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ABSTRACT

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This paper provides a comprehensive analysis of employment and child care payment decisions of single mothers in the early post-welfare reform environment, using data from the National Survey of America's Families (NSAF). I develop and estimate a model that examines the effects of the price of child care and the wage rate on employment decision as well as the decision to use paid child care among single mothers. The model distinguishes between the full-time and part-time employment decisions as well as the prevailing wages in these two employment markets. A semi-parametric random effects estimator and the Gaussian Quadrature are used together to estimate the system of equations for the discrete outcomes of full-time and part-time employment, and child care payment, and the linear equations of the price of child care, and part-time and full-time wages in a unified framework. The econometric model also controls for the endogeneity of child care subsidy receipt and adjusts the hourly price of child care for the amount of subsidy for mothers who receive one. The results show that full-time working mothers are more sensitive to the price of child care than part-time working mothers. A lower price of child care leads to increases in overall employment and the use of paid child care. However, much of the increase in employment is in the form of full-time employment. An increase in the full-time wage rate leads to increases in overall employment and the use of paid child care. The effects of full-time wage rate are estimated to be much larger than those of the price of child care. Part-time wage effects are found to be so small to have significant implications.

JEL Classification: J13, C14, J23

Keywords: child care, employment, wages, child care subsidies

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I. Introduction

The 1996 Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA), commonly known as the welfare reform legislation, marks a cornerstone in the U.S. welfare policy. The primary goals of the PRWORA were to increase employment and reduce welfare dependence among economically disadvantaged population. In order to facilitate the transition from welfare to employment and help low-income families maintain economic self-sufficiency, the new law streamlined the child care assistance system by consolidating four main child care subsidy programs into a single block grant, the Child Care Development Fund (CCDF), and increased child care funding substantially.[1] Under the new law, states were given unprecedented flexibility to design and conduct their own child care assistance programs. As part of this general flexibility, states were given permission to transfer up to 30 percent of their Temporary Assistance to Needy Families (TANF) funds into the CCDF, and to spend additional TANF funds directly for child care assistance.[2] These changes have placed child care at the center stage of the welfare reform debate as policymakers view child care subsidies as an important tool for the success of welfare reform. Five years after the enactment of welfare reform, the public and congressional attentions are now focused on the reauthorization of welfare reform, and child care remains one of the most important items in the reauthorization agenda.

The objective of this paper is to use data from the early post-welfare reform period to examine the effects of the price of child care and wages on part-time and full-

[1] The main reason for consolidating the four funding streams was to eliminate the fragmentation and help create a "seamless" system, which would be easier for families to access and for administrators to manage. See Blau (2000) and Blau and Tekin (2001) for reviews of the child care system under welfare reform.
[2] In 1999, states spent all of their CCDF allotment of 6 billion dollars and transferred another 4 billion dollars from TANF into CCDF.

time employment decisions, as well as the decision to use paid child care among single mothers. Despite the increased public and legislative attentions on child care, there are still gaps in our knowledge regarding the responses of single mothers to the price of child care, the wage rate, and child care subsidies. It is of important policy relevance to provide insights into the effects of the price of child care on employment behavior because child care costs are often considered as a significant barrier to the labor force involvement of low income mothers. Although it has been well documented in the literature that the cost of child care serves as a deterrent to the employment of mothers, most of this literature pertains to married mothers and the evidence on single mothers is less conclusive. This study focuses on single mothers because they are the main target group for welfare reform.[3] Single mothers also constitute an increasingly large portion of all mothers with young children.[4] Furthermore, the labor force participation rate for single mothers has risen dramatically over the past two decades, from 52 percent in 1980 to 74 percent in 2000, and outpaced the growth in the rate of married mothers (Census Bureau).[5] This trend is likely to accelerate further as these mothers start hitting the time-limit on welfare receipt imposed under welfare reform. An obvious implication of these events is an increase in the demand for child care among single mothers. Therefore, the issue of providing affordable child care for single mothers trying to get off welfare and for those trying to sustain employment is central to the welfare reform challenge.

It is equally important to investigate the impacts of wages on single mothers' behavior in order to understand the implications of different policy options on the success

[3] Over 90 percent of the TANF cases in 1998 were single mothers (Committee on Ways and Means, 2000).
[4] According to Census data, about 18 percent of families with children were headed by a single mother in 1996, compared with less than 11 percent in 1970.
[5] The labor force participation rate for married mothers increased from 54 percent to 70.6 percent during the same period.

of welfare reform. Because the primary goals of welfare reform are to reduce welfare dependence and increase employment, policies designed to increase the effective wage rate, such as a wage subsidy like the Earned Income Tax Credit (EITC), the minimum wage, training programs, and other skill and career development packages offered by states may contribute to these goals or can be considered as an alternative to child care subsidies.

Another contribution of this study stems from the use of a data set from the early post-reform period. The great majority of existing studies use data that predate welfare reform and other important policy changes of 1990's. However, the scope of the policy changes during this period is so large that drawing inferences on the post-welfare reform period by using the estimates from these studies may be misleading. In this paper, I use data from the National Survey of America's Families (NSAF), conducted in 1997. Another key advantage of the NSAF is that it is the only available nationally representative survey with information on child care subsidies.

I develop and estimate a behavioral model for the choices of part-time and full-time employment decisions, as well as the decisions to pay for child care and receive a child care subsidy. One innovation of the model is that it controls for the endogeneity of child care subsidy receipt and adjusts the price of child care for the amount of subsidy for those mothers who receive one. This allows me to avoid assigning incorrect child care prices to those mothers who receive a subsidy. I calculate the hourly subsidy rate and determine a mother's eligibility for a child care subsidy using the state program rules and family characteristics. Previous studies could not address this issue because of a lack of data on the receipt of a child care subsidy. The empirical strategy accounts for the fact that these decisions are made simultaneously. A multinomial choice model of the discrete outcomes are estimated jointly with the linear wage equations for part-time and full-time employment, and the price of child care, using a combination of a semi-parametric random effects estimator and the Gaussian Quadrature. This strategy allows me to control for correlation across the discrete outcomes and the linear equations and to account for wages and child care price when they are not observed.

The estimation results show that both the price of child care and the wages influence the behavior of single mothers in the directions that are predicted by the economic theory. Specifically, a decrease in the price of child care increases employment and the use of paid child care. Similarly, an increase in the full-time wage rate raises overall employment and the use of paid child care. The effect of the part-time wage rate is estimated to be much smaller than the effect of the full-time wage rate. The results also reveal that single mothers who are employed full-time are more sensitive to the price of child care than those who are employed part-time. The full-time wage effect is estimated to be a stronger determinant of employment and paid child care than the price of child care. Finally, simulation results suggest that policies which increase the effective wage rate are likely to have significant effects on both employment and the use of paid child care if they are targeted on full-time employment.

The remainder of the paper is organized as follows. Section two reviews the literature relevant to this study. Section three describes the theoretical model and discusses the econometric approach. Section four describes the data set. Empirical results are discussed in section five. Finally, section six presents the concluding remarks and policy implications.

II. Previous Literature

There is a large body of literature examining the links between the child care price, the wage rate, and employment behavior of mothers with young children. The primary motivation of this literature is to provide insights into the impacts of child care and wage subsidies on employment and child care payment decisions. These studies consistently find that a lower child care price is associated with higher probabilities that a mother will work and pay for care, and a higher wage rate is associated with higher probabilities that she will work and pay for care. Although a consensus appears to have emerged regarding the presence of an effect, there is no agreement in the literature on the magnitude of the relationship.[6] Also, only a small fraction of this literature focuses on single mothers, the main target group for welfare reform. The existing studies differ in their data sources, sample compositions, specifications, and estimation methods. However, sample compositions and data sources are unlikely to account for much of the large variation that exists in the estimated price elasticity because the range of estimates is still large within studies using the same data set and similar sample compositions (Kimmel 1998; Blau 2000). Therefore, it is likely that specification and estimation issues cause much of this variation.

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[6] Estimated price elasticities range from 0.06 to –1.26. Examples for married mothers and combinations of both married and single mothers include –0.34 (Blau and Robins 1988), -0.74 (Ribar 1992), -0.20 (Blau and Hagy 1988), -0.92 (Kimmel 1998), -0.20 (Connelly 1992), -0.78 (Averett et al. 1997), -0.30 (Anderson and Levine 2000), -0.19 (Han and Waldfogel 1999), -0.16 (Michalopoulos and Robins 2000), -1.26 (Hotz and Kilburn 1994), 0.06 for high income and –0.45 for low-income (Fronstin and Wissoker 1995), 0.04 (Blau and Robins 1991). For single mothers, researchers found zero (Connelly 1990; Michalopoulos et al. 1992), -0.22 (Kimmel 1998), –0.47 (Anderson and Levine 1999), -0.41 (Han and Waldfogel 1999), and –0.37 for part-time employment and –1.22 for full-time employment (Connelly and Kimmel 2000). A review of the literature on the relationship between the price of child care and employment can be found in Anderson and Levine (2000) and Blau (2000). Chaplin et al. (1999) review the literature on the effect of the price of child care on the type of care chosen by mothers.

Previous studies exclusively rely on data that predate welfare reform and other important policy changes of 1990's. However, the 1996 welfare reform changed the systems of welfare and child care assistance fundamentally. For example, the pre-reform system placed less emphasis on moving welfare participants into employment. A mother might have been able to turn down a child care subsidy offer before welfare reform and remain out of the labor force without losing her welfare eligibility (Blau and Tekin 2001). A mother who turned down a subsidy today would be more likely to lose welfare eligibility. Therefore, the results of the studies conducted in the pre-reform period will not necessarily be a reliable guide to the behavior in the post-reform era.

Most of the previous literature investigated the discrete "yes" or "no" employment decision.[7] However, it is important to recognize that child care utilization is likely to differ between part-time and full-time employment due to different attractiveness and transactions costs associated with each type of work.[8] Therefore, child care price and wages may have different effects on part-time and full-time employment. Furthermore, there is vast evidence in the labor demand literature, which suggests that wages are determined separately in part-time and full-time employment markets. For example, if workers sort themselves into different markets based on their preferences and skills, there would exist wage differentials between the two groups even under identical wage determination mechanisms. Alternatively, wages may be determined separately under the dual labor market theory, which categorizes the labor market into high-wage

[7] Exceptions include Michalopolos et al. (1992) and Averett et al. (1997) who estimated hours of work equations for married mothers; and Powell (1998) (for married mothers), Michalopoulos and Robins (2000) (for married mothers) and Connelly and Kimmel (2000) (separately for married and single mothers) who analyzed the part-time and full-time employment choices.
[8] For example, Blank (1988) reports that female heads of households face significant fixed costs of work.

and low-wage categories.[9] Therefore, wages should be estimated separately for the two employment sectors. This paper is the first in the child care literature to pay attention to this issue. Consequently, part-time and full-time wages in the two markets are estimated and their effects are assessed separately.

