6). Let us look first at the agency's decision to offer the subsidy. Denote by y_{2i}^{*} the net utility for the agency of offering the subsidy to mother i, $U_{23} - U_{24}$. Let X_{2i} and ε_{2i} represent the observable and the unobservable components of the net utility, respectively. Let Y_{2i} be an indicator variable that takes the value 1 if the agency offers a subsidy to the applicant mother i and 0, if not. Therefore, the latent index function for the *agency*'s decision to

offer the subsidy is

$$\begin{aligned} Y_{2i}^{*} &= U_{23} - U_{24} \\ & X_{2i}\gamma_2 + \varepsilon_{2i} \\ Y_{2i} &= 1 \text{ if } Y_{2i}^{*} > 0, Y_{2i} = 0 \text{ otherwise} \end{aligned} \tag{1.19}$$

where the subsidy if offered ($Y_{2i} = 1$) if the net utility for the agency is positive ($Y_{2i}^{*} > 0$), and it is not offered otherwise. The net utility for the agency can represent the benefits of allocating the subsidy to mother i instead of mother j, or simply the benefits of not offering the subsidy to mother i in order to keep the subsidy budget under control. Indeed, states ration benefits to households with specific characteristics. Usually those leaving welfare for work have priority (Herbst, 2006; Schulman et. al., 2001).

The mother considers her probability of being offered a subsidy by the subsidy agency when she decides whether to apply. This probability scales down the expected benefits of receiving the subsidy. In other words, the presence of waiting lists for type i mothers in some states is likely to influence not only the probability of receiving the subsidy through the agency's decision, but also through its influence in the decision to apply for the subsidy. Thus, if a mother i living in a state with long queues for mothers of type i believes that her probability to get the subsidy is low enough, she will not even bother to apply for the subsidy.

The mother does not observe ε_2 (neither the analyst). She is uncertain of agency's action and, therefore, has to estimate the probability that the agency will offer the

subsidy to her, $P_{2i} \equiv \Pr(Y_{2i}^* > 0)$. Following Figure 6, if the mother does not apply, she gets the best attainable utility without the subsidy, $U_{11} = V(D = 0) \equiv V_0$ and does not incur on the fixed cost to apply (Γ). If she does apply and receives the subsidy, she gets $U_{14} = V(D = 1) - \Gamma \equiv V_1 - \Gamma$. If she applies and does not get the subsidy, she gets $U_{13} = V_0 - \Gamma$. Therefore, the (expected) utility of applying for the subsidy is given by $(1 - P_2) * (V_0 - \Gamma) + P_2 * (V_1 - \Gamma)$. Let Y_{1i} be an indicator variable that takes the value 1 if the mother i applies for the subsidy and 0, if not. Therefore, the latent index function for the *mother*'s net utility of applying for the subsidy is

$$\begin{aligned} Y_{1i}^* &= (1 - P_{2i}) * U_{13} + P_{2i} * U_{14} - U_{11} \\ &= (1 - P_{2i}) * [V_{0i} - \Gamma_i] + P_{2i} * [V_{1i} - \Gamma_i] - V_{0i} \\ &= P_{2i} * [V_{1i} - V_{0i}] - \Gamma_i \qquad (1.20) \\ Y_{1i} &= 1 \text{ if } Y_{1i}^* > 0, Y_{1i} = 0 \text{ otherwise} \end{aligned}$$

where the mother applies ($Y_{1i} = 1$) if the net utility is positive ($Y_{1i}^* > 0$), and she does not apply otherwise. Hence, mothers who do not apply for the subsidy include (1) mothers with low or negative $[V_{1i} - V_{0i}]$ (e.g., mothers that would not be induced to work by the subsidy, or mothers who would need to significantly reduce the numbers of hours worked to become eligible); (2) mothers whose P_{2i} is low (e.g. mothers in states with long queues for type i mothers, such as low income mothers not in welfare); (3) mothers with high Γ_i (e.g., mothers in states that impose high bureaucracy costs to apply for the subsidy); or (4) any combination of (1), (2) and (3).

From equation (1.17), we know that $V_{1i} - V_{0i}$ is given by $Y_s^*(w, p, A, s, E, Ew, EA, \alpha_u, \alpha_q)$. Let X_{1i} and ε_{1i}^v represent the observable and unobservable characteristics of mother i that determine Y_s^*, such that $V_{1i} - V_{0i} = X_{1i}\beta_1 + \varepsilon_{1i}^v$. Let the fixed cost to apply for the subsidy to the mother i be determined by $\Gamma_i = Z_{1i}\delta_1 + \varepsilon_{1i}^c$. Then (1.20) becomes

$$\begin{aligned} Y_{1i}^* &= P_{2i} * [X_{1i}\beta_1] - Z_{1i}\delta_1 + \underbrace{P_{2i} * \varepsilon_{1i}^v - \varepsilon_{1i}^c}_{=\varepsilon_{1i}} \\ &= (P_{2i}X_{1i})\beta_1 - Z_{1i}\delta_1 + \varepsilon_{1i} \qquad (1.21) \\ Y_{1i} &= 1 \text{ if } Y_{1i}^* > 0, Y_{1i} = 0 \text{ otherwise} \end{aligned}$$

Note that the error term ε_{1i} is not constant across observations, since it depends on P_{2i}. This introduces heterocedasticity in the model that we have to deal with in order to get consistent estimates[31].The propensity to receive the subsidy is then the joint probability of the mother applying for the subsidy and the agency offering the subsidy to the mother

$$\Pr(D_i = 1) = \Pr(Y_{1i} = 1) * \Pr(Y_{2i} = 1 / Y_{1i} = 1)$$

1.5.2 Empirical Implementation

The empirical implementation of the model consists on estimating the following three equations, which are repeated below for clarity on the exposition: (1) an outcome equation, like the mother's decision to work (equation (1.18)); (2) the mother's decision

[31]Recall that if we ignore heterocedasticity in the linear regression model, the LS estimator is still unbiased and consistent, but inefficient. However, in non-linear models, such as probit models, heterocedasticity implies that MLE estimators are inconsistents. See for example, Greene 2002, p679, or Yatchew and Griliches (1985).

to apply for a subsidy (the applying equation (1.21)); and (3) the decision of the subsidy agency to offer a subsidy for the applicant mother (the rationing equation (1.19)).

$$\begin{aligned}
\text{Outcome Eq:} \quad & H_i^* = X_i\beta + \psi_s \mathbf{D}_i + U_i \\
Y_{Hi} &= 1 \text{ if } H_i^* > 0;\ Y_{Hi} = 0 \text{ otherwise} \\
\text{Applying Eq} \quad : \quad & Y_{1i}^* = (P_{2i}X_{1i})\beta_1 - Z_{1i}\delta_1 + \varepsilon_{1i} \\
Y_{1i} &= 1 \text{ if } Y_{1i}^* > 0,\ Y_{1i} = 0 \text{ otherwise} \\
\text{Rationing Eq:} \quad & Y_{2i}^* = X_{2i}\gamma_2 + \varepsilon_{2i} \\
Y_{2i} &= 1 \text{ if } Y_{2i}^* > 0,\ Y_{2i} = 0 \text{ otherwise}
\end{aligned}$$

where it is assumed that $\varepsilon_{2i} \perp (\varepsilon_{1i}, U_i)$, $\varepsilon_{2i} \tilde{} N(0,1)$, and $(\varepsilon_{1i}, U_i) \tilde{} N(0, \begin{pmatrix} P_{2i}^2 * \sigma_{1v}^2 + 1 & \rho \\ & 1 \end{pmatrix})$, with the variance of the fixed cost to apply normalized to one ($\sigma_{\varepsilon_1^c} = 1$).

The model is estimated by Full Information Maximum Likelihood approach (FIML), in which I specify the joint distribution of the three equations (rationing, applying and outcome equations) and maximize the joint log-likelihood function. The outcome equation refers to work, work during the day (6am-6pm) or the use formal care as the primary child care arrangement, depending on the outcome analyzed. Unlike two-steps procedures such as Limited Information Maximum Likelihood (LIML), the FIML approach produces the correct asymptotic covariance matrix (under the normality assumption) for inference purposes[32]. Since ε_{2i} is assumed uncorrelated with ε_{1i} and

[32]The first step of the LIML approach would involve estimating the probability of being offered a subsidy P_{2i} for each mother in the sample from a univariate probit model based on equation (1.19). The second step would involve constructing new

U_i, the applying and outcome equations form a heterocedastic bivariate probit model, where the heterocedasticity depends on the square of the probability of being offered a subsidy for the mother i, P_{2i}. The heteroscedastic bivariate probit model is as follows (see the full likelihood function in Figure 7) :

$$\Pr(Y_{Hi}=1, Y_{1i}=1) = \Phi_2(X_i\beta + \psi_s \mathbf{D}_i, \frac{(P_{2i}X_{1i})\beta_1 - Z_{1i}\delta_1}{\sqrt{(P_{2i}^2\sigma_{\varepsilon_1^v}^2 + 1)}}, \rho_*)$$

The independence assumption ($\varepsilon_2 \perp (\varepsilon_1, U)$) rules out the possibility of selection on unobservables by the program administrators. If program administrators select mothers on the basis of characteristics that are not observed by the investigators, then the procedure developed in this study would yield inconsistent estimates. However, this assumption allow us to avoid the difficulties that would arise in the estimating process if we had assumed that the error terms ε_1 and ε_2 are correlated.[33] Also, this assumption is not different from the assumption made when using waiting lists as a control group

---

regressors $\widetilde{X_{1i}} = \widehat{P_{2i}} * X_{1i}$ to estimate the applying equation with the transformed regressors, such that $Y_{1i}^* = \widetilde{X_{1i}}\beta_1 - Z_{1i}\delta_1 + \widetilde{\varepsilon}_{1i}$. The second step is therefore a heterocedastic bivariate probit model of the decision to apply for a child care subsidy (using the transformed regressors) and an outcome equation (like the decision to work), where a subsidy indicator acts as an endogenous explanatory variable in the outcome equation. As any two-steps approach, the Two-steps MLE does not yield the correct asymptotic covariance matrix and therefore, would require correcting the standard errors using the Murphy-Topel's procedure.

[33] If we assumed that the error terms are correlated, we would say that when the mother forms the beliefs about the agency's probability of offering the subsidy to her, she conditions on its own draw of ε_1. In that case, we would have that $Y_{1i}^* = \Pr(Y_{2i}^* \leqslant 0 / \varepsilon_1) * U_{13} + \Pr(Y_{2i}^* > 0 / \varepsilon_1) * U_{14} - U_{11} + \varepsilon_1$. This would imply solving for ε_1 for every observation in the sample when doing the maximum likelihood estimation, which is not trivial. See further explanations on this respect in Signorino (2002).

for subsidy recipients, which is the main strategy used in Berger and Black (1992), for example.[34] Nevertheless, to relax this assumption could be part of further research on this topic.

Figure 7. Likelihood Function

$$
\begin{aligned}
\ln(L) &= \sum_{y_{2i}=1} \ln(P_{2i}) + \sum_{y_{2i}=0} \ln((1-P_{2i})) + \\
\sum_{y_{1i}=1,,y_{Hi}=1} \ln(P(y_{1i} &= 1, y_{Hi}=1)) + \sum_{y_{1i}=1,,y_{Hi}=0} \ln(P(y_{1i}=1, y_{Hi}=0)) + \\
\sum_{y_{1i}=0,,y_{Hi}=1} \ln(P(y_{1i} &= 0, y_{Hi}=1)) + \sum_{y_{1i}=0,,y_{Hi}=0} \ln(P(y_{1i}=0, y_{Hi}=0))
\end{aligned}
$$

$$
\begin{aligned}
\ln(L) = & \sum_{y_{2i}=1} \ln(P_{2i}) + \sum_{y_{2i}=0} \ln((1-P_{2i})) + \\
& \sum_{y_{1i}=1,,y_{Hi}=1} \ln(\Phi_2(\frac{(P_{2i}X_{1i})\beta_1 - Z_{1i}\delta_1}{\sqrt{(P_{2i}^2\sigma_{\varepsilon_1^v}^2+1)}}, X_i\beta + \psi_s\mathbf{D}_i, \rho_*)) + \\
& \sum_{y_{1i}=1,,y_{Hi}=0} \ln(\Phi_2(\frac{(P_{2i}X_{1i})\beta_1 - Z_{1i}\delta_1}{\sqrt{(P_{2i}^2\sigma_{\varepsilon_1^v}^2+1)}}, -X_i\beta - \psi_s\mathbf{D}_i, -\rho_*)) + \\
& \sum_{y_{1i}=0,,y_{Hi}=1} \ln(\Phi_2(\frac{-(P_{2i}X_{1i})\beta_1 + Z_{1i}\delta_1}{\sqrt{(P_{2i}^2\sigma_{\varepsilon_1^v}^2+1)}}, X_i\beta + \psi_s\mathbf{D}_i, -\rho_*)) + \\
& \sum_{y_{1i}=0,,y_{Hi}=0} \ln(\frac{-(P_{2i}X_{1i})\beta_1 + Z_{1i}\delta_1}{\sqrt{(P_{2i}^2\sigma_{\varepsilon_1^v}^2+1)}}, -X_i\beta - \psi_s\mathbf{D}_i, \rho_*)
\end{aligned}
$$

[34]These authors recognize, however, that the waiting list group could not be a valid control group if program administrators select mothers on the basis of unobserved characteristics. To deal with this issue, they analyze whether selection explains the observed employment effects by decomposing what they call full effects of subsidies into sign-up, waiting list, creaming and subsidy effects. See Berger and Black (1992) for further details.

The model is a semi-reduced form specification in the following sense. The overall strategy in constructing covariates assumes that a mother's observed demographic characteristics (e.g. marital status and the ages and number of children), the state-level demographic characteristics, the child care and welfare policy rules she faces, and the economic environment in her state are all exogenous.[35] Thus, to maintain a reduced form specification, every covariate used is a function of those demographic, policy, and economic environment variables. In this way, the strategy adopted is similar to Fang and Keane (2004) and Bernal and Keane (2006).[36] As a result, the applying equation is a fully-reduced form specification, whereas the outcome equation is a semi-reduced form specification, since the subsidy receipt is endogenously determined.

For exclusion restrictions to help identify the model, I use the variation across states in some (plausibly) exogenous determinants of the probability of being rationed out of the subsidy, such as the amount of pre-determined child care funding (Mandatory

[35]The evidence on the effects of child care subsidies on fertility is inconclusive. For example, Blau and Robins (1989) find that higher child care costs lower the birth rate for non-employed women, but not for employed women. Related studies examine the effects of personal tax exemption for dependents, finding a positive effect on the national birthrate (see e.g., Whittington et. al, 1990; Whittington, 1992; Whittington, 1993). The larger evidence on the effects of welfare payments on marriage and fertility is inconclusive as well. See the surveys as this respect in Hoynes (1997) and Moffit (1997). Hoynes concludes that there is no compelling evidence of an effect of welfare on fertility. Moffit interprets the evidence as being inclined of a relationship, but with no robustness. Also, a structural model of life-cycle behavior would be needed to model the choices in some of these dimensions, which is beyond the scope of this chapter.

[36]For example, I do not use a mother's actual welfare participation history to determine if she had hit the time limit (or to calculate the remaining months on her time limit clock), because actual welfare participation decisions are endogenous. In contrast, I follow the approach of Fang and Keane (2004) and Bernal and Keane (2006) in constructing a dummy variable for whether the time limit could have been binding for each mother, given the ages of her children. See more details in the next section.

Funds plus Maintenance-of-Effort Funds), scaled by the number of children 0-5 years old living with a female householder in 2000 in each state (see the list of exclusion restrictions in Table 1.3). The exclusion restrictions are assumed to affect the probability of being rationed out of the subsidy, but not the probability of being employed, conditional on subsidy status.[37] To be valid instruments, these variables must be uncorrelated with the unobservable determinants of employment of single mothers, U (conditional on observables X). Because vary across states, the instruments may be correlated with unmeasured state-level variables that affect current employment decisions of single mothers. In particular, state waivers implemented before 1996 may have affected AFDC child care expenditures in 1992-1995 (affecting Mandatory Funds) and may affect current employment decisions of single mothers as well. This would preclude the use of pre-determined funds as exclusion restrictions. Likewise, variation across states in welfare regulation and the severity of the welfare reform would preclude the use of CCDF policy variables as exclusion restrictions determining the probability of rationing only. Unless we control for the welfare regulation characteristics across states, the CCDF policy variables could pick up idiosyncratic characteristics of the states influencing employment outcomes. As a result, I use a set of state welfare policy

[37] *Mandatory Funds* provide a guaranteed level of federal child care funding to states, for which no state matching funds are required. Each state receives a fixed amount each year, equal to the federal funding it received under the AFDC child care programs in either FY 1994, FY 1995, or the average of FY 1992-1994, whichever is highest (Besharov and Higney, 2006). *MOE funds* are the money that states must spend on child care in order to become eligible for federal Matching Funds. State MOE requirements are set at the greater of each state's FY 1994 or FY 1995 spending levels in the Title IV-A child care programs. See further details in Besharov and Higney (2006) and Meyer and Rosenbaum (2000).

variables constructed by Fang and Keane (2004) and Bernal and Keane (2006) to control for differences in welfare regulation across states in the employment equation. These welfare policy variables are also interacted with demographic characteristics at the individual level.

1.6 Data

To estimate the models, I use repeated cross-section survey data from the 1999 and 2002 rounds of the National Survey of America's Families (NSAF), conducted by the Urban Institute. The NSAF was designed to analyze the consequences of transferring the responsibility for social programs from the federal government to the states. The survey was conducted by telephone on a sample derived primarily from random-digit dialing[38]. Residents of 13 states[39] were over-sampled in order to allow within-state analysis. Additionally, low-income households (below 200 percent of the federal poverty level) were also over-sampled. The entire NSAF sample includes approximately 40,000 households in each round. Using both 1999 and 2002 rounds, I select a sample from the 13 over-sampled states of unmarried mothers between 19 and 44 years old with at least one child under age 5, and with family income below 200 percent of the federal poverty line. I use observations from the over-sampled states because few observations satisfy my sample selection criteria in each of the

[38]Cellular telephones distributed by the survey organization were used to conduct interviews with households without a telephone.

[39]Alabama, California, Colorado, Florida, Massachusetts, Michigan, Minnesota, Mississipi, New Jersey, New York, Texas, Washington and Wisconsin.

other states[40]. The income limit threshold of 200 percent of the FPL is selected for convenience, since the NSAF survey only asks persons with family income below this threshold about rationing issues. Thus it defines the potential population that could demand the CCDF subsidies[41]. After dropping observations with missing values, the resulting sample size is 2131 observations.

A mother is coded as *receiving a child care subsidy* if a welfare or social service helped her pay for child care in the month prior to the survey date or she received government assistance in paying for child care in the past 12 months. According to this classification, 30 percent of the selected sample reports receiving a child care subsidy (see last row of Table 1.2).

A mother is coded as *having applied for a subsidy* if she is either coded as receiving a subsidy (according to the previous criteria) or has been rationed out of it. I code in turn a mother as being rationed out based on the information collected from the NSAF question showed in Figure 8 Specifically, a mother is coded as *rationed out* if all three of the following situations occurs: (1) she did not receive government assistance in paying for child care in the last 12 months, (2) she inquired or applied for government assistance in paying for child care in the last 12 months, but she did not get the assistance, and the reason for that was that (3) the assistance was not available, or she was put on waiting list, or she was discouraged/ gave up/ too much hassle to get

[40]The 1999 and 2002 rounds contain 350 observations from the non over-sampled states that satisfy my sample selection criteria. The average across states is 17 observations only, wtih a maximum of 33 (Ohio).

[41]For example, the average across states was 189 percent of the FPL in 2000. Only 15 states had a limit above this threshold.

it[42]. Although not optimal, this classification allow us to estimate the rationing status for each mother in the sample whose family income is below 200 percent of the federal poverty line.

Figure 8. NSAF Question Used to Identify Mothers Rationed Out

K38. In the past 12 months, did you receive government assistance in paying for child care?
YES..... 1 (GO TO BOX K39) NOT RATIONED
NO..... 2

K38a. You said you didn't receive government assistance in paying for child care. Did you inquire about or apply for it in the past 12 months?
YES..... 1 (GO TO K38b)
NO..... 2 (GO TO BOX K39) NOT RATIONED

K38b. Why didn't you receive this assistance?
[PROBE: Any other reason?]
[CODE ALL THAT APPLY]
NOT ELIGIBLE / MAKE TOO MUCH MONEY..... 1 DO NOT APPLY
ASSISTANCE NOT AVAILABLE..... 2 RATIONED
PUT ON WAITING LIST ..... 3 RATIONED
DISCOURAGED / GAVE UP / TOO MUCH HASSLE.... 4 RATIONED
DECIDED DIDN'T WANT / NEED HELP FROM GOV.. 5 DO NOT APPLY
OTHER (SPECIFY) .....91 DROPPED

Source: NSAF 2002 questionnaires (http://www.urban.org/center/anf/questionnaire.cfm).

