Do Child Care Subsidies Increase Employment Among Low-Income Parents?

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Abstract: State child care subsidy programs are intended to support the employment of low-income parents, particularly for families receiving or likely to receive Temporary Assistance for Needy Families (TANF). To study the impact of child care subsidies on employment, this study used detailed data from a survey of low-income parents in Minnesota, linked with administrative

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data on subsidy receipt, to estimate endogenous switching models of subsidy receipt and parent work status. Parental preferences about the child development-related characteristics of child care settings were the basis for an instrumental variable used to predict subsidy receipt. Receiving a subsidy significantly increases the probability of employment and especially of full-time employment. The findings suggest that expansion of the child care subsidy program could lead to increased employment among low-income parents with young children.

Key words: child care, work support, child care subsidies, employment, endogenous switching model, instrumental variables

JEL Codes: J22, J13, I38

Do Child Care Subsidies Increase Employment Among Low-Income Parents?

Seven out of ten American mothers with children under the age of 18 were in the labor force in 2014 (US Bureau of Labor Statistics Current Population Survey 2014). After steadily rising for decades, US women's labor force participation rates have leveled off and even declined slightly in recent years (Toossi 2012). An extensive literature has demonstrated that the cost of child care influences mothers' employment decisions in the US (see, for example, Anderson and Levine 2000; Blau and Hagy 1998; Connelly 1992; Connelly and Kimmel 2003; Kimmel 1998; Ribar 1992). Most of these studies found that mothers' employment was negatively associated with the price of child care; that is, the studies predicted that more mothers will work in response to lower child care costs, though the size of the employment change varied considerably across studies. However, as women's labor force participation has increased, Fitzpatrick (2012) suggested "perhaps childcare subsidization no longer has the ability to increase the labor supply of mothers at the margin" (p. 585). Nonetheless, it is likely that subsidization of child care will have heterogeneous effects on women depending in part upon their attachment to the labor market (Hardoy and Schøne 2013; Pronzato and Sorrenti 2015).

Government subsidies for child care are intended to reduce the barrier to work created by child care expenses, especially for low-income families. For poor American families with working mothers using paid care for their young children, nearly 36% of the family's income and 43% of the mother's earnings were spent on child care on average (US Census Bureau 2013). Previous studies have found consistent evidence that in the US, child care subsidies to parents were associated with a higher likelihood of maternal employment (Ahn 2012; Bainbridge et al. 2005; Berger and Black 1992; Blau and Tekin 2007; Cochi Ficano et al. 2006; Crawford 2006; Herbst 2010; Tekin 2005, 2007a, 2007b). However, most of these studies were based on data that are now more than a decade old, and some used methods that did not account for the potential

endogeneity of child care subsidy and employment decisions. They also typically used survey data on subsidy receipt, which are prone to reporting errors (Bowman et al. 2009, 2010; Johnson and Herbst 2013; Krafft et al. 2015).

This paper presents new evidence on the strong relationship between employment and child care subsidies for low-income families while addressing the categorical and joint nature of decisions about work and child care. Our work extends the previous literature by estimating an endogenous switching model for the joint decisions of work and subsidy receipt. This approach allows for the joint decision to be influenced by unobserved factors that affect both employment and subsidy participation. We also introduce an innovative instrumental variable (IV) to predict subsidy receipt based on parental preferences with regards to child care settings. Further, we have linked administrative data to measure subsidy receipt to avoid the problem of misreporting of program participation common in survey responses.

The results provide strong evidence that child care subsidies substantially increased the full-time employment of low-income mothers[2] with young children. We found a negative correlation between the time-varying unobserved variables associated with subsidy take up and employment decisions, suggesting that individuals who used a child care subsidy were less likely to obtain employment without a subsidy. Previous studies have assumed this correlation to exist, but were unable to estimate its sign or size. The study's findings demonstrate the continuing importance of child care subsidies in facilitating employment for low-income families. In recent years, federal funding for the Child Care and Development Fund has not increased, and as a result, fewer children received child care subsidies in 2014 than in 2006 (Administration for Children and Families Department of Health and Human Services 2015; Matthews and Schmit

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[2] Because less than 10% of the respondents in our study were male, and nearly all were the mothers of the focal child, we refer to the respondents as mothers interchangeably with parents.

2014). Thus, by demonstrating the importance of child care subsidies in increasing employment, these findings have important policy implications for supporting low-income families with children.

Background and Recent Research

Since the 1990s, US anti-poverty policy has largely shifted from providing cash assistance towards providing work supports for low-income families. Government subsidies to help low-income parents pay for child care, typically through vouchers, comprise a sizeable portion of the spending on these work supports. In 1996, Congress consolidated several child care programs into a single block grant, the Child Care and Development Fund (CCDF), and funding was increased substantially at that time. Federal CCDF spending surpasses federal spending on Temporary Aid for Needy Families (TANF) by about 1 billion dollars each year ($6.4 billion compared to $5.4 billion in 2014)[3] (Administration for Children and Families Department of Health and Human Services 2015). Thus, child care subsidies through the CCDF represent a major public investment to support America's low-income families and parents' ability to work.

The federal Child Care and Development Block Grant Act of 2014 reauthorized the CCDF for the first time since 1996, and emphasized the CCDF's dual goals of "promoting families' economic self-sufficiency by making child care more affordable, and fostering healthy child development and school success by improving the quality of child care" (Child Care and Development Fund (CCDF) Program; Proposed Rule, 2013, p.29442). Other publicly funded programs, such as Head Start or state pre-kindergarten programs, provide free or reduced-price care for young children, however, CCDF child care subsidies are more directly tied to supporting parental employment than other early education programs. States define eligibility rules for

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[3] All dollar values are in US currency.

CCDF child care subsidies under broad federal guidelines (Adams and Matthews 2013) and typically require parents to be employed or engaged in approved education or job training activities (Herbst and Tekin 2011).

States have wide latitude in setting policies for their child care subsidy programs, which are funded by federal, state and sometimes local (e.g., county) funds (Matthews and Schmit 2014). In particular, states determine eligibility rules, provider payment rates, and parent copayments with some guidance from federal regulations. In Minnesota, the Child Care Assistance Program (CCAP) provides financial subsidies to help low-income families pay for child care so that parents may "pursue employment or education leading to employment, and that children are well cared for and prepared to enter school ready to learn" (Minnesota Department of Human Services 2012). Families receive assistance through either the Basic Sliding Fee (BSF) program if their income is 47% or less of the state median income, adjusted for family size, or through the Minnesota Family Investment Program (MFIP, which is Minnesota's TANF program).

Families eligible for child care assistance in Minnesota receive a voucher to use to pay for care at the provider they choose, which may be a child care center, a family child care provider, or a relative. The provider bills the county for the hours of care provided to the child (up to the number of hours authorized) and is paid their usual rate or the maximum payment rate set by the state, whichever is less. Depending on family size and income, the family may be required to pay part of the costs of care through a co-payment. The average annual amount paid by the government in 2014 ranged from $10,320 per family in the Basic Sliding Fee (BSF) program to $15,312 per family in the MFIP child care program. During state fiscal year 2014, Minnesota served an average of over 30,000 children per month, at a cost of approximately $216 million in federal, state and county dollars (Minnesota Department of Human Services 2015).

While the MFIP-related portion of the child care subsidy program is fully funded, the BSF program is not, and there are waiting lists in some counties.

While estimates vary across states and time periods, there has been consistent evidence that many American families who are eligible for CCDF child care subsidies do not utilize them. To participate in a state child care subsidy program, a parent must complete an application process, usually with a local government social services agency. Estimates of subsidy take-up among eligible families have varied across states and studies with rates ranging from 15% (Isaacs 1999) to 42% (Danziger et al. 2004). Nationally, in 2011, an estimated 17% of the children eligible under federal rules received subsidies, or 29% of those eligible under (tighter) state rules (Office of the Assistant Secretary for Planning and Evaluation, 2015). Lack of knowledge about eligibility for the program was a problem frequently cited by parents (Adams et al. 2002; Meyers and Heintze 1999).