Most of the previous studies estimate the discrete employment decision by probit. They predict the price of child care and the wage rate from regression models that are estimated separately from the employment model, using samples of employed mothers and those who pay for child care. Both the child care price and the wage equations are corrected for potential sample selection bias. However, little research has addressed that the employment decision is made simultaneously with other decisions, such as the decision to pay for child care and receive a child care subsidy. One important exception is Blau and Hagy (1998) who extended the literature by conducting a joint analysis of employment, child care payment, and the choice of mode decisions of mothers, using a multinomial choice model. They found the elasticity of employment with respect to price of child care to be –0.20 and the elasticity of paying for care to be –0.34. The present study contributes to the literature by analyzing the part-time and full-time employment decisions, and the decisions to pay for child care and to receive a child care subsidy in a unified framework. This is also the first study in the literature to estimate the supporting wage and child care price equations jointly with the discrete outcomes.

Previous studies rely on several sources of variation to identify the effect of the price of child care. The most common approach uses the variation in child care costs across households (e.g. Powell 2002; Kimmel 1998; Connelly and Kimmel 2000;

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[9] See Cain (1976) and Dickens and Lang (1985) for more on the dual-labor market theory. Also, see Hotchkiss (1991) for more on the unique determination of wages in part-time and full-time employment sectors.

Anderson and Levine 2000). Some studies use the variation in child care workers' wages (e.g. Barrow 1996; Han and Waldfogel 1999) and others take a natural experiment approach by comparing the employment outcomes of mothers who are exogenously separated into different groups (e.g. Berger and Black 1992; Gelbach 1999). This study uses the variation in household expenditure on child care to construct market level prices of child care, where a market is defined by a geographic state. Thus, the child care cost varies only by state of residence and not across individuals.

The vast majority of previous studies evaluate the impact of child care subsidies by estimating the effect of child care price on employment of mothers. However, there may be substantial costs to taking up a subsidy, either in the form of time costs required to negotiate the subsidy bureaucracy or psychic costs (stigma) of participating in a means-tested program. If this is the case, the receipt of a child care subsidy is endogenous and a failure to account for this endogeneity would create biased estimates of the impact of child care subsidy receipt.[10] Receiving a child care subsidy is not an option for non-eligibles and all eligibles do not receive the same amount of subsidy. The previous literature failed to address this issue mainly because of a lack of data on child care subsidies. The NSAF data used in this study provide information on the receipt of a child care subsidy. Therefore, the decision to receive a subsidy can be incorporated into the mother's choice set, and consequently, the price of child care can be adjusted for the amount of subsidy for those mothers who receive one.

[10] This is a problem similar to non-participating eligibles in welfare or Food Stamp programs. See Moffitt (1983) and Fraker and Moffitt (1988) for examples of such studies.

III. Theoretical Model and Empirical Strategy

The behavioral model follows the tradition of a single decision-maker framework. The discrete choices facing a single mother with a child are: (1) whether to work, and conditional on working, whether to work part-time or full-time; (2) whether to use paid child care; and (3) whether to use a child care subsidy. I introduce a categorical variable, I, defined by a cross-classification of the discrete alternatives available to each mother. It can take on the values 1,….,J, where J is the total number of alternatives.

A single mother maximizes her utility from time at home (L), quality of her children (Q), consumption of market goods (C), unpaid child care hours (H_{NP}), and the categorical variable (I). The utility function can be expressed as

$$U = U(L, Q, C, H_{NP}, I; \mathbf{X}, \upsilon_1), \tag{1}$$

where $\mathbf{X}$ and υ_1 are the observed and unobserved determinants of preferences, respectively.[11] A mother may derive disutility from receiving a child care subsidy, using a paid child care arrangement, or being employed due to fixed costs associated with each of these individual choices or combinations of them. For example, there may be direct disutility from receiving a child care subsidy as a result of stigma. The discrete choice indicator (I) is included in the utility function in order to represent these fixed utility costs.[12] It can influence utility directly and indirectly by interacting with other variables in the utility function. I assume that a child care subsidy can only be received if a mother

[11] There may be indirect costs associated with the use of unpaid services (such as the value of the care provider's time in alternative activities), and these costs may influence the mother's decision as to whether to utilize paid care or unpaid care. Including unpaid child care hours in the utility function captures these indirect costs. Specifically, incorporating unpaid child care hours in the utility function allows for the possibility that a mother would choose a paid child care arrangement when an unpaid alternative with the same quality is available. If unpaid child care hours are omitted from the utility function, the model would lead to a degenerate solution in which the mother uses only unpaid care, which is inconsistent with the data.
[12] See Blau and Hagy (1998) for a similar approach.

is employed and her income is below the income eligibility limit.[13] I also assume that paid child care can only be used if a mother is employed.[14] Following these assumptions, there are (a maximum of) seven discrete alternatives available to a single mother. A complete list of possible alternatives is presented in Table 1.

Child quality is the outcome of a production process with the inputs of unpaid child care time (H_{NP}), paid child care time (H_P), the mother's time at home (L), and the quality of purchased child care (A). The quality production function can be expressed as

$$Q = Q(H_{NP}, H_P, L, A; \mathbf{X}, \upsilon_2), \tag{2}$$

where $\mathbf{X}$ and υ_2 are the observed and unobserved determinants of quality, respectively.

A child is cared for by his/her mother during the mother's leisure hours, and receives care from paid and unpaid sources during her work hours. The time constraints facing a mother and her child are as follows:

$$\mathrm{L} + \mathrm{H} = \mathrm{L} + \mathrm{H}_{\mathrm{NP}} + \mathrm{H}_{\mathrm{P}} = 1, \tag{3}$$

where H is the mother's number of work hours; H_{P} and H_{NP} are paid and unpaid child care hours, respectively. I limit the employment choices to (i) no work, (ii) part-time work, and (iii) full-time work. This approach simplifies the labor supply decision to a multinomial choice problem and avoids the difficulties of dealing with a highly nonlinear budget constraint. The budget constraint that the mother faces depends on the alternative chosen, and is displayed in Table 1. It incorporates the cost of child care, $P_s H_P$, if she uses paid care, where P_s is the hourly price of child care in market s; labor income from

[13] The law requires parents to be employed or attending a job training or educational program to be eligible for a child care subsidy. Some of the non-employed mothers in the sample may be using a child care subsidy if they attend a training or educational program. Given that the focus of the paper is employment decision, I eliminate the possibility of subsidy receipt for non-employed mothers.

[14] This assumption is necessary because of data limitations since child care information is available only for employed mothers. It is reasonable to assume that the use of paid care among non-employed single mothers is rare since these individuals tend to live in low-income households, and the mother is the primary child care provider most of the time.

part-time employment, $W_{PT}H$, if she is employed part-time, where W_{PT} is the part-time wage rate; labor income from full-time employment, $W_{FT}H$, if she is employed full-time, where W_{FT} is the full-time wage rate; and the amount of the child care subsidy, S_sH_P, if she uses one (conditional on being eligible for one), where S_s is the hourly subsidy rate in market s.

The mother maximizes her utility subject to her quality production, budget, and time constraints, along with the appropriate non-negativity constraints. The outcome of interest is I, the discrete choice indicator. For a given value of I, the utility function can be maximized with respect to L, C, H_{NP}, H_P, and A, and then the demand functions can be substituted into the utility and quality production functions. By substituting the quality production function into the utility function, one can obtain the alternative-specific indirect utility function for a given value of I as a function of the explanatory variables in the system. A linear approximation to the indirect utility function for alternative i yields the following equation

$$V_i = \mathbf{X}\,\beta_i + \alpha_{Pi}P_s^* + \alpha_{PTi}\,W_{PT} + \alpha_{FTi}\,W_{FT} + \varepsilon_i, \qquad i=1,\ldots,J \tag{4}$$

where ε_i is the alternative specific disturbance, **X** is a vector of observed determinants that are invariant to the alternative chosen (e.g. age, non-wage income, etc.), and the β's and α's are the parameters. The α's are allowed to differ by employment type and child care payment status.[15] The price of child care used in equation (4) is adjusted for the amount of child care subsidy for eligible mothers who receive a subsidy. Specifically, for each of the discrete choices available to a mother, eligibility for a child care subsidy is determined by a comparison between the mother's income and the state income threshold

[15] Blau and Hagy (1998) and Michalopoulos and Robins (2000) also use specifications that allow varying effects of price and wage on behavior.

for subsidy eligibility. Income is the sum of non-wage income and the labor income from part-time or full-time employment depending on mother's type of employment.[16] Note that incomes from all three employment alternatives (no-work, part-time work, and full-time work) are required for each mother in order to be able to determine eligibility in each of these employment types. There are three possible scenarios to consider for a mother. In the first scenario, the mother is not eligible for a child care subsidy regardless of her employment type. Thus, alternatives 2 and 5 from Table 1 are excluded from her choice set. In the second scenario, she is eligible for a subsidy only when she is employed part-time. Thus, alternative 5 is excluded from her choice set. In the third scenario, she is eligible for a subsidy regardless of her employment type. In this case, all seven alternatives are relevant to the mother. Therefore, the total number of alternatives available to a mother, J, can be five, six, or seven, depending on which of the three scenarios is relevant for her. Consequently, the hourly rate of subsidy is subtracted from the hourly price of child care for those alternatives in which the mother uses a subsidy.[17] Therefore, P_s^* is equal to $P_s - S_s$ in alternatives 2 and 5 and is equal to P_s otherwise (See Appendix A for a detailed description of these three scenarios).

The theoretical model implies that a higher price of child care reduces the utility in alternatives in which a mother uses paid child care and it does not affect the utility in other alternatives (i.e., α_{P2}, α_{P4}, α_{P5}, $\alpha_{P7}<0$; $\alpha_{P1}=\alpha_{P3}=\alpha_{P6}=0$); a higher part-time wage increases the utility in alternatives in which a mother works part-time and it does not

[16] Labor income from part-time (full-time) employment is calculated by multiplying the part-time (full-time) wage rate by the average number of part-time (full-time) hours worked per year in the sample. The wage rates used in this calculation are predicted from regression models that are corrected for selection into both labor force and part-time/full-time employment types.