For the observables common to the applying equation and the outcome equations, I use a set of individual characteristics and a set of state-level variables (state demographic controls, state subsidy policy variables and state welfare rules) that

[42]A mother is coded as not having applied for a subsidy if she inquired or applied for government assistance but either she was told that she is not eligible/ makes too much money, or she eventually decided that she did not want or need help from the government. It is assumed that in those cases the mother self-selects to be not eligible or simply regrets her initial choice. Cases in which the reason for not receiving the subsidy is classified as "Other" are dropped from the sample. The results presented below are not sensitive to these classfications.

represent the exogenous determinants of wages w, prices of non maternal care p, and tastes and productivities α_u and α_q. The models also include state-level policy variables interacted with individual-level demographics characteristics. Specifically, the equations include exogenous determinants of wages w (such as educational attainment, potential experience, health condition and region), exogenous determinants of informal versus formal care use and non maternal care costs in general (such as the number of children, the presence of children older than 13), and other factors associated with opportunities and preferences for time spent in market or non-market activities (such as race, nativity and the first principal component of a battery of questions related to welfare, work and maternity attitudes)[43]. To control for unobserved heterogeneity that might be correlated with the subsidy receipt and the outcome variables, the specifications include a dummy indicating whether the family received TANF benefits (welfare) at any time in the last two years. Table 1.2 shows the descriptive statistics of the individual demographic characteristics included in the estimations. Subsidy recipients are more likely to have received welfare at some point during the last two years, less likely to be Hispanic, and have less education than non-recipients.

Employment status is measured by whether the mother is working positive number of hours as of the respective round date. According to this classification, 74 percent

[43]Previous studies have found that mothers' tastes for alternative care arrangements vary with education, ethnicity, and immigration status. In particular, less educated and immigrant mothers are more likely to rely on family members and friends as non-maternal care providers (see studies cited in Meyers et. al., 2002). It is therefore anticipated that mothers with more education and those born in the U.S. are more likely to seek child care subsidies.

Table 1.2. Descriptive Statistics

Youngest Child 0-4y

Variable	Subsidy Recipients	Non Subsidy Recipients	All Sample
Working	0.74	0.57	0.62
	(0.44)	(0.49)	(0.48)
Working full time (35h+/week)	0.52	0.39	0.43
	(0.50)	(0.49)	(0.50)
Working during the day (6am-6pm)	0.60	0.41	0.47
	(0.49)	(0.49)	(0.50)
In the labor force	0.90	0.76	0.80
	(0.31)	(0.43)	(0.40)
Subs-type care as primary arr.	0.64	0.32	0.42
	(0.48)	(0.47)	(0.49)
Welfare at any time in last two yrs.	0.63	0.34	0.43
	(0.48)	(0.48)	(0.49)
Health condition that limits work	0.11	0.12	0.11
	(0.31)	(0.32)	(0.32)
Black	0.40	0.37	0.38
	(0.49)	(0.48)	(0.49)
Hispanic	0.15	0.27	0.23
	(0.36)	(0.44)	(0.42)
Age	26.96	27.64	27.44
	(5.78)	(5.96)	(5.91)
High school graduate only	0.47	0.47	0.47
	(0.50)	(0.50)	(0.50)
Some or complete college	0.34	0.27	0.29
	(0.48)	(0.44)	(0.45)
Non wage income	0.10	0.13	0.12
	(0.26)	(0.32)	(0.30)
Number of children	2.10	2.07	2.08
	(1.11)	(1.15)	(1.14)
At least one kid 13-17 years old	0.09	0.09	0.09
	(0.28)	(0.29)	(0.29)
Youngest child aged 3 to 4	0.43	0.37	0.38
	(0.50)	(0.48)	(0.49)
Foreign-born, US citizen	0.01	0.03	0.02
	(0.11)	(0.17)	(0.15)
Fgn-born,non-citizen, in US 0-4y	0.01	0.03	0.02
	(0.09)	(0.18)	(0.16)
Fgn-born,non-citizen, in US 5y+	0.03	0.09	0.08
	(0.17)	(0.29)	(0.26)
PCA score attitudes	0.98	0.84	0.88
	(1.26)	(1.24)	(1.25)
Observations	635	1496	2131
	30%	70%	100%

Standard deviations in parentheses

Source: Author's calculations from the 1999 and 2002 NSAF.

of the subsidy recipients in the sample are employed, compared to 57 percent of non-recipients. The differences in labor force participation between those groups are also large (90 percent versus 76 percent).

To look at employment quality outcomes, this study uses the information on whether the mother works during standard hours versus night hours. Sixty percent of the subsidy recipients work during the day (6am-6pm), compared to 41 percent of non-recipients. This implies that it is more common for working mothers that receive a subsidy to work during the day (81 percent) than it is for working mothers that do not receive a subsidy (72 percent). Notice that this analysis does not control for any other characteristics of the mothers, unlike the analysis presented below which shows that the largest effects of the subsidy receipt are indeed related to the probability of working during the day.

Table 1.2 also presents the proportion of the sample that uses a subsidized-type care as the primary care arrangement of the focal child[44]. The subsidized-type care includes center-based care, before/after school care, and non-relative care outside of child's home. The unsubsidized-type care includes care in child's home, relative care outside of child's home, parental care or self care. As expected, the subsidized-type of care is more commonly used among subsidy recipients (64 percent) than among non-recipients (32 percent). However, this association could be simply indicating a positive self-selection of the subsidy by mothers that would have demanded this type

[44]The focal child is a sampled children within a household in the NSAF. In the sample of households, the NSAF subsamples household members to reduce the respondent burden. If there were multiple children under age 6, one was randomly selected. The same was done for children ages 6 to 17. No more than two children were sampled from each household.

of child care anyway. However, the results presented below indicate that the subsidy receipt does induce the use of formal care as the primary mode.

Table 1.3 presents the list of state characteristics, state CCDF subsidy policy variables, state welfare rules, other policy variables, and state-level variables interacted with individual demographics that are included in each equation estimated (Rationing Equation, Applying Equation, and Outcome Equation). Each variable has up to three subscripts: i for mother, j for State and t for round (either 1999 or 2002). The variables in italics are the ones that are only included either in the rationing or in the applying equation, but not in the outcome equation. Specifically, the characteristics of the recertification process to retain the subsidy are assumed to affect only the applying decision. Likewise, the following variables are assumed to affect the rationing status but neither the applying equation nor the outcome equation directly: (1) the state eligibility limit as a proportion of the federal limit of 85 percent of the state median income; (2) a dummy indicating whether the state has waiting lists for the subsidy; and (3) the amount of predetermined funds (Mandatory Funds plus MOE funds) scaled by the number of children 0-5 years old living with a female householder in 2000 in each state.

State welfare rules variables used in this chapter were first constructed by Fang and Keane (2004) and Bernal and Keane (2006). The state-level variables includes two set of welfare rules. The first set of rules characterizes the main aspects of state waivers implemented before 1996, whereas the second set describes the main rules of

Table 1.3. List of State and Welfare Controls

Variable	Description	Equation Rationing	Equation Applying	Equation Outcome
	State Characteristics			
$URATESIN_j$	Unemp. of single mothers in 2000		X	X
$SWAGE_{jt}$	Wage at the 20th per. distribution		X	X
$CCWAGE_{jt}$	Average wage of child care workers		X	X
	CCDF Subsidy Policy Variables			
$SUBLIM_{ijt}$	CCDF inc. limit by family size		X	X
$SUBMEDIA_{jt}$	State j uses mass media	X	X	X
$SUBGUAR_j$	State j guarantees subsidy	X	X	X
$SUBRECMO_j$	*Months until recertification*		X	
$SUBRECPER_j$	*Recertification in person*		X	
$SUBLIM_{jt}$	*CCDF inc. limit/85% SMI (family of 3)*	X		
$SUBWLIST_{jt}$	*Existence of waiting lists*	X		
$SUBFUNDS_j$	*Predet. funds/0-5 children of s. m.*	X		
	Welfare Rules before the PRWORA			
$TLPRW_j$	Time Limit before 1996 (d)			X
$WRPRW_j$	Work req. before 1996			X
$WRAGEEX_j$	Work req.*age exempted before 1996			X
$WRSANPRW_j$	Work req.*ult. sanction before 1996			X
	Welfare Rules after the PRWORA			
TL_{jt}	Time Limit			X
$WRLENGTH_{jt}$	Work req.*work req. length			X
$WRAGEEX_{jt}$	Work req.*age exempted			X
$WRSAN_{jt}$	Work req.*ult. Sanction			X
$TLHIT_{ijt}$	Mother i would have hit time limit			X
$TLREMAIN_{ijt}$	Min. pot. length of mother's i time limit			X
$WRHIT_{ijt}$	Mother i could be subject to a w.r.			X
$WREXEMCC_{ijt}$	W.r. exemption if c. care not available (varying by the age of youngest child)			X
$TANFBEN_{ijt}$	TANF max. benefit by fam. size			X
$TANFDIS_{jt}$	Disregarded earnings for TANF			X
	Other Policy Variables			
$EITCPH_{ijt}$	EITC phase in rate by num. of children			X
$EITCMAX_{ijt}$	EITC max. benefit by num. of children			X

Note: State welfare rules and EITC variables used in this chapter were first constructed by Fang and Keane (2004) and Bernal and Keane (2006). Variables with the ijt subscript correspond to state-level variables jt interacted with mother's i characteristics

the welfare system that were in place as of the survey date (either in 1999 or 2002)[45]. All these variables vary only across states. In addition to these state-level welfare rules, I construct a set of interactions between demographic characteristics of the mother i living in state j and state j welfare rules in place in each round (either 1999 or 2002). As previously mentioned, these variables are constructed using "potential" rather than "actual" measures of welfare participation. This is due to the actual measures being endogenous and thus do not belong in a reduced-form specification as used in this study[46].

The models also include the TANF maximum benefit (in case of zero earnings) interacted with the number of children in the family, the earnings disregard flat income for welfare, and a year dummy for the 2002 round. Similarly, the Earned Income Tax Credit (EITC) phase in rate and the EITC maximum benefit level, constructed from both federal and state level, are both interacted with the number of children in the family[47].

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[45]I use the length (in months) of work requirement limit in state j in 1999 (or 2002), instead of a dummy for work requirement in place because of the high collinearity between the dummy for work requirement and the interacted version of this dummy, which varies according to mother's demographics. I decide to include the interacted version of this dummy instead of the dummy itself.

[46]For example, these variables do not measure whether a woman is actually subject to a work requirement, or for how long ago a woman has actually hit a time limit. Instead, they measure whether a time limit or a work requirement could have been "potentially" reached by a mother. For example, a mother whose oldest child is 4 years old as of the survey date cannot have received welfare for more than 4 years. The time limit would not be binding for this woman, unless the limit is less than 4 years, regardless of how many years ago her state implemented time limits. Thus the year in which time limits may first bind varies across women in the same state. See more details of this strategy in Fang and Keane (2004) and Bernal and Keane (2006).

[47]The EITC rules specify four parameters: a phase-in rate, a phase-out rate, a

1.7 Empirical Results

1.7.1 Main Results

As an initial benchmark, Table 1.4. shows the estimates from an univariate probit model of the effect of subsidy receipt on employment status. Both the subsidy receipt and the employment status are observed as dichotomous variables. As in all specifications in the chapter, the models include state controls, welfare controls and interactions between state-level variables and individual characteristics. Also, all the estimations in the chapter are done using survey sample weights. In the univariate probit model, the subsidy receipt dummy is implicitly treated as an exogenous variable. The estimated coefficients and marginal effects at the mean of the explanatory variables are reported. The results indicate that receiving a subsidy increases the probability of being employed by 17.5 percent, at the sample means of the covariates (increasing the employment probability from 0.57 to 0.75 percent). The results are similar when looking at the effects on part-time employment (working 20 hours or more a week) and full-time employment (working 35 hours or more a week), as presented in Table 1.8, column 2.

As shown in Tables 1.2, there are some significant differences in observable characteristics between subsidy recipients and non-recipients, which suggests a selection into subsidy receipt on *observed* characteristics. A natural question, therefore,

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phase-in income range, and a phase-out income range. All these parameters depend on family size. The EITC increases in proportion to earned income at the phase-in rate until the credit reaches the (fixed) maximum amount. The credit starts to decrease at the phase-out rate when earned income exceeds another fixed threshold. I use the phase-in rate and the maximum benefit level by the number of children living in the family.

Table 1.4. Probit Model of Employment Status

dependent variable: 1=employed; 0=not employed				
	(1) Coefficients		(2) Marginal Effects	
	b	se	me	se
Subsidy (d)	**0.476**	**(0.108)****	**0.175**	**(0.038)****
Welfare at any time in last two yrs. (d)	-0.423	(0.098)**	-0.163	(0.038)**
Health condition that limits work (d)	-0.678	(0.148)**	-0.266	(0.056)**
Black (d)	0.195	(0.108)	0.075	(0.041)
Hispanic (d)	0.035	(0.136)	0.013	(0.052)
Age	0.202	(0.069)**	0.078	(0.027)**
Age squared/100	-0.334	(0.116)**	-0.129	(0.045)**
High school graduate only (d)	0.303	(0.114)**	0.116	(0.043)**
Some or complete college (d)	0.559	(0.129)**	0.204	(0.044)**
Non wage income	-0.300	(0.146)*	-0.116	(0.056)*
Number of children	-0.206	(0.077)**	-0.079	(0.030)**
At least one kid 13-17 years old (d)	0.763	(0.197)**	0.254	(0.052)**
Youngest child aged 3 to 4 (d)	0.078	(0.108)	0.030	(0.042)
Foreign-born, US citizen (d)	0.294	(0.241)	0.108	(0.084)
Fgn-born,non-citizen,liv in US 0-4y (d)	-0.453	(0.273)	-0.179	(0.107)
Fgn-born,non-citizen,liv in US 5y+ (d)	-0.053	(0.176)	-0.020	(0.069)
PCA score attitudes	0.070	(0.037)	0.027	(0.014)
State Controls	Yes			
Welfare Controls	Yes			
Dep Var Sample Mean if Subsidy=0	0.57			
N	2131			

NOTES: Marginal effects at the mean of covariates are reported. The model is estimated selecting from the oversampled states single mothers between 19 and 44 years old, with at least one child under 5 years old whose family income was <=200% FPL last year. It includes the state and welfare controls presented previously and also the potential instruments that fail the specification tests and hence, that should be included in the employment equation.

I code a mother as receiving a child care subsidy if a welfare, income maintenance, social service, family service, or child care resource and referral agency helped her pay for child care either in the month prior to the survey date or in the past 12 months. The omitted category in age of the youngest child dummies is 0 to 2 years old. The omitted category in the schooling dummies is less than high school. The omitted category of inmigration status dummies is US-born citizen. Non-wage income includes all family income during past calendar year except family earnings and income from means-tested programs. The PCA score variable is the first score of principal component analysis applied to a battery of questions about attitudes toward welfare, work and maternity.

(d) marginals for discrete change of dummy variable from 0 to 1

* $p<0.05$, ** $p<0.01$

is whether there is a selection into subsidy receipt on *unobserved* characteristics as well. In that case, the univariate probit models would be misestimating the true effects of subsidy receipt. I address this point by jointly modeling the propensity to receive a child care subsidy and the respective outcome equation (like the decision to work), where the subsidy dummy acts as one of the binary dependent variables in the outcome equation. As mentioned, this involves jointly estimating a probit model of the subsidy rationing status and a heterocedastic bivariate probit model of the decision to apply and the decision to work (or the respective outcome analyzed).

Table 1.5 shows the parameters of the rationing status equation estimated by FIML. In general, the parameters are imprecisely estimated, with the exception of the coefficient on the dummy for whether welfare was received in last two years and the coefficient on the predetermined funds scaled by single mothers' children 0-5 years old. This model is estimated using the sample of "applicant" mothers, which includes mothers that either received a child care subsidy at any time during the last 12 months or were classified as being rationed out according to the criteria explained in the previous section. The probability of receiving the subsidy increases if the mother received welfare at any time in the last two years, if she lives in a state that guarantees the subsidy to all eligible applicants, and if there are no waiting lists in the state. An increase in the state income limit as a proportion of the federal limit decreases the probability of receiving the subsidy, since the pool of applicants is larger. The probability of receiving the subsidy is positively and significantly associated with the scaled predetermined funds.

Table 1.5. Parameters Estimated by FIML: Rationing Equation

dependent variable: 1=subsidy is offered; 0=the mother is rationed out		
	(1) Coefficients	
	b	se
Received welfare at any time in last two years (d)	0.585	(0.193)**
Welfare at any time in last 2y x State guarantees subsidy	-0.735	(0.548)
State guarantees subsidy (d)	0.406	(0.406)
Waiting lists in the state (d)	-0.538	(0.343)
Round 2002 (d)	-0.368	(0.206)
State uses mass media to diffuse subsidy	0.343	(0.308)
State income limit	-0.007	(0.012)
State prioritizes welfare recipients (d)	0.343	(0.308)
Predet. funds per single's child 0-5y	0.074	(0.032)*
Dependent Var Sample Mean		0.86
N Rationing Equation		740
Total N FIML		2131

NOTES: The parameters are estimated by Full Information Maximum Likelihood Approach (FIML) jointly with Applying Status, and Employment Status Equation (see next table). The models are estimated selecting from the oversampled states single mothers between 19 and 44 years old, with at least one child under 5 years old, whose family income was <= 200% FPL last year. The dependent variable indicates whether the mother either received a child care subsidy at any time during the last 12 months, or inquired about or applied for it in the past 12 months. The dependent variable is 1 if the mother received a child care subsidy at any time during the last 12 months, and it is 0 if all three of the following situations occurs: (1) she did not receive government assistance in paying for child care in the last 12 months, (2) she inquired or applied for government assistance in paying for child care in the last 12 months, but she did not get the assistance, and the reason for that was that (3) the assistance was not availa

(d) marginals for discrete change of dummy variable from 0 to 1

* $p<0.05$, ** $p<0.01$

Table 1.6 presents the parameters of the applying and employment equations estimated by FIML. The applying and the employment status equation include common covariates. The variables that are exclusively included in the employment equation are the subsidy dummy and welfare regulation controls. The applying equation includes variables representing the fixed cost to apply for the subsidy. The dummy of welfare receipt during the last two years and the recertification characteristics of the subsidy (the months until the next recertification and a dummy variable indicating whether the recertification must be done in person) are assumed to proxy for the observables that determine the fixed cost of applying for the subsidy.[48].

Table 1.7 presents two "informal" specification tests to support the exclusion restrictions used in the estimation of the model presented in Tables 1.5 and 1.6. When estimating the model, I assume that the variables excluded from the employment equation only affect the employment status through its effects on subsidy receipt. Table 1.7 presents evidence on the validity of these exclusions. It shows three probit models of employment status estimated by using two samples that are not eligible for the child care subsidies analyzed in this chapter: (1) single childless women and (2) single women with no children under 13 years old (the eligibility age limit for CCDF child care subsidies). All models include the same regressors used in the employment

[48]Having received welfare during the last two years was assumed to probably facilitates the access and the knowledge necessary to apply for the subsidy. However, the coefficient on this dummy is imprecisely estimated. ,The months until the next recertification and whether the recertification must be done in person or not are assumed to proxy for the bureaucracy related to the application process (for which I have no data).

Table 1.6. Parameters Estimated by FIML: Applying and Employment Status

	(1) Applying Status Coefficients		(2) Employment Status Coefficients	
	b	se	b	se
Subsidy			**0.15**	**(0.217)**
Welfare at any time in last two yrs.	9.691	(18.409)	-0.356	(0.106)**
Health condition that limits work	0.307	(0.903)	-0.668	(0.147)**
Black	0.547	(1.124)	0.208	(0.107)
Hispanic	-0.755	(1.551)	0.041	(0.136)
Age	-0.861	(1.528)	0.182	(0.071)*
Age squared/100	1.225	(2.184)	-0.302	(0.118)*
High school graduate only	1.328	(2.264)	0.324	(0.113)**
Some or complete college	2.369	(4.228)	0.589	(0.128)**
Non wage income	-0.554	(1.141)	-0.302	(0.149)*
Number of children	0.976	(1.707)	-0.189	(0.077)*
At least one kid 13-17 years old	0.464	(1.254)	0.76	(0.192)**
Youngest child aged 3 to 4	0.318	(0.687)	0.099	(0.108)
Foreign-born, US citizen	0.545	(1.826)	0.273	(0.243)
Fgn-born,non-citizen,liv in US 0-4y	-1.721	(3.250)	-0.456	(0.276)
Fgn-born,non-citizen,liv in US 5y+	-1.881	(3.385)	-0.079	(0.178)
PCA score attitudes	0.128	(0.267)	0.071	(0.037)
Parameters Cost to Apply				
Welfare at any time in last two yrs.	6.267	(12.421)		
Months until recertification	0.06	(0.121)		
Recertification in person	-0.16	(0.787)		
State Controls	Yes		Yes	
Welfare Controls			Yes	
Dep. Var Sample Mean	0.35		0.62	
Dep. Var Sample Mean for Subsidy=1			0.74	
Dep. Var Sample Mean for Subsidy=0			0.57	
rho			**0.215**	
rho(se)			**(0.117)**	
N			2131	

NOTES: The parameters are estimated by FIML jointly with Rationing Equation (see previous table). The model is estimated selecting from oversampled states single mothers between 19 and 44 years old, with at least one child under 5 years old whose family income was <=200% FPL last year. The model also includes the state and welfare controls presented previously, plus the potential instruments that fail the specification tests presented previously and hence, should be included in both equations. These are a dummy for the use of mass media to diffuse the CCDF subsidies in the state, and a dummy for whether the state guarantees the subsidy to all eligible applicants.

