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Do reduced child care prices make parents work more?

Daniela Lundin
Eva Mörk
Björn Öckert

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Postal address: P.O. Box 513, 751 20 Uppsala
Visiting address: Kyrkogårdsgatan 6, Uppsala
Phone: +46 18 471 70 70
Fax: +46 18 471 70 71
ifau@ifau.uu.se
www.ifau.se

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Do reduced child care prices make parents work more? ⋆

by

Daniela Lundin, Eva Mörk and Björn Öckert♣

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Abstract

This paper exploits exogenous variation in the price of child care stemming from a major child care price reform, to estimate the effects of child care costs on parents' labour supply. The reform introduced a cap on the price that local governments could charge parents, and lead to considerable reductions in the price of child care depending on family type and region. Since the price is determined by a handful of observed characteristics, we are able to match households that are similar in all relevant aspects, but experienced quite different price changes due to the reform. Our difference-in-differences regression matching estimates are very precise, but mostly close to zero.

Keywords: Labour supply, price of child care, difference-in-differences regression matching
JEL-codes: J21, J13

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♣ Institute for labour market policy evaluation (IFAU), Box 513, SE-751 20 Uppsala, Sweden, daniela.lundin@ifau.uu.se, eva.mork@ifau.uu.se and bjorn.ockert@ifau.uu.se

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1 Introduction

Subsidized child care has typically been used as a way of increasing labour force participation among low-income mothers. For example, subsidized child care was one of the components in the major welfare reform implemented in the US during the 1990s. In Europe, the supply of subsidized child care as well as the level of female labour supply varies tremendously. The Nordic countries (excluding Finland) have a well developed child care system with high enrolment rates; over 60 percent of 3-year-olds and more than 70 percent of 5-year-olds are enrolled in child care centres. The female labour supply in these countries is also high from an international perspective (OECD, 2001). The question is, of course, whether this is a cause or an effect of the developed child care system.

There is a large literature investigating the link between parents' (i e mothers') labour supply and the cost for child care; see Anderson & Levine (2002) and Blau & Currie (2004) for two surveys. The major problem with the existing studies is that information on the true price of child care is typically not available. Therefore, most earlier studies have used predicted values from a sample of households that pay for care. This approach provides a price measure for the entire sample, but requires an exclusion restriction to identify the effect of the price of child care on labour supply (i e there must exist some variable that explains the price of child care but not labour supply). The instruments used have (in the best cases) been factors that vary across regions, such as the local area cost of child care and the average wages of child care workers. As argued by, e g, Baker *et al* (2005) the validity of these instruments is questionable, since they might be correlated with the state of the local economy and the area wages.[1] Therefore, several recent studies (e g, Baker *et al*, 2005; Schlosser, 2005; Berlinski & Galiani, 2004; and Cascio 2006) exploit time and regional variation in the access and/or price of child care, due to child care regulations or child care reforms, to estimate the effects of the price of child care on maternal labour supply. The major weakness of these difference-in-differences evi-

[1] Two studies that avoid this problem are Berger & Black (1992) and Gelbach (2002).

dence is that regions that experienced different changes in the access or the price of child care might not always be comparable.

This paper exploits exogenous variation in the price of child care stemming from a major child care reform in Sweden, to estimate the effects of child care costs on parents' labour supply. Before the reform, local governments were allowed to set the price of child care freely. Typically, the price varied with respect to the number of children in different ages and to household income, leading to substantial variation in the price of child care both between and within municipalities.[2] In 2002 there was a major child care price reform, which introduced a cap on the price that local governments could charge parents.[3] This made all municipalities impose more or less the same price structure, where prices varied by type of household in a similar way. The reform led to considerable reductions in the price of child care, depending on the area of living and the type of household. Since the type of household is defined by a handful of observed characteristics, we are able to match households that are similar in all relevant aspects, but that experienced quite different price changes due to the reform. We exploit this variation to estimate the effect of the price of child care on labour supply in a difference-in-differences regression matching framework. Since we are able to compare households that are identical with respect to all the child care prices determinants, we hope to overcome some of the problems in the earlier difference-in-differences literature. In addition, we investigate the effects of child care prices on *fathers'* labour supply as well as mothers'. Looking at males is important in the Swedish context, since two months of parental leave are reserved for fathers and most fathers take some parental leave.