A number of studies have analyzed the factors associated with applying for and receiving a child care subsidy, focusing primarily on family and child characteristics. Herbst (2008) noted that the similarity in factors associated with subsidy receipt across studies may reflect state policy decisions concerning which types of families have priority to receive subsidies. Recent studies have found subsidy receipt more likely among African-American families, single parents, more educated parents, those with current or past welfare (TANF) receipt, those with more children, and those using formal or center-based care (Blau and Tekin 2007; Burstein and Layzer 2007; Herbst 2008; Huston et al. 2002; Lee et al. 2004; Lemke et al. 2007; Meyers et al. 2002; Tekin 2005, 2007b, 2007a). A recent study comparing recipients to eligible non-recipients found that subsidy recipients had more advantages than eligible non-recipients, including higher incomes relative to their needs (Johnson et al. 2011). Herbst (2008) also found that subsidy-receiving households had higher levels of education and younger children and were more likely

to receive other forms of public assistance than those households who were eligible but did not receive child care subsidies.

Research has demonstrated that the availability of a government subsidy to help pay for child care can expand the child care options accessible to low-income parents by increasing the affordability of certain types of care (Collins et al. 2007; Lee et al. 2004). Studies in multiple states have found that parents using child care subsidies were more likely to use center-based care (Burstein and Layzer 2007; Krafft et al. 2017; Ryan et al. 2011; Tekin 2005; Weinraub et al. 2005). A key question is whether having the subsidy leads parents to choose center care more often, or whether parents who want to use center care are more likely to apply for and obtain subsidies. Findings from Burstein and Layzer (2007) supports the latter. Burstein and Layzer (2007) found both subsidy receipt and parents' priorities for care to be associated with type of care using binary logistic models, but estimated marginal effects of subsidy receipt on mode of care changed little when parent preference variables were included.

Research on Child Care Costs, Subsidies and Parental Employment

An extensive literature has demonstrated that the cost of child care influences mothers' employment decisions in the US (Anderson and Levine 2000; Blau and Hagy 1998; Connelly 1992; Connelly and Kimmel 2003; Kimmel 1998; Ribar 1992). Blau and Currie (2004) compared the findings from a number of studies and concluded that the price elasticity of employment with respect to child care price was relatively small. Kalb (2009) and Morrissey (2017) noted that the employment effect was larger for low-income and for mothers with lower education levels.

The most relevant studies for our purposes are those that have focused directly on the relationship between participation in the child care subsidy program and employment of low-income mothers in the US. Blau and Tekin (2007), for example, found that subsidy receipt was

associated with between a 13 and 33 percentage point increase in the likelihood of employment for single mothers. Crawford (2006) concluded that child care subsidy receipt was associated with a 21 percentage point increase in the probability of employment. Berger and Black (1992) exploited the existence of subsidy waiting lists in Kentucky and estimated a 12 percentage-point increase in employment for those receiving subsidies. In contrast, one study using a random assignment design found no effect on the employment or earnings of families receiving child care vouchers, but the sample included only families above the standard income-eligibility limits, most of whom were already employed (Michalopoulos et al. 2010).

A related strand of research investigates the relationship between maternal labor supply and child care costs by exploiting variation over time or location in the availability of publicly provided or state-subsidized kindergarten and preschool programs. A number of these studies have found that implicit subsidization of the cost of non-parental care through expansion of public kindergarten or public preschool programs had little effect on maternal labor supply in the US and certain other countries (Cascio 2009; Fitzpatrick 2010, 2012; Havnes and Mogstad 2011). However, other studies have found positive effects on mothers' employment for certain subgroups, including women with less education or lower incomes, or in countries with lower female labor force participation rates (Baker et al. 2008; Coneus et al. 2009; Fitzpatrick 2012; Gelbach 2002; Havnes and Mogstad 2015). These studies provide limited information about the direct effects of CCDF-type child care subsidies on mothers' employment given the differences in program objectives, hours of care and availability. Most early education programs such as Head Start or state pre-kindergarten operate on a school-day and school-year schedule, and some are part-day programs, which may not meet the child care needs of low-income working parents, many of whom work evenings and weekends (Henly and Lambert 2005; Tekin 2007b).

Methodological Challenges

A key challenge in estimating the effect of child care subsidies on employment decisions is the joint nature of the employment decision and the decision to apply for and use a child care subsidy. Some studies assume that the employment decision is exogenous or precedes the child care decision. For instance, Ahn (2012) and Crawford (2006) simply included a dummy for subsidy receipt in predicting the probability of employment. Other studies (Goerge 2009; Lee et al. 2004) acknowledged the probable endogeneity of these decisions and noted that their results must be interpreted as correlation rather than causation. A few studies used a two-stage approach to first estimate the probability of subsidy receipt and then estimated an employment equation (Blau and Tekin 2007; Meyers et al. 2002). However, these authors used the predicted probability of subsidy receipt in the second stage, which has been shown to lead to inconsistent estimates in the case of a binary outcome (Terza et al. 2008).[4] As an alternative to two-stage methods, joint categorization of outcome variables has been applied to similar questions, such as the relationship between work hours and subsidy receipt (Tekin 2007b) or type of child care and employment (Tekin 2005).

One approach to the endogeneity problem is to use an instrumental variables technique. Instrumental variable techniques allow one to account for unobservable factors that influence both employment and subsidy use. These unobservable factors could be intangibles, such as self-efficacy, which would be linked to both employment decisions and the ability to navigate the administrative burden of accessing subsidies. One challenge of using instrumental variables is that appropriate instruments are difficult to find. Tekin (2005) used variation in state subsidy policy to identify the subsidy receipt equation, while in another study he included state dummy

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[4] Blau and Tekin (2007) used a linear probability model, which should be consistent if the linear assumption provides an accurate specification of the binary choice processes.

variables (Tekin 2007a). Blau and Tekin's (2007) study used county dummies as identifying instruments. By using these geographic instruments, they assumed that labor market conditions were unrelated to subsidy policy at the state or county level. Herbst and Tekin (2011) created an instrument based on the distance to the nearest social service agency to explore the effect of subsidies on parents' decisions to enroll in education or training programs. These studies used data from the 1990s (the National Survey of America's Families, conducted in 1997-1999, or the 1998 Kindergarten Cohort of the Early Childhood Longitudinal Study, ECLS-K). Changes in economic conditions and subsidy policy since then may have altered the relationship between subsidy and employment. As noted by Morrissey (2017), there is a need for studies using more recent data.

As described in the next section, our approach uses more recent data and also extends the literature recognizing the joint nature of child care subsidy and employment decisions as well as the literature attempting to correct for endogeneity (Blau and Tekin 2007; Herbst and Tekin 2011; Tekin 2005, 2007a, 2007b). We used an instrumental variable model to predict our endogenous variable (subsidy use), without predicting our main outcome (employment choice). This approach allowed us to obtain an estimate of the direct link between parents' employment and subsidy decisions.

Empirical Strategy

Parents deciding to use non-parental child care may have free options, either from a family member or friend, or from a public program such as Head Start. However, parents may be unable to work if they are not able to obtain a child care subsidy, or if there is insufficient free care available during the hours needed for work. The joint nature of employment and subsidy decisions means that these decisions must be modeled with corrections for endogeneity. Standard two-stage Heckman type models for sample selection or endogenous switching work well for

continuous outcomes and endogenous variables but are "only approximate" in the case of binary, count or ordinal responses (Miranda and Rabe-Hesketh 2006, p. 286), and using predicted values from the first stage in the second stage will often yield inconsistent estimates (Terza et al. 2008). Instead of a two-stage model we used maximum likelihood estimation of an endogenous switching model (Deidda 2014; Miranda and Rabe-Hesketh 2006) to estimate a probit model for subsidy receipt and probit or ordered probit models for binary or ordinal employment choice. The endogenous switching model was implemented with David Roodman's cmp package (Roodman 2011) in STATA 14.2. The endogenous switching model (also known as the dummy endogenous variable model) was appropriate in this setting because it allowed joint determination of the two outcome variables and took into account that unobserved factors that affected one of the outcomes may also have influenced the other (Angrist 2001).