See Notes in Table 1.4 for an explanation of the Subsidy dummy and for a description of the variables included in the estimation. (d) marginals for discrete change of dummy variable from 0 to 1. * $p<0.05$, ** $p<0.01$.

equations estimated in the chapter, plus potential instruments. The first and the third models include all variables that can be potentially excluded, whereas the second model only includes the variables that were finally excluded from the employment equation. The italic covariates are non-significant, which means that they have no effect on the employment status of a population for which these variables should be irrelevant in its employment decision. This provides no evidence against the bivariate probit model specification that excludes these covariates from the outcome equation. On the contrary, the first two italic covariates are significant and hence, are not excluded from the employment equation.

Table 1.8 shows the marginal effects estimated from the parameters of the univariate probit models and the FIML model. According to the FIML parameters, the marginal effect of subsidy receipt on employment participation is not significant. The estimated effect is nearly third the estimated effect from the univariate model. This is consistent with the positive and statistically significant correlation estimated between the unobservables of the applying equation, ε_1, and the unobservables of the employment equation, U, resulting from the FIML estimations ($\rho = 0.22$). Likewise, the entire difference between the labor force participation of subsidy recipients and non-recipients can now be explained by observed and unobserved factors that vary across both groups. The positive correlation between the unobservables of both the applying and the outcome equations indicates that the unobserved factors that increase the probability of applying for subsidy are positively correlated with the unobservables that promote employment (and labor force) participation. Thus, higher ε_1 is associated with higher

Table 1.7. Informal Specification Tests

Probit Model of Employment Status using Non Eligible Samples (dependent variable: 1=employed; 0=not employed)						
	(1) Single Childless Women		(2) Single Childless Women		(3) Single Women With No 0-12 Kids	
	me	se	me	se	me	se
Welfare in l. two yrs. (d)	-0.051	(0.240)	-0.051	(0.240)	-0.694	(0.186)**
Health that limits work (d)	-0.291	(0.141)*	-0.291	(0.141)*	-1.279	(0.137)**
Black (d)	-0.479	(0.164)**	-0.479	(0.164)**	-0.296	(0.169)
Hispanic (d)	-0.191	(0.173)	-0.191	(0.173)	-0.318	(0.182)
Age	0.245	(0.075)**	0.245	(0.075)**	0.011	(0.067)
Age squared/100	-0.398	(0.121)**	-0.398	(0.121)**	-0.017	(0.074)
H. school graduate only (d)	-0.021	(0.168)	-0.021	(0.168)	0.485	(0.162)**
Some or comp. college (d)	0.224	(0.169)	0.224	(0.169)	0.615	(0.175)**
Non wage income	-0.474	(0.133)**	-0.474	(0.133)**	-0.820	(0.124)**
Number of children					0.122	(0.108)
Foreign-born, US citizen (d)	0.421	(0.318)	0.421	(0.318)	0.334	(0.202)
F-b,non-cit., in US 0-4y (d)	0.017	(0.257)	0.017	(0.257)	1.468	(0.629)*
F-b,non-cit,liv in US 5y+ (d)	0.431	(0.214)*	0.431	(0.214)*	0.773	(0.255)**
PCA score attitudes	0.023	(0.040)	0.023	(0.040)	0.055	(0.045)
State guarantees subsidy	**-1.229**	**(0.712)**			**0.644**	**(0.768)**
Use of mass media	**-0.784**	**(0.552)**			**-0.323**	**(0.624)**
Waiting lists in the state	**-0.368**	**(0.421)**	**-0.368**	**(0.421)**	**0.554**	**(0.433)**
State income limit	**-0.010**	**(0.019)**	**-0.010**	**(0.019)**	**0.015**	**(0.021)**
Months until recert.	**-0.015**	**(0.042)**	**-0.015**	**(0.042)**	**-0.038**	**(0.032)**
Recert. in person	**0.145**	**(1.241)**	**-0.945**	**(1.447)**	**0.180**	**(1.303)**
P. funds per s.'s child 0-5y	**-0.030**	**(0.111)**	**-0.049**	**(0.112)**	**-0.025**	**(0.114)**
State Controls	Yes		Yes		Yes	
Welfare Controls	Yes		Yes		Yes	
Dep. Var Sample Mean	0.63		0.63		0.68	
N	1656		1656		1302	

Note: Marginal effects at the mean of independent variables are reported. The models are estimated selecting from the oversampled states mothers of the respective group whose family income was <=200 FPL last year. It also includes region dummies. See notes in previous tables for a detailed explanation of the covariates. Blue covariates are non-significant, which provides no evidence against the bivariate probit model specification that excludes these covariates from the outcome equation. Red covariates are significant and hence, are not excluded from the employment equation. (d) marginals for discrete change of dummy variable from 0 to 1. * p<0.05, ** p<0.01.

U so that mothers with high values of ε_1 (who are more likely to apply for a subsidy) are more likely to have higher probability of employment, holding constant the subsidy receipt and other covariates. These conclusions are also valid in the case of part-time employment and full-time employment. Overall, these results indicate that the observed differences in employment rates between subsidy recipients and non-recipients are not in the most part because of the subsidy, but are mainly due to observed and unobserved differences between both groups.

A different conclusion arises when looking at the effect of subsidy receipt on the probability of working during standard hours, that is at any time between 6am and 6pm (see Table 1.8, middle rows). The univariate models indicate a positive and significant effect of subsidy receipt in all outcomes (working any number of hours, working part-time, and working full-time during standard hours). The FIML parameters also show a positive and significant effect of subsidy receipt, especially on the probability of part-time employment during standard hours, which approximately rises from 0.39 to 0.63 because of the subsidy. The estimated correlation between the unobservables is nearly zero in all models and thus the results from the probit and FIML models are similar in all cases.

The lower section of Table 1.8 presents the effects of subsidy receipt on the use of more formal care arrangements. As mentioned, the subsidized-type care category includes more formal care modes, whereas the unsubsidized-type care includes more informal care modes and also parental care (see the explanation in Data section). The results indicate a large and significant effect of the subsidy receipt on the probability

Table 1.8. Effects of Subsidy Receipt on Employment Outcomes

Marginal Effects from Univariate Probit and FIML Models					
		(1)		(2)	
	Mean if	Univariate Probit		FIML	
	subsidy=0	me	se	me	se
Employment Outcomes (A)					
Employment Status Last Week	0.57	0.175	(0.038)**	0.056	(0.079)
rho(se)				0.215	(0.117)
Part-Time Employment	0.54	0.198	(0.039)**	0.127	(0.080)
rho(se)				0.124	(0.120)
Full-Time Employment	0.39	0.114	(0.041)**	0.044	(0.085)
rho(se)				0.121	(0.122)
Labor Force Status	0.76	0.108	(0.029)**	-0.001	(0.060)
rho(se)				0.295	(0.116)
(A) Employment Status: 1=employed last week, 0=not employed; Part-Time Employment: 20+ h/week; Full-Time Employment: 35+ h/week. Labor Force Status: 1=employed or unemployed last week, 0=out of labor force.					
Employment Quality Outcomes (B)					
Working in standard hours	0.41	0.177	(0.041)**	0.166	(0.088)
rho(se)				0.02	(0.127)
Part-Time Employment in std. hours	0.39	0.192	(0.041)**	0.236	(0.086)**
rho(se)				-0.074	(0.128)
Full-Time Employment in std. hours	0.30	0.115	(0.038)**	0.104	(0.085)
rho(se)				0.025	(0.132)
(B) Standard hours: working any number of hours between 6am-6pm. Part-Time Employment in std. hours: 20+h/week in std. hours, 0=otherwise. Full-Time Employment in std. hours: 35+h/week in std. hours, 0=otherwise.					
Child Care Arrangements (C)					
Subsidized-type of care	0.32	0.327	(0.040)**	0.377	(0.087)**
rho(se)				-0.087	0.139
(C) Subsidized-type of care chosen as the primary child care arrangement. The primary care arrangement is the child care arrangement in which the focal child spends the most number of hours each week. The subsidized-type care includes center-based care, before/after school care, and non-relative care outside of child's home. The unsubsidized-type care includes care in child's home, relative care outside of child's home, parental care or self care.					

NOTES: All outcomes are discrete. The models are estimated selecting from the oversampled states 2131 single mothers between 19 and 44 years old, with at least one child under 5 years old whose family income was <=200% FPL last year. The models include all the controls presented previously, including state and welfare controls. Rho is a coefficient from the FIML estimations that indicates the correlation between the unobservables of the applying equation and the unobservables of the respective outcome equation. I code a mother as receiving a child care subsidy if a welfare, income maintenance, social service, family service, or child care resource and referral agency helped her pay for child care either in the month prior to the survey date or in the past 12 months. * $p<0.05$, ** $p<0.01$.

of using a subsidized-type care as the primary care arrangement for the focal child. According to the FIML results, the probability of using formal care as the primary arrangement rises from 0.32 to 0.69 because of the subsidy receipt.

1.8 Conclusions

Child care subsidies are an integral part of the 1996 welfare reform in the U.S., aimed at encouraging employment and reducing welfare dependence among low-income mothers. However, there is little evidence whether they have, in fact, contributed to increasing employment and self-sufficiency among low-income families. This study aims at contributing to filling this gap by providing post-welfare reform evidence of the effects of these subsidies on the work effort of single mothers.

Controlling for selection into the subsidy receipt, the results from the Full Information Maximum Likelihood (FIML) models indicate that child care subsidy receipt is not considerably associated with an increase on the employment participation of the mean single mother whose youngest child is under 5 years old. According to the FIML models, the observed differences in employment rates between subsidy recipients and non-recipients can be explained for the most part by the observed and unobserved differences between both groups and not because of the subsidy receipt. Moreover, the differences in labor force participation between subsidy recipients and non-recipients can be entirely explained by differences between both groups and hence, according to

this evidence the subsidy receipt plays no role in stimulating labor force participation of these mothers.

A different conclusion arises when looking at the effect of subsidy receipt on the probability of working during standard hours (6am-6pm). Controlling for selection, the results from the FIML models show a positive and significant effect of subsidy receipt, especially on the probability of working part-time during standard hours, which approximately rises from 0.39 to 0.63 because of the subsidy. Also, the models of child care arrangement outcomes show a large and significant effect of the subsidy receipt on the probability of using a subsidized-type care as the primary care arrangement for the focal child. According to the FIML results, the probability of using formal care as the primary arrangement rises from 0.32 to 0.69 because of the subsidy receipt.

Overall, the evidence from the different outcomes points in one direction: the child care subsidies analyzed in this chapter do not help mothers to move into employment in the first place, but they do help mothers to change their work schedule toward more standard hours and to switch from informal to formal child care.

The null statistical effect of subsidy receipt on the employment participation of single mothers suggests that conditioning the access to child care subsidies on having an employment at the moment of applying is not helping to attract mothers that would benefit the most in terms of employment participation. According to this study, the subsidy system is attracting mothers that would work anyhow, with or without the subsidy. The subsidy might be helping them to get better jobs and (probably) more stable child care, but it is not achieving one of the main goals of the child care subsidy

system, which is to support work among low-income families in order to reduce welfare dependence. This could also be a consequence of the difficulties that some mothers face during the application process. In some cases the timing of the approval process does not match with the requirements of mothers that recently became employed and therefore need a fast resolution of their child care needs. In those cases, mothers might be forced to quit their employments and keep searching. It is therefore advisable to design a system such that mothers know in advance if they would get the subsidy in case they get a job. That system does not need to subsidize mothers while they are searching for a job; it only needs to guarantee the subsidy payments once the mothers prove they got one.

CHAPTER 2
PUBLIC SCHOOL ENROLLMENT AND MATERNAL LABOR SUPPLY AFTER THE WELFARE REFORM

2.1 Introduction

During the last three decades, the labor force participation of mothers with children under age 6 has approximately increased by 76 percent in the U.S. (Green Book, 2004). Since the early 1990s welfare reform has encouraged employment of single mothers formerly receiving welfare benefits. Child care subsidies play a central role to help mothers in welfare to move into the workforce and for keeping other low-income families from becoming welfare dependent.

This study provides new evidence on the maternal employment effects of the implicit child care subsidy provided by free public kindergarten for five-year-old children. In the context of child care studies, Gelbach (2002) was the first study to use quarter of birth (QOB) variables as instruments for whether five-year-olds are enrolled in kindergarten at age 5. He estimates the implicit child care subsidy provided by free public kindergarten using data from the 1980 Census. In that year the coverage of

pre-school and early development programs was low, there were few incentives to work for single mothers in welfare and the funding for child care subsidies had not increased to current levels. Not surprisingly, he finds a significant impact on labor supply outcomes of having one's child eligible for kindergarten earlier. His results suggest that access to free public school increased the employment probability by five percentage points at the interview date and by four percentage points during calendar year 1979. He also finds positive effects on hours of work per week, weeks worked per year, wage-salary income in 1979, and on the probability of not receiving public assistance in 1979.

My study aims to document whether the results from Gelbach's study can be extended to the context of the post welfare reform era in the U.S. (after 1996), when access to child care and single mothers' labor force participation have increased substantially compared to 1980. It also explores the possibility of heterogeneity on the impact of this implicit subsidy across different groups of mothers and groups of states. I use data from the 2005, 2006 and 2007 rounds of the American Community Survey (ACS). Unlike the Public Use Sample of the 1990 and 2000 Census, the ACS provides the quarter of birth for each respondent in the sample, along with the age in years at the moment the survey was filled out.

I basically follow the same IV strategy of Gelbach. The ACS data, however, has one disadvantage compared to the 1980 Census used by Gelbach. Although Gelbach does not have the exact date of birth, nor the child's birth year, he can infer the year of birth by using the interview date (April 1st for all respondents), the age (in years), and

the QOB of each child. Unlike the Census, the ACS is a monthly rolling sample that is administered throughout the respective calendar year. As a result, I cannot infer the year of birth directly from the age in years and the QOB of each child. To deal with this issue, I select all single mothers who have at least one child that has a positive probability to have been a five-year-old by April 1st of the respective year[1]

My results suggest that, twenty-six years later, kindergarten access is still a significant source of child care for single mothers with young children. The point estimates are relatively similar to Gelbach's, however, the percentage effects of school enrollment are somewhat smaller because the baseline labor supply of single mothers is currently higher compared to 1980.

Results from the specifications estimated by ethnicity of mothers and by two group of states suggest a differential impact of public school enrollment across mother and state characteristics. The effects are larger among black mothers whose youngest child is five and among Hispanic mothers whose youngest child is younger than five. According to the full day kindergarten/ not full day kindergarten classification of states, the estimated impact of free kindergarten is larger among mothers who lives in a state promoting full day kindergarten, especially among mothers whose youngest child is five.

This chapter is organized in the following way. Section 2.2 presents the econometric specification. Section 2.3 discusses the data from the ACS used in this chapter and

[1] See further explanation in Section 2.3.

shows descriptive statistics of the demographic covariates used in the estimations. Section 2.4 shows the empirical results. Section 2.5 concludes.

2.2 Econometric Specification

The outcomes equations estimated below take the form

$$y_{ist} = X_{ist}\beta + \alpha D_{ist} + \theta_t^y + \mu_s^y + \varepsilon_{ist} \tag{2.1}$$

where y_{ist} is the observed outcome measure for mother i living in state s in year t, X_{ist} are individual controls such as mother's age, education and family composition, D_{ist} is a dummy variable equal to 1 if the mother's five year-old is enrolled in public school and 0 otherwise, and ϵ_{ist} includes unobservable components affecting outcomes. All specifications include year fixed effects, θ_t^y, and some of them include state fixed effects, μ_s^y. This allows us to control for unobserved factors influencing outcomes that vary across years and states.

The endogeneity problem arises from the possibility of y and D being jointly determined and hence D being correlated with ε. It is likely that public school enrollment affects employment outcomes but employment decisions probably influence public school enrollment status of five-year-olds as well. Mothers with stronger unobserved tastes for work will be more likely to enroll a child in school at the earliest possible age, making subsidy receipt endogenous (Gelbach, 1999). Mothers also may choose to hold their children back a year or enroll them in private school (Gelbach, 2002). D might be negatively correlated with ε if the least employable mothers (in

some unobserved characteristics) choose public schooling in greater proportion than the rest of mothers.[2]

I deal with this endogeneity issue by using five-year-old's quarter of birth (QOB) variables as instruments for public school enrollment (the same strategy used by Gelbach, 2002). The first-stage regressions take the form

$$D_{ist} = X_{ist}\beta + Z_{ist}\gamma + \theta_t^d + \mu_s^d + v_{ist} \tag{2.2}$$

where X are the individual controls included in (2.1), Z are the QOB instruments, θ^d and μ_s^d represent the year and state fixed effects and v_{ist} the unobservable components that affect public school enrollment. Therefore Z is assumed uncorrelated with unobservables of the outcome equation ε, once controlling for X,θ^y and μ^y.

2.3 Data

In this chapter, I use microdata from the 2005, 2006 and 2007 rounds of the Public Use Sample of the American Community Survey (ACS). This is a repeated cross-section survey that collects data nationwide since 2000[3]. It is conducted by the Census Bureau as an integral part of the 2010 decennial census program. The ACS collects information similar to Census surveys, such as age, race, income, education, employment and other variables. It is conducted using three methods of data collection to contact households: mail, telephone and personal visits.

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[2]I include all mothers regardless of income in order to avoid selecting the sample based on income from employment and welfare.

[3]I select the rounds from 2005 onward because the quarter of birth variable is only available since that round.

I define a single mother of a five-year-old as a female householder who is not married and has at least one child that is *probably* five years old as of April 1st of the respective year. Gelbach (2002) selects all single mothers with children who were five-years old on April 1st, 1980 (the reference date for the Census). To mimic his approach, I pick April 1st as the reference date. Although Gelbach does not have the exact date of birth nor the year of birth of the children, he can infer the year of birth using the age (in years) and the QOB of each child. But unlike the Census, the ACS is a monthly rolling sample that is administered to respondents throughout the respective calendar year. Moreover, it is not possible to know the date the respondent filled out the survey because of confidentiality restrictions.[4] As a result, the term *probably* comes from the uncertainty about the age of the child as of a specific date (such as April 1st).[5]

To deal with this issue, I select all single mothers who have at least one child who has a positive probability to have been a five-year-old by April 1st of the respective year (hereafter mothers of likely five-year-olds, or simply, *mothers of five-year-olds*). These are mothers of children born in quarter one who are reported as being four-years-old at the survey date (4Q1), mothers of children reporting being 5, regardless of the QOB

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[4]The Census Bureau releases neither the exact date of birth nor the year of birth of each respondent.

[5]This uncertainty arises because the ACS only provides the QOB and the age (in years) of each respondent at the moment in which each survey was filled out. Therefore, we could have the case of two children (say A and B), where A was interviewed in the first quarter (Q1) and B in Q4. At the moment of the survey, A was five and B was six, but A was born in Q2 and B in Q3. Which child is the youngest? According to the age (in years) reported in the ACS, A would be the youngest (she is 5 and B is 6). But if we knew the date of the interview, we would know that B is the youngest since A turned five in Q2 of last year and B turned five in Q3 of last year, a quarter after A.

(5Q1, 5Q2, 5Q3, 5Q4), and mothers of children born in the last three quarters reporting being 6 at the survey date (6Q2, 6Q3, 6Q4)[6]. Table 2.1 depicts the probability of being five-years-old on April 1st for each of these children, assuming that the ACS is given uniformly across quarters throughout the respective calendar year[7].

Table 2.1. Sample Selection: Mothers of Children with Probability of being 5 by April 1st

QOB 1			QOB 2			QOB 3			QOB 4		
(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
4 Q1	0.125	4.125	5 Q2	0.375	4.375	5 Q3	0.625	4.625	5 Q4	0.875	4.875
5 Q1	0.875	5.125	6 Q2	0.625	5.625	6 Q3	0.375	5.375	6 Q4	0.125	5.125

(1) Age at Interview Date/ Quarter of Birth; (2) Probability of being 5 years old by April 1st; (3) Expected Age by April 1st (using probability).

Note: I select all single mothers who have at least one child who has a positive probability to have been a five-year-old by April 1st of the respective year. The probability of being 5 by April 1st is estimated assuming the same number of surveys filled out each month. For example, let us consider the case of a child reporting 4 years old at the (unknown) interview date who was born in Q1 (a 4Q1 child). If the 4Q1 child was interviewed in Q2, or Q3 or Q4, then she was not 5 by April 1st. But if she was interviewed in Q1 after her 4th birthday, then she will be 5 by April 1st. Assuming that her birthday is in the middle of Q1, the 4Q1 child thus has a 12.5% of probability of being 5 by April 1st.