[17] The subtraction of S_s from P_s is indicated by the theoretical model and is illustrated in Table 1. The child care subsidy rate is the hourly rate if the state sets an hourly level. If the subsidy amount is set daily (weekly), average hourly rate is calculated by dividing the daily (weekly) level by eight (forty).

affect the utility in other alternatives (i.e., α_{PT2}, α_{PT3}, α_{PT4}>0; α_{PT1}= α_{PT5}=α_{PT6}= α_{PT7}=0); a higher full-time wage increases the utility in alternatives in which a mother works full-time and it does not affect the utility in other alternatives (i.e., α_{FT5}, α_{FT6}, α_{FT7}>0; α_{F1}= α_{F2}=α_{F3}= α_{F4}=0); and a higher child care subsidy increases the utility in alternatives in which a child care subsidy is received and it does not affect the utility in other alternatives (i.e., α_{P2}, α_{P4}< 0; α_{P1}, α_{P3}, α_{P5}, α_{P6}, α_{P7} = 0).[18]

Letting i= 1,…..,J be the possible alternatives from the choice set, it will be optimal for a mother to choose state i if

$V_i > V_j, \quad \forall\, j \neq i$ or

$$\varepsilon_i - \varepsilon_j > \mathbf{X}(\beta_j - \beta_i) + P_s^*(\alpha_{Pj} - \alpha_{Pi}) + W_{PT}(\alpha_{PTj} - \alpha_{PTi}) + W_{FT}(\alpha_{FTj} - \alpha_{FTi}), \quad \forall\, j \neq i, \qquad (5)$$

Given the discrete nature of the alternatives, a multinomial choice model is used to estimate equations (4) and (5). In addition to the multinomial choice model, there are three linear auxiliary equations, two for the wage rates (for part-time and full-time employment) and one for the price of child. Estimating these equations is necessary for two reasons. First, these variables may be endogenous. Second, one needs to assign a child care price and two wage rates to each mother in the sample regardless of her child care payment and employment status in order to estimate the multinomial choice model.

The price of child care is observed only for mothers who are employed and pay for child care, and this may be a self-selected sample. Further, the price is not exogenous because it depends in part on the quality of care purchased. Specifically, the price of

[18] It can be argued that the price of child care affects a mother's decision by lowering her wage rate. In this case, the coefficients of the price of child care and the wage rates should be equal to each other in magnitude, but with opposite sign. The specification in equation (4) is more general and does not impose this restriction. See also Blau and Hagy (1998) and Michalopoulos and Robins (2000) for similar approaches.

child care is determined by the quality of purchased care, A, and the market specific characteristics that capture the variation in the price of child care caused by differences in conditions across different markets. In the absence of data on quality attributes of care, the demand function for the quality of purchased care can be derived as a function of all exogenous variables in the model by solving the first order conditions to the optimization problem. Therefore, the variation in the quality of child care can be captured by household variables. The market specific price variation on the other hand, can be captured by cross-state variation under the assumption that each geographic state constitutes a separate child care market. This cross-state variation captures the variation in the price of child care caused by differences in market conditions and is assumed to be independent of the choices made by the mothers. This results in a fully reduced form price equation in the following form

$$P_s = \sum_{s=1}^{S} \delta_s D_s + \mathbf{X}\, \delta_P + \xi_P, \tag{6}$$

where $\mathbf{X}$ is the set of all exogenous variables in the model, the δ_P's are the parameters, and ξ_P is the disturbance term. D_s is a binary indicator for residence in state s, and S is the total number of states. δ_s is the state specific intercept. Then the quality-adjusted exogenous price of child care can be constructed from the fitted values, holding $\mathbf{X}$ constant at the sample means.

In order to identify the child care price coefficient in the multinomial choice model, α_{Pi}, one must have at least one variable in the price equation (eq. 6) that does not affect the mother's preferences (eq. 4). However, as described above, the child care price function is a fully reduced form equation, thus it contains all the exogenous variables in the model. This implies that the only theoretical basis for identification of the child care price coefficient is the intercept term in equation (6), $\Sigma^S{}_s\delta_s D_s$. Therefore, I rely on state fixed effects to identify the child care price effect in equation (4). Using the set of state dummies as an identifying restriction implicitly assumes that a mother's residence of state has no direct effect on her preferences, but does help determine the price of child care.[19] Equation (6) is estimated jointly with the multinomial choice model, allowing ξ_P to be correlated with the ε_i's in equation (4). This strategy corrects for selection bias due to the possibility that mothers who use and pay for child care constitute a nonrandom sample of the population. The Gaussian Quadrature is used to account for missing prices by integrating over the distribution of error term in equation (6) for mothers who do not pay for child care (Butler and Moffitt 1982).[20]

Likewise, measures of a part-time and a full-time wage rate are required for each mother in the sample regardless of her employment status in order to estimate the multinomial choice model. Furthermore, observed wages may be endogenous. Wages are assumed to be a function of human capital, regional variation, and demand effects. Labor demand, as measured by the state unemployment rate and labor force participation rate for females, is used to identify the wage effects (α_{PTi} and α_{FTi}) in the multinomial choice model. These variables are included in the wage equation, but are excluded from the discrete choice model under the assumption that they have no direct effect on mothers' preferences. The wage equations for part-time and full-time employment are

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[19] Identification strategy assumes that the location affects preferences only via its effects on price. A more plausible alternative would be to rely on within-state variation by using county dummies as identifying instruments, assuming that each county is a different child care market rather than the state. However, this would add a large number of parameters to the model, which would be computationally infeasible to estimate. Further, county information is available only for the 13-targeted states in the NSAF.

[20] The Gaussian Quadrature allows me to estimate the price and wage equations jointly with the multinomial choice model. See Appendix B for a description of the method and its implementation in the present context.

estimated jointly with the multinomial choice model, allowing for correlation across the disturbance terms. This strategy corrects for self-selection into the labor force as well as part-time and full-time employment sectors. Similar to the estimation of the child care price, the Gaussian Quadrature method is used to integrate over the distributions of the error terms in the part-time and full-time wage equations to account for the missing wages. Specifically, if the mother is not employed, the computation of a two-dimensional integration is required by the Gaussian Quadrature. If she is employed part-time or full-time, only one-dimensional Gaussian integration is necessary (See Appendix B for a detailed discussion).

Error Structure and Econometric Implementation

The possible correlation across disturbances in the indirect utility functions (the ε_i's) could produce biased estimates. Such a correlation is likely to occur because alternatives are defined by cross classifying the discrete outcomes available to a mother. For example, if a mother has strong preferences for work, this will affect the ε_i's in all the alternatives in which she is employed (alternatives 2-7). Similarly, if a mother has unobserved preferences for part-time (full-time) work, this effect will appear in all the alternatives in which she is employed part-time (full-time). Furthermore, the mothers who receive child care subsidies are a self-selected sample of the population. A mother's decision concerning whether to use a child care subsidy is likely to be correlated with her labor supply. For example, a mother with strong preferences for work may also have a higher motivation to use a child care subsidy. However, a multinomial logit model restricts the correlation among the disturbance terms to zero because of the independence of irrelevant alternatives assumption. A second source of error correlation would be between the discrete outcomes and the linear wage and child care price equations. For example, a mother who is strongly motivated for work may also have a higher wage rate. Further, a higher price of child care may induce a mother to use a child care subsidy or use unpaid child care.

To estimate the econometric model, I use a semi-parametric random effects estimator, known as the discrete factor model, which allows the error terms to be correlated across the discrete outcomes and the linear wage and child care price equations. The discrete factor model approximates the distribution of the heterogeneity with a step function and "integrates out" through a weighted sum of probabilities. Mroz (1999) shows that the discrete factor model provides more robust estimates when compared with techniques imposing a specific distributional assumption.[21]

To implement the discrete factor model, I impose the following structure on the disturbances in the equations for the discrete outcomes and the linear wage and child care price:

$$\varepsilon_i = u_i + \rho_i \eta, \tag{7}$$
$$\xi_P = \mu_P + \rho_P \eta, \tag{8}$$
$$\xi_{FT} = \mu_{FT} + \rho_{FT} \eta, \tag{9}$$
$$\xi_{PT} = \mu_{PT} + \rho_{PT} \eta, \tag{10}$$

where ξ_{FT} and ξ_{PT} are the error terms in full-time and part-time wage regressions, respectively. The u_i, μ's and η are mutually independent disturbances that are also

[21] In principle, one could estimate the system of equations by imposing a joint distribution, such as joint normality, for the sources of unobserved heterogeneity and integrating over its distribution. The problem with this approach is that it requires computing complex multiple integrals. Further, it requires making strong assumptions about the exact distribution of heterogeneity. See Blau and Hagy (1998), Hu (1999), and Mocan and Tekin (in press) for applications of the discrete factor model.

assumed to be independent of **X**, W_{PT}, W_{FT}, and P_s^*. The ρ's are factor loadings.[22] This structure places the restriction that all correlation among the error terms enters the model through the common factor η that is assumed to have a discrete distribution (Heckman and Singer 1984). The unobserved factor is then integrated out using the discrete factor model following Mroz (1999).

The equation for the discrete choice model (eq. 4), the price of child care (eq. 6), and two wage equations are estimated jointly by full information maximum likelihood (FIML), with discrete factors integrated out of the model using the discrete factor model. The Gaussian Quadrature method is also used in the estimation to integrate over the distributions of the disturbances for wages and price of child care when they are not observed. The u's in equation (7) are assumed to have mean zero and to be independently extreme-value distributed; the μ's in equations (8)-(10) are assumed to have mean zero and to be independently normally distributed. The likelihood function and details of the heterogeneity distribution are discussed in Appendix B.

IV. Data

The data used in the empirical analysis are drawn from the National Survey of America's Families (NSAF). The NSAF was conducted by the Urban Institute between February and November 1997.[23] The survey was conducted by telephone on a sample derived primarily from random-digit-sampling and was designed to help researchers

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[22] Rather than imposing a one-factor structure, it would be more plausible to consider for multiple factors to account for possibly a more complex structure of correlation (e.g. Blau and Hagy (1998), Mocan and Tekin (in press.)). I tried estimating the system of equations using multiple factors. However, given the complexity of the likelihood function, the optimization routine failed to converge and I had to switch to a single factor framework to obtain stable estimates.

[23] Another round of the NSAF was conducted in 1999, with a new sample. Complete data from the 1999 round have not yet been released to the public.

analyze the consequences of devolution of responsibility for social programs from the federal government to states. Residents of 13 states and households with income below 200 percent of the federal poverty line were over-sampled.[24] The full NSAF sample contains 44,461 households.