We find that parental labour supply does not seem to depend on child care prices; our difference-in-differences regression matching estimates are very precisely estimated, but the point estimates are close to zero. In a few cases,

[2] Gustafsson & Stafford (1992) exploit this cross-sectional variation in the price of child care for two parent households with one pre-school aged child. The child care prices for these families differ with respect to household income and municipality. However, since earnings potential is closely related to labour supply and since the differences in the price-structures across municipalities might reflect differences in labour supply, one might worry that the cross-sectional variation in the price of child care is not exogenous.

[3] It was voluntary to introduce the new price structure, but since municipalities were compensated for the loss in revenues all but two municipalities did.

especially for male employment, we find statistically significant effects. However, these effects are not of any economic significance. We can rule out that the child care price elasticity with respect to labour supply is greater than 0.02 for both females and males.

The paper is organized as follows: In the next section we present some earlier empirical evidence. Then, we provide some institutional background information about subsidized child care in Sweden, as well as a description of the child care price reform that we will exploit to identify the effects. In section 4, we discuss our empirical approach, and in section 5 we present the data. The results from the empirical analysis follow in section 6. Finally, section 7 concludes.

2 Earlier studies

Economic theory gives a clear prediction regarding the effects of reduced child care prices on labour force participation. A reduction in the child care price will increase the probability that the wage – net of child care costs – will exceed the individual's reservation wage, and, thus, make it more likely that (s)he choose to participate in the labour force. When it comes to hours worked, given labour force participation, economic theory cannot determine whether these are likely to increase or decrease when child care prices fall. On the one hand, the income effect makes individuals work less when child care prices are reduced, but on the other hand, the substitution effect works in the other direction given that the price is income dependent. Hence, it is an empirical question whether reductions in child care prices will make parents work less or more hours. Below, we will present earlier empirical evidence from the most reliable studies available on the effects of the price of child care on labour supply.

Berger & Black (1992) use US data and compare mothers receiving child care subsidies with those on the waiting list for such subsidies. Using a regression-discontinuity-like approach, they create treatment and control groups that are similar in all relevant aspects. However, the treatment group receives subsidies whereas the control group does not. They find positive effects of child care subsidies on female labour force participation (subsidized mothers have approximately 12 % higher probability of being employed), but no effects on hours worked.

Gelbach (2002) investigates the effect of public school enrolment for five-year olds (kindergarten) on mothers' labour supply in the US. Since parents may choose to hold back their children one year or to enrol them in private schools, and since this choice probably is correlated with factors determining labour supply, public school enrolment might be endogenous. Gelbach exploits the fact that a child's date of birth decides when (s)he is eligible for kindergarten, and instrument school enrolment with five-year-old's quarter of birth. He finds that both single and married mothers with a five-year old – but with no younger child – increase their labour supply (6–24 % for single mothers and 6–15 % for married mothers) due to public schooling. For mothers with younger children, no effects are found, which is reasonable since they still need to arrange child care for them.

Cascio (2006) also analyses labour supply effects of school enrolment, but exploits the fact that different states introduced public kindergarten at different times. Her difference-in-differences estimates point at large effects on single mothers' labour force participation, given that they had no child younger than five; for every ten children enrolled in public school, three mothers entered the labour force. She finds no effects for single mothers who have a five-year-old and younger children or for married mothers (the latter finding contradicts the Gelbach results).