According to these criteria, I select 20805 single mothers whose youngest child is a likely five-year-old, and 10538 single mothers who have a younger child in addition to the likely-five year-old. As mentioned in Gelbach (2002), mothers who have both a five-year-old and a younger child must find child care for the younger child even if the

[6]Four-year-olds born in the last three quarters (4Q2, 4Q3, 4Q4) are four years old on April 1st, regardless of the date of the interview. Their fifth birthday is definitively after April 1st. Likewise, six-year-olds born in the first quarter (6Q1) are definitively six-years-old by April 1st.

[7]According to the IPUMS, the ACS is a monthly rolling sample given throughout the respective calendar year with no different intensity across quarters.

five-year-old is enrolled. Hence, I complete the analysis with both separate samples, according to whether the woman's five-year-old is her youngest child. To look at the sensitivity of the results to the sample selection criteria, I also run regressions weighting each observation by the probability of being five-years-old on April 1st according to the age reported and the QOB.

A five-year-old child is coded as enrolled in public schooling if she attended regular public school at any time in the last three months. Therefore, the public school enrollment dummy is equal to 1 if the mother's five-year-old is enrolled in public school and 0 otherwise. Table 2.2 shows public school enrollment rates by QOB for single mothers included in the selected samples. Differences across quarters are highly statistically significant (high F-statistics, with p-values close to 0). Public school enrollment rates are higher among children born in Q2 and Q3 than among children born in Q1 and Q4. This is consistent with children born in Q2 and Q3 being older than Q4 and Q1 children. At the same time, private school enrollment rates increases in an opposite direction to public school enrollment. This is valid for all samples shown in the table. Overall, these numbers suggests that QOB dummies are strong predictors of public school enrollment among five-years-old children. My instruments, however, are more noisy than Gelbach's instruments. For example, Q1 children from Gelbach's samples are less likely to be enrolled in public school than Q1 children from my samples. This is mostly related to the missclassification of an (unknown) fraction

of Q1 children in my sample, since some of them are probably six-year-olds wrongly classified as five-year-olds.[8]

Table 2.2. Public and Private Enrollment Rates by QOB

	Quarter of Birth					
Variable	QOB2	QOB3	QOB4	QOB1	All Sample	F
Youngest is five years old						
5-year-old enrolled in public school	0.83	0.83	0.77	0.54	0.74	530.06
	(0.38)	(0.37)	(0.42)	(0.50)	(0.44)	
5-year-old enrolled in private school	0.10	0.11	0.13	0.17	0.13	48.29
	(0.30)	(0.31)	(0.33)	(0.38)	(0.33)	
Observations	5077	5371	5146	5095	20805	
Youngest is younger than five						
5-year-old enrolled in public school	0.59	0.86	0.87	0.80	0.78	265.36
	(0.49)	(0.35)	(0.34)	(0.40)	(0.41)	
5-year-old enrolled in private school	0.09	0.05	0.06	0.08	0.07	12.01
	(0.28)	(0.23)	(0.23)	(0.28)	(0.25)	
Observations	2494	2572	2815	2605	10538	

Note: F-statistic for the test of equivalence across quarters.
Standard deviations in parentheses.

Table 2.3 presents means of the demographic covariates by QOB of the five-year-old. To maintain comparability, I use the same set of controls as in Gelbach's study, with some slight changes due to differences in the Census 1980 and ACS questionnaires[9]. As expected, mothers whose youngest child is younger than five are not as old as mothers whose youngest child is five. They are more educated, less likely to be white, and have fewer older children than mothers whose youngest child is five. For single

[8]Those children correspond to the ones that were interviewed in Q1, just before their sixth birthday and hence, were eligible for kindergarten on September of the previous year.

[9]Specifically, I use education level dummies instead of years of education and I change the range of the family composition covariates to exclude children four-to-six years-old (who might be classified as likely-five-year-olds).

mothers whose youngest child is five, significant differences across five-year-old's QOB appear only for mother's age variables and for the number of children aged 13-17. For single mothers whose youngest child is younger than five, significant differences across QOB appear in the same variables mentioned above, plus the number of children aged 0-3. The estimations presented below control for these demographic variables, however, in Section 2.4 I discuss the sensitivity of the IV estimates to excluding them from the estimations.

Table 2.3. Demographic Characteristics by QOB

	Youngest is five years old						Youngest is younger than five					
Variable	QOB1	QOB2	QOB3	QOB4	All Sample	F	QOB1	QOB2	QOB3	QOB4	All Sample	F
Age of mother	32.53	33.88	33.68	33.75	33.46	47.5	28.32	29.24	29.24	29.35	29.04	20.0
	(6.58)	(6.52)	(6.43)	(6.48)	(6.53)		(5.33)	(5.45)	(5.33)	(5.41)	(5.39)	
Age of mother squared /100	11.01	11.91	11.76	11.81	11.62	42.4	8.31	8.84	8.83	8.90	8.72	17.1
	(4.46)	(4.55)	(4.48)	(4.50)	(4.51)		(3.31)	(3.45)	(3.37)	(3.46)	(3.40)	
Mother edu: <HS	0.13	0.12	0.13	0.13	0.13	1.4	0.23	0.22	0.22	0.22	0.22	0.9
	(0.33)	(0.33)	(0.34)	(0.34)	(0.34)		(0.42)	(0.41)	(0.41)	(0.41)	(0.42)	
Mother edu: HS graduate	0.32	0.31	0.32	0.31	0.32	0.4	0.38	0.36	0.36	0.34	0.36	2.3
	(0.47)	(0.46)	(0.47)	(0.46)	(0.46)		(0.49)	(0.48)	(0.48)	(0.48)	(0.48)	
Mother edu: some college	0.39	0.39	0.38	0.40	0.39	1.2	0.32	0.33	0.33	0.34	0.33	1.4
	(0.49)	(0.49)	(0.49)	(0.49)	(0.49)		(0.46)	(0.47)	(0.47)	(0.47)	(0.47)	
Mother edu: college grad.	0.17	0.18	0.17	0.15	0.17	3.5	0.07	0.10	0.09	0.10	0.09	4.1
	(0.37)	(0.38)	(0.37)	(0.36)	(0.37)		(0.26)	(0.30)	(0.28)	(0.30)	(0.28)	
White	0.59	0.62	0.60	0.59	0.60	3.0	0.51	0.54	0.54	0.53	0.53	1.5
	(0.49)	(0.49)	(0.49)	(0.49)	(0.49)		(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	
Living in central city	0.19	0.18	0.19	0.19	0.19	0.9	0.22	0.21	0.22	0.21	0.22	1.1
	(0.40)	(0.39)	(0.39)	(0.39)	(0.39)		(0.42)	(0.41)	(0.42)	(0.40)	(0.41)	
Num of children 0-3	0.00	0.00	0.00	0.00	0.00		1.15	1.04	1.02	1.01	1.06	35.1
	0.00	0.00	0.00	0.00	0.00		(0.52)	(0.59)	(0.58)	(0.59)	(0.58)	
Num of children 7-12	0.59	0.63	0.61	0.63	0.62	3.7	0.46	0.49	0.51	0.50	0.49	2.1
	(0.76)	(0.75)	(0.74)	(0.75)	(0.75)		(0.73)	(0.74)	(0.74)	(0.73)	(0.74)	
Num of children 13-17	0.23	0.27	0.28	0.28	0.26	10.4	0.10	0.12	0.14	0.12	0.12	2.8
	(0.53)	(0.56)	(0.57)	(0.58)	(0.56)		(0.38)	(0.39)	(0.43)	(0.40)	(0.40)	
Num of children >=18	0.06	0.07	0.07	0.07	0.07	1.1	0.02	0.02	0.02	0.02	0.02	0.5
	(0.27)	(0.30)	(0.29)	(0.30)	(0.29)		(0.17)	(0.16)	(0.17)	(0.17)	(0.17)	
Num of other hh memb.<18	0.06	0.06	0.06	0.06	0.06	0.6	0.05	0.06	0.05	0.04	0.05	1.7
	(0.30)	(0.31)	(0.33)	(0.36)	(0.33)		(0.29)	(0.28)	(0.31)	(0.25)	(0.28)	
Num of other hh memb.>=18	0.31	0.30	0.31	0.30	0.31	0.7	0.39	0.36	0.38	0.36	0.37	1.4
	(0.58)	(0.57)	(0.60)	(0.57)	(0.58)		(0.63)	(0.62)	(0.62)	(0.64)	(0.63)	
Observations	5095	5077	5371	5146	20805		2494	2572	2815	2605	10538	

Standard deviations in parentheses

Table 2.4 shows means of outcome variables by public enrollment status of the five-year-old. It also shows the same demographic variables presented previously. As expected, mothers with both a five-year-old and a younger child have lower employment rates compared to mothers whose youngest child is five. For example, mothers with both a five-year-old and younger child worked an average of almost 30 weeks in the previous year compared to 38 weeks among mothers whose youngest is five. Mothers of younger children earned less income in the previous year than mothers with older children, and a higher proportion of them were on welfare during last 12 months.

In both subsamples we observe no significant differences in work status across public enrollment status. However, mothers whose five-year-old is enrolled in public school have lower incomes, tend to be less educated and are less likely to be white than mothers whose five-year-old is not enrolled. This suggests there is a negative selection into public schooling with respect to socioeconomic status, which is confirmed by the negative relationship between public school enrollment and employment outcomes that I find from the OLS regressions presented below.

The increase over time of the employment participation of single mothers with young children is visible by comparing the employment rates documented by Gelbach (1980 Census) with the ones documented in this study (ACS 2005-2007). Single mothers whose youngest child is younger than five have employment outcomes similar to the ones of single mothers with older children in 1980 (see Table 4, Gelbach, 2002). In next section I show that this increase in the baseline labor supply of single mothers

Table 2.4. Outcomes and Demographic Characteristics by Enrollment Status

	Youngest is five years old			Youngest is younger than five		
Variable	Enrolled	Not Enrolled	All Sample	Enrolled	Not Enrolled	All Sample
Worked last year	0.86	0.87	0.86	0.76	0.79	0.77
	(0.35)	(0.34)	(0.35)	(0.43)	(0.41)	(0.42)
Worked 35+ h/w last yr.	0.65	0.69	0.66	0.53	0.56	0.54
	(0.48)	(0.46)	(0.47)	(0.50)	(0.50)	(0.50)
Weeks worked last yr.	37.51	38.91	37.87	29.64	31.14	29.96
	(20.09)	(19.49)	(19.95)	(22.05)	(21.73)	(21.99)
In welfare last year	0.10	0.07	0.09	0.18	0.16	0.17
	(0.30)	(0.26)	(0.29)	(0.38)	(0.37)	(0.38)
Wage income/1000	20.32	26.69	21.94	13.38	18.12	14.41
	(23.23)	(32.48)	(26.05)	(21.14)	(31.90)	(23.98)
Worked last week	0.73	0.75	0.73	0.58	0.62	0.59
	(0.45)	(0.43)	(0.44)	(0.49)	(0.48)	(0.49)
5-year-old age at int. date	5.38	4.88	5.25	5.37	4.85	5.26
	(0.61)	(0.65)	(0.66)	(0.60)	(0.63)	(0.65)
Age of mother	33.35	33.76	33.46	28.97	29.30	29.04
	(6.42)	(6.82)	(6.53)	(5.22)	(5.94)	(5.39)
Age of mother sq. /100	11.54	11.86	11.62	8.66	8.94	8.72
	(4.44)	(4.71)	(4.51)	(3.29)	(3.78)	(3.40)
Mother edu: <HS	0.14	0.11	0.13	0.23	0.20	0.22
	(0.35)	(0.31)	(0.34)	(0.42)	(0.40)	(0.42)
Mother edu: HS grad.	0.33	0.27	0.32	0.37	0.33	0.36
	(0.47)	(0.44)	(0.46)	(0.48)	(0.47)	(0.48)
Mother edu:some college	0.39	0.39	0.39	0.33	0.32	0.33
	(0.49)	(0.49)	(0.49)	(0.47)	(0.47)	(0.47)
Mother edu: col. grad.	0.14	0.24	0.17	0.07	0.14	0.09
	(0.35)	(0.43)	(0.37)	(0.26)	(0.35)	(0.28)
White	0.58	0.67	0.60	0.51	0.59	0.53
	(0.49)	(0.47)	(0.49)	(0.50)	(0.49)	(0.50)
Living in central city	0.19	0.19	0.19	0.22	0.21	0.22
	(0.39)	(0.39)	(0.39)	(0.41)	(0.40)	(0.41)
Num of children 7-12	0.66	0.50	0.62	0.52	0.39	0.49
	(0.76)	(0.71)	(0.75)	(0.75)	(0.68)	(0.74)
Num of children 13-17	0.28	0.20	0.26	0.13	0.10	0.12
	(0.58)	(0.50)	(0.56)	(0.41)	(0.35)	(0.40)
Num of children >=18	0.07	0.05	0.07	0.02	0.03	0.02
	(0.30)	(0.26)	(0.29)	(0.15)	(0.21)	(0.17)
Num of other hh m.<18	0.07	0.05	0.06	0.05	0.04	0.05
	(0.34)	(0.27)	(0.33)	(0.29)	(0.26)	(0.28)
Num of other hh m.>=18	0.31	0.31	0.31	0.37	0.39	0.37
	(0.58)	(0.58)	(0.58)	(0.62)	(0.67)	(0.63)
Observations	15492	5313	20805	8245	2293	10538

Standard deviations in parentheses.

over time implies lower estimated effects of public school enrollment in the 2005-2007 sample compared to Gelbach's estimates from the 1980 sample.

2.4 Empirical Results

To analyze the effect of public school enrollment of five-year-olds on maternal employment, I focus on four outcomes: employment in last 12 months, full time work (35 or more hours per week) in last 12 months, weeks worked in last 12 months and current employment (in the previous week).[10] I also look at the effects of public school enrollment on wage and salary income earned in last 12 months and on the receipt of public assistance (welfare) in the same period. These outcomes are similar to the ones analyzed by Gelbach, thus the estimated effects are easy to compare across studies.[11]

The analysis is done by subsamples, according to whether the woman's five-year-old is her youngest child. Hence, there are two set of results depending on the subsample

[10]Unlike Gelbach, I only use *usual hours worked per week in last 12 months* to construct a full-time work indicator, but not as a outcome measure directly. In this way, I follow the recomendations from Baum-Snow and Neal (2008). They document that in recent decennial censuses and the American Community Survey (ACS) *usual hours worked per week* contains significant and systematic errors that invalidate its use, specially for analyzing part-time employment outcomes.

[11]The main difference is that the Census asks for employment outcomes in 1979 ("last year") whereas the ACS asks for employment outcomes in "last 12 months". Recall that, unlike the Census, the ACS does not have a reference date; it is given to respondents throughout the respective calendar year. This might affect the comparison of 1979 labor-supply variables of Gelbach (which implicitly consider the effect on only four months of free schooling -September through December 1979) with my last-12-months outcomes (which consider an unknown number of months of free schooling, depending on the month each survey was filled out). Another difference is that Gelbach does not analyze the effects on full-time employment. Likewise, I do not look at the effects on hours worked in the last week, since the ACS does not provide that information.

utilized: (1) single mothers whose youngest child is five, and (2) single mothers whose youngest child is younger than five.

2.4.1 First Stage Results

Table 2.5 presents the first stage linear model for the public school enrollment status using the sample of single mothers whose five-year-old is the youngest child. The first column shows the estimates with no QOB dummies and no state fixed effects. The second column includes QOB dummies and the third column includes both QOB dummies and state fixed effects. As suggested from the raw relationship between public school enrollment and QOB presented in Table 2.2, the QOB dummies are strong predictors of public school enrollment. For example, five-year-olds born in Q2 or Q3 have 27 percent higher probability of being enrolled than five-year-olds born in Q1 who are included in the sample. The F-statistic testing the joint significance of the QOB dummies is 439.6, yielding a p-value of 0, and the partial R2 of the instruments is high relative to the total R2. In the sample of single mothers whose youngest child is younger than five, the QOB are strong instruments as well, but the F-statistic is lower because of the smaller sample (see Table 2.6). Overall, the first stage results indicate that QOB dummies are very good instruments to determine public school enrollment status.

Table 2.5. First Stage Linear Probability Model- Youngest child is five years old

dependent var: 5-year-old enrolled in public school			
	lpmfirst1 b/se	lpmfirst2 b/se	lpmfirst3 b/se
Age of mother	0.017	0.009	0.01
	(0.005)**	(0.005)	(0.005)*
Age of mother squared /100	-0.025	-0.016	-0.018
	(0.007)**	(0.007)*	(0.007)**
Mother edu: HS graduate	0.009	0.01	0.01
	(0.009)	(0.009)	(0.009)
Mother edu: some college	-0.022	-0.02	-0.021
	(0.009)*	(0.009)*	(0.009)*
Mother edu: college graduate	-0.123	-0.117	-0.118
	(0.012)**	(0.012)**	(0.012)**
White	-0.055	-0.056	-0.052
	(0.006)**	(0.006)**	(0.006)**
Living in central city	-0.024	-0.023	-0.031
	(0.008)**	(0.008)**	(0.008)**
Num of children 0-3	0	0	0
	0.000	0.000	0.000
Num of children 7-12	0.042	0.041	0.04
	(0.004)**	(0.004)**	(0.004)**
Num of children 13-17	0.03	0.029	0.028
	(0.005)**	(0.005)**	(0.005)**
Num of children >=18	0.022	0.026	0.025
	(0.010)*	(0.010)**	(0.010)*
Num of other hh members <18	0.023	0.021	0.02
	(0.008)**	(0.008)**	(0.008)*
Num of other hh members >=18	-0.004	-0.003	-0.002
	(0.005)	(0.005)	(0.005)
5-year-old born in quarter 2		0.276	0.277
		(0.009)**	(0.009)**
5-year-old born in quarter 3		0.281	0.282
		(0.008)**	(0.008)**
5-year-old born in quarter 4		0.215	0.216
		(0.009)**	(0.009)**
State fixed effects	No	No	Yes
F Statistic exc. instruments		435.15	439.58
Partial r2 exc. instruments		0.071	0.071
r2	0.029	0.098	0.105
N	20805	20805	20805

Notes: White-robust standard errors are in parentheses. The regressions include year fixed effects (all) and state fixed effects (when mentioned). 5-year-olds correspond to the children who probably were 5 years old on April 1st of the survey year (the reference date for Census). These are the 4Q1,5Q1,5Q2,5Q3,5Q4,6Q2,6Q3 and 6Q4 children. See the text for further explanation. * $p<0.05$, ** $p<0.01$.

Table 2.6. First Stage Linear Probability Model- Youngest child is younger than five

dependent var: 5-year-old enrolled in public school			
	lpmfirst1 b/se	lpmfirst2 b/se	lpmfirst3 b/se
Age of mother	0.032	0.024	0.023
	(0.008)**	(0.007)**	(0.007)**
Age of mother squared /100	-0.052	-0.042	-0.042
	(0.012)**	(0.012)**	(0.012)**
Mother edu: HS graduate	-0.001	0.001	0.005
	(0.011)	(0.010)	(0.010)
Mother edu: some college	-0.014	-0.015	-0.012
	(0.011)	(0.011)	(0.011)
Mother edu: college graduate	-0.133	-0.134	-0.132
	(0.019)**	(0.018)**	(0.019)**
White	-0.039	-0.042	-0.032
	(0.008)**	(0.008)**	(0.008)**
Living in central city	-0.004	-0.004	-0.007
	(0.010)	(0.009)	(0.010)
Num of children 0-3	-0.048	-0.032	-0.033
	(0.007)**	(0.007)**	(0.007)**
Num of children 7-12	0.029	0.029	0.029
	(0.006)**	(0.005)**	(0.005)**
Num of children 13-17	0.024	0.023	0.022
	(0.010)*	(0.010)*	(0.010)*
Num of children >=18	-0.046	-0.037	-0.04
	(0.029)	(0.028)	(0.027)
Num of other hh members <18	0.022	0.019	0.018
	(0.014)	(0.013)	(0.013)
Num of other hh members >=18	-0.007	-0.004	-0.007
	(0.007)	(0.006)	(0.007)
5-year-old born in quarter 2		0.263	0.263
		(0.012)**	(0.012)**
5-year-old born in quarter 3		0.266	0.264
		(0.012)**	(0.012)**
5-year-old born in quarter 4		0.202	0.2
		(0.012)**	(0.012)**
State fixed effects	No	No	Yes
F Statistic exc. instruments		204.08	201.29
Partial r2 exc. instruments		0.069	0.068
r2	0.026	0.093	0.102
N	10538	10538	10538

Notes: White-robust standard errors are in parentheses. The regressions include year fixed effects (all) and state fixed effects (when mentioned). 5-year-olds correspond to the children who probably were 5 years old on April 1st of the survey year (the reference date for Census). These are the 4Q1,5Q1,5Q2,5Q3,5Q4,6Q2,6Q3 and 6Q4 children. See the text for further explanation. * $p<0.05$, ** $p<0.01$.