In the endogenous switching model, we observed the variable E_{it}, an ordinal or binary employment indicator, and the variable S_{it}, a binary indicator of the receipt of a child care subsidy. Because we had panel data, we observed these outcomes at multiple points in time (t). These outcomes were driven by the unobserved latent variables:

$$E_{it}^* = X_{it}'\beta + \gamma S_{it} + \eta_i + u_{it}$$
$$S_{it}^* = Z_{it}'\delta + \tau_i + v_{it}$$

Here, X_{it} was a set of exogenous predictors of respondent's employment, and Z_{it} were exogenous predictors of subsidy use, which included X_{it} and the instrumental variable described in greater detail below. Employment and subsidy receipt were expected to be related to a number of characteristics of the respondent, household and community, which are described below in the data section. The parameters β, γ and δ were to be estimated. The random effects η_i and τ_i controlled for time-invariant unobserved characteristics of the respondents and their environment, and the time-varying error terms u_{it} and v_{it} captured any remaining unobserved

factors. Both the vector of random effects, η_i and τ_i, and the vector of time-varying error terms, u_{it} and v_{it}, were assumed to have bivariate normal distributions. This model incorporated the standard assumption of random effects models, that the random effects η_i and τ_i were uncorrelated with observed characteristics X_{it}, Z_{it} and S_{it}.[5]

If the correlations between subsidy receipt (S_{it}) and the unobserved characteristics affecting the employment decision were zero (i.e., if S_{it} is not correlated with η_i and u_{it}), S_{it} would be exogenous and standard binary or ordered probit methods could be used to estimate the effect of S_{it} on E_{it}. However, we expected that time-varying unobserved factors that affect the likelihood of receiving a child care subsidy would be correlated with time-varying unobserved characteristics that impact employment decisions, and therefore we expected the correlation to be non-zero. To capture this endogeneity we estimated a correlation, ρ, between the time-varying error terms u_{it} and v_{it} in the endogenous switching model.

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[5]A fixed effects approach has appeal because it does not require the individual effects to be orthogonal to the observed regressors. However, a fixed effects approach may result in biased estimates due to the incidental parameters problem (Lancaster 2000; Neyman and Scott 1948). While consistent estimators in the presence of the incidental parameters have been developed for binary outcomes (Hamerle and Ronning 1995), as of yet there are no solutions for this problem in the joint endogenous switching model. Therefore, in order to test the validity of our random effects assumption, we computed Hausman tests of random versus fixed effects in separate subsidy and binary employment equations (using the xtlogit command in STATA 14.2, which produces consistent fixed effects estimators for a logit binary outcome). For these tests, we necessarily excluded time-invariant predictors, and we excluded the subsidy variable in the employment equation because we could not control for endogeneity of the subsidy using xtlogit. In both equations, we failed to reject the validity of random effects.

We observed $S_{it} = 1$ if $S_{it}^* > 0$, otherwise $S_{it} = 0$. Our observed value of E_{it} follows the form

$$E_{it} = \begin{cases} 0 \text{ if } E_{it}^* < c_1 \\ 1 \text{ if } c_1 < E_{it}^* < c_2 \\ \vdots \\ n-1 \text{ if } c_{n-1} < E_{it}^* \end{cases}$$

where c_n denotes a cutoff value. When $n=2$, this simplifies to a binary employment variable (employed or not); when $n=3$, this became our three-level ordinal employment variable (no employment, part-time employment and full-time employment).

Identification of our model was achieved through the use of an innovative instrument based on a factor analysis of the mother's child care preferences, which predicts subsidy take-up but is otherwise unrelated to employment decisions. When asked about the importance of various characteristics of care, parents tended to report all items as important (Coley et al. 2014; Early and Burchinal 2001). Also, parents' preferences about different characteristics were likely to be related as parents may look for a set of characteristics rather than focusing on one or two priorities. Given the high correlation among the responses, a factor analysis allowed us to model the underlying latent variable that reflected the variation in the data. This factor was used to predict subsidy receipt, but was otherwise expected to be unrelated to the employment decision. Further information about the instrument is provided in the data section below.

Data and methods

Sample Description

The data were obtained from the longitudinal parent survey conducted as part of the Minnesota Child Care Choices study.[6] The survey was conducted by telephone with parents who, at the time of the baseline survey, had at least one child age six or younger and who had applied to receive financial assistance (such as TANF) through a county social services agency. The sample was restricted to parents living in one of nine participating counties at the time of the baseline survey. These counties originally were determined based on their participation in a pilot study of a quality rating and improvement system and included two large metropolitan counties (Hennepin and Ramsey) and seven mostly rural counties (Brown, Blue Earth, Faribault, LaSueur, Martin, Nicollet, Sibley in southern Minnesota).[7]

Following the protocol approved by the Minnesota Department of Human Services Institutional Review Board to protect the confidentiality of the families, potential survey respondents were given packets of information about the study at the county social services office. All families with young children who came into the office during a set time period were given the study materials, and asked to send a postcard or make a phone call in order to participate. Families willing to participate in the study were later contacted by phone by an independent research organization. Of the 437 families who agreed to participate in the study, 323 (74%) completed the baseline interview. The other families did not participate because 16

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[6] The Minnesota Child Care Choices study was conducted by Child Trends and the University of Minnesota with funding from the Office of Planning, Research and Evaluation, Administration for Children and Families, US Department of Health and Human Services.

[7] We included county fixed effects in the models to account for time-invariant differences across counties in economic, social and other characteristics.

were not ultimately eligible, 24 later refused to participate when contacted, and 74 could not be reached by telephone. Unfortunately, county staff did not track the number of information packets distributed so that an overall response rate could not be calculated. Concerns about the generalizability of the findings due to this sampling strategy are discussed below in the limitations section.

For each family, one child under age six was randomly designated to be the focal child and detailed information was collected about the child care arrangements used for this child. The survey respondent was the person with the most knowledge of the focal child's care arrangements, usually the mother. The survey asked detailed questions about parents' child care preferences, parents' perceptions of the quality of their child care, family and child characteristics, parental employment, and use of public assistance programs.[8] The data used in this study come from the first three waves of the survey, which were conducted approximately every six months between 2009 and 2011. The baseline sample included 323 families; 250 families responded in Wave 2, and 218 families did so in Wave 3. Due to a small number of missing values, the analysis sample included panel data containing 780 observations (318 from Wave 1, 248 from Wave 2 and 214 from Wave 3).

The study population consisted of low-income families with young children who were likely to be eligible for child care subsidies. The subset of the study sample receiving subsidy, when compared with the administrative data on all subsidy recipients, had similar patterns of subsidy receipt[9] (Krafft et al. 2017). The majority of households (52.9%) in the sample had

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[8] More details about the survey can be found in Tout et al. (2011).

[9] We also compared the characteristics of subsidy recipients in our sample to the characteristics of all subsidy recipients in Minnesota (Davis et al. 2014). The comparison showed similar but not identical characteristics. For instance, the same percentage of single parent households (74%) occurred in both data

income under $15,000.[10] Four-fifths had income that was less than $25,000. Most of the sample

families used some form of non-parental child care on a regular basis. Approximately one third

(37.2%) of children in this sample were in child care centers, preschools or nursery schools.

Another third (37.7%) were in the care of family, friends, or neighbors. The remainder were in

family child care[11] (11.0%) or parental care only (14.0%).[12] On average, there were 1.86 children

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sources for subsidy recipients in Minnesota. However, we sampled more individuals receiving welfare

benefits (65%) than had MFIP/DWP in the administrative data (47%), likely due to our sampling strategy.

Use of center-based care was somewhat higher in the administrative data (62% vs. 50%). The

generalizability of the results are discussed in the limitations section of the paper.