Two other quasi-experiments studies of the effects of introducing free preschool gradually across the country are Schlosser (2005) and Berlinski & Galiani (2004). Schlosser investigates the effects of the 1999-introduction of free public preschool for children aged 3 and 4 on Arab mothers' labour supply in Israel. She finds that mothers' labour supply increased sharply (7 %) and that the increase was largest for more educated mothers. Berlinski & Galiani study the expansion of preschool for children aged 3–5 in Argentina, and exploit the variation in treatment intensity across regions and cohorts to identify the effects on maternal labour supply. They find that the programme had a positive and statistically significant effect on mothers' employment.

Finally, Baker *et al* (2005) investigate a Canadian reform implemented in Quebec 1997.[4] The aim of the reform was to provide child care spaces to all

[4] This reform is also studied by Lefevbre & Merrigan (2005a, b).

children aged 0–4 at a parental contribution of $ 5 per day and child.[5] Comparing maternal labour supply in Quebec with maternal labour supply in the rest of Canada, they find a highly significant effect of reduced child care prices on female employment with a measured elasticity of 0.24.

The major shortcoming of the available difference-in-differences evidence is that regions with different changes in the access to or the price of child care might not be otherwise comparable. In particular, one might worry that households in regions with large changes in the access to or the price of child care differ in unobserved ways from households in other regions. If these differences are related to labour supply decisions, the estimates might be biased.

3 Publicly provided child care in Sweden

Since 1995 local governments in Sweden are obliged by law to supply child care to children with parents that either work or are full-time students,[6] within three to four months from parents' request.[7] *Table 1* shows that most children aged 1–5 attend publicly subsidized child care and that non-subsidized private alternatives are rare.[8]

[5] The Quebec-reform is similar to the Swedish reform in that a cap on the price was introduced. It differs from the Swedish reform in that prices became independent of income.

[6] Besides child care, Swedish local governments are responsible for supplying primary and secondary education, care for the elderly, individual and family care, infrastructure, as well as some cultural activities. The main revenue source is a proportional income tax that the municipalities are free to set. Tax revenues constitute about 60–70 percent of total current revenues. The rest is made up by user fees and central government grants, where 15–20 percent of total revenues consist of grants. Grants are typically of unconditional lump sum type and are used both for transferring funds from the central to the local level and for an ambitious equalisation program.

[7] The Swedish National Agency for Education (2001a)

[8] Blau & Currie (2004) note that most earlier studies do not account for the existence of unpaid child care options, something that might lead to biased estimates. However, since the use of unpaid child care in Sweden is rare this is unlikely to affect the estimates.

Table 1 Type of care for children aged 1–5, percent

	1999	2002
Subsidized care (municipal preschool or family day care homes)	76	85
Non-subsidized care (relatives, au-pair, etc)	3	2
At home with parent	18	13
Other	3	1

Source: The Swedish National Agency for Education (2001b, 2004)

Until 2002 the municipalities were free to set their own child care prices, as long as the prices were "reasonable". According to Government bill 93/94:11, "prices are not allowed to be so high that parents, for economic reasons, restrain from letting their children attend an activity that the children would do well from attending". This definition clearly gives room for wide interpretations, and consequently prices differed considerably between municipalities, both with respect to level and construction. In 2002, an option for the municipalities to impose a cap (stipulated by the government) on the price was introduced. If municipalities chose to implement this cap they were granted extra state fund to cover the loss in revenues. In 2002, all but two municipalities imposed the price cap and in 2003 the two remaining municipalities followed.

The child care price reform consisted of two parts. First, the price of child care was determined as a fixed rate of the household income. The percentage rates differed with respect to the number and age of the children, with higher per-child prices the fewer children in public child care and the younger the child.[9] Second, a cap on the price was introduced so that municipalities could only charge parents the fixed share of their household income up to SEK 38,000. Thereafter, the price of child care was constant.