The NSAF is particularly well-suited for this study for several reasons. It was specifically designed to collect detailed information on income, child care, and participation in various programs, and to provide better data on such variables than can be obtained from most other surveys. It was conducted after the enactment of the welfare reform legislation and many other important policy changes of 1990's. Another advantage of the NSAF is that it is the only national household survey from the post-welfare period that contains information about child care subsidies. Unlike administrative data, the NSAF provides information on both subsidy recipients and non-recipients. Therefore, the potential endogeneity of child care subsidy receipt can be addressed. Finally, the NSAF provides a relatively large sample of single mothers, who are the target group for welfare reform.

The main variables of interest are employment, child care payment, and child care subsidy receipt. A mother who reports that part or all of her child care expenses are paid by a welfare or social services agency is coded as receiving a child care subsidy. Employment is specified as a trichotomous variable defined at zero hours of work, part-time work, and full-time work.[25] Child care payment status is a binary variable equal to one if the mother reported any payment for child care, and zero otherwise.

[24] The 13-targeted states were Alabama, California, Colorado, Florida, Massachusetts, Michigan, Minnesota, Mississippi, New Jersey, New York, Texas, Washington, and Wisconsin.
[25] Mothers with weekly work hours from 1 to 35 are classified as working part-time, and those with 35 and over are classified as working full-time. Similar definitions have been previously used in both the child care

The mother's wage rate is computed by dividing annual earnings by annual hours of work. In the NSAF, child care hours are collected for up to two randomly chosen children, one between ages 0-5, and the other between ages 6-12. Child care expenditures on the other hand, are collected for all children between ages 0-12. Therefore, the hourly child care expenditure per child can be approximated by dividing the total child care expenditures for all children between ages 0-12 by the sum of child care hours for all children between ages 0-5 (the product of the child care hours for the randomly chosen child between ages 0-5 and total number of children between ages 0-5) and child care hours for all children between ages 6-12 (the product of the child care hours for the randomly chosen child between ages 6-12 and total number of children between ages 6-12). However, this computation is not possible because the NSAF does not provide information on the number of children between ages 0-12. Rather, we know the number of family members between ages 0-5 and 6-17. In order to approximate the number of children between ages 6 and 12, I obtained the proportion of U.S. population between ages 6 and 12 among the population between ages 6 and 17 in 1997 from the U.S. Bureau of Census records. Then I multiplied this figure by the total number of family members between ages 6 to 17 for the mothers who have more than one child in this age range. Note that I do not need to make this adjustment for those cases with no randomly chosen child between ages 6-12 (i.e., the mother has no child between ages 6-12) or for those cases with a randomly chosen child between ages 6-12 and only one family member between ages 6-17 (i.e., the mother has only one child between ages 6-12,

literature (e.g. Michalapoulos and Robins 2000; and Connelly and Kimmel 2000) and transfer program literature (e.g. Fraker and Moffitt 1988; Hoynes 1996; and Keane and Moffitt 1998).

thus no adjustment is necessary). Only 28 percent of the single mothers in the sample have more than one child between ages 6-12.

The statute for federal eligibility criteria for a child care subsidy is that "eligible children must be under the age 13 and reside with a family whose income does not exceed 85 percent of the state median income for a family of the same size and whose parent(s) are working or attending a job training or educational program or who receive or need to receive protective services" (Child Care Development Block Grant 658E(c)(3)(B), 658P(4)). The federal law allows states to set up the eligibility criteria up to 85 percent of State Median Income, but only nine states set income eligibility at the 85 percent level and seven states set it at less than 50 percent level in 1997. I supplemented the NSAF data with information from other data sources on income eligibility limit, subsidy amounts, and median income for each state in year 1997. Data on income eligibility limit and subsidy amounts are obtained from the Child Care Bureau and the State Policy Demonstration Projects web sites. Data on state median income are obtained from the U.S. Census Bureau.

The other variables used in the analysis include the mother's age, non-wage income, race, ethnicity, and binary indicators for the mother's educational attainment, health status, the presence of children by age, and the region of residence. These variables are included in the model to control for mother's preferences and her quality of care. Non-wage income is the sum of household income from non-market sources. I also include the number of family members aged 25 and over to control for the availability of free care to the mother. Finally, I included the state dummies in the child care price equation, and the state's unemployment rate and the labor force participation rates for females in the wage rate equations for identification.

The empirical analysis is performed on a subsample of households headed by a single mother with at least one child under age 13.[26] After excluding cases with missing data, sample consists of 4,029 households. Definitions and the summary statistics for the variables used in the analysis are presented in Tables 2 and 3. Mothers who are employed and paying for child care have on average a higher level of education compared to those who are not employed and not paying for child care. Mothers who do not pay for care tend to have more adults in the household compared to those who pay for care. Mothers who pay for child care earn on average higher wages compared to mothers who do not pay for child care. Among mothers who pay for care, the average hourly expenditure is $2.18 for part-time workers and $2.03 for full-time workers. This is consistent with the evidence that part-time care is typically more expensive per hour than full-time care (Hofferth et al. 1991). As expected, mothers working full-time earn higher wages compared to those working part-time.

Table 4 displays the distribution of employment, child care payment, and child care subsidy outcomes. About 68 percent of the single mothers in the sample are in the labor force; 17.2 percent of the sample work part-time and 50.9 percent are employed full-time. About 56 percent of mothers working part-time and 63 percent of those working full-time pay for care. Approximately 12 percent of part-time and 10 percent of full-time workers use a child care subsidy. Sixty four percent of working mothers in the sample are eligible for a child care subsidy under the income eligibility rules set by states

[26]I include all single mothers regardless of income in order to avoid conditioning on income from employment and welfare.

in 1997 and 16.7 percent of these eligibles use a child care subsidy. This figure is close to that of the Administration for Children and Families (1999), which estimates that 12-15 percent of eligibles are served under the state-set limits in 1998.

V. Results

The full set of results from the estimations of the child care price, and the full-time and part-time wage equations are presented in Tables C1 and C2. While space limitation precludes a detailed discussion of these results in the text, they are generally consistent with those found in the relevant literature.[27]

The estimates of the discrete choice model are presented in Table C3. The results presented in the paper are taken from a model with three Hermite and four mass points.[28] The reference category is alternative 1 in which the single mother is not employed, does not pay for child care, and does not use a child care subsidy. A likelihood ratio test rejected the model with a single price coefficient against a model that allowed price coefficients to vary by part-time and full-time employment status. Consistent with the predictions of the theoretical model, a higher price of child care reduces the utility in alternatives in which the mother works and pays for child care. The coefficient estimate on the price of child care is -0.198 and significant (t = 2.01) when the mother works full-

[27] There is considerable variation in the child care price across states. The coefficient of variation of the child care price ranges from 0.92 to 5.36 and averages 1.95 across states. The relatively small number of observations with paid care per state (44.2) accounts for the mostly high standard errors in the estimates. However, a specification test strongly rejected the hypothesis that the coefficients on state dummies are jointly zero.

[28] I estimated the model with alternative combinations of numbers of heterogeneity and Hermite points. A model with four Hermite points did not provide a significant improvement in the likelihood over a model with three Hermite points. Also, a model with five mass points did not yield a higher likelihood compared to a model with four mass points. Evidence of unobserved heterogeneity in the model is presented by the estimates of the heterogeneity parameters in Table C4. The factor loadings are estimated to be significant and large in most cases.

time, and is -0.103, but estimated with less precision (t = 1.45), when the mother works part-time.[29] These estimates suggest that the price of child care is a stronger deterrent to full-time employment than it is to part-time employment. The implied child care price elasticities with respect to full-time and part-time employment are –0.149 and –0.072, respectively.[30] The finding that the price elasticity with respect to part-time employment is less than that of full-time employment in absolute value is consistent with other studies that distinguish between part-time and full-time employment.[31] The implied price elasticity of paying for care is –0.162, and is comparable to estimates in several other studies.[32]

The implied price elasticity with respect to overall employment is estimated to be –0.121. This figure falls in the lower end of the range of estimates found in the literature. However, both the model and econometric approach used in this paper differ from the rest of the literature in a number of important ways. First, I account for the decision to receive a child care subsidy, and consequently implement an adjustment to the price of child care for the amount of subsidy for those who use one. Second, I distinguish between part-time and full-time employment. Third, I estimate a multinomial choice

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[29] A similar differential effect between the part-time and full-time employment types is also found by Michalopoulos and Robins (2000).

[30] To find the price elasticity of employment, the derivative of the probability of choosing state i, Pr(i), with respect to the predicted price of child care is computed for each mother in the sample. This is then integrated over the heterogeneity distribution since Pr(i) is a function of the heterogeneity. Then the expression, $[\Sigma_{WORK}(\partial Pr(i)/\partial P)]P/Pr(\mathit{WORK})$, is calculated, where WORK represents the set of alternatives in which the mother is employed, Pr(*WORK*) is equal to $\Sigma_{WORK}Pr(i)$, and $\partial Pr(i)/\partial P$ is equal to $\alpha_{Pi}Pr(i)[1 - Pr(i)]$. Finally, the elasticity is obtained by averaging this term over the sample.

[31] Examples include Powell (1998) (who estimated the elasticities to be –0.20 for part-time employment and –0.71 for full-time employment using a sample of married mothers from Canada), Connelly and Kimmel (2000) (who estimated the elasticities to be –0.372 for part-time and –1.221 for full-time employment for single mothers), and Michalopoulos and Robins (2000) (who estimated the elasticities to be +0.159 for part-time and –0.342 for full-time using a sample of two-parent families from Canada and the U.S.).