[10] Some households did not know their annual income, but did give a monthly income, which was

multiplied by 12 to approximate annual income. Many households gave annual or monthly ranges of

income rather than specific numbers. A few households (N=8) were unable or unwilling to report their

income, even categorically. Income figures from different survey waves were not adjusted for inflation,

since many responses were categorical.

[11] Family child care (FCC) was distinguished from family, friend and neighbor (FFN) care based on

respondents' answers to questions about the care setting. All care in the child's home was classified as

FFN. If the out of home provider was identified by the parents as a professional babysitter, the

arrangement was classified as FCC. FCCs were also identified as care settings where caregiving was the

provider's primary job and where the provider cared for children not related to the respondent or the

provider. Otherwise, the provider was considered FFN care.

[12] The pattern of types of care in the sample was similar to that reported for a representative sample of all

Minnesota households in 2009 (Chase and Valorose 2010). For children under age six in regular

arrangements, the primary reported type of care was FFN (41%), centers (37%), FCC (20%) and other

(2%). Excluding children in parental care only from our sample, the share of each type of care in this

study is similar, FFN (44%), centers (43%) and FCC (13%).

in a family, including the focal child, for whom the respondent was the primary caregiver. Focal children were all aged six or younger at the baseline. When observed across the three waves, 20.9% were infants (under 16 months), 28.2% were toddlers (16-32 months), 43.2% were preschool aged (33 months-79 months, not yet in school), and 7.7% were school-aged (in school or 80 months and older).

Dependent Variables

While many studies of the effect of child care subsidies on employment have used a binary employment variable, in this study we estimated separate models for any employment and for full- vs. part-time employment because of the difference in hours of child care needed. The first model used a binary variable indicating whether or not the respondent worked for pay or held a job in the past week. The second model was estimated using a three-category ordinal variable, indicating (1) if the respondent did not work for pay or hold a job in the past week, (2) worked for pay or held a job last week, but works less than 30 hours during a typical week ("part-time employment"), (3) worked for pay or held a job last week, and works for 30 or more hours during a typical week ("full-time employment"). As shown in Table 1, across the three survey waves, approximately half (48.5%) of respondents were not employed at the time of the survey wave. More of those who were employed had full-time jobs (35.5%) than part-time jobs (16.0%).

The variable indicating subsidy receipt at the time of the survey was drawn from administrative data from the Minnesota Child Care Assistance Program that were matched with the survey data. The Minnesota Department of Human Services provided monthly administrative data for children participating in the child care subsidy program during the period January 2009 until December 2012. Survey respondents were matched to the state administrative database based on respondents' name, gender and date of birth, and additional variables were compared if

needed to confirm the match (including home address and child's date of birth and gender). A matching household record in the administrative data was found for 98% of the survey respondents using this look-up process. The survey respondents were in the state database because they applied for or received public benefits such as TANF, Medicaid or SNAP. They did not necessarily apply for or receive child care subsidies.

The household was coded as receiving a child care subsidy if the focal child received care paid for (in part or full) by the Child Care Assistance Program during the calendar month in which the survey was completed. The subsidy variable indicated both that the focal child was eligible for the subsidy, and that subsidy was taken up. The use of administrative data to identify child care subsidy receipt is a substantial improvement over most previous studies that rely on survey responses which are likely to include some measurement error (Bowman et al. 2009, 2010; Johnson and Herbst 2013; Krafft et al. 2015).

Explanatory Variables

The joint models of employment and child care subsidy receipt included a rich set of respondent, child, and family characteristics expected to be related to these outcomes. Table 1 provides descriptive statistics based on all observations used from the three waves (included in the analysis) and based on unique observations from Wave 1. Notably, characteristics were similar over time, despite attrition, largely changing in predictable ways (such as children aging). Although not presented in the table, fixed effects for county were included in all the multivariate models.

At the time of the baseline (Wave 1) survey, a quarter (25.5%) of respondents had less than a high school education, while a third (34.3%) had exactly a high school education, and the remainder (40.3%) more than a high school education (Table 1). Mother's education influences her employment decisions, and has also been shown to be associated with child care use and

subsidy take-up (Herbst 2008; Johnson et al. 2011; Tekin 2007a). Other control variables included the respondent's race and ethnicity, age, and whether the respondent was male or female. A majority of respondents were non-White and non-Hispanic (53.1%) while more than one-third were White and non-Hispanic (39.0%), and 7.9% identified as Hispanic at the baseline. Few respondents (9.8%) were male. The average respondent age (as of Wave 1) was 25.2 years.

Parental employment and the need for (and cost of) child care clearly will be influenced by the number and ages of children in the family. Over the course of the three survey waves, a quarter (23.1%) of households had at least one child under a year old. Nearly two-thirds of the sample (65.3%) had only one child age 5 or younger in the household, 22.4% had two children age 5 or younger, and 10.4% had three or more young children in the household.[13] A small fraction (1.9%) had no children under age 5.

The number of adults in the respondent's household was expected to affect both employment choices and the need for non-parental child care. Averaging across the three waves, a large minority (43.5%) of respondents were the sole adult in the household. Most of the remainder (44.4%) lived in two adult households, and 12.2% lived in households with three or more adults. Half (54.0%) of households had a friend or family member available to provide care for the focal child. The availability of someone to provide care is highly likely to influence decisions about employment and the need for subsidies to help pay for child care (Davis and Connelly 2005).

Factor Analysis: Child Development Support as a Parental Priority

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[13] In our multivariate models, we only controlled for three or more children because this specification passed the proportional odds test. Results were not substantially different with other parameterizations of number of children of different ages.

Across the survey waves, 39.6% of children received a subsidy to help pay for their care (based on administrative records). Given the expected endogeneity of child care subsidy receipt, we included an instrumental variable (IV) in the subsidy receipt equation that was excluded from the employment equation. The IV was based on a factor analysis of parental preferences with regard to the characteristics of child care arrangements. Parents who prioritize the educational features of care settings may be drawn to center-based care and more likely to use child care subsidies because child care centers tend to have higher prices than family child care providers. A number of studies have found that parents receiving child care subsidies were more likely to use center-based than other types of care arrangements (Burstein and Layzer 2007; Tekin 2005; Weinraub et al. 2005).

In the survey, respondents were asked a series of questions about how important they considered different characteristics in a child care setting, such as a warm environment, educated staff, or the availability of books and learning materials. The question asked about child care providers in general, not the focal child's arrangement. Specifically, the following questions were asked:

Child care programs, teachers, and caregivers do many things when they care for children. I have a list of some of these things and would like to ask you how important each one is to the overall quality of a program. Your response choices for these items are extremely important, somewhat important, not very important, or not at all important. How important is it that the provider…

a. Talk with you each day?

b. Use a curriculum or planning tool for teaching?

c. Have a lot of books and learning materials?

d. Provide a warm and caring environment with positive relationships between teachers and caregivers and children?

e. Help your child get along with other children?

f. Track your child's learning and development using an assessment tool?

g. Have teachers and caregivers with formal education and training to work with young children?

h. Have staff that are warm and friendly with your child?

i. Enroll children from different backgrounds, for example, race, ethnicity, and religion?

j. Have caregivers or teachers who speak your family's native language with your child?

Not surprisingly, nearly all parents rated most or all of these items as somewhat or extremely important. Given the high correlation among the responses, we conducted a factor analysis to model the underlying latent variables that would reflect the variation in the data. Factor analysis is a statistical method for parsimoniously combining related information from a number of variables in order to identify underlying latent factors (Harman 1976). In this case, we used factor analysis to combine parents' responses to the ten questions about the importance of a number of characteristics of child care settings.[14] While other characteristics such as cost and proximity are likely to influence parents' decisions about choosing a particular child care provider, these questions and the factor analysis were intended to focus on aspects of the child care setting itself.

