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The Effects of State Regulations on Childcare Prices and Choices

RANDAL HEEB, M. REBECCA KILBURN

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Randal Heeb
INSEAD

M. Rebecca Kilburn
RAND

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Abstract

We examine the effects of state-level childcare regulations on the price of childcare, the type of care chosen, and mothers' decisions to work using regulations collected from state archives and data from the National Childcare Survey, which was collected in the U.S. in 1990. We find that regulations have an economically significant effect on the price of childcare, which in turn affects both the demand of regulated care and the labor force participation choices of the mothers. We find no direct quality assurance effect of regulation on childcare demand. This suggests that regulations may not achieve their intended objectives, and alternatives such as subsidies might be more effective at achieving policy goals.

JEL Classifications: L51 (Regulation), J13 (Childcare), C35 (Discrete Choice Econometrics)

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Corresponding author: Randal Heeb
Randal Heeb: INSEAD, Boulevard de Constance, 77305 Fontainebleau Cedex, FRANCE, randal.heeb@insead.edu
Rebecca Kilburn: RAND, 1700 Main St., P.O. Box 2138, Santa Monica, CA 90407, Rebecca_Kilburn@rand.org

1. INTRODUCTION

Over the last three decades, the United States has witnessed a substantial growth in the childcare market, fueled, in large part, by the rise in the labor force participation rates of married women (Blau, 2001). The growth of the childcare market has resulted in an increased interest in and debate about the need for governmental regulation of childcare services. While all states in the U.S. already regulate some aspects of childcare services, childcare advocates have pressed for the imposition of more stringent regulations of these services and their standardization across states by the federal government. The case for imposing minimum standards on childcare services rests on one or more of the following arguments: (1) the potential for irreparable harm by exposing children to low-quality childcare services, (2) the difficulty that parents may have in evaluating such services due to informational problems which characterize childcare markets, and (3) the potential under-provision of parental-determined childcare due to the externalities associated with children.

Whatever the justification given for childcare regulations, their advocates contend that instituting minimum quality standards for childcare should improve the average quality of the non-parental care to which children are exposed. This contention, however, depends crucially on how parental demand for such services responds to the imposition of more stringent regulations. Consider, for example, an increase in the minimum standards set for the educational credentials of childcare providers. The imposition and enforcement of more stringent educational requirements for childcare providers may reduce the uncertainty parents have about the quality of childcare services they are likely to receive in the market. As a result of this greater certainty, parents may demand more of the regulated childcare—an effect we call *the quality-assurance effect*. However, requiring childcare providers use more or higher quality labor inputs is likely to raise the price charged for the childcare which will induce some parents to shift out of regulated care into cheaper lower-quality care. As a consequence of these two opposing effects, it is not clear *a priori* whether minimum quality standards on net raise average childcare quality, reduce the average quality of care, or have no effect on childcare quality.

Other studies have examined the role of childcare regulations in the childcare market, and have generally found weak effects (Blau, 2003, Blau, 2001) except when regulations are used in price equations (Powell, 2002, and Hofferth and Chaplin, 1998). See Leibowitz (1996) for a detailed discussion of economic rationale for government involvement in the childcare market. This paper adds to this literature in three ways. First, we use a specification that provides a better characterization of the relationship between child-to-staff ratios and childcare prices by explicitly accounting for the way that regulations increase labor costs. Second, we empirically assess whether regulations affect household decisions about childcare use and maternal labor force participation using simultaneous estimation of prices and wages, and including both the price and quality-assurance effects of the regulations. Third, by simulating the policy implications of changes in regulation, we find that relatively modest changes in regulations would have large and economically important consequences, and that the overall effect of increased regulation might be counter to their advocates' intentions. Our evidence indicates that state regulations influence parents' childcare decisions primarily through a price effect, which lowers use of regulated childcare and discourages labor force participation. We find no evidence for a quality-assurance effect. We use data from the National Childcare Survey (NCCS) and state-level regulations collected directly

from the state regulators.

The remainder of the paper is organized as follows. In the next section, we briefly review the previous literature. In the third section, we describe the structure of state-level childcare regulations and the data we use in this study. We outline the likely ways in which childcare regulations would affect families' childcare decisions and maternal labor force participation in the fourth section. After outlining our econometric specification in Section 5, in Section 6 we present estimates of the effects of two types of minimum quality standards—child-to-staff ratios and educational/training requirements of childcare providers—on household choices. The final section summarizes the main findings and conclusions.

2. PREVIOUS LITERATURE

Several other papers have estimated joint models of childcare choice and maternal labor supply. Using Canadian data, Powell (2002) examines the role of childcare prices and women's wages on joint employment and childcare mode choice using mixed logit and universal logit models. She finds that wages positively affect the likelihood that parents choose one of the working states and that childcare prices reduce the probability of working and choosing each childcare mode. She estimates two-step models with selection-corrected childcare price and maternal wage equations.

Blau and Hagy (1998) estimate a multinomial log model with discrete unobserved heterogeneity. They also estimate the elasticity of employment with respect to childcare costs and own-price elasticities of childcare prices. Hofferth and Chaplin (1998) also use the National Childcare Survey to examine the role of regulations in the childcare market. Their estimated effects of regulations on childcare use are inconsistent and small. Hofferth and Chapline (1998) do not consider maternal employment and do not account for potential selectivity in their estimates. Michalopoulos and Robins (2000) pool Canadian and U.S. data and also estimate a multinomial logit model of employment and childcare choices. They find stronger effects of changes in center prices on the choice of center care than the changes in other types of childcare prices have on the choice of those modes, respectively.

Childcare regulations have been used to identify prices in a number of papers, such as Powell (2002), Michalopoulos and Robins (2000), Kimmel (1998), and Ribar (1992). These papers all found a significant relationship between regulations such as the child-to-staff ratio on the price of care, and in fact relied on the regulations for identification of the effect of price in their estimates of childcare utilization.

Early studies found that more stringent childcare regulations were associated with fewer childcare slots (Lowenberg and Tinnin, 1992), lower enrollment in childcare centers (Rose-Ackerman, 1986), and fewer centers and family day care providers per child in a state (Gormley, 1991). In a more recent study, Blau (2003) examines the role of childcare regulations on the childcare market more broadly, examining the relationship between prices and such childcare market outcomes as supply of childcare, price of childcare, quantity demanded of childcare and labor supply of mothers of young children. The general finding of this research is that the effects of the regulations are small, even when using across-year within state variation in regulations as well as across state variation.

In other research on regulations, Blau (2001) reports that regulations may have little impact on the market because they are not binding on the bulk of providers—that is many providers operate well within the regulated boundaries

and that many appear to be exempt from regulation or not comply with the regulations. Very few providers provide care at precisely the regulated level of various inputs.

3. STRUCTURE OF CHILDCARE REGULATIONS AND DATA

3.1 The Structure of Childcare Regulations

In the U.S., childcare regulations are the purview of states. Every state regulates the childcare market to some degree, but the stringency of and the form the regulations take vary substantially across states. Regulation of the childcare market may include checking the criminal records of providers, requiring children to have immunizations, guaranteeing unannounced visitation of parents, specifying the minimum square footage of childcare spaces, and a host of other stipulations. For this project, we obtained data on the regulations in each state by contacting the relevant regulatory agency in each state, and obtaining the historical regulations. This approach was supplemented by law library investigations of historical regulations. These data are available upon request to other researchers. For additional detailed information about federal or state government childcare regulations, see Morgan [1987], the U.S. Department of Labor [1988], and Robins [1991].

In this paper, we examine only the staff-to-child ratios and whether a state requires that teachers have special training in childcare centers. First, all states regulate these two dimensions of childcare quality and they do so in a similar fashion. Second, staff-to-child ratios and provider training are two types of regulations that are widely cited in the child development literature as being regulable aspects of childcare that have an impact on child development (see Hayes, *et al.* [1990], and Studer [1992], for example). We examine only regulations of centers because it is easy to distinguish childcare centers in data on childcare utilization, and because the majority of centers are subject to regulations. While many states regulate family day care homes, many of these homes are exempt from regulation, and it is difficult in demographic surveys to identify which of these might be subject to regulations.

The NCCS data include respondents from 36 states, of which we have 1990 day care center regulations for 35 states. Regulations specify a child-to-staff ratio for each child age, and for each child in our data, we examine the age-specific regulation. We show the variation in states' maximum staff-to-child for children aged 1 in day care centers in Figure 1 and for children aged 5 in Figure 2. Figure 1 shows that while the maximum child-to-staff ratio for one-year-olds in centers ranges from 3 to 10 for families in our sample, almost 90 percent of respondents reside in a state where the maximum child to staff ratio for this type of care is 4 to 7. For five-year-olds, the child-to-staff ratios range from 9 to 25, as shown in Figure 2, with more dispersion across different values.