[32] Examples of several other estimates of the price elasticity of paying for care are –0.34 for a sample of both married and single mothers (Blau and Robins 1988 and Blau and Hagy 1998) and –0.298 for single mothers (Michalopoulos et al. 1992).

model, whereas most of the literature estimated binary models of employment. Fourth, I estimate the full system of equations in a unified framework. Specifically, I control for the unobserved heterogeneity and correlation across the errors in the discrete choice model and the linear equations of wages and the price of child care, using a combination of the discrete factor model and the Gaussian Quadrature. Nonetheless, the elasticity found in this paper is comparable to those of several other studies that are similar to the present study in several respects.[33]

Table 5 displays the generated simulations of the impact of subsidizing the price of child care on the state choice probabilities. In each simulation, a price of child care, and a part-time and a full-time wage rate are predicted for each mother in the sample by using the coefficient estimates. Then the state choice probabilities are computed for each mother, integrating over the estimated heterogeneity distribution, which are then averaged across the sample. The first simulation reduces the price of child care by fifty percent from its current level. This can be considered as a subsidy that is available to all the mothers and is equivalent to an annual subsidy of about 1,900 dollars for a full-time, full-year worker using paid child care. As displayed in Table 5, the simulation results indicate that single mothers respond to reductions in the price of child care moderately. A fifty percent reduction in the price of child care would increase full-time employment by 3.5 percentage points (a 6.7 percent increase) and part-time employment by 0.6 percentage point (a 3.3 percent increase). Combining these two effects, the overall employment would increase by about 4.1 percentage points (a 5.8 percent increase) as a

[33] Examples include –0.09 of Ribar (1995) and -0.38 of Blau and Robins (1988) both of whom estimate a discrete choice model with multinomial logit; -0.342 of Michalopoulos and Robins (2000) who estimate a multinomial logit distinguishing between full-time and part-time employment; and –0.20 of Blau and Hagy (1998) who estimate a discrete choice model by a semi-parametric estimator similar to the one employed in the present study.

result of the subsidy. The probability of paying for child care increases by 3.2 percentage points (a 7.5 percent increase) in response to a fifty percent reduction in the price of child care. If the price of child care is fully subsidized, the predicted probabilities of full-time and part-time employment would increase by 6.0 percentage points (11.5 percent) and 1.2 percentage points (6.2 percent), respectively. The probability of paying for child care would increase by 6.2 percentage points (14.5 percent).

Turning to the wage effects, a higher part-time (full-time) wage increases the utility in those alternatives in which the mother works part-time (full-time) and does not affect the utility in other alternatives, confirming the predictions of the theoretical model. A likelihood ratio test rejected the model that restricted the part-time and full-time wage coefficients to be the same across these two employment types against a model that allowed separate effects. The coefficient estimates on the part-time and full-time wage rate are 0.229 (t=1.94) and 1.109 (t=4.51), respectively. The implied elasticity of full-time employment is 0.897 with respect to the full-time wage rate, and is -0.095 with respect to the part-time wage rate. Similarly, the implied elasticity of part-time employment is 0.511 with respect to the part-time wage rate, and is –0.102 with respect to the full-time wage rate. Combining the impacts on the full-time and part-time employment, the implied elasticity of overall employment is 0.694 with respect to the full-time wage rate, and is 0.081 with respect to the part-time wage rate. These results imply that full-time wage is a much stronger determinant of overall employment than the part-time wage rate.

According to the simulation results presented in Table 5, a 15 percent increase in the full-time wage rate leads to a 8.7 percentage points (16.7 percent) increase in full-time employment and a 0.3 percentage point (1.7 percent) decrease in part-time employment. Thus, the overall employment increases by 8.4 percentage points (11.9 percent). A similar increase in the part-time wage rate leads to a 1.7 percentage points (9.4 percent) increase in part-time employment and a 0.8 percentage point (1.5 percent) decrease in full-time employment, which represents a 0.9 percentage point (1.3 percent) increase in overall employment.

The full-time wage elasticity of paying for care is estimated to be 0.756 and the part-time wage elasticity of paying for care is estimated to be 0.126. Similar to the effect on employment, full-time wage rate is a much stronger determinant of paying for child care than the part-time wage rate. As shown in Table 5, a 15 percent increase in the full-time wage rate leads to a 5.5 percentage points (12.8 percent) increase in using paid child care. A similar increase in the part-time wage rate generates only a 0.6 percentage points (1.4 percent) increase in using paid care.

Finally, I simulated the impact of reducing the income eligibility limit for a subsidy on the state choice probabilities. The simulation decreases the eligibility limit by 25 percent, holding the price of child care constant. Approximately 65 percent of the working mothers are eligible for a child care subsidy at the original eligibility limit. With a 25 percent decrease in the income eligibility limit, the proportion of the sample eligible for a subsidy increases to about 84 percent. As displayed in Table 5, the full-time and part-time employment probabilities increase by 2.7 percentage points (4.8 percent) and a half percentage point (2.8 percent), respectively, which represents an increase in overall employment by 3.2 percentage points (about 5 percent). The probability of using paid child care increases by 2 percentage points (4.7 percent).

Sensitivity Analyses and Specification Tests

As discussed earlier, one of the innovations of this paper that distinguishes it from the rest of the literature is its inclusion of the child care subsidy receipt as an additional alternative in the mother's choice set and its adjustment of the child care price for the amount of the subsidy in the estimation. To determine the sensitivity of the results to this treatment and to provide a set of results that are more comparable to previous studies, I estimated the model excluding the subsidy decision from the model. In this case, the single mother only makes employment and child care payment decisions, which generates a model with five alternatives. The results show that the responses of employment and child care payment to the price of child care are more elastic in the five-choice model relative to the benchmark results presented earlier. The elasticity of overall employment with respect to the price of child care is estimated to be –0.348 and the elasticity of paying for care is –0.421. Results also indicate that exclusion of the subsidy receipt from the model has little effect on the estimated wage elasticities.

Note that the amount of child care expenditures in the survey is reported by the mother and this is assumed to represent the amount net of subsidy, P_s-S_s, for those who receive one. This is equivalent to assuming that all subsidies were directly paid to the provider and any expenditure made by the mother represents her out-of-pocket payment, not the total price of child care. This assumption is necessary because it is not possible to identify in the data whether the mother uses a voucher. A violation of this assumption would cause P_s-S_s to be overestimated. If voucher versus direct payment to the provider were random and uncorrelated with the explanatory variables in the model, then the child care price coefficient would still be estimated with no bias. If this is not the case, however, the price effect will be biased. In order to test the validity of this assumption, I estimated the model treating the subsidy recipients as if the price of child care for them is unobserved. This is equivalent to treating these cases as if they use unpaid child care. This allowed me to avoid making an assumption as to whether the cost of child care is subsidized with a voucher or through a direct payment to the provider. Therefore, the price of child care is substituted with a regression function for these mothers, just like those who use unpaid child care.[34] Note that this implementation is necessary only for 294 mothers in the sample who reported receiving a subsidy. The price elasticity of overall employment is estimated to be –0.149 and the price elasticity of paying for care is estimated to be -0.191. These results are close to those of the benchmark model and do not change any of its implications.

VI. Conclusions

This paper provides new evidence on the effects of the price of child care and wages on employment and child care payment decisions of single mothers in the early post-welfare reform period. It improves on previous work in several aspects. First, it uses data from a new survey, which was conducted after the enactment of welfare reform and other important policy changes of early and mid-1990s. Second, it addresses the endogeneity of child care subsidy receipt by incorporating the subsidy decision into the mother's choice set. This also allows to appropriately adjust for the price of child care by the amount of subsidy for eligible mothers. Third, it distinguishes between the part-time and full-time employment markets as well as the wages prevailing in these markets. This

[34] Note that the Gaussian Quadrature is used to integrate over the distribution of the error term of the price of child care for these cases.

accounts for the possibilities that each of these employment markets may have different wage determination mechanisms and the mothers' behavior in one market may systematically differ from that of the other. Fourth, the econometric strategy employed in the paper estimates the system of equations in a unified framework using full information likelihood (FIML). This is the first paper to employ the discrete factor method and the Gaussian Quadrature together in the estimation. This empirical strategy allows the outcomes analyzed to be determined simultaneously.

The results suggest that single mothers who are employed full-time are more sensitive to changes in the price of child care than those who are employed part-time. A lower price of child care increases the employment and the use of paid child care among those who are employed full-time, but has much smaller impacts on those who are employed part-time. Income from part-time employment may be so low that even with a reduction in the price of child care, mothers may not have enough incentive to leave welfare and seek employment. Also, mothers who are employed part-time may rely more on relative care during their work hours compared to their full-time working counterparts. The estimated elasticity of overall employment with respect to the price of child care is –0.12, which falls in the lower end of the range of estimates found in the literature.

An increase in the full-time wage leads to an increase in overall employment and the use of paid care. However, the full-time wage effects are found to be much more elastic than to the price effects. The elasticity of overall employment with respect to the full-time wage rate is estimated to be 0.69. The part-time wage rate on the other hand, is estimated to have much less of an effect on the behavior of single mothers. The implied elasticity of overall employment elasticity with respect to the part-time wage rate is only

0.08. Part-time employment may not be financially rewarding enough for single mothers to induce them choose employment over a potentially more attractive alternative of welfare.

One important implication of the findings is that policies that provide financial incentives to mothers, such as the Earned Income Tax Credit (EITC), minimum wages, and enhanced earnings disregards are likely to have significant effects on the work effort of single mothers, especially if they are targeted to the full-time labor market. At the federal level, the EITC provides earnings subsidies for low-income families with children. It has been expanded substantially in the 1990s and the real EITC maximum subsidy rose by 216 percent for a family with two children between 1990 and 1998 (Blank et al. 2000). The minimum wage was also increased in 1990, 1991, 1996, and 1997, with a cumulative 9 percent increase in real terms between 1990 and 1998. States also introduce financial incentives into their welfare systems, most often via increased earnings disregards. In addition to these financial incentive programs, state initiatives subsidizing skill formation (e.g. career and job skills development and training programs) that would lead to increases in future wages would also strengthen the welfare-to-work efforts of low-income mothers.

The results presented in this paper do not provide evidence on the tradeoff between the quality and the quantity of child care since all the price effects are quality-adjusted. Therefore, no inferences can be made about the child care quality dimensions of the price and wage impacts. If child care subsidies are employment-related, that is, they are aimed only at increasing employment with no restrictions on the quality, the results suggest that they could be useful in achieving this goal. Given that these subsidies are found to be effective only for full-time employment, they could also help single mothers achieve economic self-sufficiency and reduce future welfare dependence if on-the-job-training and experience in full-time jobs lead to improved skills over time. An example of employment-related child care subsidies is the Child Care Tax Credit (CCTC) that provides a tax credit to families with young children without placing any restrictions on the quality of child care.