To conduct the factor analysis we selected one observation per respondent at random across the survey waves. This approach was used in order to have greater variation in the ages of

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[14] Results including all ten variables for the responses instead of the factor were substantively similar.

the focal child. It also kept only one observation per focal child, which ensured that respondents were weighted equally. The relationships (factor loadings) identified in the factor analysis using one observation per focal child were used to compute the factor as a time-varying covariate, based on responses in each wave, for all observations across waves.

To determine which and how many factors were important, we first examined the eigenvalues from the factor analysis. The eigenvalue associated with a factor represents the amount of the variance of the variables explained by that factor (J.-O. Kim and Mueller 1978). One factor, which we call the "child development support as a parental priority" factor, had an eigenvalue of 1.91. All other factors had eigenvalues less than one. Factors with eigenvalues less than one are not considered reliable (Kaiser 1960).

In the second step, we examined the relationship between the "child development support as a parental priority" factor and its underlying variables. The scoring coefficients, shown in Appendix Table A.1, tell us how the factor was obtained as a weighted sum of standardized versions of the underlying variables, with the scoring coefficients being the weights placed on each variable. Factor loadings indicate the correlation between a variable and the factor. They are computed using the squared multiple correlations, also known as the communality. Higher factor loadings indicate a variable is more closely related to the factor. Uniqueness is the percentage of variance in a given variable explained by the factor subtracted from one, computed as one minus the communality. A higher uniqueness means little of the variance is explained, a lower uniqueness means that more of the variance is explained.

In Appendix Table A.1, it can be seen that the features of a provider that were weighted most heavily in the factor were educational dimensions, such as using a curriculum or planning tool, tracking child learning, and having teachers with formal education. Appendix Table A.2 displays the underlying distribution of the variables that enter into the "child development

support as a parental priority" factor. Figure 1 shows the distribution of the factor among the

random sub-sample that was used to create it. As both the distribution of the underlying variables

and the distribution of the factor showed, parental priorities for child development support were

highly concentrated among higher values. For each of the characteristics, the majority of parents

stated that it is very important. The educational characteristics of a provider were identified as

consistently related. This does not mean that parents considered a warm environment

unimportant—315 of 320 did. However, the patterns in the other variables were not as strongly

related as the set of variables related to education that received the most weight in the factor.

Thus, through the factor analysis, we identified a single, dominant factor that emphasized several

priorities related to education, including the importance of an educated staff, tracking the child's

learning and the presence of tools for teaching. This factor allowed us to incorporate into our

models variation in the importance parents place on educational features of a care setting as a

predictor of using a child care subsidy.

Validity of the Instrument

Conceptually, we expected our instrument, the child development priority factor, which

measures the importance parents place on the educational and child development-related

characteristics of the child care setting, to influence parents' decisions to seek a child care

subsidy but to be otherwise unrelated to employment decisions. Most studies of selection of child

care types focus on family and child characteristics, although a few have included information

about parental preferences about the type or characteristics of care. Studies using qualitative

methods have found parents who emphasize safety and relationship with a known provider were

more likely to select family or relative care rather than child care centers (Chaudry 2004; Lowe

and Weisner 2004). Quantitative analyses that included parent preferences about provider

training, speaking English or group size found mixed results: what parents say is important was

only sometimes significantly related to the type of care they are using (Burstein and Layzer 2007; Davis and Connelly 2005; Early and Burchinal 2001; Peyton et al. 2001; Tang et al. 2012). However, Coley et al. (2014) found that parents who put more weight on provider training and English were more likely to use center-based care. Similarly, Kim and Fram (2009) found that "learning and quality-focused parents" were more likely to use center-based care arrangements (p. 87).

While some parents may prefer center-based care, it is often more expensive that other types of care. Based on data from Child Care Aware (2015), the cost of full-time care for a four-year-old in a child care center was over 50% higher than with a licensed family child care provider in Minnesota. Numerous studies have shown that subsidy receipt was associated with higher use of center or formal, regulated care (Crosby et al. 2005; Forry and Hofferth 2011; Herbst and Tekin 2010; Johnson et al. 2012; Krafft et al. 2017; Markowitz et al. 2014; Michalopoulos et al. 2010; Ryan et al. 2011; Tekin 2005), suggesting that subsidies increased access to the more expensive type of care for parents who preferred it. Only one study to date has directly tested parent preferences about care characteristics in a model of subsidy take-up (Johnson et al. 2011). While they found that certain parental preferences were related to subsidy receipt (such as cost and proximity), the importance of caregiver training was not. High correlation among the six dummy variables, one related to each preference, may explain the lack of statistical significance in their study.

In contrast, we used a factor analysis to capture parents' underlying preferences about child care settings in a single factor. The items with the highest loadings for this factor were related to education and support for child development, such as using a curriculum or planning tool, tracking child learning, and having teachers with formal education. Parents who prioritize child development aspects of care are more likely to prefer center-based care, which is generally

more expensive, and thus are more likely to take up the subsidy to help pay for the care. The factor varied with the focal child's age as parents placed higher emphasis on child development aspects of care (the factor was higher) when focal children were toddler-aged (16 months) and older as compared to infants. This pattern was expected since studies show that predictors of family's child care use decisions differ by child age (Coley et al. 2014; Early and Burchinal 2001; Hirshberg et al. 2005). As shown below, this factor predicted subsidy receipt, but was otherwise unrelated to employment decisions. It should be noted that we purposely did not include the parental preferences identified by Johnson et al. (2011) as being related to subsidy receipt (cost and proximity) because each of these variables, particularly cost, could be related to parents' employment.

Two primary conditions must hold for an instrument to be valid: the instrument must have predictive strength in estimation of the endogenous variable, and the instrument must not be correlated with the outcome of interest other than through the endogenous variable. Our parental priority instrument showed strong predictive power in our endogenous switching model, with a p-value for the coefficient of our instrument of 0.012 in the subsidy equation of both specifications. In addition to statistical significance, we assessed the strength of the instrument by computing the impact of including the instrument on a series of pseudo-R^2 measures computed from the subsidy estimation, including McFadden's adjusted R^2, Efron's R^2, and an adjusted count R^2. The instrument increased R^2 measures by 11 to 20%, demonstrating meaningful improvements in prediction of subsidy take-up when the instrument was incorporated into our subsidy model. In a separate test of a subsidy-only estimation, using a random effects logit model, a likelihood ratio test of the model with and without the instrument produced a p-value less than 0.003. In addition to the strength of the instrument, if there were unobserved variables that cause our instrument to be correlated with employment other than

through the subsidy take-up decision, our instrument would be invalid. Unfortunately, there is no formal test of this condition when only one instrument is available. However, a likelihood ratio test conducted for each employment outcome (binary and categorical) comparing a model of employment as a function of the controls and subsidy against a model adding our instrument indicated that the instrument had no additional predictive power when subsidy was used to predict employment (p-value of 0.992 for the categorical employment outcome and 0.737 for the binary employment outcome). While this was not a formal test of excludability, we believe our instrument plausibly met the conditions for validity.

Empirical Results

We first present the results in Table 2 for the binary and ordered probit[15] models for employment without correcting for the endogenous and joint nature of employment decisions and subsidy take up, for the purpose of comparison. The results from these simple models were similar across both employment outcome variables (binary and ordinal employment responses). In both models the youngest respondents were less likely to be employed. The results indicated that a more than high school educated respondent was significantly more likely to be employed than a respondent with less than a high school education. In addition, a respondent whose household included a child under one year or three or more children age 5 or younger was significantly less likely to be employed.

The key variable of interest, subsidy receipt, was positive and statistically significant in both employment models without correction for endogeneity. While looking just at these models without correcting for endogeneity would lead one to conclude that subsidy receipt had a positive effect on employment outcomes, the estimated effect was much smaller than in the endogeneity-corrected models, which we discuss next.

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[15] The ordered probit models passed the proportional odds test.