States also typically regulate whether the individuals providing care in licensed facilities must have specialized training. Different training requirements are usually specified for staff with different roles in the facility: directors, teachers, and aides. We found a high degree of correlation between regulations for the different staff titles, so we only include one regulation: whether training is required for teachers in childcare centers. Out of the states in the NCCS for which we have regulations, 80 percent required teacher training in childcare centers.

3.2 NCCS Data Description

The data on childcare utilization and maternal labor force participation used in this study are taken from the National Childcare Survey (NCCS) (Hofferth, et al., 1991). These data were collected via a telephone survey in 100 U.S. county groups between October 1989 and May 1990. The sample was a stratified random sample of households with at least one child less than 13 years old. We only include a subset of NCCS respondents in our study. First, we only include families where the respondent was the mother. This was because detailed data on labor force participation was only asked of the respondent. Hence, in order to capture the mother's labor force status and wages in these data, she must be the respondent. Second, we only include families whose youngest child had not started elementary school and was below the age of six because we are primarily interested in early childhood care. The NCCS asked detailed questions about the childcare arrangements of the youngest child in each family, hence we focus on the childcare arrangements for this child. Our final sample includes 2204 respondents.

We use the maternal work choice combined with the type of childcare utilized as our dependent variable. Mothers who work 8 hours or more per week are considered to be "working" mothers, and those who work fewer than 8 hours per week we call "non-working" mothers. The percentage of mothers in our working group is 46.2 percent. The childcare choices include parental care (which may include paternal care), paid center care, paid other care (non-parental and non-center), and unpaid non-parental care. As shown in Figure 3, among all households in our sample, the most common of the eight work and childcare combinations is parental care with the mother not working (36.2 percent). Of the next most common five work and childcare combinations, the incidence is relatively similar, ranging from 9.3 percent to 13.7 percent. The least common combinations are non-working mothers using the two paid types of care.

4. THEORY OF REGULATORY IMPACT

4.1 The Choice Model

We begin with the standard economic childcare choice models as presented in Ribar (1992), Blau and Grossberg (1992), and Blau and Hagy (1997), among others. This is a one-period model in which we assume that parents have perfect information about the attributes of non-parental childcare services available in the childcare market; and the market for non-parental childcare services are not regulated.

Parents are assumed to make decisions concerning the care of their preschool age children, their own consumption, and the allocation of the parent's time to alternative activities. To focus on the essential issues to be modeled, we assume that the following are exogenously determined: (i) the number and age distribution of the children in the household, as well as the presence other adults in the household; (ii) the marital status of the mother; (iii) the wage and labor force participation of the father, if present; and (iv) the non-labor income of the household. Thus we focus exclusively on the labor-force participation choice of the mother, and childcare arrangement choices of the family. We assume the family receives a take-it-or-leave-it wage offer for the mother to work, and a take-it-or-leave-it price offer for both center-care and other-paid-care. We model the following four possible childcare arrangements: exclusively parental care (either mother-only care or care provided by both parents), paid center care, other paid care, and other non-paid care.

We assume the family observes this wage and these prices and chooses to accept or not the job offer, and assigns the youngest child (our unit of observation) to one of the four possible childcare arrangements.

4.2 Effect of Regulations

We hypothesize that regulations could impact parents' childcare choices through two avenues: by affecting the price by altering the quantity or quality of inputs or by changing the view parents have of the quality of care they are consuming. We now discuss each of these in turn.

One important feature that has not been spelled out in other papers that examine the relationship between child-care choice and price or that examine the role of regulations in childcare prices is the nature of the price equation. Other studies have shown that labor costs account for as much as 70 percent of childcare costs (Cost, Quality and Child Outcomes Study Team, 1995). This suggests that a regulation such as child-to-staff ratio that dictates the minimum amount of labor that can be used in a center will have a substantial influence on the price of care. Given that the going wage for childcare workers is likely to reflect market conditions depending on other opportunities, the wage for childcare workers in a particular market could be viewed as being relatively fixed. Previous studies have in fact shown that labor supply to the childcare market is highly elastic (Blau, 1993). In this case, the price of childcare in a center that a family faces is likely to vary inversely with the child-to-staff ratio. That is, the price will vary as a function of wages and non-wage childcare center expenses approximately as follows:

$$price = \left(\frac{staff\ wage}{child\ staff\ ratio} \right) + f\left(other\ non{-}wage\ costs \right).$$

Equivalently, the price per child is: $\frac{\$}{child} = \left(\frac{\$}{staff} \frac{staff}{child} \right) + \frac{other\ non{-}wage\ costs}{child}$.

Reinforcing this characterization of the per-child price of center care, Zellman and Gates (2002) find that the price of infant care—where child-to-staff ratios are lowest—is generally higher than that of care for older children. In fact, they find that prices in centers decline with the age of the child, just as child-to-staff ratios rise with the age of the child. Regulations on child-to-staff ratio also become less stringent at older ages. For these reasons, we use the age-specific child-to-staff regulation for each observation in our data.

To account for these features of how childcare prices are related to childcare wages and child-to-staff ratios, we include a term in our price equations that is the state-level average weekly wage of women with a high school education, divided by the child-to-staff ratio that is specific to the age of the child. That is, for each observation, we include a term that has a state-level wage divided by the state and age-specific child-to-staff ratio. As we show below, this yields a better characterization of how this type of regulation affects the price of care, and ultimately, parents' choices about child-care use and maternal labor force participation. The other regulation we examine, whether workers in centers are required to have special training, is likely to affect the price by increasing the wage childcare workers must be paid.

The second potential effect of the minimum quality standards arises because of the information or certification provided to parents by virtue of regulating the market. Consider a parent using a childcare arrangement that already op-

erates at some newly imposed minimum quality standard. There is no provider response to the regulation because the provider already meets the standard. However, the parent is now consuming a potentially superior good: the arrangement is now being monitored not only by the parent but also by the state. The provider has less occasion for malfeasance and is subject to sanctions from the state in addition to admonishments from the parent if the minimum quality standard is not upheld. If the regulation improves the quality of care as perceived by the parent, the demand for that arrangement would rise. However, as we report below, we find no evidence for such a direct positive demand impact from either maximum child-staff ratios or compulsory training.

5. ECONOMETRIC IMPLEMENTATION

We consider a generalized discrete choice specification in which mothers make two simultaneous choices: whether or not to work and what type of childcare to use. These choices are explicitly affected by prices of alternative childcare arrangements and the wage earning potential of the mother. The former is an attribute of the childcare mode and the latter a characteristic of the mother. In both cases, these factors are endogenous, generating a classic selection problem. Moreover, wages are observed only for mothers who work, and childcare prices are only observed for the mode actually selected. The model below explicitly accounts for both dimensions of selectivity as well as the non-observability of some critical variables in non-chosen states, specifically wage offers and prices. The distributional assumptions of the random utility model given below lead to parameter estimation using a highly-restricted multinomial probit. The restrictions, which are imposed for tractability, are essentially the standard covariance restrictions implied by the more familiar universal logit model.[1]

Let $n = 1,\ldots,N$ index the set of mother's labor force participation (LFP) alternatives, N. LFP is considered as a binary choice between working and not working, so $N = 2$. Let $m = 1,\ldots,M$ index the set of childcare mode choices (CCMode), M. CCMode is a choice among four modes: parental care (irrespective of care by one or both parents), paid childcare centers, other paid care, and other non-paid care ($M = 4$). The rationale for this choice framework is discussed below. Let $j = 1,\ldots,J$ index the choice pairs, J, so $J = (M \times N) = 8$. The following notational conventions are used below. $h(m,n)$ uniquely maps (M,N) into (J). The mode actually chosen for any given observation is denoted $k = h(\overline{m}, \overline{n}) \in J$.

5.1 Index Equations (Utility)

In the random utility model, let the utility associated with a particular choice $j = h(m,n)$ be given by:

$$V_{ji} = X_i^1 \beta_j^X + W_n \beta_j^W + P_m \beta_j^P + \varepsilon_{ji} \text{ where } \varepsilon_{ji} \sim N(0, \sigma_{\varepsilon_j}^2) \quad (1)$$

[1] Because the model of two simultaneous choices has not been implemented in standard statistical software, we wrote a new MLE program to estimate the model. The choice of probit instead of logit was driven by the anticipated extension of this analysis to panel data with random effects, for which the extreme value distribution on which logit is founded would be inappropriate. Moreover, the usual reason for choosing the extreme value distribution, that closed-form maxima can be computed, does not apply to this model. The covariance matrix is restricted to be diagonal, as in the standard logit model. This implies the assumption of independence of irrelevant alternatives, as in the logit model.

and β is the vector of all parameters that enter in (1), including θ_{η_i}. The X_i^1 are characteristics of the child and family. For choices for which they are observed, P_m and W_n are the childcare price and wage, respectively. For the unobserved alternatives, that is, the choices not taken, the right-hand sides of the characteristics equations below are substituted as explained in detail below.