2.4.2 Reduced Form Estimations

Table 2.7 reports the conditional mean outcomes by QOB when all other controls and state fixed effects are held at their means. Significant differences in these means across QOB constitute evidence of a systematic reduced-form relationship between outcomes and QOB. For mothers whose youngest child is five, F-statistics indicate significant differences across QOB for working full time in last 12 months (35 or more hours per week), and nearly significant differences for weeks worked (p-values slightly above the five percent threshold). Cross-QOB equivalence of outcomes cannot be rejected specially for receipt of welfare in last 12 months, earnings received in the same period, and working participation either during last 12 months or in the last week. For single mothers with both a five-year-old and a younger child, there are no significant differences across QOB in six of the eight outcomes analyzed. The exception is full-time employment in last 12 months (with a p-value slightly above the five percent threshold). This evidence indicates that, if any relationship between QOB and outcomes exists, it is more concentrated along the intensive margin of labor supply (weeks worked) rather than along the extensive margin (employment participation).

Table 2.7. Outcomes by QOB and Youngest Child's Age

	Q1		Q2		Q3		Q4			
	b	se	b	se	b	se	b	se	F	pvalue
Youngest child is five										
Worked last year	0.061	(0.039)	0.072	(0.039)	0.076	(0.039)	0.075	(0.039)	2.037	0.106
Worked 35+ h/week last year	0.033	(0.047)	0.052	(0.047)	0.056	(0.047)	0.057	(0.047)	2.864	0.035
Weeks worked last year	3.24	(2.005)	3.789	(2.006)	4.197	(2.004)*	4.111	(2.005)*	2.584	0.051
In welfare last year	-0.026	(0.031)	-0.035	(0.031)	-0.034	(0.031)	-0.031	(0.031)	0.863	0.46
Wage and salary income	1500.2	-2005.6	2002.9	-2008.0	1937.2	-2006.5	1635.4	-2003.4	0.524	0.666
Worked last week	0.077	(0.044)	0.09	(0.044)*	0.087	(0.044)*	0.094	(0.044)*	1.328	0.263
Youngest child is younger than five										
Worked last year	-0.089	(0.056)	-0.088	(0.056)	-0.068	(0.056)	-0.072	(0.056)	1.827	0.14
Worked 35+ h/week last year	-0.113	(0.065)	-0.104	(0.065)	-0.081	(0.065)	-0.086	(0.065)	2.53	0.055
Weeks worked last year	-3.74	(3.143)	-3.603	(3.144)	-2.677	(3.142)	-2.866	(3.144)	1.658	0.174
In welfare last year	-0.101	(0.064)	-0.109	(0.064)	-0.114	(0.064)	-0.103	(0.064)	0.687	0.56
Wage and salary income	-2649.8	-1683.2	-2738.7	-1684.2	-2870.0	-1675.5	-2667.3	-1681.8	0.059	0.981
Worked last week	-0.113	(0.066)	-0.124	(0.066)	-0.107	(0.066)	-0.109	(0.066)	0.692	0.557

Note: This table is analogous to Table 4 in Gelbach (2002). White-robust standard errors are in parentheses. F-statistic and p-values are from tests of equivalence across quarters. The table presents the coefficients on a full set of QOB dummies in regressions including (demeaned) state fixed effects and (demeaned) demographic variables. QOB coefficients represent the conditional mean outcomes for the respective QOB when all other variables are held at their means.

2.4.3 OLS and 2SLS Estimates

As an example of the regressions estimated for each outcome, Table 2.8 shows estimates of the enrollment effect on weeks worked during last 12 months among single mothers whose youngest child is five. The first column shows the OLS estimation with no controls added, which indicates a negative and significant coefficient of public school enrollment. Adding controls and state fixed effects (column 2) reduces the magnitude of this coefficient substantially, accounting for a significant amount of the endogeneity illustrated in column 1. Column 3 presents the same IV approach utilized by Gelbach, using three QOB dummies as instruments for public school enrollment. The estimated coefficient indicates an increase in 3.1 week worked as a result of public school enrollment of the five-year-old. This effect is roughly equivalent to a 8 percent increase on weeks worked (sample mean of 37.8 hours per week, approximately). The coefficients of the demographic variables included in the equation are consistent with previous studies. More educated mothers and mothers with older children work longer hours. Other adults in the household increase the number of hours worked, possibly indicating the presence of informal sources of child care, such as grandparents living in the household.

Table 2.9 presents the coefficient on the public school enrollment dummy for all outcomes among mothers whose youngest child is five. The fifth column shows the percentage effect implied by the coefficient estimated by 2SLS and the baseline means for the outcomes. As before, simple OLS estimates are wrong-signed and they reduce

Table 2.8. OLS and IV estimates- Youngest child is five

dependent var: Weeks Worked in Last 12 Months			
	OLS	OLS	IV
	b/se	b/se	b/se
5-year-old enrolled in public school	-1.402	-0.091	3.107
	(0.312)**	(0.306)	(1.174)**
Age of mother		1.613	1.557
		(0.211)**	(0.212)**
Age of mother squared /100		-2.398	-2.312
		(0.304)**	(0.306)**
Mother edu: HS graduate		8.471	8.441
		(0.512)**	(0.512)**
Mother edu: some college		11.549	11.621
		(0.496)**	(0.495)**
Mother edu: college graduate		14.764	15.161
		(0.546)**	(0.562)**
White		1.357	1.516
		(0.306)**	(0.312)**
Living in central city		-1.351	-1.25
		(0.388)**	(0.390)**
Num of children 7-12		-2.073	-2.205
		(0.197)**	(0.202)**
Num of children 13-17		-0.723	-0.817
		(0.276)**	(0.278)**
Num of children >=18		0.27	0.203
		(0.537)	(0.538)
Num of other hh members <18		-0.427	-0.498
		(0.482)	(0.486)
Num of other hh members >=18		0.546	0.556
		(0.244)*	(0.244)*
State fixed effects	No	Yes	Yes
F Statistic exc. instruments			439.58
Partial r2 exc. instruments			0.071
r2	0.001	0.073	
N	20805	20805	20805

Notes: White-robust standard errors are in parentheses. The regression in column 1 does not include any control. The other regressions include year fixed effects and state fixed effects. 5-year-olds correspond to the children who probably were 5 years old on April 1st of the survey year (the reference date for Census). These are the 4Q1,5Q1,5Q2,5Q3,5Q4,6Q2,6Q3 and 6Q4 children. See the text for further explanation. * $p<0.05$, ** $p<0.01$.

in magnitude once we add controls and state fixed effects. 2SLS estimates indicate a positive and significant effect of public school enrollment on the work effort of these mothers. Among the significant estimates, the strongest effect is on full-time employment. Unlike results in Gelbach (2002), I find no significant effect of school enrollment on wage and salary income.

Table 2.9. Effect of Public School Enrollment on Labor Outcomes- Youngest child is five

Outcome	Means	OLS No Controls	OLS All Controls	2SLS All Controls	% Effect
Worked last 12 m	0.860	-0.012	0.007	0.053	6.2%
	(0.347)	(0.005)	(0.005)	(0.021)	
Worked 35+ h/w last 12 m	0.663	-0.034	-0.012	0.081	12.2%
	(0.473)	(0.007)	(0.007)	(0.028)	
Weeks worked last 12 m	37.867	-1.402	-0.091	3.107	8.2%
	(19.948)	(0.312)	(0.306)	(1.174)	
In welfare last 12 m	0.093	0.024	0.008	-0.029	-31.6%
	(0.290)	(0.004)	(0.004)	(0.017)	
Wage income	21943.3	-6373.8	-3044.9	1701.4	7.8%
	(26054.0)	(483.0)	(437.2)	(1452.9)	
Worked last week	0.733	-0.027	0.001	0.049	6.7%
	(0.443)	(0.007)	(0.007)	(0.026)	

Notes: White-robust standard errors are in parentheses. The regression in column 2 does not include any control. The other regressions include year fixed effects and state fixed effects. The percentage effect is approximated dividing the 2SLS coefficient on the public school enrollment dummy by the sample mean in column 1. 5-year-olds correspond to the children who probably were 5 years old on April 1st of the survey year (the reference date for Census). These are the 4Q1,5Q1,5Q2,5Q3,5Q4,6Q2,6Q3 and 6Q4 children. See the text for further explanation.

Table 2.10 shows analogous estimates for mothers whose youngest child is younger than five. Again, simple OLS estimates are wrong-signed, and adding controls help to reduce the endogeneity and selection issues, driving the coefficients toward zero. 2SLS estimates show a positive effect of school enrollment, but the level of significance is

smaller in this case, in part due to the smaller sample size of mothers with younger children.

Table 2.10. Effect of Public School Enrollment on Labor Outcomes- Youngest child is younger than five

Outcome	Means	OLS No Controls	OLS All Controls	2SLS All Controls	% Effect
Worked last 12 m	0.766	-0.029	-0.019	0.041	5.3%
	(0.424)	(0.010)	(0.010)	(0.038)	
Worked 35+ h/w last 12 m	0.539	-0.026	-0.015	0.075	13.8%
	(0.499)	(0.012)	(0.012)	(0.044)	
Weeks worked last 12 m	29.964	-1.504	-0.842	2.209	7.4%
	(21.988)	(0.515)	(0.494)	(1.919)	
In welfare last 12 m	0.174	0.019	0.011	-0.046	-26.4%
	(0.379)	(0.009)	(0.009)	(0.034)	
Wage income	14412.8	-4743.9	-2295.6	-770.1	-5.3%
	(23977.6)	(705.6)	(596.5)	(1848.4)	
Worked last week	0.592	-0.040	-0.024	-0.017	-2.8%
	(0.492)	(0.011)	(0.011)	(0.043)	

Notes: White-robust standard errors are in parentheses. The regression in column 2 does not include any control. The other regressions include year fixed effects and state fixed effects. The percentage effect is approximated dividing the 2SLS coefficient on the public school enrollment dummy by the sample mean in column 1. 5-year-olds correspond to the children who probably were 5 years old on April 1st of the survey year (the reference date for Census). These are the 4Q1,5Q1,5Q2,5Q3,5Q4,6Q2,6Q3 and 6Q4 children. See the text for further explanation.

Table 2.11 and 2.12 compare my estimates from both subsamples with Gelbach's estimates. Overall, the coefficients are quite similar across studies, however, the percentage effects of school enrollment estimated by Gelbach are usually larger. This is mainly a consequence of the smaller baseline labor supply in 1980 compared to that in 2005-2007.

Table 2.11. Comparison of Estimates Between Studies- Youngest child is five

Youngest child is five

	Own Estimates			Gelbach (2002) Estimates		
Outcome	Mean ACS 2005-2007	2SLS All Controls	% Effect	Mean 1980 Census	2SLS All Controls	% Effect
Worked last 12 m	0.860	0.053	6.2%	0.701	0.04	5.7%
	(0.347)	(0.021)		(0.004)	(0.02)	
H. worked/week last 12 m				25.700	2.23	8.7%
				(0.200)	(0.83)	
Worked 35+ h/w last 12 m	0.663	0.081	12.2%			
	(0.473)	(0.028)				
Weeks worked last 12 m	37.867	3.107	8.2%	28.360	3.6	12.7%
	(19.948)	(1.174)		(0.220)	(0.99)	
In welfare last 12 m	0.093	-0.029	-31.6%	0.343	-0.044	-12.8%
	(0.290)	(0.017)		(0.005)	(0.02)	
Wage income in 12 m	21943.3	1701.4	7.8%	5193	931.6	17.9%
	(26054.0)	(1452.9)		(56.000)	(258.90)	
Worked last week	0.733	0.049	6.7%	0.586	0.051	8.7%
	(0.443)	(0.026)		(0.005)	(0.02)	

Notes: Own estimates are from Table 2.9 and 2.10. The 1980 Census asks for employment outcomes in 1979 ("last year") whereas the ACS asks for employment outcomes in "last 12 months". Unlike the Census, the ACS does not have a reference date; it is given to respondents throughout the respective calendar year. Therefore, Gelbach selects single mothers of 5-years-old as of April 1st, 1980. I select single mothers who have at least one child who has a positive probability to have been a five-year-old by April 1st of the respective year (see Table 2.1). Also, this might affect the comparison of 1979 labor-supply variables of Gelbach (which implicitly consider the effect on only four months of free schooling -September through December 1979) with my last-12-months outcomes (which consider an unknown number of months of free schooling, depending on the month each survey was filled out).

Table 2.12. Comparison of Estimates Between Studies- Youngest child is younger than five

Youngest child is younger than five

	Own Estimates			Gelbach (2002) Estimates		
Outcome	Mean ACS 2005-2007	2SLS All Controls	% Effect	Mean 1980 Census	2SLS All Controls	% Effect
Worked last 12 m	0.766	0.041	5.3%	0.488	0.018	3.7%
	(0.424)	(0.038)		(0.006)	(0.03)	
H. worked/week last 12 m				17.400	0.35	2.0%
				(0.200)	(1.05)	
Worked 35+ h/w last 12 m	0.539	0.075	13.8%			
	(0.499)	(0.044)				
Weeks worked last 12 m	29.964	2.209	7.4%	15.950	0.2	1.3%
	(21.988)	(1.919)		(0.250)	(1.09)	
In welfare last 12 m	0.174	-0.046	-26.4%	0.551	0.012	2.2%
	(0.379)	(0.034)		(0.006)	(0.03)	
Wage income in 12 m	14412.8	-770.1	-5.3%	2525	-98.3	-3.9%
	(23977.6)	(1848.4)		(54.000)	(245.50)	
Worked last week	0.592	-0.017	-2.8%	0.341	-0.019	-5.6%
	(0.492)	(0.043)		(0.006)	(0.03)	

Notes: Own estimates are from Table 2.9 and 2.10. The 1980 Census asks for employment outcomes in 1979 ("last year") whereas the ACS asks for employment outcomes in "last 12 months". Unlike the Census, the ACS does not have a reference date; it is given to respondents throughout the respective calendar year. Therefore, Gelbach selects single mothers of 5-years-old as of April 1st, 1980. I select single mothers who have at least one child who has a positive probability to have been a five-year-old by April 1st of the respective year (see Table 2.1). Also, this might affect the comparison of 1979 labor-supply variables of Gelbach (which implicitly consider the effect on only four months of free schooling -September through December 1979) with my last-12-months outcomes (which consider an unknown number of months of free schooling, depending on the month each survey was filled out).

Overall, this evidence suggest that twenty-six years later kindergarten access is still a significant source of child care for single mothers with young children. A priori we would have expected even smaller effects in these days compared with the 80s, not only because of higher baseline outcomes, but also due to the increase of the coverage of pre-school programs and the implementation of the welfare reform. In particular, during the last decade most states have promoted employment of single mothers formerly on welfare by imposing time limits and work requirements, along with increasing access to child care subsidies. Also, many states have increased pre-school and early development programs. The next section explores whether differences across states are associated with differences on the effect of public school access on maternal labor supply.

2.4.4 Estimates by Ethnic Groups and States Characteristics

This section provides evidence on possible heterogeneity on the effect of school enrollment across ethnic groups and states characteristics. The nationwide analyses in previous sections could mask important differences across groups and states with respect to the effect of kinder access on maternal employment. Therefore, I estimate the same specifications shown above by two new dimensions: (1) for different ethnic groups (white non-Hispanic, black and Hispanic) and (2) for two different state groups (whether the state mandates and incentives full day kindergarten or not)[12].

[12]Comparing groups of states that vary in a particular dimension, such as full day kindergarten promotion, is essentially a descriptive exercise. The comparison across states in one dimension does not allow one to hold other state groups characteristics constant. Since we know that states are not identical in other dimensions, results from

Table 2.13 compares the OLS and 2SLS coefficients on the public school enrollment dummy by ethnicity of single mothers whose youngest child is five. The sample means of employment outcomes are relatively similar across groups, except for earnings and employment status for the last week, which are higher among white non-Hispanic mothers. However, the estimated coefficients from the black mothers sample are significantly higher than those from the other samples. For example, public school enrollment of the five-year-old children of black mothers increases their probability of having worked in last 12 months by 10 percent on average, doubling the effect among white non-Hispanic mothers whereas it has no significant effect among Hispanics.

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this exercise should be read with caution.

Table 2.13. Effect of Public School Enrollment on Labor Outcomes by Ethnic Groups- Youngest child is five

	White not Hispanic			Black			Hispanic		
	Mean	2SLS	% Effect	Mean	2SLS	% Effect	Mean	2SLS	% Effect
Worked last 12 months	0.880	0.043	4.9%	0.847	0.107	12.6%	0.821	0.001	0.2%
	(0.325)	(0.024)		(0.360)	(0.053)		(0.384)	(0.057)	
Worked 35+ h/week last 12 months	0.664	0.066	10.0%	0.669	0.143	21.3%	0.645	0.034	5.3%
	(0.472)	(0.035)		(0.471)	(0.069)		(0.479)	(0.072)	
Weeks worked last 12 months	39.452	0.187	0.5%	36.175	7.441	20.6%	35.881	6.972	19.4%
	(19.037)	(1.376)		(20.641)	(2.975)		(21.073)	(3.152)	
In welfare last 12 months	0.072	-0.031	-44.0%	0.116	-0.029	-24.8%	0.120	-0.069	-57.8%
	(0.258)	(0.019)		(0.320)	(0.046)		(0.325)	(0.048)	
Wage and salary income	24827.4	-319.9	-1.3%	19123.3	4321.7	22.6%	17398.4	2240.9	12.9%
	(29722.0)	(2075.7)		(19508.8)	(2642.3)		(21441.3)	(2967.1)	
Worked last week	0.769	0.010	1.3%	0.693	0.116	16.7%	0.690	0.058	8.5%
	(0.422)	(0.030)		(0.462)	(0.067)		(0.463)	(0.069)	
F Statistic exc. instruments		281.46			81.48			68.5	
Partial r2 exc. instruments		0.084			0.053			0.069	
N	10685	10685		5493	5493		3762	3762	

Notes: White-robust standard errors are in parentheses. The regressions include year fixed effects and state fixed effects.The percentage effect is approximated dividing the 2SLS coefficient on the public school enrollment dummy by the sample mean in column 1. 5-year-olds correspond to the children who probably were 5 years old on April 1st of the survey year (the reference date for Census). These are the 4Q1,5Q1,5Q2,5Q3,5Q4,6Q2,6Q3 and 6Q4 children. See the text for further explanation.

The results are significantly different when we look at samples of mother whose youngest child is younger than five (Table 2.14). In this case, the somewhat positive effect found in previous section nationwide seems to be driven by a large effect among Hispanic mothers. There is no clear explanation for the remarkable differences between the small effects among Hispanic mothers whose youngest child is five and the large effects among the Hispanic mothers with younger children. Even though the Hispanic sample is the smallest, the power of the instruments in the first stage regression still remains good enough (the F-statistic is 41.9) and hence, differences across groups seem not be driven by problems with the estimation. One possibility is that Hispanic mothers rely more intensively on informal source of care than other groups (Shlay et al, 2003). Informal sources typically involve free or almost free care for a limited amount of time or number of children, and no care at all after some particular time of day or for more than one child at the time (for example, depending on the available time and patience of the neighbor, friend or grandmother). In that situation, mothers of just one young child (the five-year-old) who want to work probably have access to an informal source of care. But working when having two young children could be prohibitively difficult for them, unless the older enters kindergarten (which could explain the results shown in Tables 2.13 and 2.14).

Table 2.14. Effect of Public School Enrollment on Labor Outcomes by Ethnic Groups- Youngest child is younger than five

	White not Hispanic			Black			Hispanic		
	Mean	2SLS	% Effect	Mean	2SLS	% Effect	Mean	2SLS	% Effect
Worked last 12 months	0.802	0.043	5.3%	0.769	0.000	0.0%	0.694	0.187	27.0%
	(0.398)	(0.048)		(0.422)	(0.078)		(0.461)	(0.095)	
Worked 35+ h/week last 12 months	0.549	0.043	7.8%	0.549	0.069	12.5%	0.503	0.280	55.6%
	(0.498)	(0.060)		(0.498)	(0.094)		(0.500)	(0.103)	
Weeks worked last 12 months	32.538	1.791	5.5%	28.456	1.529	5.4%	27.332	8.082	29.6%
	(21.443)	(2.532)		(21.723)	(3.959)		(22.779)	(4.592)	
In welfare last 12 months	0.139	-0.049	-35.1%	0.207	-0.161	-77.9%	0.192	0.021	10.8%
	(0.346)	(0.043)		(0.405)	(0.077)		(0.394)	(0.077)	
Wage and salary income	18059.3	690.0	3.8%	11980.9	-2445.2	-20.4%	10534.8	1140.5	10.8%
	(29834.8)	(2900.7)		(16848.8)	(3075.1)		(15832.5)	(3033.0)	
Worked last week	0.652	0.060	9.3%	0.547	-0.109	-19.9%	0.542	0.038	7.0%
	(0.476)	(0.057)		(0.498)	(0.093)		(0.498)	(0.100)	
F Statistic exc. instruments		105.76			48.13			41.94	
Partial r2 exc. instruments		0.08			0.055			0.07	
N	4495	4495		3258	3258		2313	2313	

Notes: White-robust standard errors are in parentheses. The regressions include year fixed effects and state fixed effects.The percentage effect is approximated dividing the 2SLS coefficient on the public school enrollment dummy by the sample mean in column 1. 5-year-olds correspond to the children who probably were 5 years old on April 1st of the survey year (the reference date for Census). These are the 4Q1,5Q1,5Q2,5Q3,5Q4,6Q2,6Q3 and 6Q4 children. See the text for further explanation.