In January 2003, the price cap was accompanied by an obligation for all municipalities to supply 525 hours a year of child care for all children age 4–5 years free of charge. In all, these changes made the average cost for full-time child care decrease from 6 % to 2.5 % percent of the pre-tax household in-

[9] The fixed per-child percentage rates differed between 1–3 % of household income, and the maximum rate was 6 % for those with three children aged 1–5. The fourth child in care was free of charge.

come.[10] Finally, the reform also involved an obligation for all municipalities to supply at least 3 hours a day or 15 hours a week of child care for children whose parents were unemployed (implemented in July 2001) or on parental leave (implemented in January 2002).

The main purpose of the 2001–03-reform was to increase the supply of child care, thereby giving all children access to the pedagogical activities supplied by day care centres, improving the economic conditions for families with children, and facilitating parents' labour force participation. *Figure 1* shows that when the cap was implemented in 2002, the share of children attending child care increased from an already high level. Wikström (2007) shows that the increased attendance rates after the reform are mostly driven by higher attendance rates for children to unemployed parents (+18 %) and for children whose parents are on parental leave (+22 %).

Figure 2 shows the female and male employment over the period 1976–2004. The fraction of females employed is high during the whole period, and since the middle of the 1990s, it is only slightly lower than the male counterpart. Looking at the years 2002–05, i e the period after the child care reform took place; we see a decreasing trend in both male and female employment. The question is whether the fraction employed fell differently for households with different reductions in child care prices. We will attempt to answer this question in the empirical analysis.

Contrary to earlier studies, we will study the labour supply effects of child care prices for both mothers and fathers. In Sweden, both parents are entitled to generous income support when staying home with young children. In total they are entitled to thirteen months of parental leave at a replacement rate of 80 %. However, two months of this period are reserved for fathers[11]. Eriksson (2005) shows that in 2002, fathers with children younger that 17 months on average stayed home in 37 days. 82 % of all fathers took some time off to be home with their children before the child turned eight years. About 10 % of fathers took more than 100 days of parental leave (Ekberg et al., 2004).

[10] The average cost for full-time child care decreased from 9.7 % to 4 % of after-tax income.

[11] See Ekberg *et al,* 2004; and Eriksson, 2005 for a description of the parental leave system in Sweden and for studies of the effects of the "daddy-month" on mothers' and fathers' parental leave.

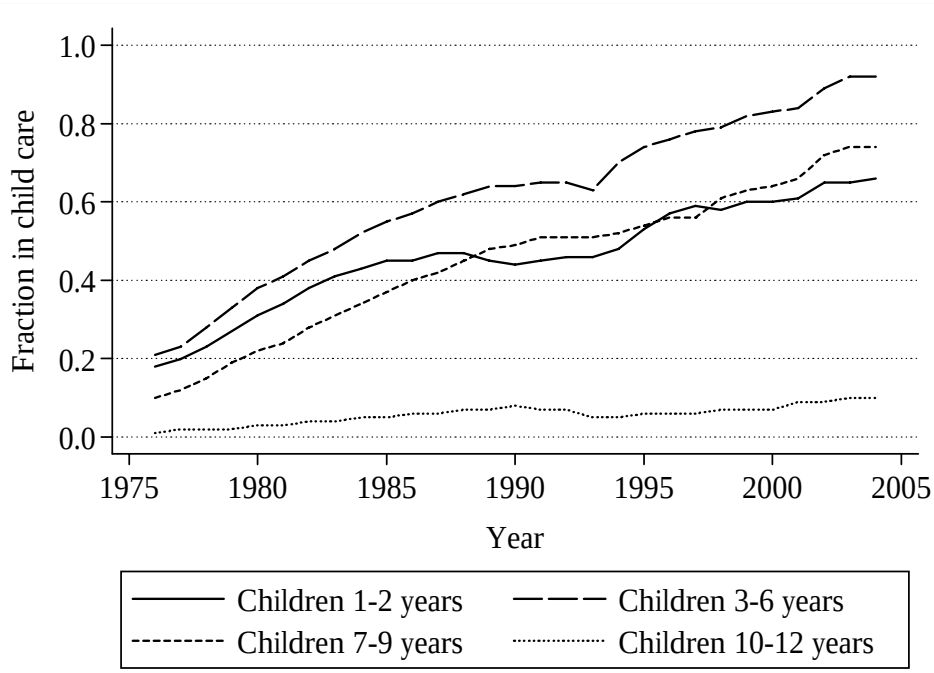


Figure 1 Fraction of children attending publicly provided child care, 1976–2004.