5.2 Childcare Prices

The childcare prices in the paid-care modes (centers and other paid) are estimated in reduced form in the following equations, for CCMode m ($\forall\, j = h(m, \cdot)$):

$$P_{mi} = X_i^2 \gamma_m^X + \upsilon_{mi}, \text{ where } \upsilon_{mi} \sim N(0, \sigma_{\upsilon_m}^2). \tag{2}$$

γ is a vector defined in a manner similar to β. The X_i^2 are characteristics of the family that are likely to influence the amount they pay for care. Prices in the non-paid modes are known to be zero, whether or not they are chosen. There is one price for each observation (either observed or predicted) for each of the paid childcare modes, regardless of the LFP choice.

5.3 Wage Equations

The wage offer the mother receives if she chooses to work is estimated in reduced form in the following equation, for LFP n ($\forall\, j = h(\cdot, n)$):

$$W_{ni} = X_i^3 \delta_n^X + e_{ni}, \text{ where } e_{ni} \sim N(0, \sigma_{e_n}^2), \tag{3}$$

where δ is a vector defined in a manner similar to β. The X_i^3 are characteristics of the mother. There is only one wage offer for each person, either observed or predicted, and it is the same regardless of the CCMode choice. The wage in the non-working state is known to be zero, whether or not it is chosen.

5.4 Choices and Their Probabilities

Person i chooses mode $k = h(\bar{m}, \bar{n})$ when $V_{ki} \geq V_{ji}$, $\forall\, j=(m,n) \in J$, $j \neq$ k. The random terms in the random utility specification are assumed to be independently, normally distributed, implying a probit model. Accordingly, let $\Phi(\cdot)$ denote the univariate normal cdf, and $\phi(\cdot)$ denote the corresponding pdf. As noted above, the covariance matrix is restricted to be diagonal, so all the error terms are independent. For notational ease, let $\theta = (\beta, \gamma, \delta, \sigma)$ denote a vector of all of the parameters of the model to be estimated, including all σ's, and let $Z_i = (X_i^1, X_i^2, X_i^3, P_{\bar{m}i}, W_{\bar{n}i})$ represent everything observable about person i other than the observed choices. The probability that person i prefers childcare mode k to mode j is:

$$\begin{aligned}\Pr\left(V_k - V_j > 0 \middle| Z_i, \theta\right) &= \Pr\left(\varepsilon_j^* < \frac{A_{kj}(Z_i,\theta)}{\sigma_{\varepsilon_j}}\right)\Pr(\varepsilon_k^*) \\ &= \int_{\varepsilon_k^*=-\infty}^{\infty}\int_{\varepsilon_j=-\infty}^{\frac{A_{kj}(Z_i,\theta)}{\sigma_{\varepsilon_j}}} df(\varepsilon_j^*)df(\varepsilon_k^*) \\ &= \int_{\varepsilon_k^*=-\infty}^{\infty}\Phi\left(\frac{A_{kj}(Z_i,\theta)}{\sigma_{\varepsilon_j}}\right)df(\varepsilon_k^*)\end{aligned} \tag{4}$$

where $A_{kj}(Z_i,\theta) = V_{ki}(Z_i,\theta) - V_{ji}(Z_i,\theta)$ and [illegible]. Since choice of mode *k* reflects the fact that *k* is preferred to all modes, the probability of choosing mode $k = h(\bar{m},\bar{n})$ is:

$$\begin{aligned}&\Pr\left(V_k - V_j > 0, \forall j \neq k \middle| Z_i, \theta\right) \\ &= \int_{\varepsilon_k^*=-\infty}^{\infty}\prod_{m\neq\bar{m}}^{M}\prod_{n\neq\bar{n}}^{N}\Phi\left(\frac{A_{h(\bar{m},\bar{n})h(m,n)}(Z_i,\theta)}{\sigma_{\varepsilon_j}}\right)df(\varepsilon_k^*)\end{aligned} \tag{5}$$

Up to this point, the expression above is the likelihood of a standard multinomial discrete choice model extended to two decisions. Unfortunately, the $A_{kj}(Z_i,\theta)$ may include variables that are unobservable and, as such, cannot be conditioned on when calculating the above probability used to form the likelihood function. In particular, P_m is observed for at most one of the two paid-care modes. The wage offer, W_n, is only observed for working mothers. For unobserved prices and wage offers, we substitute the right-hand side of equations (2) and (3), effectively conditioning on both the observable characteristics and on the choices actually made. Let $\hat{A}_{kji} = A_{kj}(Z_i,\theta)$, after the substitution of the expected price and wage equations. The structure of $\hat{A}_{kji}$ varies by choice *k,* and counterfactual alternative *j*. Suppose for example, that the in observation *i*, the mother chooses *k=3,* working and using center-care. Then $\hat{A}_{31i}$, compares the choice *k=3* with counterfactual choice *j=1*, not working and using parental care. In the later case, neither wages nor prices are observed, so:

$$\begin{aligned}\hat{A}_{kji} = {} & X_i^1(\beta_k^X - \beta_j^X) + W_{\bar{n}}\beta_k^W + P_{\bar{m}}\beta_k^P \\ & - X^2\gamma_m^X\beta_j^P - \upsilon_m\beta_j^P - X^3\delta_n^X\beta_j^W + \sigma_{e_{\bar{n}}}\varepsilon_k^*\end{aligned} \tag{6}$$

In order to efficiently estimate the price and wage equations simultaneously with the choices, we form the likelihood contribution of the observed prices and wages (where appropriate). For example, the density function for the observed childcare price $P_{\bar{m}i}$ is induced by the distribution of $\upsilon_{\bar{m}i}$ is $\phi(A_{\bar{m}}^P)$, where $A_{\bar{m}}^P = \left(P_{\bar{m}i} - X_i^2\gamma_{\bar{m}}^X\right)\Big/\sigma_{\upsilon_{\bar{m}}}$. Similarly, the

density for the observed wage is $\phi(A_{\bar{n}}^{W})$, where $A_{\bar{n}}^{W} = \left(W_{\bar{n}i} - X_i^3 \delta_{\bar{n}}^{X}\right) \Big/ \sigma_{e_{\bar{n}}}$.

5.5 The Likelihood Function

All that remains is to combine the above elements to form the log likelihood function, and calculate the sum of the individual contributions. To find the probability of each observation, we take expectations by integrating out the unobserved error terms of equations (2) and (3), $\upsilon_1,\ldots,\upsilon_M;e_1,\ldots,e_N \setminus \upsilon_{\bar{n}}, e_{\bar{m}}$, for the non-chosen modes. Finally, we take expectations of the random utilities (1), conditional on the choices observed. This yields:

$$L_i = \Pr_i\left(\theta \middle| Z_i, k_i\right) =$$

$$\int_{\varepsilon_k^*=-\infty}^{\infty} \int_{\upsilon_1\ldots\upsilon_M \setminus \upsilon_{\bar{m}}} \int_{e_1\ldots e_N \setminus e_{\bar{n}}} \prod_{j\in J\setminus k} \Phi\left(\frac{A_{kj}}{\sigma_{\varepsilon_j}}\right) d\phi\left(\upsilon_{1\ldots M\setminus\bar{m}}^*\right) d\phi\left(e_{1\ldots N\setminus\bar{n}}^*\right) d\phi(\varepsilon_k^*)\phi(A_{\bar{m}}^{P})\phi(A_{\bar{n}}^{W}) \tag{7}$$

where $\int_{\upsilon_1\ldots\upsilon_M \setminus \upsilon_{\bar{m}}} d\phi\left(\upsilon_{1\ldots M\setminus\bar{m}}^*\right)$ represents the multiple integral (expectation) over all the error terms of the non-chosen childcare modes.[2] Again, starred variables are normalized, so $e_n^* \equiv e_n \big/ \sigma_{e_n}$, and $\upsilon_m^* \equiv \upsilon_m \big/ \sigma_{\upsilon_m}$. Similarly, $\int_{e_1\ldots e_N \setminus e_{\bar{n}}} d\phi\left(e_{1\ldots N\setminus\bar{n}}^*\right)$ represents the expectation over the errors from the non-chosen LFP choices. L_i is the likelihood contribution of observation i. Summing the log of (7) over all observations yields the log likelihood function.

Note that standard identification conditions for discrete choice models apply to the above model. At least one of the remaining variance parameters of must be arbitrarily fixed. More generally, one often over-restricts this set of variances. We have assigned all error parameters from equations (1) a value of $\sqrt{2}$, so that our covariance structure is equivalent to the conventional covariance structure of the standard multinomial logit with variance contrasts equal to 1.0. Also keeping to the standard assumptions of the multinomial logit model, the covariance matrix is assumed diagonal.[3] Error terms in equations (2) and (3) are estimated as free parameters for equations for which there is uncertainty. The integrals in (7) are approximated by Gauss-Hermite quadrature with seven abscissas per choice equation. Effectively, this approximates the (highly-restricted) multinormal distribution by a weighted sum of 2401 likelihood function evaluations per observation, or about 5.5 million function evaluations per iteration. The exclusion restrictions on X_i^1, X_i^2, X_i^3 are necessary to ensure that the wage and price coefficients are identified are discussed below.