Table 1
Frequency Distributions of the Discrete Outcomes

Alternative	Employment Status	Child Care Payment Status	Child Care Subsidy Status	Budget Constraint
1	No	---	---	$C=N$
2	Part-time	Yes	Yes	$C+(P_s-S_s)H_P=W_{PT}H+N$
3	Part-time	No	No	$C=W_{PT}H+N$
4	Part-time	Yes	No	$C+P_sH_P=W_{PT}H+N$
5	Full-time	Yes	Yes	$C+(P_s-S_s)H_P=W_{FT}H+N$
6	Full-time	No	No	$C+H_P=W_{FT}H+N$
7	Full-time	Yes	No	$C+P_sH_P=W_{FT}H+N$
Total				

Table 2
Variable Definitions

Discrete Choice Indicator, *I*	= The categorical variable defined by the cross-classification of employment, child care payment, and subsidy status.
Age	= Mother's age in years
Race[a]	
White	=1 if mother is white, 0 otherwise
Black	=1 if mother is black, 0 otherwise
Hispanic	=1 if mother is of Hispanic ethnicity, 0 otherwise
Region[b]	
Northeast	=1 if mother lives in Northeast, 0 otherwise
Midwest	=1 if mother lives in Midwest, 0 otherwise
South	=1 if mother lives in South, 0 otherwise
Health	=1 if mother is in good health, 0 otherwise
Mother's Education[c]	
Highsch	=1 if mother is high school or some college graduate, 0 otherwise
Bachelor	=1 if mother is college graduate or more, 0 otherwise
Othadult	= Number of family members aged 25+ in the household
Nonwage	= Annual non-labor income (= total income-own earned income – income from means tested programs)
Presence of children[d]	
Child0-5	=1 if mother has at least one child between 0-5, 0 otherwise
Child6-12	=1 if mother has at least one child between 6-12, 0 otherwise
$\text{Wage}_{\text{part-time}}$	= Hourly part-time wage rate in dollars
$\text{Wage}_{\text{full-time}}$	= Hourly full-time wage rate in dollars
$\text{Price}_{\text{child care}}$	= Hourly price of child care
Slfp	= State labor force participation rate for females in 1997
Sunemp	= State unemployment rate for females in 1997

[a] Omitted category is Other.
[b] Omitted category is West.
[c] Omitted category is Nodegree.
[d] Omitted category is Childboth.

Table 3
Descriptive Statistics

Variable	Full Sample	Non-employed	Employed part-time	Employed full-time	Pay for Care	Don't Pay for Care
Age	31.94	30.56	31.54	32.93	31.43	32.29
	(6.89)	(6.90)	(6.87)	(6.74)	(6.56)	(7.10)
Black	0.32	0.36	0.29	0.31	0.30	0.34
	(0.47)	(0.48)	(0.45)	(0.46)	(0.46)	(0.47)
White	0.65	0.60	0.68	0.66	0.68	0.63
	(0.48)	(0.49)	(0.47)	(0.47)	(0.47)	(0.48)
Northeast	0.23	0.27	0.25	0.19	0.22	0.24
	(0.42)	(0.45)	(0.44)	(0.39)	(0.41)	(0.43)
Midwest	0.29	0.22	0.33	0.33	0.33	0.27
	(0.46)	(0.42)	(0.47)	(0.47)	(0.47)	(0.44)
South	0.31	0.32	0.25	0.33	0.29	0.33
	(0.46)	(0.47)	(0.43)	(0.46)	(0.45)	(0.47)
Health	0.93	0.90	0.95	0.95	0.95	0.92
	(0.25)	(0.30)	(0.22)	(0.23)	(0.23)	(0.27)
Highsch	0.73	0.64	0.77	0.78	0.78	0.69
	(0.44)	(0.48)	(0.42)	(0.42)	(0.41)	(0.46)
College	0.11	0.06	0.11	0.14	0.14	0.09
	(0.32)	(0.25)	(0.32)	(0.35)	(0.34)	(0.29)
Hispanic	0.14	0.20	0.12	0.11	0.11	0.17
	(0.35)	(0.40)	(0.33)	(0.32)	(0.31)	(0.34)
Othadult	0.35	0.38	0.32	0.35	0.29	0.40
	(0.69)	(0.73)	(0.67)	(0.64)	(0.63)	(0.73)
Nonwage	7.57	6.44	7.39	8.31	7.87	7.33
(/1000)	(14.14)	(13.94)	(13.89)	(14.30)	(14.01)	(14.22)
Child0-6	0.33	0.38	0.34	0.40	0.39	0.29
	(0.47)	(0.49)	(0.47)	(0.49)	(0.49)	(0.49)
Child6-12	0.45	0.33	0.44	0.52	0.37	0.50
	(0.50)	(0.47)	(0.49)	(0.50)	(0.48)	(0.50)
$Wage_{part\text{-}time}$	6.69	---	6.69	---	6.833	6.510
	(1.46)		(1.46)		(1.52)	(1.38)
$Wage_{full\text{-}time}$	8.22	---	---	8.22	8.44	7.83
	(3.41)			(3.41)	(3.48)	(3.12)
$Price_{child\ care}$	2.07	---	2.18	2.03	2.07	---
	(1.77)		(1.79)	(1.76)	(1.77)	
Slfp	60.49	59.74	60.71	60.79	60.78	60.21
	(5.36)	(4.95)	(5.44)	(5.50)	(5.47)	(5.23)
Sunemp	5.17	5.37	5.09	5.11	5.08	5.28
	(1.45)	(1.42)	(1.48)	(1.46)	(1.45)	(1.45)
Sample Size	4,029	1,285	697	2,407	1,679	2,350

Note: Standard deviations are in parentheses.

Table 4
Frequency Distributions of the Discrete Outcomes

State	Employment Status	Child Care Payment Status	Child Care Subsidy Status	Count	Percentage Total
1	No	---	---	1,285	31.9
2	Part-time	Yes	Yes	86	2.1
3	Part-time	No	No	308	7.6
4	Part-time	Yes	No	303	7.5
5	Full-time	Yes	Yes	208	5.2
6	Full-time	No	No	757	18.8
7	Full-time	Yes	No	1,082	26.9
Total				4,029	100.0

Table 5
Simulations of Employment and Child Care Payment Probabilities

	Full-time Employment	Part-time Employment	Paying for Child Care
Predicted base probability [a]	52.2	18.1	42.9
$\text{Price}_{\text{Child Care}}$ (-50%)	55.7	18.7	46.1
$\text{Price}_{\text{Child Care}}$ (-100%)	58.2	19.3	49.1
$\text{Wage}_{\text{Full-time}}$ (+15%)	60.9	17.8	48.4
$\text{Wage}_{\text{Part-time}}$ (+15%)	51.4	19.8	43.6
Eligibility limit (-25%)	54.9	18.6	44.9

[a]A comparison between the predicted choice probabilities and the actual percentages of the discrete outcomes reveals that the model fits the data fairly well, although the probabilities of employment and paying for care are slightly over predicted. However, the predicted probabilities come within about two percentage points of accurately predicting the actual probabilities.

APPENDIX A

The Possible Scenarios of Alternatives Available to A Single Mother

A mother makes her employment decision among no employment, part-time employment, and full-time employment. Her total income in these employment states can be expressed as

I_N (Income when not employed) = N (non-wage income),

I_{PT} (Income when employed part-time) = N + $W_{PT}H$,

I_{FT} (Income when employed full-time) = N + $W_{FT}H$.

According to the theoretical model developed in the paper, each mother will choose from one of three sets of alternatives, which is determined by her eligibility status for a child care subsidy. Below, I provide a description of these scenarios:

1. In this scenario, the mother is ineligible for a child care subsidy regardless of hours worked (I_N>E, where E denotes the income eligibility limit for a child care subsidy). Alternatively, the mother's income may satisfy the eligibility criteria when not employed (I_N<E), but she may be ineligible when employed part-time or full-time (I_{PT}>E). In these cases, subsidy receipt is not part of the mother's choice set and she makes a choice from the alternatives 1, 3, 4, 6, and 7 listed in Table 1. In alternative 1, she is not employed and is therefore ineligible for a subsidy. In alternatives 3 and 6, no paid child care is used, so no subsidy can be received. In alternatives 4 and 7, the mother is employed and pays for child care, but is ineligible for a child care subsidy since her income exceeds the eligibility limit.

2. In this scenario, the mother is eligible when employed part-time (I_{PT}<E), but ineligible when employed full-time (I_{FT}>E). In this scenario, she makes a decision

among the alternatives 1-4, 6, and 7 in Table 1. In alternative (1), she is not employed and is therefore ineligible for a subsidy. In alternatives 2 and 4, she is employed part-time and her income is less than the eligibility limit, so she is eligible for a subsidy. In alternatives 3 and 6, no paid child care is used, so no subsidy is received. In alternative 7, the mother pays for child care, but she is ineligible for a child care subsidy since her income exceeds the eligibility limit.

3. In this scenario, the mother is eligible when employed full-time (I_{FT}<E). If the mother's income satisfies the eligibility criteria when she is employed full-time, it will also satisfy it when she is employed part-time. Therefore, all seven states listed in Table 1 are in the mother's choice set.

The price of child care that a mother faces is alternative-specific rather than just a single variable that is invariant across alternatives. If alternatives 2 or 5 are in the mother's choice set, the price of child care in these alternatives is net of the subsidy amount. The appropriate price of child care to be included for each alternative in the model is displayed in Table A1.

Table A1
The Adjusted Price of Child Care under Each Scenario

State	Scenario 1	Scenario 2	Scenario 3
1	0	0	0
2	---	P_s-S_s	P_s-S_s
3	0	0	0
4	P_s	P_s	P_s
5	---	---	P_s-S_s
6	0	0	0
7	P_s	P_s	P_s

APPENDIX B

Heterogeneity Specification

Assume that the u's in equation (7) are drawn from independent extreme-value distributions, and the μ's in equations (8)-(10) are drawn from independent mean-zero normal distributions. Further, the distribution of η in equations (7)-(10) is assumed to be given by the following step function:

$$\text{Prob}(\eta = n_m) = p_m, \quad m = 1,\ldots\ldots\ldots,M, \qquad p_m \geq 0,$$

and

$$\sum_{m=1}^{M} p_m = 1,$$

where n_m is the m^{th} point of support in the factor distribution, and p_m is the probability that the factor m takes on the value n_m. M is the number of points in the support of the distribution of η. The p's, ρ, and n's are parameters to be estimated along with other coefficients of the explanatory variables in the model.

The n's and p's are parameterized as follows:

$$n_1 = -0.5, \qquad n_m = \left[\frac{\exp(q_m)}{1+\exp(q_m)} - 0.5\right] \quad (\text{m} = 2,\ldots\ldots,\text{M - 1}), \quad \text{and} \quad n_M = 0.5,$$

and

$$\text{p}_\text{m} = \left[\frac{\exp(\text{r}_\text{m})}{1+\sum_{m=1}^{M-1}\exp(\text{r}_\text{m})}\right] \qquad \text{m} = 1,\ldots,\text{M} - 1, \quad \text{and} \quad \text{p}_\text{M} = \frac{1}{1+\sum_{m=1}^{M-1}\exp(\text{r}_\text{m})},$$

where q_m and r_m are free parameters to be estimated.