Table 2.15 and 2.16 present the coefficient on the public school enrollment dummy by full day kindergarten promotion in the state. According to state-level data from 2004 provided by the Education Commission of the States (2005), I classify states into two categories: (1) *states that promote full day kindergarten* either by mandating school districts to provide full-day kindergarten or by offering strong financial incentives to them to provide full-day rather than half-day kindergarten, and (2) *states that do not promote full day kindergarten*, which includes all the rest of states[13]. The coefficient on the public school enrollment dummy is substantially larger among mothers who live in a state promoting full day kindergarten, especially among mothers whose youngest child is five.

[13]incentives provided to districts to promote full-day kindergarten: Strong Incentive, Incentive, and Disincentive. See further details in Education Commission (2005).

Table 2.15. Effect of Public School Enrollment on Labor Outcomes by Full Day/ Not Full Day Kinder States- Youngest child is five

	Full Day Kinder Funding				Not Full Day Kinder Funding			
	Mean	OLS	2SLS	% Effect	Mean	OLS	2SLS	% Effect
Worked last 12 months	0.860	0.017	0.141	16.4%	0.864	0.002	0.018	2.1%
	(0.347)	(0.010)	(0.044)		(0.343)	(0.006)	(0.023)	
Worked 35+ h/week last 12 months	0.663	-0.015	0.142	21.4%	0.664	-0.011	0.057	8.5%
	(0.473)	(0.013)	(0.058)		(0.473)	(0.009)	(0.032)	
Weeks worked last 12 months	37.867	-0.273	6.433	17.0%	38.124	-0.038	1.832	4.8%
	(19.948)	(0.567)	(2.444)		(19.776)	(0.363)	(1.324)	
In welfare last 12 months	0.093	0.004	-0.025	-27.1%	0.099	0.009	-0.030	-29.9%
	(0.290)	(0.007)	(0.033)		(0.299)	(0.005)	(0.020)	
Wage and salary income	21943.3	-3791.4	1934.6	8.8%	22343.2	-2720.4	1415.4	6.3%
	(26054.0)	(848.9)	(3178.2)		(25813.1)	(508.0)	(1600.1)	
Worked last week	0.733	0.005	0.158	21.5%	0.740	-0.001	0.009	1.2%
	(0.443)	(0.013)	(0.055)		(0.439)	(0.008)	(0.029)	
F Statistic exc. instruments			114.8				330.12	
Partial r2 exc. instruments			0.059				0.078	
r2		0.064	.			0.06	.	
N	6671	6671	6671		3258	14134	14134	

Notes: Full Day Kinder Funding States: AK, AL, AR, DC, GA, IL, LA, MD, MS, NC, NE, NM, NY, SC, WI, WV. Not Full Day Kinder Funding States are the rest of states. White-robust standard errors are in parentheses. The regressions include year fixed effects and state fixed effects.The percentage effect is approximated dividing the 2SLS coefficient on the public school enrollment dummy by the sample mean in column 1. 5-year-olds correspond to the children who probably were 5 years old on April 1st of the survey year (the reference date for Census). These are the 4Q1,5Q1,5Q2,5Q3,5Q4,6Q2,6Q3 and 6Q4 children. See the text for further explanation.

Table 2.16. Effect of Public School Enrollment on Labor Outcomes by Full Day/ Not Full Day Kinder States- Youngest child is younger than five

	Full Day Kinder Funding				Not Full Day Kinder Funding			
	Mean	OLS	2SLS	% Effect	Mean	OLS	2SLS	% Effect
Worked last 12 months	0.766	-0.026	-0.020	-2.6%	0.768	-0.017	0.068	8.8%
	(0.424)	(0.018)	(0.068)		(0.422)	(0.011)	(0.045)	
Worked 35+ h/week last 12 months	0.539	-0.032	0.043	8.1%	0.541	-0.009	0.094	17.4%
	(0.499)	(0.021)	(0.080)		(0.498)	(0.014)	(0.053)	
Weeks worked last 12 months	29.964	-0.707	0.564	1.9%	30.211	-0.950	2.716	9.0%
	(21.988)	(0.905)	(3.420)		(21.964)	(0.590)	(2.307)	
In welfare last 12 months	0.174	0.003	-0.020	-11.4%	0.188	0.014	-0.050	-26.7%
	(0.379)	(0.015)	(0.058)		(0.390)	(0.010)	(0.042)	
Wage and salary income	14412.8	-2185.3	1777.0	12.3%	14989.6	-2342.2	-2100.3	-14.0%
	(23977.6)	(1032.4)	(2494.5)		(25354.8)	(731.4)	(2418.0)	
Worked last week	0.592	-0.017	-0.034	-5.8%	0.599	-0.028	-0.014	-2.4%
	(0.492)	(0.021)	(0.078)		(0.490)	(0.013)	(0.052)	
F Statistic exc. instruments			68.25				135.21	
Partial r2 exc. instruments			0.072				0.068	
r2	0.001	0.087	.		0.001	0.074	.	
N	3295	3295	3295		7243	7243	7243	

Notes: Full Day Kinder Funding States: AK, AL, AR, DC, GA, IL, LA, MD, MS, NC, NE, NM, NY, SC, WI, WV. Not Full Day Kinder Funding States are the rest of states. White-robust standard errors are in parentheses. The regressions include year fixed effects and state fixed effects.The percentage effect is approximated dividing the 2SLS coefficient on the public school enrollment dummy by the sample mean in column 1. 5-year-olds correspond to the children who probably were 5 years old on April 1st of the survey year (the reference date for Census). These are the 4Q1,5Q1,5Q2,5Q3,5Q4,6Q2,6Q3 and 6Q4 children. See the text for further explanation.

2.4.5 Sensitivity Analysis

The estimations presented above control for demographic variables. Sensitivity analyses indicate that IV estimates are quite robust to the exclusion of these controls, except for the estimated effects on earning in that the coefficient on the public school enrollment almost double in both subsamples (estimates not shown).

Table 2.17 presents the estimated coefficients on the public school enrollment dummy when we include as an additional control the expected age of the five-year-old by April 1st (see Table 2.1 for the estimation of the expected age by age reported and QOB). The coefficients are quite robust to the inclusion of this new control. Comparing Table 2.9 with the upper part of Table 2.17, we see that the estimated effects are even larger in Table 2.17.

To look at the sensitivity of the results to the sample selection criteria, I also run regressions weighting each observation by the probability of being five-years-old on April 1st according to the age reported and the QOB. For example, 5Q2 children were weighted by 37.5 whereas 6Q2 children were weighted by 62.5 (see Table 2.1). Results from this sensitivity analysis are presented in Table 2.18. As expected, standard errors are now larger. The estimated coefficients vary somewhat, but not enough to change previous conclusions.

As a robustness check for the specifications used in the chapter, I use as instruments for public school enrollment the three QOB plus their interactions with the state-level dummy that indicates whether the state promotes full day kindergarten. The first stage

Table 2.17. Sensitivity Analysis To Controlling For Expected Age in April 1st- Effect of Public School Enrollment on Labor Outcomes

Youngest child is five

Outcome	Means	OLS No Controls	OLS All Controls	2SLS All Controls	% Effect
Worked last 12 m.	0.860	-0.012	0.007	0.068	7.9%
	(0.347)	(0.005)	(0.006)	(0.026)	
Worked 35+ h/w last 12 m.	0.663	-0.034	-0.013	0.104	15.7%
	(0.473)	(0.007)	(0.008)	(0.036)	
Weeks worked last 12 m.	37.867	-1.402	-0.125	3.852	10.2%
	(19.948)	(0.312)	(0.315)	(1.484)	
In welfare last 12 m.	0.093	0.024	0.009	-0.033	-35.4%
	(0.290)	(0.004)	(0.004)	(0.022)	
Wage income	21943.3	-6373.8	-3072.7	3043.7	13.9%
	(26054.0)	(483.0)	(438.8)	(1828.0)	
Worked last week	0.733	-0.027	0.001	0.063	8.7%
	(0.443)	(0.007)	(0.007)	(0.033)	

Youngest child is younger than five

Outcome	Means	OLS No Controls	OLS All Controls	2SLS All Controls	% Effect
Worked last 12 m.	0.766	-0.029	-0.020	0.051	6.6%
	(0.424)	(0.010)	(0.010)	(0.045)	
Worked 35+ h/w last 12 m.	0.539	-0.026	-0.020	0.071	13.2%
	(0.499)	(0.012)	(0.012)	(0.053)	
Weeks worked last 12 m.	29.964	-1.504	-0.904	2.482	8.3%
	(21.988)	(0.515)	(0.506)	(2.290)	
In welfare last 12 m.	0.174	0.019	0.013	-0.050	-29.0%
	(0.379)	(0.009)	(0.009)	(0.040)	
Wage income	14412.8	-4743.9	-2602.0	-1778.7	-12.3%
	(23977.6)	(705.6)	(610.4)	(2157.4)	
Worked last week	0.592	-0.040	-0.022	-0.010	-1.7%
	(0.492)	(0.011)	(0.011)	(0.052)	

Notes: White-robust standard errors are in parentheses. The regression in column 2 does not include any control. The other regressions include year fixed effects and state fixed effects. The percentage effect is approximated dividing the 2SLS coefficient on the public school enrollment dummy by the sample mean in column 1. 5-year-olds correspond to the children who probably were 5 years old on April 1st of the survey year (the reference date for Census). These are the 4Q1,5Q1,5Q2,5Q3,5Q4,6Q2,6Q3 and 6Q4 children. See the text for further explanation.

Table 2.18. Sensitivity Analysis to the Use of Constructed Weights- Effect of Public School Enrollment on Labor Outcomes

Youngest child is five

Outcome	Unweighted Means	OLS No Controls	OLS All Controls	2SLS All Controls	% Effect
Worked last 12 m.	0.860	-0.018	0.003	0.049	5.7%
	(0.347)	(0.006)	(0.006)	(0.031)	
Worked 35+ h/w last 12 m.	0.663	-0.037	-0.011	0.077	11.6%
	(0.473)	(0.009)	(0.009)	(0.042)	
Weeks worked last 12 m.	37.867	-1.606	-0.142	2.774	7.3%
	(19.948)	(0.365)	(0.359)	(1.761)	
In welfare last 12 m.	0.093	0.029	0.009	-0.038	-41.3%
	(0.290)	(0.005)	(0.005)	(0.026)	
Wage income	21943.3	-6687.2	-3132.1	3779.1	17.2%
	(26054.0)	(540.0)	(490.4)	(2110.3)	
Worked last week	0.733	-0.032	0.000	0.023	3.1%
	(0.443)	(0.008)	(0.008)	(0.039)	

Youngest child is younger than five

Outcome	Unweighted Means	OLS No Controls	OLS All Controls	2SLS All Controls	% Effect
Worked last 12 m.	0.766	-0.047	-0.031	0.011	1.4%
	(0.424)	(0.011)	(0.011)	(0.056)	
Worked 35+ h/w last 12 m.	0.539	-0.045	-0.028	0.027	5.0%
	(0.499)	(0.014)	(0.013)	(0.067)	
Weeks worked last 12 m.	29.964	-2.510	-1.358	1.898	6.3%
	(21.988)	(0.597)	(0.570)	(2.893)	
In welfare last 12 m.	0.174	0.027	0.014	-0.007	-4.1%
	(0.379)	(0.010)	(0.010)	(0.049)	
Wage income	14412.8	-5654.9	-2647.3	-1964.6	-13.6%
	(23977.6)	(772.4)	(660.0)	(2832.7)	
Worked last week	0.592	-0.064	-0.039	-0.062	-10.5%
	(0.492)	(0.013)	(0.013)	(0.065)	

Notes: White-robust standard errors are in parentheses. The regression in column 2 does not include any control. The other regressions include year fixed effects and state fixed effects. The percentage effect is approximated dividing the 2SLS coefficient on the public school enrollment dummy by the sample mean in column 1. 5-year-olds correspond to the children who probably were 5 years old on April 1st of the survey year (the reference date for Census). These are the 4Q1,5Q1,5Q2,5Q3,5Q4,6Q2,6Q3 and 6Q4 children. See the text for further explanation.

results are quite similar and the power of the instruments remain strong. OLS and IV estimates are in the same range as when only using QOB as the instruments (results not shown).

2.5 Conclusions

This study provides new evidence on the effects of public school enrollment of five-year-olds on employment outcomes of single mothers. Gelbach (2002) was the first study using quarter of birth (QOB) variables as instruments for whether five-year-olds are enrolled in kindergarten at age 5. He estimates the implicit child care subsidy provided by free public kindergarten using data from the 1980 Census. In that year the coverage of pre-school and early development programs was low, there were few incentives to work for single mothers in welfare and the funding for child care subsidies had not increased to current levels. Not surprisingly, he finds a significant impact on labor supply outcomes of having one's child eligible for kindergarten earlier.

This study aims to document whether the results from Gelbach's study can be extended to the current post welfare reform era, twenty-six years later, when child care access and single mother's labor force participation have increased substantially compared to 1980. It also explores the possibility of heterogeneity on the impacts of this implicit child care subsidy across different groups of mothers and groups of states. I use data from the 2005, 2006 and 2007 rounds of the American Community Survey (ACS). Unlike the Public Use Sample of the 1990 and 2000 Census, the ACS provides

the quarter of birth for each respondent in the sample, along with the age in years at the moment the survey was filled out.

My results suggest that twenty-six years later kindergarten access is still a significant source of child care for single mothers with young children. The point estimates are relatively similar to Gelbach's, however, the percentage effects of school enrollment are smaller because the baseline labor supply of single mothers is currently higher compared to 1980.

Results from the specifications estimated by ethnicity of mothers and by two groups of states suggest a differential impact of public school enrollment across mothers and state characteristics. For example, public school enrollment of the five-year-old children of black mothers increases their probability of having worked in last 12 months by 10 percent on average, doubling the effect among white non-Hispanic mothers whereas it has no significant effect among Hispanics. On the contrary, the estimations indicate that public school enrollment of a five-year-old increases the labor supply of Hispanic mothers whose youngest child is younger than five substantially more than white not Hispanic and black mothers.

According to the results by full day kindergarten/ not full day kindergarten states, the estimated impact of free kindergarten is larger among mothers who live in a state promoting full day kindergarten, especially among mothers whose youngest child is five. This exploratory exercise suggests that the labor supply of single mothers responds considerably when they face a larger implicit child care subsidy provided by full-day free kindergarten.

CHAPTER 3
DATA DESCRIPTION

3.1 Data Sources Chapter 1

The main sources of information for Chapter 1 are the following: First, the 1999 and 2002 rounds of the National Survey of America's Families (NSAF), conducted by the Urban Institute, serves as the basis for estimating the models. Second, state-level data such as state unemployment rates of single mothers, the hourly wage at the 20th percentile of the wage distribution in each state and other state-level demographics come from several sources detailed below. Third, child care policy variables are mainly from Schulman et. al (2001) (The Children's Defense Fund) and from the Child Care Bureau (U.S. Department of Health and Human Services). Finally, I use two set of state-level welfare rules variables that were first constructed by Fang and Keane (2004) and Bernal and Keane (2006). The first set of rules characterize the main aspects of state waivers implemented before 1996, whereas the second set describes the main rules of the welfare system that were in place as of the survey date (either in 1999 or 2002).[1]

[1] I am grateful to these authors for giving me their state-level welfare policy data.

National Survey of America's Families (NSAF)

The NSAF was designed to analyze the consequences of transferring the responsibility for social programs from the federal government to the states. The survey was conducted by telephone on a sample derived primarily from random-digit dialing[2]. Residents of 13 states[3] were over-sampled in order to allow within-state analysis. Additionally, low-income households (below 200 percent of the federal poverty level) were also over-sampled. The entire NSAF sample includes approximately 40,000 households in each round. Using both the 1999 and 2002 rounds, I select a sample from the 13 states which were over-sampled, of unmarried mothers between 19 and 44 years old with at least one child under age 5 and with family income below 200 percent of the federal poverty line. After dropping observations with missing values, the resulting sample size is 2131 observations. Table 3.1 presents the number of observations selected using each of the sample selection criteria. The 1997 round was not used because it did not include the question about whether the respondent inquired about or applied for government assistance in paying for child care in the past 12 months. This question is the basis of coding whether a non-recipient mother was rationed out of the child care subsidies. I use observations from the over-sampled states because the other states do not have enough observations that satisfy the criteria.[4]. The income limit

[2]Cellular telephones distributed by the survey organization were used to conduct interviews with households without a telephone.

[3]Alabama, California, Colorado, Florida, Massachusetts, Michigan, Minnesota, Mississipi, New Jersey, New York, Texas, Washington and Wisconsin.

[4]The 1999 and 2002 rounds contain 350 observations from the non over-sampled states that satisfy my sample selection criteria. The average across states is only 17 observations, wtih a maximum of 33 (Ohio).

threshold of 200 percent of the FPL is selected for convenience, since the NSAF survey only asks persons with family income below this threshold about rationing issues. Thus it defines the potential population that could demand the CCDF subsidies[5].

A mother is coded as *receiving a child care subsidy* if a welfare or social service helped her pay for child care in the month prior to the survey date or she received government assistance in paying for child care in the past 12 months. According to this classification, 30 percent of the selected sample reports receiving a child care subsidy.

A mother is coded as *having applied for a subsidy* if she is either coded as receiving a subsidy (according to the previous criteria) or has been rationed out of it. I code in turn a mother as being rationed out based on the information collected from the NSAF question showed in Figure 8. Specifically, a mother is coded as *rationed out* if all three of the following situations occurs: (1) she did not receive government assistance in paying for child care in the last 12 months, (2) she inquired or applied for government assistance in paying for child care in the last 12 months, but she did not get the assistance, and the reason for that was that (3) the assistance was not available, or she was put on waiting list, or she was discouraged/ gave up/ too much hassle to get it[6]. Although not optimal, this classification allow us to estimate the rationing status for

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[5]For example, the average across states was 189 percent of the FPL in 2000. Only 15 states had a limit above this threshold.

[6]A mother is coded as not having applied for a subsidy if she inquired or applied for government assistance but either she was told that she is not eligible/ makes too much money, or she eventually decided that she did not want or need help from the government. It is assumed that in those cases the mother self-selects to be not eligible or simply regrets her initial choice. Cases in which the reason for not receiving the subsidy is classified as "Other" are dropped from the sample.

Table 3.1. NSAF Sample Selection

1999 Round	
Total num of obs	74719
Total num of obs with non-wage income>0	74502
Total num of obs from 13 over-sampled states	64234
A mother is in the hh (but not the father)	6076
Mother is not married	5880
Mother's age is >=19 and <=44	4923
Youngest child is 0-4 years old	1761
Family income <= 200% FPL	1286
Rationing reason different from "Other"	1215
Non-missing values in covariates used	1153

2002 Round	
Total num of obs	70577
Total num of obs with non-wage income>0	70393
Total num of obs from 13 over-sampled states	58292
A mother is in the hh (but not the father)	5498
Mother is not married	5322
Mother's age is >=19 and <=44	4334
Youngest child is 0-4 years old	1573
Family income <= 200% FPL	1106
Rationing reason different from "Other"	1053
Non-missing values in covariates used	978

Both Rounds	
Total num of obs	145296
Total num of obs with non-wage income>0	144895
Total num of obs from 13 over-sampled states	122526
A mother is in the hh (but not the father)	11574
Mother is not married	11202
Mother's age is >=19 and <=44	9257
Youngest child is 0-4 years old	3334
Family income <= 200% FPL	2392
Rationing reason different from "Other"	2268
Non-missing values in covariates used	2131

Note: Final number of obs selected=2131

each mother in the sample whose family income is below 200 percent of the federal poverty line.

State-level Variables

Table 3.2 shows a list including the sources of state-level characteristics and state CCDF subsidy policy variables used in the estimations. Table 3.3 presents the values for each variable for each state and year.

Table 3.2. List of State-Level Characteristics and State CCDF Subsidy Policy Variables

Variable	Description	Source
	State Characteristics	
URATESIN_j	Unemployment Rate of Single Mothers in state j in 2000	Bureau of Labor Statistics (NLS)
SWAGE_jt	Hourly wage at the 20th per. of wage distribution in state j in round t	Fang and Keane (2004)
CCWAGE_jt	Average wage of child care workers in state j in round t	Quarterly Census of Employment and Wages
	CCDF Subsidy Policy Variables	
SUBLIM_ijt	CCDF income eligible limit by family size of mother i, state j and round t	Author's calculation from NSAF and National Center for Children in Poverty
SUBMEDIA_jt	State j uses mass media to diffuse the subsidy in round t (d)	DHHS, ACF, Child Care Bureau
SUBGUAR_j	State j guarantees subsidy (d)	Schulman, K., D Ewen and H Blank (2001), Children's Defense Fund
SUBRECMO_j	Months until recertification	Schulman, K., D Ewen and H Blank (2001), Children's Defense Fund
SUBRECPER_j	Recertification in person (d)	Schulman, K., D Ewen and H Blank (2001), Children's Defense Fund
SUBLIM_jt	CCDF income eligible limit/85% SMI in state j in round t (family of 3)	National Center for Children in Poverty
SUBWLIST_jt	Waiting lists in the state j in round t (d)	National Women's Law Center, Issue Brief, Sep 2004
SUBFUNDS_j	Predetermined funds/ num 0-5 children of single mothers in state j	DHHS, ACF, Child Care Bureau and Census Bureau, 2000 Census
	Other Policy Variables	
EITCPH_ijt	EITC phase in rate by number of children of mother i in state j in round t	Fang and Keane (2004)
EITCMAX_ijt	EITC max. benefit by number of children of mother i in state j in round t	Fang and Keane (2004)

Table 3.4 shows a list of the state welfare rules used in the study. Fang and Keane (2004) and Bernal and Keane (2006) are the sources of these variables. There are two set of welfare rules. The first set characterizes the main aspects of state waivers implemented before 1996, whereas the second set describes the main rules of the welfare system that were in place as of the survey date (either in 1999 or 2002).[7].