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[2] This multiple integral could also be expressed as $\int_{\upsilon_1^*} \ldots \int_{\upsilon_{M\setminus\bar{m}}^*} d\phi\left(\upsilon_{M\setminus\bar{m}}^*\right) \ldots d\phi\left(\upsilon_1^*\right)$. The representation above is used to reduce notational burden.

[3] In particular, this implies the assumption of independence of irrelevant alternatives, as in a logit model.

5.6 Variables

We include the regulation variables both in the childcare price equations and directly in the choice equations. Wages enter only the choices where the mother is working, and the value of wage is fixed to zero for the non-working states. Similarly, prices of center care enter the center care choices, prices of other paid care enter the other paid categories, and the price of parental care and other unpaid care is fixed at zero.

In addition to regulations, prices, and wages, the choice equations include variables that represent factors that would be expected to influence the family's demand for childcare of various types and maternal labor force participation. These variables are selected both on the basis of the economic models cited above and results from previous studies. In particular, we include variables that indicate household composition and mother's marital status, family income and maternal education, and also variables that represent the availability of family providers, such as the number of non-parental adults in the household and the distance to the nearest relative.

We estimate separate prices for childcare centers and other paid care. Variables that enter the price equations but not the choice equations or wage equation include: whether the family has more than two children between the ages of 0 and 5, the average hourly wage for childcare workers in the state, childcare wages divided by the regulated child-to-staff ratio, and whether the mother received child support. The wage equation also includes variables that only appear in the wage equation: more detailed levels of mother's education, mother's age, the average weekly wage for women with a high school degree in the state, and mother's labor force experience since age 18 and its square. Table 1 reports the means and standard deviations of all the variables included in the model.

6. RESULTS

We find that childcare regulation, in particular the maximum child-teacher ratio, has a statistically significant and economically large impact on the market for childcare. The primary mechanism for this economic impact is through the price of regulated care, which is higher where regulation is tighter, after controlling for selection and other factors. We find the price elasticity for childcare centers by non-working mothers to be –1.1 (statistically significant), and the price elasticity of working mothers to be –0.9 (marginally significant), and the overall elasticity to be –1.0. Tightening child-to-staff ratio regulation raises the price of centercare significantly. For example, tightening the regulation by reducing this ratio by 2.0 children per teacher, for all ages and all states, would increase the expected price of center care offered to consumers by 12% on average. This would result in 8% fewer children placed in childcare centers, and 1% fewer mothers choosing to work. For comparison, this difference of 2.0 children per teacher is the difference between the regulated maximum for three-year-olds in California (12) verses Connecticut (10). Details of this analysis are given below.

This dramatic and robust price impact has remained somewhat obscured in previous studies, for several reasons. First, childcare production is extremely labor intensive, and maximum child-per-teacher ratios impact childcare prices by changing the minimum number of person-hours required per child. Thus the impact of this type of regulation depends upon the prevailing wage rate of childcare workers. Perhaps not surprisingly, this regulation tends to be tighter,

ceteris paribus, in states with lower hourly wage costs. This negative correlation partially obscures the effect of regulation in reduced form estimation. Our approach is more structural, as we include an inverse-interaction term between regulation and high-school educated women's hourly wages. This term is highly significant, even when both independent effects are also included. This result is extremely robust, and does not depend upon the multinomial choice framework. For example, a simple regression of prices of care among mothers who paid for care, regardless of type, yields an interaction term statistically significant above the 99% level. Indeed, this is the only variable that is statistically significant in our estimate of childcare center prices. The interaction variable is the prevailing hourly wage for high-school educated women, divided by the regulatory maximum ratio. Effectively, this is the minimum hourly cost per child.

The second major reason that the impact of regulation has been difficult to accurately measure is the huge effect of endogenous selection in this market. We have modeled two independent dimensions of selection, labor force participation and childcare arrangement choice. One indicator of the influence of this selection effect is the differences in the expected wage offers or price menus between those who make one choice compared to those making different choices. For example, by assuming that each mother receives a single, take-it-or-leave-it wage offer, we estimate that the wage accepted by working mothers is about 37% higher than the wage offer declined by mothers who choose not to work. Working mothers have obviously made very different human capital accumulation decisions on average than non-working mothers. Similarly, we estimated the expected price of center-care on average, and compared that to the expected price of center-care of those who actually choose center-care. As predicted, parents who encounter a lower price of childcare are more likely to choose paid-care alternatives, while those facing higher prices are more likely to choose non-paid options, such as parental care. This is true for both childcare centers and other paid care. The average expected price of center-care faced by all consumers about 32% higher than the price paid by those who actually choose center-care.

One contribution of this paper toward unraveling the childcare regulation puzzle is the specific econometric solution we have used. While most studies of childcare regulation attempt to control for endogenous selection, we are not aware of anyone else who has done so using an efficient MLE while addressing two independent selection effects, as we have done here. A subtle distinction must be made when comparing this study with previous work that uses two-stage methods to address selection. In addition to the improved estimation efficiency, there is another important reason to use a structurally integrated framework, rather than a two-stage approach, when there are two dimensions of selection. Consider a two-stage alternative to the model used here, with a Mills-ratio to account for the selection-corrected conditional wage distribution, in the same eight choice setting (two labor-force-participation options and four childcare arrangements). The two-stage correction for labor-force participation adjusts for the correct conditional distribution of wages, but incorrectly assumes independence of the wage draws for each of the four childcare arrangements. In fact, there is only a single wage realization, regardless of the choice of childcare arrangements. An unusually high or low wage realization may impact the choice of childcare arrangement, but this effect will be suppressed in the two-stage model. It can only be modeled correctly in a simultaneously estimated choice system. Similar problems may also arise from the two-stage correction for endogenous childcare prices, but multiple childcare prices depending on working or not working may not be quite so unreasonable.

6.1 Results – Details

The coefficient estimates in the choice equation are presented in Table 2, along with robust, heteroscedasticity-corrected standard errors. The coefficient on price of care is always negative and is statistically significant in three of the four choice equations that contain prices. The wage coefficient is always positive and significant, as expected. Center child-to-staff ratio regulation generates a coefficient of almost zero, and is statistically non-significant, even when the regulation is restricted to impact only the paid childcare arrangements. Similar results obtain if the variable appears in all choices. Hence, there is no evidence for a quality certification effect from regulation. The teacher training requirement is significant only in one choice equation: center care for working mothers. In this case the sign is negative, contrary to the theoretical prediction if there is a certification effect. In any event, we find no evidence of a quality enhancement effect from teacher training regulation. To address the concern of Blau (2003), who demonstrates the state fixed effects may be difficult to disentangle from regulations in a cross-section, we have included a wide array of state and regional variables in the all the model's equations. Most notably, we obtain precise estimates of regulation effects by interacting the regulation with state-level high-school educated women's wages. The results are not greatly changed if a sparser set of state and regional variables are substituted, further suggesting that unobserved state heterogeneity is not driving our results. The methodology to obtain heteroscedasticity-corrected standard error estimates for the coefficients in tables 2-4 is explained in the appendix.

The regulation cost variable, high-school educated women's mean wage divided by the regulatory maximum child-staff ratio is highly significant and negative in both price equations, as shown in Table 3. In the center-care equation, it is the only variable that is significant. Both of these equations also include the non-interacted components, the child-to-staff ratio and high-school educated women's wage, and neither is significant independently. Excluding either or both non-interacted components does not change this result. The interpretation of the cost coefficient in the center equation is straightforward: tightening the regulation increases labor costs and in turn the price of care. The regulatory variable applies to center care, so the interpretation of the negative coefficient on other paid care is more complex. There are three possible avenue of impact. The regulation of centers is highly correlated with regulation of other types of paid care, such as family home care. Thus, we may be detecting regulations that increase the costs of other arrangements in a manner analogous to the regulation of centers. Alternatively, if the price of other paid care is determined in a competitive environment with reference to the price of center care, then increasing the price of center care may indirectly increase the price of other care. Finally, the increase in the price of centers drives consumers to other types of care, and this increased demand should result in a higher price of other care. All of these interpretations are consistent with our results. All the significant variables have the logically expected sign.

The wage equation is presented in Table 4. As with the care price and choice equations, the wage equation includes regional dummies and state-specific variables, in addition to measures of the mother's human capital accumulation. Many of variables are significant, and all have the logical expected sign.