Likelihood Function

Note that the total number of alternatives relevant to each mother depends on her eligibility for a child care subsidy at different employment states. Apart from her eligibility, a single mother's contribution to the likelihood function depends on her employment and child care payment status. There are five possible cases available to each mother. These cases are considered below:

In case (1), the mother is employed full-time and pays for child care. In this case, we observe the full-time wage rate and the price of child care, but do not observe the part-time wage rate. Let $D_i = 1$ if the mother j chooses state i, and $D_i = 0$ otherwise. Then the likelihood function contribution for this mother is

$$L_j = \sum_{m=1}^{M} p_m \, Pr_j(D_i \mid \eta_m, P_s^*, \ln W_{FT}) \, Pr_j(P_s \mid \eta_m) \, Pr_j(\ln W_{FT} \mid \eta_m), \tag{A1}$$

where $Pr_j(D_i \mid \eta_m, P_s^*, \ln W_{FT})$ is the probability that mother j chooses state i conditional on the value of the discrete factor, the price of child care, and the full-time wage rate. $Pr_j(P_s|\eta_m)$ is the probability of observing P_s conditional on η_m, and $Pr_j(\ln W_{FT}|\eta_m)$ is the probability of observing $\ln W_{FT}$ conditional on η_m.

In case (2), the mother is employed part-time and pays for child care. Therefore, we observe the part-time wage rate and price of child care, but not the full-time wage rate. The likelihood function contribution for this mother is

$$L_j = \sum_{m=1}^{M} p_m \, Pr_j(D_i \mid \eta_m, P_s^*, \ln W_{PT}) \, Pr_j(P_s \mid \eta_m) \, Pr_j(\ln W_{PT} \mid \eta_m). \tag{A2}$$

In case (3), the mother is employed full-time and does not pay for child care. Therefore, we observe the full-time wage rate, but not the part-time wage rate and price of child care. The likelihood function contribution for this mother is

$$L_j = \sum_{m=1}^{M} p_m \, Pr_j(D_i \mid \eta_m, \ln W_{FT}) \, Pr_j(\ln W_{FT} \mid \eta_m) \tag{A3}$$

In case (4), the mother is employed part-time and does not pay for child care.

Therefore, we observe the part-time wage rate, but not the full-time wage rate and price of child care. The likelihood function contribution for this mother is

$$L_j = \sum_{m=1}^{M} p_m \Pr_j(D_i \mid \eta_m, \ln W_{PT}) \Pr_j(\ln W_{PT} \mid \eta_m). \tag{A4}$$

Finally, in case (5), the mother is not employed and does not pay for child care. Therefore, we do not observe the full-time wage rate, the part-time wage rate, and the price of child care. The likelihood function contribution for this mother is

$$L_j = \sum_{m=1}^{M} p_m \Pr_j(D_i \mid \eta_m). \tag{A5}$$

Below, I derive the exact form of the likelihood function contribution for cases (1) and (5). The basic approach for other cases is similar and the exact forms are available from the author.

The likelihood function contribution for a mother in case (1) can be rewritten as

$$L_j = \int \sum_{m=1}^{M} p_m \Pr_j(D_i \mid \eta_m, P_s^*, \ln W_{FT}, \ln W_{PT}) \Pr_j(P_s \mid \eta_m) \Pr_j(\ln W_{FT} \mid \eta_m)$$

$$\Pr_j(\ln W_{PT} \mid \eta_m) d\ln W_{PT}, \tag{A6}$$

where $\Pr_j(D_i \mid \eta_m, P_s^*, \ln W_{FT}, \ln W_{PT})$ represents the probability that mother j chooses state i conditional on the values of η, P_s^*, $\ln W_{FT}$, and $\ln W_{PT}$. $\Pr_j(P_s \mid \eta_m)$, $\Pr_j(\ln W_{FT} \mid \eta_m)$, and $\Pr_j(\ln W_{PT} \mid \eta_m)$ are the probabilities of observing P_s, $\ln W_{FT}$, and $\ln W_{PT}$ conditional on η_m. The regression functions for $\ln W_{FT}$, and $\ln W_{PT}$ can be specified as follows

$$\ln W_{PTj} = \delta_{1PT} + \mathbf{R}_j \delta_{2PT} + \mu_{PT} + \rho_{PT} \eta_m, \tag{A7}$$

$$\ln W_{FTj} = \delta_{1FT} + \mathbf{R}_j \delta_{2FT} + \mu_{FT} + \rho_{FT} \eta_m, \tag{A8}$$

where **R** is a vector of variables determining wages and δ's are the parameters to be estimated. Given that the u's in equation (7) are drawn from independent extreme-value distributions and that μ's in equations (8)-(10) are drawn from independent mean-zero normal distributions, equation (A6) can be rewritten as

$$= \int \sum_{m=1}^{M} p_m [\exp\{\mathbf{X}_j\beta_i + \alpha_{Pi}P_{sj}^* + \alpha_{PTi}(\delta_{1PT} + \mathbf{R}_j\delta_{2PT} + \mu_{PT} + \rho_{PT}\eta_m) +$$
$$\alpha_{FTi}\ln W_{FTj} + \rho_i\eta_m\} / \ \mathbf{\Omega_j}]\ \phi((\ln W_{FTj} - \delta_{1FT} - \mathbf{R}_j\delta_{2FT} - \rho_{FT}\eta_m)/\ \sigma_{FT})$$
$$\phi((P_{sj} - \Sigma^S{}_s\delta_s D_s - \mathbf{X}_j\delta_P - \rho_P\eta_m) / \sigma_P)\ \Pr_j(\ln W_{PT}|\eta_m)\ d\ln W_{PT}, \qquad \text{(A9)}$$

where ϕ is the standard normal probability density function. σ_{FT} and σ_{FT} are the standard deviations of the μ_{FT} and μ_P, respectively. $\Pr_j(\ln W_{PT}|\eta_m)$ is the shorthand for $\Pr_j(\delta_{1PT} + \mathbf{R}_j\delta_{2PT} + \mu_{FT} + \rho_{FT}\eta_m \mid \eta_m)$.

$$\Omega_j = \sum_{k=1}^{K} \exp\{\mathbf{X}_j\beta_k + \alpha_{Pk}P_{sj}^* + \alpha_{PTk}(\delta_{1PT} + \mathbf{R}_j\delta_{2PT} + \mu_{PT} + \rho_{PT}\eta_m) + \alpha_{FTk}\ln W_{FTj} + \rho_k\eta_m\},$$

with $\beta_1 \equiv 0$, and K is total number of alternatives relevant to the mother and can take on the values of five, six, or seven, depending on the eligibility of mother j for a child care subsidy as discussed in Appendix A.

Equation (A9) integrates out the distribution of η_m through a weighted sum of probabilities using the discrete factor method. To integrate out the distribution of the error term of $\ln W_{PT}$, the Gaussian Quadrature method is used. It is a convenient method to approximate an integral accurately at a low computing cost.[35] The Gaussian Quadrature approximates an integral of the form, $\int \exp(-r^2)h(r)dr$, as $\Sigma^Y{}_\tau w_\tau h(r_\tau)$, where Y is the number of points used in the approximation, w_τ is the weight applied to the τ^{th} point of support, and r_τ is the τ^{th} point of support in the approximation. w_τ and r_τ are available in statistical handbooks for alternative values of Y.

Note that equation (A7) has the form $\int \exp(-r^2)h(r)dr$, where $r = \mu_{PT}/(\sigma_{PT}\sqrt{2})$, and

[35] See Butler and Moffitt (1982) for a detailed description of the Gaussian Quadrature Method.

$$h(r) = \pi^{-1/2} \int \sum_{m=1}^{M} p_m [\exp\{\mathbf{X}_j\beta_i + \alpha_{Pi}P_{sj}^* + \alpha_{PTi}(\delta_{1PT} + \mathbf{R}_j\delta_{2PT} + r\sqrt{2}\sigma_{PT} + \rho_{PT}\eta_m) + \alpha_{FTi}\ln W_{FTj} + \rho_i\eta_m\}/\Omega_j]\phi((\ln W_{FTj} - \delta_{1FT} - \mathbf{R}_j\delta_{2FT} - \rho_{FT}\eta_m)/\sigma_{FT})\,\phi((P_{sj} - \Sigma^S{}_s\delta_s D_s - \mathbf{X}_j\delta_P - \rho_P\eta_m)/\sigma_P)\,dr.$$

Incorporating the Gaussian Qudrature into equation (A9), the likelihood function contribution of mother j can be approximated as follows:

$$L_j \approx \Sigma^Y{}_\tau \Sigma^M{}_m \pi^{-1/2} w_\tau p_m [\exp\{\mathbf{X}_j\beta_i + \alpha_{Pi} P_{sj}^* + \alpha_{PTi}(\delta_{1PT} + \mathbf{R}_j\delta_{2PT} + r_\tau\sqrt{2}\,\sigma_{PT} + \rho_{PT}\eta_m) + \alpha_{FTi}\ln W_{FTj} + \rho_i\eta_m\}/\Omega_j]\,\phi((\ln W_{FTj} - \delta_{1FT} - \mathbf{R}_j\delta_{2FT} - \rho_{FT}\eta_m)/\sigma_{FT})\,\phi((P_{sj} - \Sigma^S{}_s\delta_s D_s - \mathbf{X}_j\delta_P - \rho_P\eta_m)/\sigma_P). \quad (A10)$$

In case (5), L_j can be rewritten as

$$L_j = \iiint \sum_{m=1}^{M} p_m \Pr_j(D_i \mid \eta_m, P_s^*, \ln W_{FT}, \ln W_{PT}) \Pr_j(P_s|\eta_m) \Pr_j(\ln W_{FT}|\eta_m) \Pr_j(\ln W_{PT}|\eta_m)\, dP_{sj}\, d\ln W_{FTj}\, d\ln W_{PTj.}$$

Under the same similar distributional assumptions about u's and μ's in equations (7)-(10), L_j can be rewritten as follows:

$$= \iiint \sum_{m=1}^{M} p_m [\exp\{\mathbf{X}_j\beta_i + \alpha_{Pi}(\Sigma^S{}_s\delta_s D_s + \mathbf{X}_j\delta_P + \mu_P + \rho_P\eta_m) + \alpha_{PTi}(\delta_{1PT} + \mathbf{R}_j\delta_{2PT} + \mu_{PT} + \rho_{PT}\eta_m) + \alpha_{FTi}(\delta_{1FT} + \mathbf{R}_j\delta_{2FT} + \mu_{FT} + \rho_{FT}\eta_m) + \rho_i\eta_m\}/\Omega_j]\, \Pr_j(P_s|\eta_m)\Pr_j(\ln W_{FT}|\eta_m)\Pr_j(\ln W_{PT}|\eta_m)\, dP_{sj}\, d\ln W_{FTj}\, d\ln W_{PTj}. \quad (A11)$$