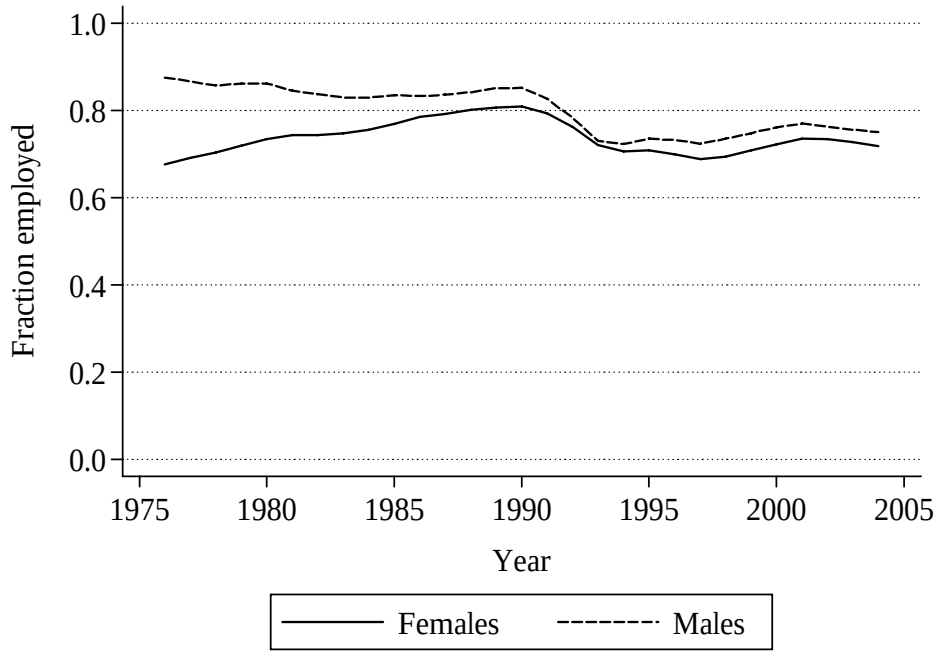


Figure 2 Fraction employed, 1976–2004

4 Econometric method

The aim of this paper is to estimate the effect of the price of child care on labour supply. Assume that the labour supply for individual *i* in municipality *m* is given by:

$$Y_{im} = \alpha_m + \beta P_{im} + \pi X_i + \delta Z_i + \varepsilon_{im}, \qquad (1)$$

where Y_{im} is either a dummy variable for employment status or the share of full-time among those who work, α_m is a municipality specific intercept, P_{im} is the price of child care per hour, X_i is a vector of household characteristics, Z_i is a vector of individual characteristics and ε_{im} is an unobserved labour supply component.

Before the reform, municipalities could set the price of child care freely, which lead to great regional price variation across municipalities. To this, there was also substantial within municipality price variation, with the price of child care given by a deterministic function of household characteristics (the number of children in different ages and the household income). The formula for calculating the child care price differed between municipalities and could be expressed as:

$$P_{im} = P_m(X_i). \tag{2}$$

Barnow *et al* (1981) show that unbiased estimates are obtainable if all factors affecting both the price of child care and labour supply are quantified and included in the model. The exact functional form of X_i in equation (1) is, however, not known. If the model fails to remove all the direct effect of X_i on Y_{im}, the estimates might suffer from bias. The most flexible specification of X_i available, is to include dummy variables for all possible combinations of values and variables in X_i (saturated model for X_i). Assume that there are J such combinations (household types). The model can then be written as:

$$Y_{ijm} = \alpha_m + \beta P_m(\gamma_j) + \gamma_{jm} + \delta Z_{ij} + \varepsilon_{ijm}, \tag{3}$$

where γ_j is a household type fixed effect and γ_{jm} is a household type×municipality fixed effect.[12] This model controls for all the child care price determinants in the most flexible way possible. Thus, the price of child care fulfils the selection-on-observables assumption, i e that the unobserved labour supply component does not vary with the price of child care conditional on γ_{jm}. Also, failing to control for other determinants of labour supply will not bias the estimate (since they do not affect the price of child care). Therefore, we can exclude Z_{ij} from the model.