The goodness of fit measures are shown in Table 5. The psuedo-R2 is .31, using a likelihood ratio as discussed in the appendix. Table 5.1 summarizes the actual choice probabilities observed in the data. Table 5.2 gives the choice probabilities as simulated from the estimated model. Tables 5.3, 5.4 and 5.5 show the average number of observations

for which the simulated prediction matches the actual choice, for labor-force participation, childcare arrangement, and both choices, respectively. The percentages given are the fractions of those observations in each observed choice cell for which the prediction is correct. For further comparison, the expected percentage of correct predictions based on knowing only the fraction of people making each choice is also given. For example, the model correctly predicts the exact choice of 30.2% of observations, on average. Using only the observed choice probabilities, one would expect 20.1% correct predictions.

To estimate the impact of various regulatory changes on childcare and labor-force participation choices, we have taken several different approaches. Table 6 shows the impact on childcare arrangement and labor-force participation choices resulting from a (simulated) tightening of regulation by 2.0 children per teacher in all states from current regulation levels. Table 6.1 shows the base case choice counts, for comparison. Table 6.2 shows the choices that result from the policy simulation. The change would reduce childcare center usage by 8.5%, and would reduce labor-force participation by mothers by 1.4% overall. Some might argue that regulation only needs to be tightened in states whose current regulations are currently too high. To examine the effect of this type of policy change, we simulate a reduction (tightening) of the children/teacher ratio by 2.0 only is those states currently above the national age-specific mean. As could be expected, this reduction does not have as much impact as tightening regulations in the more stringent states. Nonetheless, the change results in a reduction of childcare center usage by 4.9%, and a 0.5% reduction in labor-force participation. This simulation is presented in Table 7.

Alternatively, we consider a policy change that relaxes regulation. At least one state (Idaho) has relaxed its regulation expressly in order to reduce the price of childcare. We simulate a relaxation of the ratio regulation of 2.0 children per teacher for the states with current regulations more restrictive than the age-specific national mean. The results of this study are shown in Table 8. Relaxation of regulations would result in a dramatic 8.0% increase in the utilization of center care, and a 0.7% increase in labor-force participation.

We examine the price elasticity of demand for childcare through a simulation of an exogenous increase of 1% in the price of center care. These results are presented in Table 9. We find a 0.97% reduction in center care usage from the price increase, with the other arrangements absorbing about equal shares of these families. There is also a small reduction in labor-force participation.

Finally, to demonstrate the importance of the selection effect in this market, we calculate the wage offer and childcare prices faced by the average family, and compare them to the wages and prices of those who choose to work and purchase care. These results are summarized in Table 10. As expected, families are more likely to choose an arrangement if they find one that is relatively inexpensive. In addition, characteristics of the family are correlated with choices. For example, families living near relatives or who attend church are more likely to have low price alternatives than other families. Similarly, wage offers accepted by working mothers are significantly higher than the imputed wage offer rejected by non-working mothers, both because of the selection effect and because of human capital differences.

7. POLICY CONCLUSIONS

We find no impact of teacher training regulations for child care centers, but child-to-staff ratio regulation sig-

nificantly increases the price of center care, and drives families into other, unregulated childcare arrangements. The increase in the price of care is also sufficient to cause a small but measurable number of mothers to refrain from working altogether. We find no evidence of a quality certification effect from ratio regulation. This is not surprising when one considers that child-staff ratios are easily observable by the parent, so little is added by the state's monitoring. If regulations are tightened, some children will be placed in higher quality centers, but others will be diverted by the price effect to informal sector care. Quality regulation thus may have perverse results: some children may end up in lower quality care than they would have otherwise received. In addition, the increased price of care resulting from regulation causes some mothers to remain out of the workforce entirely.

In sum, child-to-staff ratio regulations may increase the quality for some child care consumers, who do not shift out of center care due to the higher price, but they certainly do not unambiguously raise the quality of care for all children. Other studies (see summary in Karoly, et al., 1998) report that the benefits of high-quality programs may be greater for children from less advantaged families. It may be that the families least able to pay for more expensive higher-quality care are the very families who would be most likely to gain from being in a high-quality program.

APPENDIX

A.1 Estimation algorithm, standard errors and goodness-of-fit measure

The likelihood function was maximized using the Broyden-Fletcher-Goldfarb-Shanno variant of the Davidon-Fletcher-Powell algorithm, in a C program custom written for this project.[4] The programming necessary to implement the likelihood function was verified by several independent means. First, the program's analytic derivatives were verified with numerical derivatives. This is a robust test of both the analytic derivatives and the function itself, since it is unlikely that a programming error would preserve the relationship between the function and its derivatives, even in a section of code shared by both. Second, the discrete choice components of the program (without simultaneous wage and price equation estimation) were validated by comparison to other multinomial choice programs, specifically Stata and HotzTran. Finally, the program was run on data simulated from the assumed underlying structural model, and it converged successfully to the simulated coefficient values.

Standard errors of the parameters reported here were estimated using the Brendt et al method, adjusted for heteroscedasticity of the state level data using the Rogers-Huber correction, the same correction that is implemented with the "robust cluster" option for a multinomial logit in Stata. More precisely, let S be the number of U.S. states for which there are data, indexed by s, and let S(s) be the set of observations from state s. Then the estimated parameter variance matrix is given by:

$$\hat{\hat{V}} = \hat{V}\left(\sum_{s=1}^{S} \tilde{u}_s{}'\tilde{u}_s\right)\hat{V} \tag{8}$$

where $\hat{V} = \left(\sum_{i=1}^{nObs} u_i{}'u_i\right)^{-1}$, u_i, a column vector, is the contribution of the i-th observation to the analytically estimated log-likelihood gradient, $\partial \ln L/\partial\theta$, evaluated at the final parameter values, and $\tilde{u}_s = \left(\sum_{i\in S(s)}^{nObs} u_i\right)$. Standard errors reported below are the square root of the corresponding diagonal elements of $\hat{\hat{V}}$. As a goodness-of-fit measure, a pseudo-R^2 is constructed as follows: $R^2 = 1 - \left(\ln L_\Omega\right)/\left(\ln L_\omega\right)$, where L_Ω is the likelihood of the full model, and L_ω is the model containing only the constant parameters in (1)-(3).

[4] The algorithm from Press, Teukolsky, Vetterling and Flannery (1995) was implemented with analytic derivatives, with a customization using a slightly more extensive line search by recursively lengthening search steps after the first improvement, to take advantage of the fact that with this likelihood function, a function evaluation without derivatives is approximately eight times faster than a derivative calculation.

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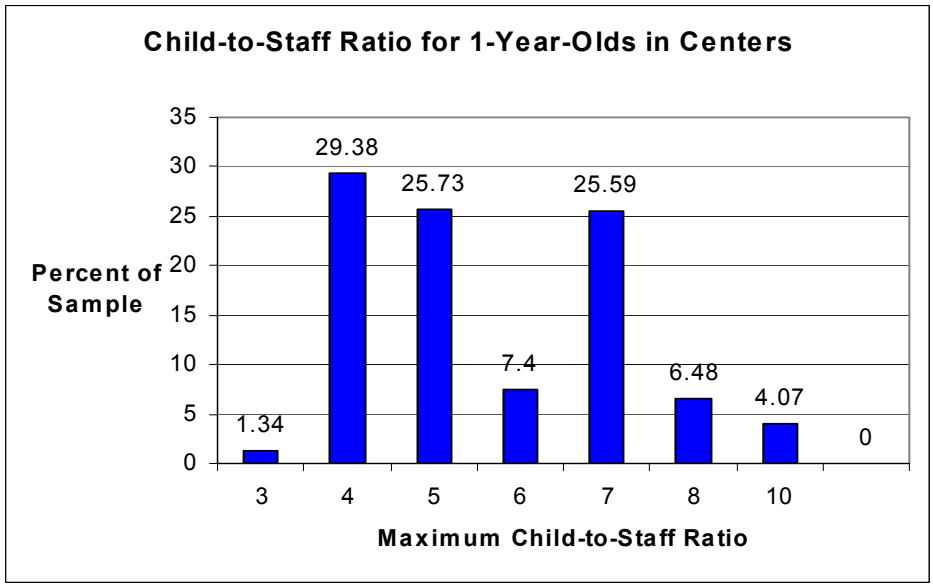
Figure 1