In addition to these state-level welfare rules, I construct a set of interactions between demographic characteristics of the mother i living in state j and state j welfare rules in place in each round (either 1999 or 2002). Specifically, I use a dummy variable indicating whether the mother i living in state j would have hit time limit in 1999 (or 2002), the minimum potential remaining length of mother i's time limit (in months) according to state j rules of 1999 (or 2002), a dummy for whether the mother i living in state j could be subject to a work requirement in 1999 (or 2002), and a dummy for whether there is an exemption from work requirements in case of child care not available in state j (varying across mothers within a state according to the age of her youngest child). These variables are constructed using "potential" rather than "actual" measures of welfare participation. This is due to the actual measures being endogenous and thus do not belong in a reduced-form specification as used in the estimations. For example, these variables do not measure whether a woman is actually subject to a work requirement, or for how long ago a woman has actually hit a time limit. Instead, they

[7]I use the length (in months) of work requirement limit in state j in 1999 (or 2002), instead of a dummy for work requirement in place because of the high collinearity between the dummy for work requirement and the interacted version of this dummy, which varies according to mother's demographics. I decide to include the interacted version of this dummy instead of the dummy itself.

Table 3.3. State-Level Characteristics and State CCDF Subsidy Policy Variables

	1 URATESIN_j	2 SWAGE_jt	2 SWAGE_jt	3 CCWAGE_jt	3 CCWAGE_jt	4 SUBMEDIA_jt
AL	9.3	6.1	7.5	2.12	2.30	1
AK	8.1	7.0	8.8	2.62	2.88	1
AZ	6.3	6.4	8.1	2.40	2.78	1
AR	8.2	6.3	6.8	2.10	2.31	1
CA	7.8	6.5	7.6	3.09	3.67	1
CO	4.9	7.7	8.5	2.66	3.14	1
CT	6.5	8.3	9.1	2.73	3.09	0
DE	6.7	8.2	8.7	2.56	2.85	1
DC	13.7	8.7	9.6	3.39	3.95	1
FL	6.6	6.5	7.5	2.47	2.76	1
GA	7.6	6.3	7.5	2.39	2.70	1
HI	6.9	6.8	8.0	2.99	3.37	0
ID	5.4	6.2	6.7	2.10	2.22	1
IL	8.1	7.7	8.4	2.72	3.07	1
IN	6.8	7.7	8.8	2.30	2.62	1
IA	6.1	6.7	8.1	1.83	2.01	1
KS	5.2	6.4	7.8	2.19	2.29	1
KY	8.5	6.3	7.2	1.99	2.30	0
LA	9.5	6.0	6.5	2.00	2.24	1
ME	5.8	6.1	7.6	2.48	2.89	1
MD	5.9	7.8	9.4	2.73	3.09	1
MA	5.9	8.0	9.4	3.35	3.78	1
MI	7.0	7.7	8.2	2.35	2.71	0
MN	4.9	7.5	8.6	2.63	2.98	1
MS	9.6	5.8	7.1	2.35	2.56	0
MO	7.2	7.2	7.3	2.28	2.55	1
MT	6.1	5.7	5.9	1.85	2.16	1
NE	5.3	5.8	7.5	2.06	2.30	1
NV	6.2	7.2	8.2	2.36	2.67	1
NH	3.6	7.4	9.6	2.58	2.96	0
NJ	7.1	8.4	9.6	2.91	3.38	1
NM	7.9	5.8	7.0	2.35	2.71	0
NY	9.2	7.2	7.8	3.20	3.58	1
NC	7.6	6.9	7.4	2.41	2.78	1
ND	5.6	5.2	6.7	1.70	1.86	1
OH	7.2	7.2	8.1	2.57	2.83	1
OK	7.3	6.4	7.1	1.94	2.21	1
OR	7.2	6.4	7.4	2.95	2.96	1
PA	7.2	6.7	8.3	2.46	2.74	1
RI	7.9	8.5	8.5	2.75	3.26	1
SC	7.8	7.2	7.5	2.10	2.40	0
SD	6.9	5.5	6.7	2.14	2.24	1
TN	8.0	6.3	7.7	2.23	2.46	0
TX	7.4	6.3	7.0	2.34	2.65	1
UT	5.6	6.6	7.7	2.07	2.33	1
VT	5.8	6.3	7.5	2.30	2.75	1
VA	5.7	7.9	8.4	2.47	2.76	0
WA	7.1	7.7	8.3	2.52	2.83	1
WV	8.4	5.8	6.9	2.04	2.26	0
WI	6.0	7.4	8.2	2.46	2.77	1
WY	5.7	6.0	7.2	2.42	2.93	1

Table 3.3. State-Level Characteristics and State CCDF Subsidy Policy Variables (cont.)

	4 SUBMEDIA_jt	5 SUBGUAR_j	6 SUBRECMO_j	7 SUBRECMO_j	8 SUBRECPER_j	9 SUBRECPER_j
AL	1	0	6	6	1	1
AK	1	0	4	1	1	0
AZ	1	0	6	6	0	0
AR	1	0	6	60	1	1
CA	1	0	12	1	1	0
CO	1	0	6	1	0	0
CT	0	0	6	6	0	0
DE	1	0	6	6	0	0
DC	1	0	6	2	1	0
FL	1	0	6	6	0	0
GA	1	0	6	6	0	0
HI	0	0	12	12	1	1
ID	1	0	6	6	0	0
IL	1	1	6	3	0	0
IN	1	0	6	6	1	1
IA	1	0	12	12	0	0
KS	1	0	12	12	0	0
KY	0	0	12	12	0	0
LA	1	0	6	12	0	1
ME	1	0	6	3	0	1
MD	1	0	12	12	0	0
MA	1	0	6	6	0	0
MI	1	0	6	12	0	0
MN	1	0	6	6	0	0
MS	0	0	6	1	0	0
MO	1	0	12	12	0	0
MT	1	0	6	12	0	0
NE	1	0	12	12	0	0
NV	1	0	3	3	0	0
NH	0	0	6	6	1	1
NJ	1	0	12	6	0	1
NM	1	0	6	6	0	0
NY	1	0	12	6	0	0
NC	1	0	12	12	0	0
ND	1	0	1	1	0	0
OH	1	0	12	12	0	0
OK	1	0	12	12	0	0
OR	1	1	6	12	0	0
PA	1	0	6	6	0	1
RI	1	1	6	12	0	0
SC	0	0	12	12	0	0
SD	1	0	6	6	0	0
TN	0	0	6	6	0	0
TX	1	0	12	12	0	0
UT	1	0	3	3	0	0
VT	1	1	6	6	0	0
VA	1	0	12	12	1	0
WA	1	0	6	6	0	0
WV	1	0	6	6	0	0
WI	1	1	6	6	1	1
WY	1	0	6	6	0	0

Note: See description of variables at the end of the table.

Table 3.3. State-Level Characteristics and State CCDF Subsidy Policy Variables (cont.)

	10 SUBLIM_jt	10 SUBLIM_jt	11 SUBWLIST_jt	11 SUBWLIST_jt	12 MANDAFED99	12 MANDAFED102
AL	87%	74%	1	1	16,441,707	16,441,707
AK	100%	88%	1	1	3,544,811	3,544,811
AZ	71%	62%	0	0	19,827,025	19,827,025
AR	70%	71%	1	1	5,300,283	5,300,283
CA	88%	78%	1	1	85,593,217	85,593,217
CO	67%	57%	0	1	10,173,800	10,173,800
CT	95%	88%	1	1	18,738,357	18,738,357
DE	53%	62%	0	0	5,179,330	5,179,330
DC	73%	94%	0	1	4,566,974	4,566,974
FL	64%	70%	1	1	43,026,524	43,026,524
GA	80%	59%	1	1	36,548,223	36,548,223
HI	83%	97%	0	0	4,971,633	4,971,633
ID	65%	60%	0	0	2,867,578	2,867,578
IL	55%	51%	0	0	56,873,824	56,873,824
IN	69%	48%	0	1	26,181,999	26,181,999
IA	63%	48%	0	0	8,507,792	8,507,792
KS	73%	66%	0	0	9,811,721	9,811,721
KY	69%	65%	0	0	16,701,653	16,701,653
LA	97%	82%	0	0	13,864,552	13,864,552
ME	99%	89%	1	1	3,018,598	3,018,598
MD	51%	47%	0	0	23,301,407	23,301,407
MA	100%	96%	1	1	44,973,373	44,973,373
MI	65%	56%	0	0	32,081,922	32,081,922
MN	95%	89%	1	1	23,367,543	23,367,543
MS	100%	91%	1	1	6,293,116	6,293,116
MO	50%	44%	0	0	24,668,568	24,668,568
MT	70%	60%	0	1	3,190,691	3,190,691
NE	76%	64%	0	0	10,594,637	10,594,637
NV	92%	79%	0	0	2,580,422	2,580,422
NH	65%	59%	0	0	4,581,870	4,581,870
NJ	74%	68%	0	1	26,374,178	26,374,178
NM	100%	88%	0	0	8,307,587	8,307,587
NY	74%	67%	1	1	101,983,998	101,983,998
NC	93%	81%	1	1	69,639,228	69,639,228
ND	90%	81%	0	0	2,506,022	2,506,022
OH	68%	67%	0	0	70,124,656	70,124,656
OK	75%	78%	0	0	24,909,979	24,909,979
OR	76%	70%	0	0	19,408,790	19,408,790
PA	85%	81%	0	1	55,336,804	55,336,804
RI	81%	71%	0	0	6,633,774	6,633,774
SC	72%	62%	1	0	9,867,439	9,867,439
SD	80%	61%	0	0	1,710,801	1,710,801
TN	75%	66%	1	1	37,702,188	37,702,188
TX	62%	76%	1	1	59,844,129	59,844,129
UT	100%	63%	0	0	12,591,564	12,591,564
VT	88%	75%	0	0	3,944,887	3,944,887
VA	67%	53%	1	1	21,328,766	21,328,766
WA	64%	74%	0	0	41,883,444	41,883,444
WV	71%	88%	0	0	8,727,005	8,727,005
WI	61%	65%	0	0	24,511,351	24,511,351
WY	55%	68%	0	0	2,815,041	2,815,041

Note: See description of variables at the end of the table.

Table 3.3. State-Level Characteristics and State CCDF Subsidy Policy Variables (cont.)

	13 MOESTA99	13 MOESTA102	14 PREDET99	14 PREDET102	15 NCHILD5SIN	16 SUBFUNDS_99
AL	6,896,417	6,896,417	23,338,124	23,338,124	59084	395
AK	3,544,811	3,544,811	7,089,622	7,089,622	6777	1046
AZ	10,032,936	10,032,936	29,859,961	29,859,961	53060	563
AR	1,886,543	1,886,543	7,186,826	7,186,826	33385	215
CA	85,593,217	85,593,217	171,186,434	171,186,434	336101	509
CO	8,985,901	8,985,901	19,159,701	19,159,701	36524	525
CT	95,287,065	101,264,830	114,025,422	120,003,187	35176	3242
DE	11,944,196	19,506,475	17,123,526	24,685,805	9197	1862
DC	4,566,974	4,566,972	9,133,948	9,133,946	12982	704
FL	33,415,872	33,415,872	76,442,396	76,442,396	169759	450
GA	22,182,651	22,315,940	58,730,874	58,864,163	107779	545
HI	4,971,633	4,971,630	9,943,266	9,943,263	10371	959
ID	1,175,819	1,175,819	4,043,397	4,043,397	9880	409
IL	56,873,824	56,873,825	113,747,648	113,747,649	131991	862
IN	15,356,949	15,356,947	41,538,948	41,538,946	64465	644
IA	5,231,004	5,078,586	13,738,796	13,586,378	23825	577
KS	6,673,024	6,673,024	16,484,745	16,484,745	22931	719
KY	7,274,537	7,274,537	23,976,190	23,976,190	44098	544
LA	5,219,508	5,219,488	19,084,060	19,084,040	73920	258
ME	1,749,818	2,707,248	4,768,416	5,725,846	10131	471
MD	23,301,407	23,301,407	46,602,814	46,602,814	62535	745
MA	44,973,372	44,973,368	89,946,745	89,946,741	58477	1538
MI	24,411,364	24,411,364	56,493,286	56,493,286	114056	495
MN	19,690,299	19,690,299	43,057,842	43,057,842	39151	1100
MS	1,715,430	1,715,430	8,008,546	8,008,546	50349	159
MO	16,548,755	16,548,755	41,217,323	41,217,323	60953	676
MT	1,313,990	1,313,990	4,504,681	4,504,681	7858	573
NE	25,132,562	10,408,003	35,727,199	21,002,640	14947	2390
NV	2,580,422	2,580,421	5,160,844	5,160,843	21465	240
NH	4,581,870	4,688,418	9,163,740	9,270,288	8149	1125
NJ	26,374,178	26,374,178	52,748,356	52,748,356	74598	707
NM	2,895,259	2,895,259	11,202,846	11,202,846	23649	474
NY	101,983,998	101,983,998	203,967,996	203,967,996	231792	880
NC	37,927,282	37,927,282	107,566,510	107,566,510	93739	1148
ND	1,017,036	1,017,036	3,523,058	3,523,058	5286	666
OH	45,403,943	69,077,090	115,528,599	139,201,746	130249	887
OK	10,630,233	10,630,233	35,540,212	35,540,212	37175	956
OR	11,714,991	11,714,966	31,123,781	31,123,756	31070	1002
PA	46,629,051	46,629,051	101,965,855	101,965,855	116446	876
RI	14,303,469	5,321,126	20,937,243	11,954,900	12313	1700
SC	4,085,269	4,085,269	13,952,708	13,952,708	53547	261
SD	802,914	802,914	2,513,715	2,513,715	7560	333
TN	18,975,782	18,975,782	56,677,970	56,677,970	68805	824
TX	34,681,426	34,681,421	94,525,555	94,525,550	235601	401
UT	4,474,923	4,474,923	17,066,487	17,066,487	15340	1113
VT	2,666,323	4,686,318	6,611,210	8,631,205	4377	1510
VA	21,328,766	21,328,762	42,657,532	42,657,528	70200	608
WA	38,707,605	38,707,605	80,591,049	80,591,049	52882	1524
WV	2,971,393	2,971,392	11,698,398	11,698,397	14903	785
WI	16,449,406	16,449,406	40,960,757	40,960,757	47353	865
WY	1,553,707	1,553,707	4,368,748	4,368,748	4151	1052

Note: See description of variables at the end of the table.

Table 3.3. State-Level Characteristics and State CCDF Subsidy Policy Variables (cont.)

	16 SUBFUNDS_j	17 EITCPH_ij99	17 EITCPH_ij102	18 EITCPH_ij99	18 EITCPH_ij102	19 EITCMAX_ij99
AL	395	0.34	0.34	0.40	0.40	2312
AK	1046	0.34	0.34	0.40	0.40	2312
AZ	563	0.34	0.34	0.40	0.40	2312
AR	215	0.34	0.34	0.40	0.40	2312
CA	509	0.34	0.34	0.40	0.40	2312
CO	525	0.37	0.34	0.43	0.40	2312
CT	3412	0.34	0.34	0.40	0.40	2312
DE	2684	0.34	0.34	0.40	0.40	2312
DC	704	0.34	0.34	0.40	0.40	2312
FL	450	0.34	0.34	0.40	0.40	2312
GA	546	0.34	0.34	0.40	0.40	2312
HI	959	0.34	0.34	0.40	0.40	2312
ID	409	0.34	0.34	0.40	0.40	2312
IL	862	0.34	0.36	0.40	0.42	2312
IN	644	0.34	0.36	0.40	0.42	2312
IA	570	0.36	0.36	0.43	0.43	2312
KS	719	0.37	0.37	0.44	0.44	2312
KY	544	0.34	0.34	0.40	0.40	2312
LA	258	0.34	0.34	0.40	0.40	2312
ME	565	0.34	0.36	0.40	0.42	2312
MD	745	0.37	0.39	0.44	0.46	2312
MA	1538	0.37	0.39	0.44	0.46	2312
MI	495	0.34	0.34	0.40	0.40	2312
MN	1100	0.41	0.41	0.48	0.48	2312
MS	159	0.34	0.34	0.40	0.40	2312
MO	676	0.34	0.34	0.40	0.40	2312
MT	573	0.34	0.34	0.40	0.40	2312
NE	1405	0.34	0.34	0.40	0.40	2312
NV	240	0.34	0.34	0.40	0.40	2312
NH	1138	0.34	0.34	0.40	0.40	2312
NJ	707	0.34	0.40	0.40	0.47	2312
NM	474	0.34	0.34	0.40	0.40	2312
NY	880	0.41	0.44	0.48	0.52	2312
NC	1148	0.34	0.34	0.40	0.40	2312
ND	666	0.34	0.34	0.40	0.40	2312
OH	1069	0.34	0.34	0.40	0.40	2312
OK	956	0.34	0.36	0.40	0.42	2312
OR	1002	0.36	0.36	0.42	0.42	2312
PA	876	0.34	0.34	0.40	0.40	2312
RI	971	0.43	0.43	0.51	0.50	2312
SC	261	0.34	0.34	0.40	0.40	2312
SD	333	0.34	0.34	0.40	0.40	2312
TN	824	0.34	0.34	0.40	0.40	2312
TX	401	0.34	0.34	0.40	0.40	2312
UT	1113	0.34	0.34	0.40	0.40	2312
VT	1972	0.43	0.45	0.50	0.53	2312
VA	608	0.34	0.34	0.40	0.40	2312
WA	1524	0.34	0.34	0.40	0.40	2312
WV	785	0.34	0.34	0.40	0.40	2312
WI	865	0.35	0.35	0.46	0.46	2312
WY	1052	0.34	0.34	0.40	0.40	2312

Note: See description of variables at the end of the table.

Table 3.3. State-Level Characteristics and State CCDF Subsidy Policy Variables (cont.)

	19 EITCMAX_ij102	20 EITCMAX_ij99	20 EITCMAX_ij102
AL	2506	3816	4140
AK	2506	3816	4140
AZ	2506	3816	4140
AR	2506	3816	4140
CA	2506	3816	4140
CO	2506	3816	4140
CT	2506	3816	4140
DE	2506	3816	4140
DC	2506	3816	4140
FL	2506	3816	4140
GA	2506	3816	4140
HI	2506	3816	4140
ID	2506	3816	4140
IL	2506	3816	4140
IN	2506	3816	4140
IA	2506	3816	4140
KS	2506	3816	4140
KY	2506	3816	4140
LA	2506	3816	4140
ME	2506	3816	4140
MD	2506	3816	4140
MA	2506	3816	4140
MI	2506	3816	4140
MN	2506	3816	4140
MS	2506	3816	4140
MO	2506	3816	4140
MT	2506	3816	4140
NE	2506	3816	4140
NV	2506	3816	4140
NH	2506	3816	4140
NJ	2506	3816	4140
NM	2506	3816	4140
NY	2506	3816	4140
NC	2506	3816	4140
ND	2506	3816	4140
OH	2506	3816	4140
OK	2506	3816	4140
OR	2506	3816	4140
PA	2506	3816	4140
RI	2506	3816	4140
SC	2506	3816	4140
SD	2506	3816	4140
TN	2506	3816	4140
TX	2506	3816	4140
UT	2506	3816	4140
VT	2506	3816	4140
VA	2506	3816	4140
WA	2506	3816	4140
WV	2506	3816	4140
WI	2506	3816	4140
WY	2506	3816	4140

Note: See description of variables at the end of the table.

Table 3.3. State-Level Characteristics and State CCDF Subsidy Policy Variables (cont.)

1. % of female householder households, no husband present, that are unemployed as % of total labor force (including Armed Forces).
2. Real hourly wage for 20 percentile wage in each state among all working people.
3. Average weekly wage, hundreds.
4. Use of mass media to educate consumers.
5. State guarantees the CCDF subsidy to all eligible applicants.
6. Months until next recertification for low income families.
7. Months until next recertification for TANF families.
8. Requirement to recertify in person for low income families.
9. Requirement to recertify in person for TANF income families.
10. Annual income limit for continuing eligibility for 3 person family/85Per State Median Income.
11. Waiting lists for obtaining the CCDF subsidy (state level mostly, county level in some states).
12. CCDF Mandatory Funds.
13. CCDF Maintenance of Effort Funds (MOE).
14. 12+13.
15. Number of families with female householder, no husband present, with related children under age 5 (year 2000).
16. 14/15.
17. EITC phase in rate, 1 child.
18. EITC phase in rate, 2 or more children.
19. EITC maximum benefit level for families with one child.
20. EITC maximum benefit level for families with two or more child.

measure whether a time limit or a work requirement could have been "potentially" reached by a mother. For example, a mother whose oldest child is 4 years old as of the survey date cannot have received welfare for more than 4 years. The time limit would not be binding for this woman, unless the limit is less than 4 years, regardless of how many years ago her state implemented time limits. Thus the year in which time limits may first bind varies across women in the same state[8].