Endogenous Switching Model

Table 3 presents our main results for the endogenous switching models for employment

and subsidy receipt, which accounted for the endogeneity of subsidy use. The first set of columns

shows the results for employment as a binary outcome, and in the second set employment was an

ordinal outcome (none, part- time employment, full-time employment). Looking first at the

employment equations, the key result is that being eligible for and taking up a subsidy was

strongly associated with employment, with parameter values nearly double the size seen in Table

2. Receiving a subsidy significantly increased the probability of any employment and especially

of full-time employment. Table 4 presents the marginal effect of subsidy receipt, comparing the

marginal effect of subsidy in the simple, uncorrected models to the marginal effect of subsidy

estimated in the endogenous switching models. To compute these marginal effects, we set the

subsidy variable to be zero or one, held all other characteristics of the respondents at their actual

values, and predicted the resulting change in the probability of each employment status.

In the simple, uncorrected models, the marginal effects of subsidy receipt showed a

statistically significant 16-18 percentage-point increase in the probability of employment (Table

4). However, in the endogenous switching model, the estimated marginal effect of subsidy

receipt was a 28-31 percentage-point increase in the probability of employment, nearly double

the uncorrected estimate. In the models with ordinal employment outcomes, this increase was

almost entirely in full-time employment: the marginal estimate in the endogenous switching

model was an increase of 28 percentage points in the probability of full-time employment, with

very little change in the probability of part-time employment. These findings provide strong

evidence that receipt of child care subsidies supports not only the move from no employment to

employment, but also the move from no employment to full-time employment.

Other estimated parameters in the endogenous switching employment models were consistent with those found without endogeneity correction. Parameters for the equation predicting the receipt of subsidy are also shown in Table 3. We see that few of the respondent characteristics were statistically significant, although coefficient signs were generally in the expected direction. The number of adults in the household played an important role in the subsidy equation. If there are two adults in the household, the focal child was significantly less likely to receive a subsidy; it is likely that the presence of multiple adults in the household creates additional options for unpaid or low-cost care. We estimated a coefficient of similar direction when there are three adults in the household, but lose statistical significance. The probability of subsidy receipt also declined in the presence of a family member or friend who is available to care for the child.

The factor capturing parental priority for child development support, our instrument for subsidy receipt, was significant and positive in predicting subsidy take-up (Table 3). The estimate of the correlation between the time-varying unobservables in the employment and subsidy equations, ρ, was negative. ρ was statistically significant only in the ordered probit model. The non-zero estimate of ρ supports the hypothesis that the two decisions are interrelated. At -0.26 to -0.37, this measure of correlation was quite large, demonstrating the strength of the correlation between the time-varying unobserved factors in the subsidy and employment equations.

Alternative Specifications and Robustness Checks

We examined a variety of different functional forms for the other independent variables, including number and ages of children and age of the respondent, to test the sensitivity of the findings to alternative specifications. Adding the age of the focal child to the subsidy equation did not alter the substance of our findings, nor did using the number or presence of children in

different age groups from the 0-5 age range used here. We found significantly better fit with the categorical respondent age variable used here, relative to a linear or quadratic parameterization. We tested the inclusion of all ten measures of parental preferences as separate variables, rather than the factor derived from the factor analysis, and the results were substantively similar. Including ZIP code-level community variables (average labor force participation rate, poverty rate and median house value) also did not substantively alter our findings. Alternative definitions of full-time versus part-time employment, at 24 or 32 hours instead of 30, led to similar results. Although other studies included TANF receipt (Crawford 2006) or non-wage income (Herbst 2010) when examining the impact of subsidy on employment, TANF and other forms of non-wage income are also endogenous to decisions about employment and childcare. We therefore excluded them from our models.

Discussion

Working in the labor market usually requires parents to secure non-parental care for their young children, and given the potential costs of these arrangements, parental decisions about employment and subsidy take-up are closely intertwined. While some previous studies addressed the joint nature of employment and subsidy use decisions, this study was the first to measure the correlation between the unobservables in both the employment and subsidy equations. Tekin (2005) posited that this relationship could be either positive or negative. This paper's non-zero estimate of this correlation supports the hypothesis that the decisions about employment and subsidy use are interrelated. The negative estimate of the correlation between the time-varying unobservables suggests that individuals who are more likely to be employed due to unobserved characteristics are less likely to seek a subsidy. Conversely, individuals who are eligible for and take up a subsidy are those who would be less likely otherwise to seek employment at that point

in time. Program administrators may prioritize funding for those who are most disadvantaged in the labor market (Tekin 2005).

Our findings indicate that public subsidies for child care encourage employment among parents who would be less likely to work without a subsidy. Because the correlation was negative, without explicitly accounting for the endogeneity, estimates of the subsidy parameter in the employment equation would be biased downward toward zero. Consistent with the expected direction of bias, in the model in which we purposefully did not control for endogeneity, the results suggested that subsidy receipt had a smaller impact on employment choice than in our endogenous switching model. The endogenous switching model results showed that subsidy receipt had a very large positive effect on the probability of being employed and of being employed full-time. The results were consistent with Blau and Tekin (2007) who estimated a 13 percentage point increase in employment using OLS methods, and a much larger effect (33 percentage points) using 2SLS. They did not distinguish part-time and full-time employment, however. Our results, like Tekin (2007b), demonstrated a stronger effect on full-time employment.

Previous studies of the relationship between maternal labor force participation and child care availability across countries have found disparate results. Where maternal labor supply and formal child care utilization are high, additional subsidization or increased supply of child care may not further increase maternal employment (Bauernschuster and Schlotter 2015). Our findings aligned, however, with those of Pronzato and Sorrenti (2015), who argued that greater availability of child care in Italy particularly increased the labor supply of mothers with less labor-force attachment. Fitzpatrick (2012) noted that access to public kindergarten in the US may have had a smaller effect on maternal employment in recent years than earlier because more mothers were already in the workforce. She found an increase in labor supply only among

mothers who were unmarried and had no children younger than age 5. In contrast, our results suggested that child care subsidies targeted to low-income mothers can be effective in increasing employment. We would expect a program aimed at supporting employment to have a larger effect on maternal labor supply than kindergarten expansions due to differences in program aims and hours.

Although our main focus was not a model of who uses a child care subsidy, the results on key factors related to subsidy take-up were mostly consistent with previous literature, although some coefficients were not estimated precisely. We found that having more than one adult in the household reduced subsidy take-up, in line with previous studies that typically used single parent status, rather than household composition. Most studies found that having young children was positively associated with subsidy use; here we find the same results. One important difference from prior work was the result that those with more education were not more likely to use subsidy, though our insignificant parameters were positive. However, findings with regard to mother's education level and subsidy receipt varied across studies depending on whether employment was treated as exogenous and whether the comparison was made to only eligible or all households.

Study Limitations

While the findings aligned with other studies, our estimate of the relationship between subsidy use and employment was at the high end of previous estimates, which was consistent with the expected bias toward zero in studies without selection correction. It should be noted that the data were from only one state, Minnesota, limiting our ability to generalize about the subsidy program in other states. Differences in child care regulations and policy, as well as labor market differences, may affect parents' willingness to use child care subsidies as well as their employment options. During the time period of the study, Minnesota's economy was improving,

as was the national economy. The unemployment rate in Minnesota fell from 7.8 to 6.5% from 2009 to 2011 in Minnesota (Bureau of Labor Statistics n.d.-a), compared to the national level falling from 9.3 to 8.9 (Bureau of Labor Statistics n.d.-b). The availability of jobs may influence both the willingness of eligible families to sign up for subsidies and parents' ability to secure employment in order to be eligible. In addition, states have the authority to determine many aspects of their child care subsidy programs that influence participation, including income eligibility limits, copayments, and provider payment rates. In 2010, during the study period, Minnesota's child care subsidy program was not particularly generous compared with other states. Over 40 states had income eligibility limits set at a higher percentage of state median income than Minnesota (Schulman and Blank 2010). CCAP payment rates were well below the federal benchmark of the 75th percentile of market prices, and had not been updated since 2006 (Schulman and Blank 2010). On the other hand, Minnesota provided child care subsidies for both eligible low-income working families and for families on or transitioning off of Temporary Assistance to Needy Families (TANF), although only the latter group was guaranteed assistance if eligible. Future research exploring the relationship between specific child care subsidy policies and parental employment is needed.