Equation (A11) integrates over the error distributions of the price of child care, the full-time, and the part-time wage. This equation is similar to case (1) in which the integration was necessary only for the distribution of the error term in the $\ln W_{PT}$ equation. Also, note that each of the integral terms in (A11) can be approximated by the Gaussian Quadrature method since they can be represented in the form $\int \exp(-r^2)h(r)dr$. Therefore, the likelihood contribution for mother j can be obtained as

$$L_j \approx \Sigma^{Y1}{}_{\tau 1}\Sigma^{Y2}{}_{\tau 2}\Sigma^{Y3}{}_{\tau 3}\Sigma^{M}{}_{m}\ (\pi^{-1/2})^3\, w_{\tau 1}\, w_{\tau 2} w_{\tau 3}\, p_m \big[\exp\{\mathbf{X}_j\beta_i + \alpha_{Pi}(\Sigma^S{}_s\delta_s D_s + \mathbf{X}\delta_P + r_{\tau 3}\surd 2\sigma_P + \rho_P\eta_m) + \alpha_{PTi}\,(\delta_{1PT} + \mathbf{R}_j\delta_{2PT} + r_{\tau 1}\surd 2\sigma_{PT} + \rho_{PT}\eta_m) + \alpha_{FTi}(\delta_{1FT} + \mathbf{R}_j\delta_{2FT} + r_{\tau 2}\surd 2\sigma_{FT} + \rho_{FT}\eta_m) + \rho_i\eta_m\}/\Omega_j\big]. \tag{A12}$$

The log-likelihood function for the full sample can be written as

$$\ln L = \sum_{j=1}^{N} \ln L_j, \tag{A13}$$

where L_j is the likelihood function contribution for mother j ,and N is the sample size. I maximize equation (A13) with respect to the parameters defined in equations (4), (6), (A8), and (A9) along with the parameters of the heterogeneity distribution.

APPENDIX C

Table C1
Estimates of the Wage Models

Variable	Log Wage$_{Full-time}$	Log Wage$_{Part-time}$
Intercept	0.433	-0.219
	(1.292)	(-1.518)
Age	0.201	0.223
	(3.119)*	(5.243)*
Age$^{2\ a}$	-0.218	-0.435
	(-4.131)*	(-8.217)*
Health	0.107	0.114
	(1.888)*	(-2.025)*
Northeast	0.126	0.133
	(4.894)*	(1.942)*
Midwest	0.151	0.210
	(1.215)	(0.710)
South	-0.123	-0.191
	(-1.892)*	(-1.122)
Highsch	0.317	0.145
	(6.218)*	(1.947)*
College	0.528	0.297
	(4.646)*	(2.106)*
Black	-0.061	-0.056
	(-0.770)	(0.442)
White	0.080	0.121
	(1.991)*	(1.381)
Hispanic	-0.024	0.049
	(-0.409)	(0.834)
Slfp[b]	-0.993	-1.028
	(-2.014)*	(-2.909)*
Sunemp[b]	-0.241	-0.186
	(1.822)*	(-1.754)*
Sample Size	2,047	697

Note: *t*-statistics are in parentheses.
[a] Variable has been divided by 1,000.
[b] Variable has been divided by 100.
* Significant at 5% level or better.

Table C2
Estimates of the Child Care Price Equation

Variable	Coefficient	t-statistics
Intercept	0.499	(0.982)
Age	0.131	(12.223)*
Age$^{2\,a}$	-1.767	(-1.854)*
Black	-0.661	(-1.433)
White	-0.521	(-1.427)
Hispanic	-0.127	(-0.519)
Health	-0.123	(-1.144)
Highsch	0.169	(0.665)
College	0.474	(1.931)*
Child0-5	0.044	(0.298)
Child6-12	0.353	(3.836)*
Othadult	-0.289	(-1.853)*
Nonwage [a]	0.018	(4.508)*
Alabama	0.081	(0.241)
Arkansas	-0.258	(-0.280)
Arizona	0.712	(1.227)
California	0.544	(1.463)
Colorado	0.491	(0.892)
Florida	0.054	(0.150)
Georgia	0.123	(0.144)
Hawaii	0.143	(0.735)
Iowa	0.006	(0.071)
Idaho	0.514	(0.955)
Illinois	0.067	(0.082)
Indiana	-0.441	(-0.418)
Kansas	-0.256	(-0.232)
Kentucky	-0.649	(-0.724)
Louisiana	-0.591	(-0.423)
Massachusetts	0.567	(1.392)
Maryland	-0.157	(-0.182)
Maine	-0.152	(-0.189)
Michigan	0.279	(1.014)
Minnesota	0.028	(1.101)
Missouri	0.224	(0.243)
Mississippi	-0.199	(-0.863)
Montana	-0.469	(-0.511)
North Carolina	0.152	(0.163)
North Dakota	-0.457	(-0.444)
New Jersey	0.493	(1.714)*
New Mexico	0.018	(0.030)
Nevada	-0.518	(-0.532)
New York	0.425	(1.819)*
Ohio	-0.451	(-0.552)
Pennsylvania	0.295	(0.472)
South Carolina	-0.754	(-0.629)

Tennessee	-0.076	(-0.789)
Texas	0.513	(0.991)
Virginia	-0.222	(-0.737)
Washington	0.265	(0.813)
Wisconsin	0.191	(1.831)*
West Virginia	-0.539	(-0.572)
Sample Size	1,679	

[a] Variable has been divided by 1,000.
* Significant at 5% level or better.

Table C3
Maximum Likelihood Estimates of the Discrete Choice Model

Variable	State 1 Work=No Paid care=No Subsidy = No	State 2 Work=Part-time Paid care=Yes Subsidy=Yes	State 3 Work=Part-time Paid care=No Subsidy=No	State 4 Work=Part-time Paid care=Yes Subsidy=No	State 5 Work=Full-time Paid care=Yes Subsidy=Yes	State 6 Work=Full-time Paid care=No Subsidy=No	State 7 Work=Full-time Paid care=Yes Subsidy=No
Intercept	---	1.088	-1.271	-.889	-0.979	-1.037	0.714
		(2.991*	(1.808)*	(-1.485)	(-1.604)	(-1.082)	(1.477)*
Age	---	-0.102	0.101	0.112	0.101	0.011	0.087
		(-2.123)*	(1.992)*	(1.342)	(1.218)	(0.311)	(3.122)*
Northeast	---	0.886	0.762	0.563	0.433	0.564	0.488
		(3.178)*	(2.165)*	(1.973)*	(2.079)*	(0.830)	(2.614)*
Midwest	---	0.412	0.702	0.615	0.921	1.312	0.963
		(0.740)	(1.937)*	(2.113)*	(3.082)*	(2.310)*	(2.776)*
South	---	-0.227	-0.431	0.253	-0.592	-0.612	0.416
		(-1.049)	(-1.212)	(0.591)	(-1.781)*	(-0.939)	(0.813)
Black	---	-0.542	-0.483	-0.191	0.614	0.892	-0.104
		(-1.717)*	(-1.314)	(-0.830)	(0.926)	(1.268)	(-1.322)
White	---	0.582	0.362	0.243	0.886	1.361	0.524
		(0.872)	(1.281)	(1.877)*	(2.653)*	(1.931)*	(1.864)*
Hispanic	---	-0.793	-0.555	-0.280	-0.721	-0.602	-0.723
		(-1.911)*	(-0.740)	(-2.194)*	(-1.146)	(-0.864)	(-2.059)*
Health	---	-0.526	-0.212	0.113	-0.351	-0.159	0.446
		(-0.709)	(-0.629)	(0.767)	(0.792)	(-0.227)	(1.243)
Highsch	---	0.943	0.246	0.769	0.653	1.413	0.912
		(2.435)*	(1.814)*	(3.117)*	(2.142)*	(2.544)*	(2.561)*
College	---	0.996	0.669	0.997	0.669	1.832	0.997
		(3.752)*	(1.494)	(2.544)*	(1.881)*	(2.663)*	(2.523)*
Nonwage[a]	---	-0.801	-0.508	-0.182	-0.251	0.413	-0.227

		(-2.111)*	(-1.913)*	(-1.956)*	(-1.514)	(1.118)	(1.504)
Child0-5	---	0.214	0.288	-0.025	-0.102	-0.177	0.067
		(0.489)	(0.873)	(-0.443)	(0.527)	(-0.393)	(0.591)
Child6-12	---	0.418	0.302	-0.066	-0.415	-0.714	0.346
		(1.332)	(1.816)*	(-1.092)	(-1.569)	(-1.240)	(1.352)
Othadult	---	0.112	0.182	-0.141	-0.109	-0.349	-0.412
		(1.163)	(2.405)*	(-1.241)	(-1.368)	(-1.291)	(-2.419)*
$Price_{child\ Care}$	---	-0.198	---	-0.198	-0.103	---	-0.103
		(2.014)*		(2.014)*	(1.452)		(1.452)
Log $Wage_{part\text{-}time}$	---	0.229	0.229	0.229	---	---	---
		(1.942)*	(1.942)*	(1.942)*			
Log $Wage_{full\text{-}time}$	---	---	---	---	1.109	1.109	1.109
					(4.508)*	(4.508)*	(4.508)*
Number of observations	4,029						
Log likelihood	-10,871.1						

Note: t-statistics are in parentheses. State 1 is the omitted category.

[a] Variable is divided by 1000.

[*] Significant at the 5% level or better.

Table C4
Estimates of the Heterogeneity Parameters

State		Factor Loading
State 1		---
State 2		-2.771
		(1.424)
State 3		-4.162
		(-2.108)*
State 4		-1.994
		(-2.753)*
State 5		0.969
		(3.011)*
State 6		-1.344
		(2.659)*
State 7		2.418
		(1.813)*
ρ_P		-0.347
		(-2.347)*
ρ_{FT}		0.889
		(4.461)*
ρ_{PT}		0.591
		(3.870)*
	Mass Points	Probability Weights
Support #1, n_1	-0.500	5.65%
Support #2, n_2	0.273	71.56%
	(2.691)*	(13.70)*
Support #3, n_3	0.341	21.51%
	(6.194)*	(11.83)*
Support #4, n_4	0.500	1.28%

*Coefficient is significant at 5 percent level or better.

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