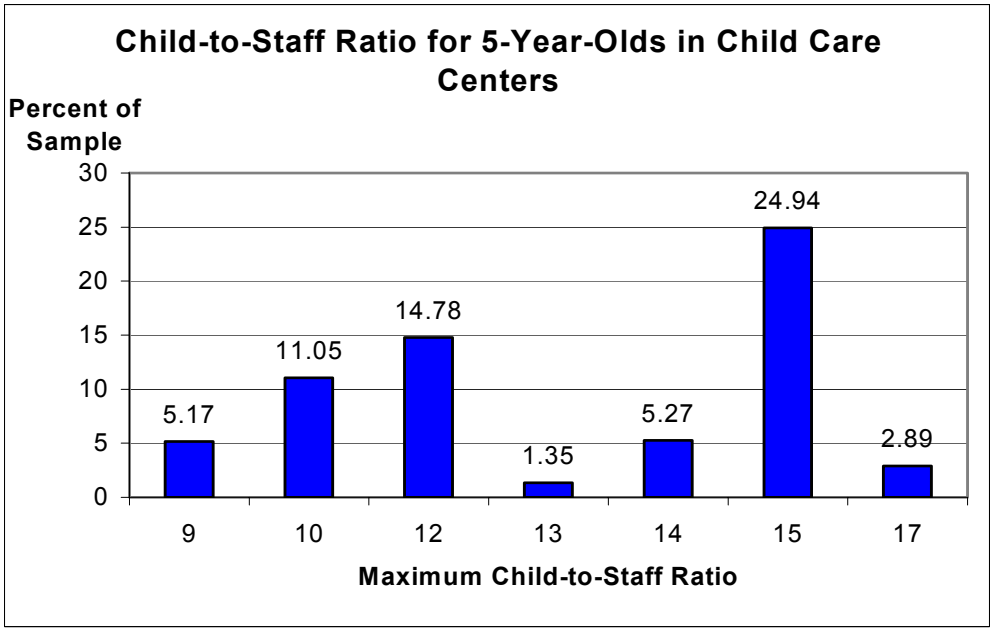


Figure 2

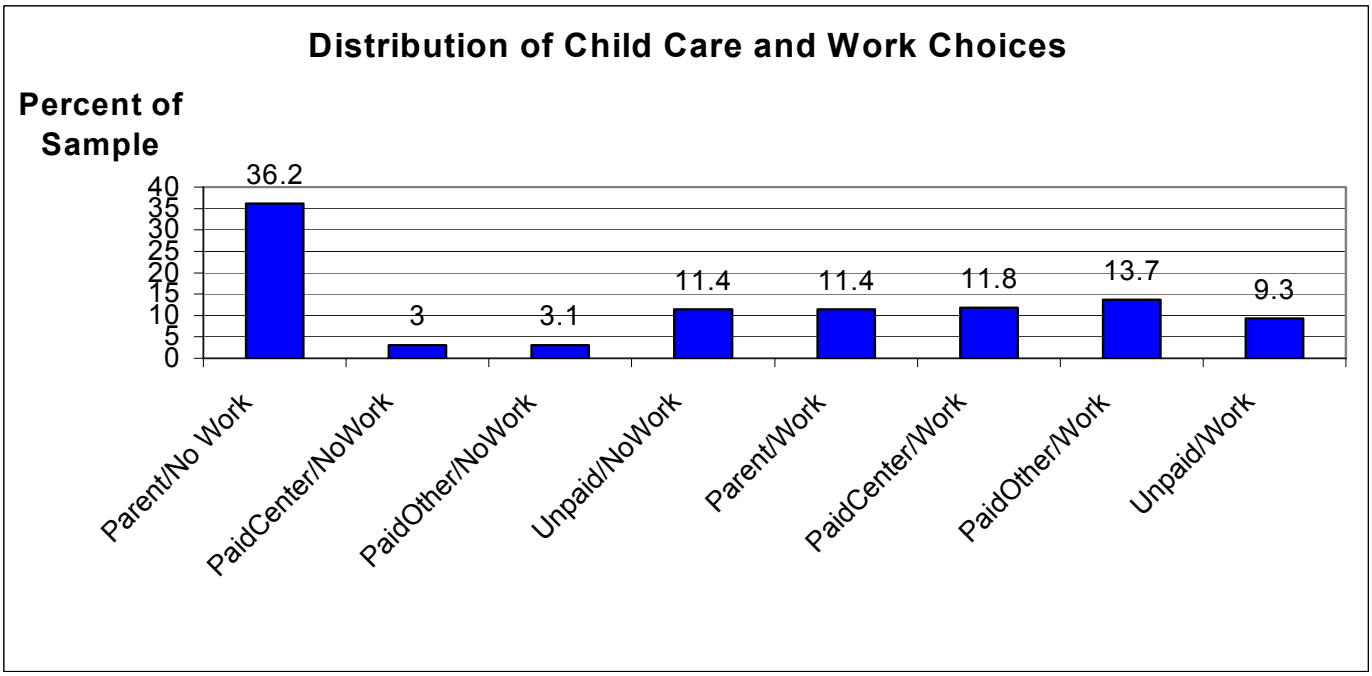

Distribution of Child Care and Work Choices
Percent of Sample
40
35
30
25
20
15
10
5
0
36.2
3
3.1
11.4
11.4
11.8
13.7
9.3
Parent/No Work
PaidCenter/NoWork
PaidOther/NoWork
Unpaid/NoWork
Parent/Work
PaidCenter/Work
PaidOther/Work
Unpaid/Work

Figure 3

Table 1
Mean and Standard Deviation of Variables

Household income	.3581	.2348
Income squared	.1834	.3045
Income missing	.1012	.3016
West Region	.2028	.4022
East Region	.1897	.3921
South Region	.3280	.4696
Mother's Education < H.S.	.1034	.3046
Mother's Education > H.S.	.4823	.4998
Mother's Age	.2953	.0562
Child is girl	.4746	.4995
More than 5 children in family	.6348	.8276
5 or fewer children in family	1.3961	.5824
Number of adults in family	.2559	.6703
Mean earnings of female H.S. grad in state	.8067	.1053
Max state + fed tax credit, 2kids, $15k earnings	.2231	.1435
Non-metro residence	.2600	.4387
Central city residence	.4056	.4911
Black	.1062	.3081
Hispanic	.0975	.2968
Distance to nearest relative less than 32 km	.3902	.4879
Mother had early childhood training	1.7160	.4511
Mother regularly attends religious services	.3843	.4865
Age-specific child-to-staff ratio in centers	8.3773	3.9311
Training required for teachers in centers	.7972	.4022
Missing regulation information	.0318	.1754
Child has health problems	.0250	.1560
Mother received public assistance	.2001	.4002
2 or more kids < 6 yrs in family	.3494	.4769
Ave hourly wage for child care workers in state	.6820	.0746
Child care wages divided by ratio regulation	1.0110	.4882
Receives child support	.0912	.2880
Ave weekly wage for women w/ 12 yrs ed in state ($1000's)	.2656	.0268
L-force exp of mother since 18 (/100)	.0575	.0659
L-force exp squared	.0766	.1321
Child care wages divided by ratio regulation	1.0110	.4882
Mother's education: some college	.2414	.4280
Mother's education: college	.1751	.3802
Mother's education: more than college	.0658	.2480
Price	.1542	.2703
Log wage	2.0335	.3966