[8]See more details of this strategy in Fang and Keane (2004) and Bernal and Keane (2006).

Table 3.4. List of Welfare Controls

Variable	Description
	Welfare Rules before the PRWORA
TLPRW_j	Time Limit in place in state j before 1996 (d)
WRPRW_j	Work requirement in place in state j before 1996 (d)
WRAGEEX_j	Work Requirement*Age in months exempted before 1996 in state j
WRSANPRW_j	Work Requirement*Ultimate Sanction dummy before 1996 in state j
	Welfare Rules after the PRWORA
TL_jt	Time Limit in place in state j in round t
WRLENGTH_jt	Work Requirement*Work Requirement Length in months, state j round t
WRAGEEX_jt	Work Requirement*Age in months exempted, state j in round t
WRSAN_jt	Work Requirement*Ultimate Sanction, state j in round t
TLHIT_ijt	Dummy whether mother i would have hit time limit of state j in round t
TLREMAIN_ijt	Min. potential remaining length of mother's i time limit in state j in round t
WRHIT_ijt	Dummy whether mother i could be subject to a w.r. in state j in round t
WREXEMCC_ijt	Dummy for w.r. exemption if child care not available in state j in round t (varying by the age of youngest child)
TANFBEN_ijt	TANF maximum benefit (zero earnings) by fam. size i in state j in round t
TANFDIS_jt	Flat amount of earnings disregarded in calculating the TANF benefit

Note: State welfare rules used in the estimations were first constructed by Fang and Keane (2004) and Bernal and Keane (2006). Variables with the ijt subscript correspond to state-level variables jt interacted with mother's i characteristics.

3.2 Data Sources Chapter 2

Chapter 2 uses microdata from the 2005, 2006 and 2007 rounds of the Public Use Sample of the American Community Survey (ACS). This is a repeated cross-section survey that collects data nationwide since 2000. I select the rounds from 2005 onward because the quarter-of-birth variable (QOB) is only available since that round. This survey is conducted by the Census Bureau as an integral part of the 2010 decennial census program. The ACS collects information similar to Census surveys, such as age, race, income, education, employment and other variables. It is conducted using three methods of data collection to contact households: mail, telephone and personal visits.

I define a single mother of a five-year-old as a female householder who is not married and has at least one child that is *probably* five years old as of April 1st of the respective year. The Census Bureau releases neither the exact date of birth nor the year of birth of each respondent. Also, the ACS is a monthly rolling sample that is administered to respondents throughout the respective calendar year. It is not possible to know the date the respondent filled out the survey because of confidentiality restrictions. As a result, the term *probably* comes from the uncertainty about the age of the child as of a specific date (such as April 1st). To deal with this issue, I select all single mothers who have at least one child who has a positive probability to have been a five-year-old by April 1st of the respective year (hereafter mothers of likely five-year-olds, or simply, *mothers of five-year-olds*). These are mothers of children born in quarter one who are reported as being four-years-old at the survey date (4Q1), mothers of children reporting being 5, regardless of the QOB (5Q1, 5Q2, 5Q3, 5Q4), and mothers of children born in the last three quarters reporting being 6 at the survey date (6Q2, 6Q3, 6Q4)[9]. Table 2.1, in Chapter 2, depicts the probability of being five-years-old on April 1st for each of these children, assuming that the ACS is given uniformly across quarters throughout the respective calendar year[10].

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[9]Four-year-olds born in the last three quarters (4Q2, 4Q3, 4Q4) are four years old on April 1st, regardless of the date of the interview. Their fifth birthday is definitively after April 1st. Likewise, six-year-olds born in the first quarter (6Q1) are definitively six-years-old by April 1st.

[10]According to the IPUMS, the ACS is a monthly rolling sample given throughout the respective calendar year with no different intensity across quarters.

According to these criteria, I select 20805 single mothers whose youngest child is a likely five-year-old, and 10538 single mothers who have a younger child in addition to the likely-five year-old. Table 3.5 presents the number of observations selected using each of the sample selection criteria.

Table 3.5. ACS Sample Selection

2005 Round	
Total num of obs	2878380
Total num of mothers	467973
Mother is the householder	197988
Mother is unmarried	103441
Mother is not in the Armed Forces	103303
At least one child is 5 year old	10549
Mother's age <= 50	10481
The 5-year-olds is the youngest	7036
The 5-year-olds is not the youngest	3445

2006 Round	
Total num of obs	2969741
Total num of mothers	469750
Mother is the householder	201422
Mother is unmarried	104446
Mother is not in the Armed Forces	104323
At least one child is 5 year old	10542
Mother's age <= 50	10486
The 5-year-olds is the youngest	6954
The 5-year-olds is not the youngest	3532

2007 Round	
Total num of obs	2994662
Total num of mothers	471773
Mother is the householder	208398
Mother is unmarried	104445
Mother is not in the Armed Forces	104341
At least one child is 5 year old	10437
Mother's age <= 50	10376
The 5-year-olds is the youngest	6815
The 5-year-olds is not the youngest	3561

All Rounds	
Total num of obs	8842783
Total num of mothers	1409496
Mother is the householder	607808
Mother is unmarried	312332
Mother is not in the Armed Forces	311967
At least one child is 5 year old	31528
Mother's age <= 50	31343
The 5-year-olds is the youngest	20805
The 5-year-olds is not the youngest	10538

Note: Final number of obs selected=20805 and 10538.

APPENDIX A
EXTENSIONS TO THE MODEL OF CHAPTER 1

Introducing Informal Care to the Model

In this appendix, the non maternal care is subdivided into formal care F and informal care 1. This allows to explain why some fraction of working and eligible mothers decide to pass up the subsidy and also to explain the crowding out effect from informal to formal care that we might expect as a consequence of the subsidy.

For simplicity, let the quality of child care be determined by a linear production function $Q(L, F, I) = \alpha_L L + \alpha_F F + \alpha_I I$. The linear function implicitly assumes that only one type of non maternal care is used and that the quality associated with each care mode does not vary with the number of hours utilized of that mode. Relaxing these assumptions would not alter the qualitative results from the analysis. Let p_I represent the monetary representation of the shadow cost of informal care, where as a first approximation the informal care utilization is assumed to involve a transfer of consumption goods only. A more complete approach would include not only the monetary costs but also the value of the informal-caregiver's time into the maximization

program (See an example that focuses on the informal provider's time in Blau and Robins, 1988).

Assuming that the child's time constraint is not binding at the optimum, the mother chooses the non-maternal provider comparing the price per unit of quality of the formal care versus the price per unit of quality of the informal care, $\frac{(p-sD)}{\alpha_F} \gtrless \frac{p_I}{\alpha_I}$. If $\frac{p}{\alpha_F} < \frac{p_I}{\alpha_I}$, the mother chooses to use formal care only, even without the subsidy. On the contrary, if $\frac{p-s}{\alpha_F} > \frac{p_I}{\alpha_I}$, the mother chooses to use informal care only and does not take the subsidy up. If $\frac{p-s}{\alpha_F} < \frac{p_I}{\alpha_I} < \frac{p}{\alpha_F}$, the mother is induced to switch from informal to formal care as a consequence of the subsidy.

Overall, this implies that the price of formal care and the amount of the subsidy are irrelevant for the employment and child care decisions of eligible mothers who has reliable and cheap informal care available (i.e., mothers that face a low enough $\frac{p_I}{\alpha_I}$). This could introduce a "parameter heterogeneity" problem in the econometric specifications. That is, in a regression of labor market outcomes on child care subsidy measures, all of the child care subsidy coefficients should equal zero for mothers with low $\frac{p_I}{\alpha_I}$. If mothers in the sample with low $\frac{p_I}{\alpha_I}$ largely exceeded the rest of single mothers, analyzing the effect of child care subsidies on all single mothers could lead one to conclude that child care subsidies had little or no effect on labor outcomes, even if their effect on mothers with no access to cheap informal care were significant. Given the characteristics of the single mothers sample, however, it is unlikely that a majority of mothers can be classified as having reliable and cheap informal care available. Nevertheless, in future work I plan to test the sensitivity of my results with this respect.

APPENDIX B
ANALYSIS OF THE CASES PRESENTED IN CHAPTER 1

B.1 Basic Model

We can characterize the optimal solution to the conceptual model presented in Section 1.4 by analyzing equation (1.14), which is repeated below for completeness

$$\underbrace{\frac{U_L + U_Q[Q_L - Q_N]}{U_C}}_{=MRS_D} \gtrless w - p + sD - \frac{\theta_2 wD}{\theta_1}$$

This equation represents the comparison that the mother makes between the Marginal Rate of Substitution (MRS_D) and the net wage (net of child care cost) at the optimum. There are (eventually) five cases, depending on the hourly wage rate w of the mother (holding tastes, productivities and all other parameters constant. See Table B.1). Some combination of parameters could rule out some cases. For example, extremely strong preferences for leisure could lead to no case V. Extremely strong preferences for consumption could lead to no case 1. Hence, the analysis assumes there is a combination of parameters that yields optimal solutions for each case.

Case I: Not induced to work (w_1 too low), subsidy is not taken (see Figure 2). At w_1, the effective wage under the subsidy regime $w_1 - p + s$ is not

Table B.1. Optimal Solution to the Model- Cases

Case	Segment	Description	Subsidy is Taken?	Induced to Work?	Δ in hours worked
I	AC	Not induced to work	No	No	0
II	AC	Induced to work	Yes	Yes	+
III	AC	Already working	Yes	No	+ or - (S.E. vs. I.E.)
IV	AC	Eligibility limit binding	Yes	No	- (to become eligible)
V	DB	Eligibility limit too restrictive	No	No	0

enough to induce the mother to work. $D = 0$: $w_1 - p < w_r \Rightarrow L^0 = 1$, $MRS_0(C^0 = A, L^0 = 1, D = 0) \equiv MRS_0(Z_I) > w_1 - p$.$D = 1$: $w_1 - p + s < w_r \Rightarrow L^1 = 1 \Rightarrow$, $MRS_1(C^1 = A, L^1 = 1, D = 1) \equiv MRS_1(Z_I) > w_1 - p + s$.

Case II: Induced to work, Eligibility Limit not binding, subsidy is taken (see Figure 1). At w_2 we get $w_2 - p + s > w_r$ and thus, the mother is induced to work. $D = 0$: $w_2 - p < w_r \Rightarrow L^0 = 1$, $MRS_0(C^0 = A, L^0 = 1, D = 0) \equiv MRS_0(Z_I) > w_2 - p$. $D = 1$: $w_r < w_2 - p + s \Rightarrow L^1 < 1$, $w_2(1 - L^1) + A < E \Rightarrow \theta_2 = 0 \Rightarrow MRS_1(Z_{II}) = w_1 - p + s$.

Case III: Already working, Eligibility Limit not binding, subsidy is taken (see Figure 2). At w_3, the mother works $1 - L_0$ hours without the subsidy and $1 - L_1$ hours with the subsidy. In Figure 2, $L_1 < L_0$, but the effect on hours worked depends on whether substitution effect $\lessgtr$ income effect. The limit E is not binding at Z_1. $D = 0$: $w_r < w_3 - p \Rightarrow L^0 < 1$, $MRS_0(Z_0) = w_3 - p$. $D = 1$: $w_r < w_3 - p + s \Rightarrow L^1 < 1$, $w_3 H^1 + A < E \Rightarrow \theta_2 = 0 \Rightarrow MRS_1(Z_1) = w_3 - p + s$.

Case IV: Hours worked reduced to become eligible, Eligibility Limit binding, subsidy is taken (see Figure 3). At w_4, the optimal number of hours worked with the subsidy would be $1 - L_1'$, however, the eligibility limit is binding and thus the

mother chooses to work $1 - L_1 < 1 - L_1'$. It is still worth it to take-up the subsidy ($V_0 < V_1$). $D = 0$: $w_r < w_4 - p \Rightarrow L^0 < 1$, $MRS_0(Z_0) = w_4 - p$. $D = 1$: $w_r < w_4 - p + s \Rightarrow L^1 < 1, w_4 H^1 + A = E \Rightarrow \theta_2 > 0 \Rightarrow MRS_1(Z_1) < w_4 - p + s$.

Case V: The mother prefers to be not eligible (w_5 too high), subsidy is not taken (see Figure 3). At w_5, the eligibility limit is too restrictive. The mother should reduce the hours worked too much to keep being eligible. As a result, it is optimum to pass up the subsidy ($V_0 > V_1$). $D = 0$: $w_r < w_5 - p \Rightarrow L^0 < 1$, $MRS_0(Z_0) = w_5 - p$. $D = 1$: $w_r < w_5 - p + s \Rightarrow L^1 < 1, w_5 H^1 + A = E \Rightarrow \theta_2 > 0 \Rightarrow MRS_1(Z_1) < w_5 - p + s$, $V(Z_0) > V(Z_1)$.

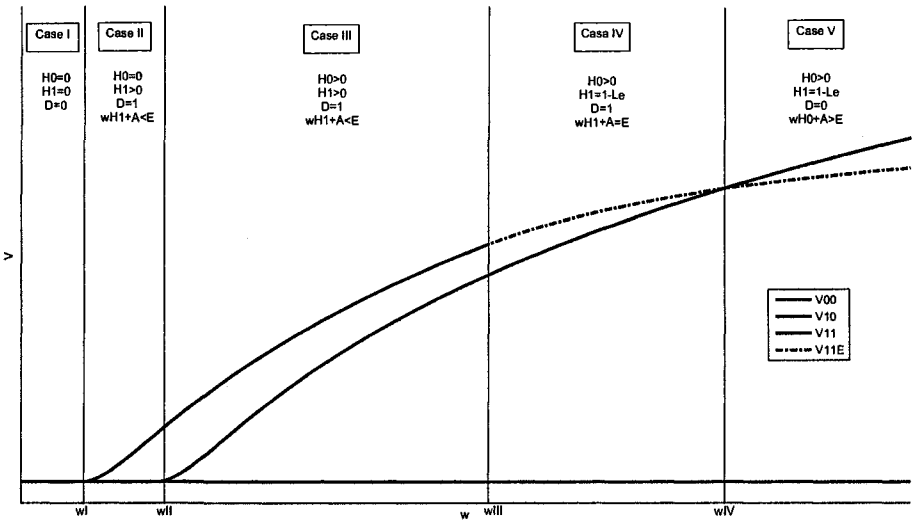
B.2 Indirect Utility

Figure 9 depicts the indirect utility functions of not working ($V00$), working and not taking the subsidy up ($V10$) and working and taking the subsidy up ($V11$ when the limit is not binding, $V11E$ when it is binding).

The cutoff points that divide the figure in the five cases mentioned before are given by:

w_I is the hourly wage rate that equals the effective wage (i.e., wage rate net of hourly price of non maternal care) under the subsidy regime $w_I - p + s$ to the MRS evaluated at ($C = A, L = 1$), i.e., the reservation wage w_r. Any $w > w_I$ makes working under the subsidy regime ($V11$) to be more attractive than not working at all

Figure 9. Effect of a Child Care Subsidy on Work Effort- Indirect Utility



($V00$). Hence, w_I solves

$$\begin{aligned} w_I - p + s &= w_r \qquad \text{(B.1)} \\ &= \frac{U_L + U_Q(Q_L - Q_N)}{U_C}_{C=A,L=1} \\ w_I &= \frac{U_L + U_Q(Q_L - Q_N)}{U_C}_{C=A,L=1} + p - s \end{aligned}$$

$\mathbf{w}_{II}$ is the hourly wage rate that equals the effective wage without receiving the subsidy $w_I^* - p$ to the reservation wage w_r. Any $w > w_{II}$ makes working without receiving ($V10$) to be more attractive than not working at all ($V00$). Hence, w_{II} solves

(note that $w_I < w_{II}$)

$$\begin{aligned} w_{II} - p &= w_r \\ &= \left.\frac{U_L + U_Q(Q_L - Q_N)}{U_C}\right|_{C=A,L=1} \\ w_{II} &= \left.\frac{U_L + U_Q(Q_L - Q_N)}{U_C}\right|_{C=A,L=1} + p \end{aligned} \tag{B.2}$$

$\mathbf{w}_{III}$ is the hourly wage rate that equals the effective wage under the subsidy regime $w_{III} - p + s$ to the MRS evaluated at the eligibility limit E ($C = C_E(w_{III}), L = L_E(w_{III})$, where $C_E = w_{III}(1 - L_E) + A$ and $L_E = 1 - (E - A)/w_{III}$ such that $w_{III}(1 - L_E(w_{III})) + A = E$). Any $w > w_{III}$ makes the eligibility limit E to be binding at the optimum under the subsidy regime and so, as w increases L_E increases, which means that mothers reduce the hours worked to stay eligible for the subsidy. w_{III} solves

$$w_{III} - p + s = \left.\frac{U_L + U_Q(Q_L - Q_N)}{U_C}\right|_{C=C_E(w_{III}),L=L_E(w_{III})} \tag{B.3}$$

By normality of C and L, we know that $MRS(C = A, L = 1) < MRS(C = C_E(w_{III}), L = L_E(w_{III}))$. Hence, $w_{II} < w_{III}$.

$\mathbf{w}_{IV}$ is the hourly wage rate that equals the indirect utility of working and not receiving the subsidy ($V10$) with the utility of working, receiving the subsidy and constraining the hours worked to comply with the eligibility limit ($V11E$). In the $V10$ case, the mother freely chooses the optimal number of hours worked such that $MRS(C0, L0, D = 0) = w_{IV} - p$, whereas in the $V11E$ case she has to restrict the hours worked such that $w_{IV}(1 - L_E(w_{IV})) + A = E$ and thus,

$MRS(C_E(w_{IV}), L(w_{IV}), D = 1) < w_{IV} - p + s$. Formally, w_{IV} solves

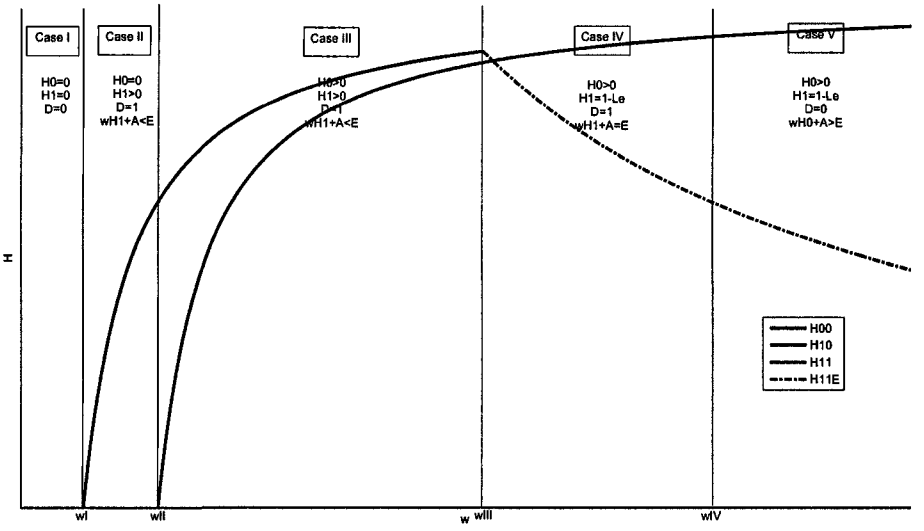
$$V(C0(w_{IV}, .), L0(w_{IV}, .), Q(w_{IV}, .)) = V(C_E(w_{IV}, .), L_E(w_{IV}, .), Q(w_{IV}, .)) \quad \text{(B.4)}$$

Since previously $MRS(C = C_E(w_{III}), L = L_E(w_{III})) = w_{III} - p + s$ and now $MRS(C = C_E(w_{IV}), L = L_E(w_{IV})) < w_{IV} - p + s$, by normality of C and L we know that $w_{III} < w_{IV}$.

B.3 Hours Worked

Figure 10 depicts the hours worked at different w, according to the same cutoff points presented in Figure 9. As mentioned before, the positive range of hours worked under the subsidy regime starts at w_I whereas the positive range without the subsidy starts at w_{II}. Case II represents mothers that are induced to work positive hours due to the subsidy. Case III shows the effect on hours worked for mothers who are already working without the subsidy. In this figure, it is assumed that the substitution effect of a effective wage increase is greater than the income effect, such that Case III shows an increase on hours worked under the subsidy regime. Hours worked decrease after w_{III} under the subsidy regime because the eligibility limit is binding and thus an increase in w has to be compensated with a decrease in H_1, such that $wH_1 + A = E$ holds. Beyond w_{IV}, it is better to become non-eligible and work more than stay eligible and restrain hours worked.

Figure 10. Effect of a Child Care Subsidy on Work Effort- Hours Worked



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