The use of factor analysis on parental preferences as the basis for the instrumental variable has both strengths and weaknesses. Parental preferences with regards to aspects of care related to child development have been shown in other research (Coley et al. 2014; J. Kim and Fram 2009) to be related to use of center-based or more formal care. In accordance with these studies, this study found that the parent priorities instrument strongly predicted subsidy receipt, but not employment. Nonetheless, the instrument would be invalid if there were unobserved variables creating a correlation between the instrument and employment, other than through

subsidy receipt. Interpretation of the relationship between subsidy receipt and employment as a causal effect relies on the validity of the assumptions of the instrumental variable approach.

A few aspects of the sample and sampling design that were also limitations of the study. First, the sample size was small, limiting our ability to test for subgroup differences (e.g., by age of child) or to detect small non-zero effects. The sampling design was not based on a random draw from the population, and the families who participated in the survey may have differed from those who did not agree to be contacted. Similarly, the high rate of attrition between the first and second waves raised further concerns that the sample was not representative of all low-income families in Minnesota. The attrition occurred primarily when the survey firm could not locate families; most did participate once contacted. Nonetheless, the results should be interpreted with these limitations in mind, and may not be generalizable to a wider population. Future research, employing similar methods to account for interrelated child care and employment decisions and larger, representative samples from different state policy and economic contexts, is needed to provide support for these findings.

Conclusion

This study contributes to the growing literature on the relationship between maternal employment and state subsidized child care by focusing on low-income mothers who are likely to be eligible for targeted child care subsidies. Unlike studies that looked at maternal labor supply and the availability of public preschool or kindergarten (Fitzpatrick 2010, 2012; Gelbach 2002), this study provided direct evidence on the use of child care vouchers and parental employment. Although several previous studies have attempted to estimate a causal effect of subsidy receipt on employment, others have simply included subsidy as an exogenous regressor. Due to the interrelated nature of decisions about child care subsidy receipt and employment, findings from those studies may be biased. This study addressed some of the limitations of prior

work through the use of an endogenous switching model and by estimating the correlation between unobservables in predicting employment and subsidy use. Importantly, we found that unobserved characteristics of parents that shaped employment decisions were correlated with unobserved characteristics that influence the decision to use a child care subsidy.

The study extended work by Tekin (2005, 2007a, 2007b) who estimated models of joint decisions about child care subsidies and employment. Our study made three main contributions to the literature. First, we used an endogenous switching model to obtain consistent estimates, which also allowed us to estimate the sign and size of the correlation between the unobservables influencing subsidy use and employment. Second, we incorporated an innovative instrumental variable that related the decision to use a subsidy to parental values about the characteristics of child care settings. Third, we used linked administrative data to measure subsidy receipt, avoiding concerns about measurement error in survey responses about subsidy participation.

Our results demonstrated strong support for the hypothesis that subsidy receipt leads to increased employment. In particular, the sign of the correlation suggested the sizable increase in full-time employment occurred among parents who otherwise would be less likely to be employed at that point in time. These findings have important implications for both research and policy. The sizeable difference in results when accounting for endogeneity confirms that future research should employ methods that take into account the interrelated nature of employment decisions and child care subsidy use. Studies that fail to do so may find smaller effects of subsidy receipt on employment. Further exploration and testing of appropriate instrumental variables and other quasi-experimental approaches in different policy and economic contexts are warranted.

The study also has important implications for public policy. The findings suggest that expansions of the child care subsidy program could lead to increased employment among low-income parents with young children. Based on the endogenous switching model, subsidy receipt

has a very large positive effect on the probability of being employed and of being employed full-time, particularly for parents who would be less likely to work without a subsidy. Yet, total funding for child care subsidies has declined since 2010 (Schulman and Blank 2016), and the number of children served has fallen from 1.8 million per month in 2001 to 1.4 million in 2015 (Office of Child Care Administration for Children and Families US Department of Health and Human Services 2001, 2013). Expansions in funding for child care subsidies through CCDF would likely have a positive effect on parent employment. One caution, however; while child care subsidies appear to be increasing employment among the target population, further study of broader outcomes, such as family well-being and child readiness for school, is needed for a comprehensive evaluation of child care subsidy policy.

Compliance with Ethical Standards

Funding

(removed for anonymous review)

Conflict of Interest

The authors declare they have no conflicts of interest.

Human Subject Protections

Informed consent was obtained from all individual participants included in the study. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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Table 1. Descriptive statistics

	Sample mean [Std dev]	
	All observations	Unique respondents, Wave 1
Respondent characteristics		
Employment		
No employment	48.5%	58.5%
Part-time employment (<30 hrs)	16.0%	17.9%
Full-time employment (30+ hrs)	35.5%	23.6%
Age (in years)	25.8	25.2
	[5.8]	[5.7]
Education		
Less than high school	24.1%	25.5%
High school graduate/GED	34.9%	34.3%
More than high school	41.0%	40.3%
Male	8.1%	9.8%
Race		
White, non-Hispanic	38.3%	39.0%
Hispanic	7.6%	7.9%
Non-White, non-Hispanic	54.1%	53.1%
Child development support as a parent priority		
For those not receiving subsidy for focal child	-0.135	-0.088
	[1.055]	[0.923]
For those receiving subsidy for focal child	0.154	0.065
	[0.878]	[0.904]
Household characteristics		
Infant is present in the household for whom respondent was a primary caregiver	23.1%	32.4%
Number of children age 5 or younger in household for whom respondent was a primary caregiver		
0 children	1.9%	0.6%
1 child	65.3%	65.7%
2 children	22.4%	23.0%
3 or more children	10.4%	10.7%
Number of adults in the household		
1 adult	43.5%	42.5%
2 adults	44.4%	44.3%
3 or more adults	12.2%	13.2%
Family/friend was available to care for child regularly	54.0%	54.1%
Household in rural zip code	26.4%	26.4%
Focal child characteristics		
Subsidy received for child's care	39.6%	37.4%
Number of observations		
Wave 1	318	318
Wave 2	248	
Wave 3	214	
Total	780	318

Source: Authors' calculations based on Minnesota Child Care Choices Survey data and subsidy administrative data.

Table 2. Models of employment assuming subsidy is exogenous: Estimated coefficients with [Standard errors]

	Binary probit employment	Ordered probit employment
Subsidy received for focal child's care	0.565** [0.178]	0.484** [0.158]
Respondent characteristics		
Age		
20 and younger	-0.676** [0.262]	-0.611* [0.240]
21-25	*reference*	*reference*
26-35	-0.066 [0.189]	0.077 [0.169]
36-55	-0.110 [0.370]	-0.104 [0.327]
Education		
Less than high school	*reference*	*reference*
High school graduate/GED	0.416 [0.220]	0.280 [0.201]
More than high school	0.737*** [0.219]	0.715*** [0.199]
Male	0.192 [0.287]	0.242 [0.261]
Race		
White, non-Hispanic	*reference*	*reference*
Hispanic	0.353 [0.351]	0.258 [0.308]
Non-White, non-Hispanic	-0.246 [0.226]	-0.215 [0.205]
Household characteristics		
Infant is present in the household for whom respondent was a primary caregiver	-0.401* [0.203]	-0.432* [0.185]
Three or more children age 5 or younger in household for whom respondent was a primary caregiver	-0.750** [0.286]	-0.600* [0.262]
Number of adults in the household		
1 adult	*reference*	*reference*
2 adults	0.090 [0.185]	0.187 [0.167]
3 or more adults	-0.297 [0.268]	-0.212 [0.242]
Family/friend was available to care for child regularly	0.159 [0.173]	0.116 [0.155]

	Binary probit employment	Ordered probit employment
Household in a rural ZIP code	-0.947	-0.830
	[0.972]	[0.886]
Constant	-0.187	
	[0.477]	
Cut points		
Cut 1		0.163
		[0.428]
Cut 2		0.795
		[0.430]
N	780	780
Fraction of variance explained by the model	0.170	0.124

Model included fixed effects (not shown) for eight largest counties; constant and cut points represent the average impact of the remaining nine counties with less than 10 observations each. Fit explained by the model based on Efron's R^2 statistic for binary employment model, and a multinomial extension of Efron for the ordinal employment model.