Table 2
Coefficients in Choice Equations

Variables	Care Type: Parental Working		Center Non-Working		Center Working		Other Paid Non-Working		Other Paid Working		Un[aid Non-Working		Unpaid Working	
	COEF	StdErr	COEF	StdErr	COEF	StdErr	COEF	StdErr	COEF	StdErr	COEF	StdErr	COEF	StdErr
Constant	-2.26	0.66	-0.42	2.48	-1.85	1.23	-0.51	1.22	-0.68	0.90	-1.23	0.53	-3.28	0.81
Child age=2	0.23	0.16	0.42	0.57	0.37	0.30	0.28	0.36	0.35	0.22	0.03	0.10	0.31	0.16
Child age=3	0.27	0.15	0.92	0.87	0.87	0.29	-0.09	0.36	0.25	0.28	0.25	0.11	0.44	0.17
Child age=4	0.52	0.17	1.32	0.92	0.91	0.27	0.46	0.27	0.26	0.22	0.32	0.13	0.56	0.16
Child age=5	0.48	0.28	1.50	1.04	1.22	0.47	-4.10	FIXED	0.57	0.62	0.72	0.27	0.97	0.28
Mother single	-0.30	0.19	-0.01	1.52	0.45	0.21	0.88	0.38	0.33	0.23	0.55	0.17	0.12	0.19
Mother previously married	-0.34	0.22	0.93	0.46	0.49	0.21	0.98	0.34	0.41	0.26	0.41	0.18	0.49	0.20
Household income	-0.48	0.69	2.61	1.94	0.65	1.03	1.11	1.20	0.34	0.92	-0.28	0.48	-0.74	0.75
Income squared	-0.22	0.68	-0.87	1.00	-0.52	0.71	0.29	0.73	-0.11	0.79	0.43	0.33	-0.23	0.93
Income missing	-0.41	0.15	-0.66	0.52	-0.45	0.32	0.06	0.30	-0.39	0.24	0.00	0.17	-0.15	0.14
West Region	-0.37	0.17	0.18	0.70	-0.10	0.30	-0.28	0.47	-0.03	0.29	-0.02	0.11	-0.04	0.15
East Region	-0.12	0.16	-0.08	0.81	-0.06	0.29	-0.49	0.41	-0.10	0.22	0.11	0.12	0.07	0.20
South Region	-0.15	0.22	0.60	0.68	0.67	0.32	-0.06	0.41	0.07	0.32	0.20	0.15	0.48	0.21
Mother's Education < H.S.	0.10	0.16	0.31	0.66	-0.22	0.27	0.09	0.31	-0.11	0.27	0.18	0.13	0.02	0.21
Mother's Education > H.S.	-0.11	0.14	0.40	0.43	-0.14	0.13	0.24	0.28	-0.11	0.11	0.20	0.12	-0.22	0.14
Mother's Age	-1.28	1.06	3.39	3.15	-2.30	1.14	0.03	1.23	-2.44	1.18	-0.64	0.97	-1.44	1.07
Child is girl	-0.03	0.07	0.13	0.25	0.06	0.10	0.27	0.21	0.15	0.10	0.08	0.10	0.17	0.11
More than 5 children in family	-0.01	0.08	-0.21	0.26	-0.25	0.10	-0.17	0.14	-0.20	0.08	-0.10	0.08	-0.12	0.07
5 or fewer children in family	0.01	0.05	-0.17	0.26	-0.22	0.13	-0.33	0.15	-0.36	0.13	0.06	0.05	-0.09	0.09
Number of adults in family	0.14	0.09	-0.21	0.33	0.02	0.09	-0.11	0.21	0.17	0.09	0.11	0.06	0.21	0.06
Mean earnings of female H.S. grad in state	0.56	0.80	-1.09	2.71	0.11	0.82	0.22	1.36	0.74	0.82	-0.09	0.45	0.10	0.70
Max state + fed tax credit, 2kids, $15k earnings	-0.03	0.22	-0.78	3.95	-0.60	0.59	-0.03	0.41	-0.15	0.21	-0.21	0.18	-0.70	0.46
Non-metro residence	0.55	0.14	-0.64	0.73	0.23	0.21	-0.05	0.22	0.40	0.16	-0.07	0.12	0.40	0.20
Central city residence	0.11	0.14	0.47	0.60	0.22	0.22	0.06	0.23	0.05	0.17	-0.04	0.12	-0.02	0.19
Black	0.00	0.24	0.61	0.38	0.08	0.19	-0.01	0.33	-0.06	0.19	0.15	0.16	0.24	0.15
Hispanic	-0.25	0.21	-0.65	0.66	-0.26	0.19	0.15	0.42	0.10	0.22	-0.01	0.12	-0.06	0.16
Distance to nearest relative less than 32 km	0.16	0.13	0.21	0.37	-0.10	0.13	0.06	0.26	0.14	0.18	0.57	0.07	0.72	0.12
Mother had early childhood training	-0.17	0.11	-0.14	0.25	-0.16	0.12	-0.04	0.25	-0.10	0.12	0.07	0.10	-0.09	0.11
Mother regularly attends religious services	-0.24	0.09	-0.19	0.36	-0.22	0.19	-0.44	0.26	-0.20	0.13	-0.02	0.10	-0.11	0.10
Unemployment rate in state	2.27	6.36	-16.80	18.75	-11.91	7.44	-1.38	8.36	-12.13	6.31	-7.73	3.48	-2.42	5.96
Sum of state AFDC, Food stamp and Medicaid benefits	-0.13	1.01	-0.14	3.16	0.46	1.18	0.31	1.55	-0.80	1.04	0.60	0.42	0.83	0.81
Received financial assistance from relatives	0.19	0.17	0.24	0.65	0.21	0.14	0.33	0.22	-0.07	0.22	0.02	0.14	0.16	0.18
Age-specific child-to-staff ratio in centers	0.00	FIXED	0.00	0.08	0.01	0.03	0.00	FIXED	0.00	FIXED	0.00	FIXED	0.00	FIXED
Training required for teachers in centers	0.00	FIXED	-0.13	0.42	-0.28	0.15	0.00	FIXED	0.00	FIXED	0.00	FIXED	0.00	FIXED
Missing regulation information	0.00	FIXED	0.25	0.89	0.09	0.26	0.00	FIXED	0.00	FIXED	0.00	FIXED	0.00	FIXED
Child has health problems	-0.04	0.27	0.35	0.71	0.14	0.49	0.14	0.64	-0.28	0.57	-0.11	0.30	-0.09	0.34
Mother received public assistance	-0.11	0.10	-0.11	0.43	-0.39	0.14	-0.26	0.27	-0.21	0.14	0.08	0.15	-0.30	0.15
PRICE	0.00	FIXED	**-2.21**	**1.01**	**-1.30**	**0.97**	-2.15	0.78	-2.01	0.59	0.00	FIXED	0.00	FIXED
WAGE	**1.39**	**0.15**	0.00	FIXED	**1.97**	**0.18**	0.00	FIXED	**1.99**	**0.18**	0.00	FIXED	**1.56**	**0.17**

Notes: Shaded coefficients have Pr(b>Coef IF β=0) < 0.95
"FIXED" means the variable is restricted to be the coefficient value indicated

Table 3
Price Equations

	Center		Other Paid	
	COEF	StdErr	COEF	StdErr
Constant	0.2602	0.3524	0.1901	0.1580
Child age=2	-0.0850	0.0553	-0.0254	0.0460
Child age=3	-0.0877	0.1070	-0.1530	0.0733
Child age=4	-0.1246	0.1068	-0.1335	0.0795
Child age=5	-0.1556	0.1725	-0.1372	0.2451
Household income	0.0389	0.2377	-0.1002	0.1979
Income squared	-0.0355	0.1104	0.2789	0.1596
Income missing	-0.0008	0.0786	0.0909	0.0656
West Region	-0.0218	0.0607	0.0594	0.0597
East Region	-0.0115	0.0580	0.0383	0.0515
South Region	-0.0221	0.0601	0.0053	0.0499
Central city residence	0.0194	0.0501	0.0890	0.0376
Non-metro residence	-0.1112	0.0696	0.0045	0.0452
2 or more kids < 6 yrs in family	-0.0360	0.0553	-0.1243	0.0221
Mother regularly attends religious services	-0.0301	0.0375	-0.0213	0.0449
Ave hourly wage for child care workers in state	0.5422	0.3386	0.3745	0.2292
Child care wages divided by ratio regulation	**0.1403**	**0.0667**	0.1168	0.0541
Age-specific child-to-staff ratio in centers	0.0025	0.0099	0.0134	0.0097
Training required for teachers in centers	-0.0266	0.0791	-0.0410	0.0361
Missing regulation information	0.0285	0.0881	0.0020	0.1081
Child has health problems	0.0114	0.1995	-0.0521	0.1930
Receives child support	0.0409	0.0726	-0.0359	0.0564
SigmaP	0.2539	0.0179	0.2369	0.0162

Note: Highlighted coefficients have Pr(b>Coef IF β=0) < 0.95

Table 4
Wage Equations

	Working	
	COEF	StdErr
Constant	1.1605	0.2419
West Region	0.0592	0.0604
South Region	0.0432	0.0438
East Region	0.1273	0.0607
Mother's Education < H.S.	-0.2559	0.0588
Mother's education: some college	0.0572	0.0568
Mother's education: college	0.2512	0.0607
Mother's education: more than college	0.4868	0.0772
Mother's Age	-0.5549	0.3772
Ave weekly wage for women w/ 12 yrs ed in state ($1000's)	0.2334	0.7633
Central city residence	0.0274	0.0519
Non-metro residence	-0.1982	0.0619
Black	0.0874	0.0710
Hispanic	0.0769	0.0740
Unemployment rate in state	-0.6002	1.6599
L-force exp of mother since 18 (/100)	9.3355	0.7606
L-force exp squared	-2.1915	0.3431
SigmaW	0.6083	0.0254

Note: Highlighted coefficients have Pr(b>Coef IF β=0) < 0.95

Table 5
Simulation and Goodness of Fit Measures

Psuedo - R2: 0.3124 Observations: 2204
Simulations: 10000

Table 5.1, Actual Count

		NonWork	(%)	Working	(%)	Total	(%)
CC MODE	Parent	799	36.3%	252	11.4%	1051	47.7%
	Center	66	3.0%	261	11.8%	327	14.8%
	OthPaid	69	3.1%	301	13.7%	370	16.8%
	UnPaid	252	11.4%	204	9.3%	456	20.7%
	Total	1186	53.8%	1018	46.2%		

Table 5.2, Simulation Count

		NonWork	(%)	Working	(%)	Total	(%)
CC MODE	Parent	806.8	36.6%	252.8	11.5%	1059.6	48.1%
	Center	70.6	3.2%	248.8	11.3%	319.4	14.5%
	OthPaid	74.7	3.4%	292	13.2%	366.6	16.6%
	UnPaid	254.4	11.5%	204	9.3%	458.4	20.8%
	Total	1206.5	54.7%	997.5	45.3%		