Source: Authors' calculations based on Minnesota Child Care Choices Survey data and subsidy administrative data.
Notes: *p<0.05; **p<0.01; ***p<.001.

Table 3. Endogenous switching models of employment and subsidy receipt: Estimated coefficients with [Standard errors]

	Binary probit employment		Ordered probit employment	
	Employment	Subsidy receipt	Employment	Subsidy receipt
Subsidy received for focal child's care	0.893***		0.960***	
	[0.229]		[0.200]	
Instrument				
Child development support as a parent priority		0.259*		0.260*
		[0.104]		[0.104]
Respondent characteristics				
Age				
20 and younger	-0.678**	0.075	-0.612**	0.080
	[0.259]	[0.290]	[0.234]	[0.291]
21-25	reference	reference	reference	reference
26-35	-0.082	0.017	0.053	0.024
	[0.187]	[0.209]	[0.165]	[0.209]
36-55	-0.083	-0.402	-0.067	-0.387
	[0.366]	[0.413]	[0.319]	[0.413]
Education				
Less than high school	reference	reference	reference	reference
High school graduate/GED	0.392	0.264	0.246	0.256
	[0.218]	[0.244]	[0.196]	[0.245]
More than high school	0.711**	0.279	0.669***	0.277
	[0.218]	[0.239]	[0.195]	[0.240]
Male	0.212	-0.188	0.273	-0.195
	[0.284]	[0.332]	[0.255]	[0.333]
Race				
White, non-Hispanic	reference	reference	reference	reference
Hispanic	0.381	-0.551	0.299	-0.552
	[0.347]	[0.399]	[0.301]	[0.400]
Non-White, non-Hispanic	-0.254	-0.037	-0.224	-0.029
	[0.224]	[0.263]	[0.200]	[0.263]
Household characteristics				
Infant was present in the household for whom respondent is a primary caregiver	-0.369	-0.251	-0.381*	-0.257
	[0.202]	[0.225]	[0.181]	[0.226]
Three or more children age 5 or younger in household for whom respondent was a primary caregiver	-0.754**	0.149	-0.605*	0.153
	[0.283]	[0.313]	[0.256]	[0.314]

	Binary probit employment		Ordered probit employment	
	Employment	Subsidy receipt	Employment	Subsidy receipt
Number of adults in the household				
1 adult	*reference*	*reference*	*reference*	*reference*
2 adults	0.148	-0.641**	0.271	-0.636**
	[0.185]	[0.205]	[0.164]	[0.205]
3 or more adults	-0.267	-0.434	-0.168	-0.428
	[0.265]	[0.298]	[0.237]	[0.298]
Family/friend was available to care for child regularly	0.225	-0.730***	0.210	-0.732***
	[0.173]	[0.191]	[0.153]	[0.192]
Household in a rural ZIP code	-0.947	-0.515	-0.813	-0.574
	[0.964]	[1.476]	[0.869]	[1.510]
Constant	-0.296	-0.767		-0.784
	[0.474]	[0.590]		[0.592]
Cut points				
Cut 1			0.323	
			[0.420]	
Cut 2			0.938*	
			[0.421]	
Correlation of error terms	-0.258		-0.372***	
	[0.134]		[0.112]	
N	780		780	
Fraction of variance explained by the model	0.160		0.114	

Model included fixed effects (not shown) for eight largest counties; constant and cut points represent the average impact of the remaining nine counties with less than 10 observations each. Fit explained by the model based on Efron's R^2 statistic for binary employment model, and a multinomial extension of Efron for the ordinal employment model.

Source: Authors' calculations based on Minnesota Child Care Choices Survey data and subsidy administrative data.
Notes: *p<0.05; **p<0.01; ***p<.001.

Table 4. Comparison of the estimated employment distribution and estimated marginal effect of child care subsidy on employment

	Models assuming subsidy is exogenous (from Table 2)				
	Binary employment		Ordinal employment		
	Not employed	Employed	Not employed	Part-time employment	Full-time employment
Estimated employment choice with subsidy=1	0.383	0.617	0.399	0.204	0.397
Estimated employment choice with subsidy=0	0.563	0.437	0.556	0.187	0.256
Difference (marginal effect and [Std dev])	-0.180** [0.056]	0.180** [0.056]	-0.157** [0.051]	0.017* [0.007]	0.140** [0.046]

	Models assuming subsidy is endogenous (from Table 3)				
	Binary employment		Ordinal employment		
	Not employed	Employed	Not employed	Part-time employment	Full-time employment
Estimated employment choice with subsidy=1	0.321	0.679	0.308	0.197	0.495
Estimated employment choice with subsidy=0	0.603	0.397	0.617	0.172	0.211
Difference (marginal effect and [Std dev])	-0.282*** [0.070]	0.282*** [0.070]	-0.309*** [0.062]	0.025** [0.009]	0.284*** [0.061]

Source: Authors' calculations based on Minnesota Child Care Choices Survey data and subsidy administrative data.
Notes: *p<0.05; **p<0.01; ***p<.001.
   Based on models in Tables 2 and 3

Appendix: Factor analysis of child development support as a parental priority

Table A1. Scoring coefficients, factor loadings, and uniqueness of the factor

	Scoring coefficient	Factor loading	Uniqueness
a. Talk each day	0.040	0.131	0.983
b. Tool for teaching	0.257	0.654	0.572
c. Books and materials	0.138	0.433	0.813
d. Warm environment	0.073	0.184	0.966
e. Help children get along	0.084	0.260	0.933
f. Track learning	0.256	0.636	0.595
g. Educated staff	0.324	0.708	0.498
h. Staff warm	0.067	0.170	0.971
i. Racial diversity	0.137	0.457	0.791
j. Native language used	0.063	0.180	0.968

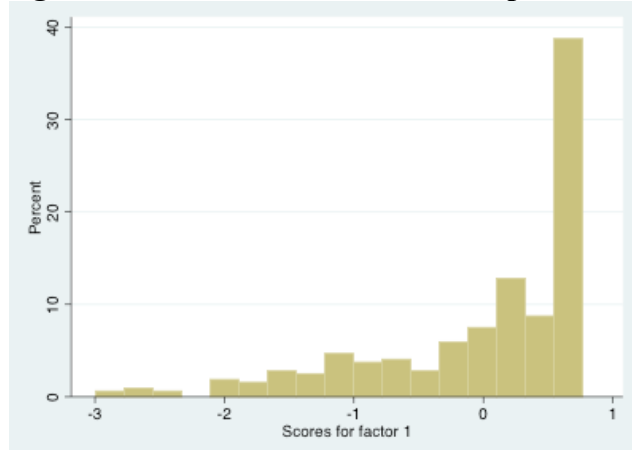*Source*: Authors' calculations based on Minnesota Child Care Choices Survey data.

Table A2. Underlying distribution of parental responses used in the factor analysis

Importance	Not at all	Not very	Somewhat	Extremely
a. Talk each day	1	5	52	262
b. Tool for teaching		15	92	213
c. Books and materials		1	45	274
d. Warm environment			5	315
e. Help children get along			22	298
f. Track learning		18	84	218
g. Educated staff		10	78	232
h. Staff warm		2	11	307
i. Racial diversity	4	27	94	195
j. Native language used	3	10	50	257

Source: Authors' calculations based on Minnesota Child Care Choices Survey data.
Notes: N=320

Figure 1. Distribution of child development support as a parental priority factor

Source: Authors' calculations based on Minnesota Child Care Choices Survey data.