Table 5.3, Correct LFP, by Actual Choice

		NonWork	(%)	Working	(%)	Total	(%)	
CC MODE	Parent	533	66.7%	130.8	51.9%	663.8	63.2%	
	Center	37.2	56.4%	163.8	62.7%	201	61.5%	
	OthPaid	39.5	57.2%	177.7	59.0%	217.2	58.7%	
	UnPaid	165.2	65.6%	114	55.9%	279.2	61.2%	Compared
	Total	774.9	65.3%	586.4	57.6%			to Chance
					Total	1361.2	61.8%	50.3%

Table 5.4, Correct CC Mode, by Actual Choice

		NonWork	(%)	Working	(%)	Total	(%)	
CC MODE	Parent	474.5	59.4%	132.5	52.6%	607.1	57.8%	
	Center	24.5	37.1%	78.9	30.2%	103.4	31.6%	
	OthPaid	14.2	20.6%	71.9	23.9%	86.1	23.3%	
	UnPaid	80.6	32.0%	58.6	28.7%	139.2	30.5%	Compared
	Total	593.8	50.1%	341.9	33.6%			to Chance
					Total	935.8	42.5%	32.1%

Table 5.5, Correct LFP & CC Mode, by Actual Choice

		NonWork	(%)	Working	(%)	Total	(%)	
CC MODE	Parent	387.4	48.5%	44.2	17.5%	431.6	41.1%	
	Center	12.5	18.9%	65.5	25.1%	78	23.9%	
	OthPaid	4.8	6.9%	62	20.6%	66.8	18.0%	
	UnPaid	54.4	21.6%	33.9	16.6%	88.3	19.4%	Compared
	Total	459.1	38.7%	205.6	20.2%			to Chance
					Total	664.7	30.2%	20.1%

Notes: "Compared to Chance" based on randomizing using Actual Count probabilities.

Choices for all 2204 observations were simulated during each simulation run, so the total number of choices simulated is 22.04 million. Simulation counts shown are averages per run, for comparison with Actual Counts.

Table 6
Simulation of Tightening Child-Staff Ratio Regulation in All States by 2 Children from Current Level

Table 6.1, Simulation Count - Existing Regs
(Table 4.2 reproduced for easy reference)

		NonWork	(%)	Working	(%)	Total	(%)
CC MODE	Parent	807	36.6%	253	11.5%	1060	48.1%
	Center	71	3.2%	249	11.3%	319	14.5%
	OthPaid	75	3.4%	292	13.2%	367	16.6%
	UnPaid	254	11.5%	204	9.3%	458	20.8%
	Total	1207	54.7%	998	45.3%		

Table 6.2, Simulation Count - Reg Tightened by 2.0

		NonWork	(%)	Working	(%)	Total	(%)
CC MODE	Parent	825	37.4%	268	12.2%	1093	49.6%
	Center	66	3.0%	226	10.3%	292	13.3%
	OthPaid	68	3.1%	274	12.4%	342	15.5%
	UnPaid	261	11.8%	216	9.8%	477	21.6%
	Total	1220	55.4%	984	44.6%		

Table 6.3, Change Resulting from Reg Tightening,
as a Percentage of Count under Existing Regulation

		NonWork	Working	Total
CC MODE	Parent	2.3%	6.0%	3.2%
	Center	-6.4%	-9.1%	**-8.5%**
	OthPaid	-9.4%	-6.2%	-6.8%
	UnPaid	2.7%	5.9%	4.1%
	Total	1.1%	**-1.4%**	

Note: Highlighted figures are discussed in the text

Table 7
Simulated Tightening Regulation by 2.0 Children/Teacher only in States Currently above (Looser Than) the Age-specific National Average

(Number of Observations = 942)

Table 7.1, Base Case

		NonWork	(%)	Working	(%)	Total	(%)
CC MODE	Parent	329.3	35.00%	90.7	9.60%	420	44.60%
	Center	40.3	4.30%	135.3	14.40%	175.6	18.60%
	OthPaid	31	3.30%	126.7	13.40%	157.7	16.70%
	UnPaid	103.1	10.90%	85.6	9.10%	188.7	20.00%
	Total	503.8	53.50%	438.2	46.50%		

Table 7.2, Simulation Count - Reg Tightened by 2.0

		NonWork	(%)	Working	(%)	Total	(%)
CC MODE	Parent	825.2	35.20%	92.2	9.80%	423.9	45.00%
	Center	66.1	4.20%	127.7	13.60%	167	17.70%
	OthPaid	67.7	3.30%	129.3	13.70%	160.7	17.10%
	UnPaid	261.2	11.00%	86.7	9.20%	190.4	20.20%
	Total	1220.1	53.70%	435.9	46.30%		

Table 7.3, Change Resulting from Reg Tightening,
as a Percentage of Count under Existing Regulation

		NonWork	(%)	Working	(%)	Total	(%)
CC MODE	Parent	331.8		1.65%		0.93%	
	Center	39.3		-5.62%		**-4.90%**	
	OthPaid	31.4		2.05%		1.90%	
	UnPaid	103.7		1.29%		0.90%	
	Total	506.1		**-0.52%**			

Note: Highlighted figures are discussed in the text.

Table 8
Relaxation of Ratio Regulation
States Currently Tighter than Mean

(Number of observations = 1262)

Table 8.1, Base Case

		NonWork	(%)	Working	(%)	Total	(%)
CC MODE	Parent	477	37.8%	162	12.8%	639	50.7%
	Center	30	2.4%	114	9.0%	144	11.4%
	OthPaid	44	3.5%	165	13.0%	208	16.5%
	UnPaid	152	12.0%	119	9.4%	270	21.4%
	Total	703	55.7%	559	44.3%		

Table 8.2, Simulation Count - Reg Relaxed by 2.0

		NonWork	(%)	Working	(%)	Total	(%)
CC MODE	Parent	472	37.4%	158	12.5%	630	49.9%
	Center	32	2.5%	124	9.8%	156	12.3%
	OthPaid	45	3.6%	166	13.2%	212	16.8%
	UnPaid	150	11.9%	115	9.1%	265	21.0%
	Total	699	55.4%	562.7	44.6%		

Table 8.3, Change Resulting from Reg Relaxation
as a Percentage of Count under Existing Regulation

		NonWork	Working	Total
CC MODE	Parent	-1.1%	-2.6%	-1.5%
	Center	5.9%	8.4%	**8.0%**
	OthPaid	3.2%	1.0%	1.5%
	UnPaid	-1.1%	-2.9%	-1.9%
	Total	-0.5%	**0.7%**	

Note: Highlighted figures are discussed in the text.

Table 9
Price Elasticity Estimates

Table 9.1, Base Case (Table 4.2 reproduced)

		NonWork	(%)	Working	(%)	Total	(%)
CC MODE	Parent	806.8	36.6%	252.8	11.5%	1059.6	48.1%
	Center	70.6	3.2%	248.8	11.3%	319.4	14.5%
	OthPaid	74.7	3.4%	292	13.2%	366.6	16.6%
	UnPaid	254.4	11.5%	204	9.3%	458.4	20.8%
	Total	1206.5	54.7%	997.5	45.3%		

Table 9.2, Simulation Count - Center Prices Increased by 1%

		NonWork	(%)	Working	(%)	Total	(%)
CC MODE	Parent	808.1	36.70%	253.3	11.50%	1061.3	48.20%
	Center	69.8	3.20%	246.5	11.20%	316.3	14.40%
	OthPaid	74.9	3.40%	292.3	13.30%	367.2	16.70%
	UnPaid	254.7	11.60%	204.4	9.30%	459.1	20.80%
	Total	1207.4	54.80%	996.6	45.20%		

Table 9.3, Price Elasticities of Center Care
(% Change resulting from 1% Price increase)

		NonWork	t-stat	Working	t-stat	Total
CC MODE	Parent	0.16%		0.20%		0.16%
	Center	**-1.13%**	2.19	**-0.92%**	1.35	**-0.97%**
	OthPaid	0.27%		0.10%		0.16%
	UnPaid	0.12%		0.20%		0.15%
	Total	0.07%		-0.09%		

Note: Highlighted figures are discussed in the text.
T-statistics are derived from the price coefficient standard errors in the choice equation, Table 2.

Table 10
Price and Wage Offers for Mothers Purchasing Care and Working Compared to All Mothers

	Estimated for Purchasing or Working Mothers	All Mothers	Actual (Observed in Data)
Center Price ($ / child-week)	50.78	67.26	50.32
Other Paid Price ($ / child-week)	46.39	61.24	45.99
Wage Offer ($ / Hr)	7.61	4.41	7.51