[12] Many earlier studies exploit cross-sectional regional variation to identify the effect of the price of child care on labour supply. However, it is quite likely that municipalities choose the price structure as a response to the labour supply for different types of households. Thus, the cross-sectional regional variation in the prices of child care for a given type of household might be endogenous. To account for the possible endogeniety of the price structure across municipalities, we interact household type with municipality.

$$E\left[\varepsilon_{ijm} P_m\left(\gamma_j\right) \mid \gamma_{jm}, Z_{ij}\right] = E\left[\varepsilon_{ijm} P_m\left(\gamma_j\right) \mid \gamma_{jm}\right] = 0\,. \tag{4}$$

LS estimates of (3) will, thus, yield an unbiased estimate of β. However, since the price of child care in municipality m is a deterministic function of X_i, there is no variation in the price conditional on $\gamma_{jm.}$ Thus, the effect of the child care price on labour supply cannot be estimated without additional sources of variation.

In this paper we exploit the change in the price of child care due to the reform in 2002, to estimate the effect of the price of child care on labour supply. As mentioned earlier, before the reform, municipalities were allowed to set the price of child care freely, with varying impact of different household characteristics. The reform imposed a common child care price structure, leading to substantial changes in the child care price depending on the pre-reform price structure. Introducing time variation to model (3), yields:

$$Y_{ijmt} = \alpha_m + \beta P_{mt}\left(\gamma_j\right) + \gamma_{jm} + \lambda_{jt} + \varepsilon_{ijmt}\,, \tag{5}$$

where t = {2001, 2003} indexes years and λ_{jt} is a household type×time effect. This is a difference-in-differences regression matching estimator.[13] Note that the estimate of β is the weighted sum of J difference-in-differences estimates at the household type level, with the weights set to the number of households of type j. Thus, λ_{jm} and λ_{jt} are the municipality fixed effects and a time fixed effect for household j, respectively. Below, we will describe how we will match households in practise.

[13] This is similar to the difference-in-differences matching estimator in Heckman *et al* (1997) and Smith and Todd (2005).

5 Data

5.1 Definitions and descriptive analysis

We use two data sources; register data from Statistics Sweden and survey data on municipal day care prices collected by us.[14] As described in section 4 above, we will use data from two years in order to identify the effects of the child care price on labour supply; one year before the reform (2001) and one after (2003). For each year, we use the entire population consisting of two-parent households with at least one child aged 1–9.[15] The price formulas are based on a few household characteristics that all are observed in the data, namely year, municipality of residence, household income (wages), number of children aged 1–9, and the age of each child. However, we do not calculate prices using observed wages for several reasons; first, wages might be endogenous and depend on hours worked, and second, we do not observe wages for parents who do not work. Therefore, we use predicted wages from a traditional Mincer-equation, where we control for age, age squared, educational level and type, country of birth, parents' country of birth and parents' educational level.[16] We run separate regressions with respect to gender and time period. Given the information on the number and age of the children and the predicted household income, we use the survey data on the price-structure to calculate the exact full-time price

[14] We collected child care prices via an email-request sent to all Swedish municipalities asking for exact formulas on how they calculated prices in 2001–04. We received information about the exact price structure from 220 of Sweden's 290 municipalities.

[15] The reason for focusing on two-parent households is that we cannot, in data, separate unmarried couples without common children from single-parent households. Since prices are based on household income, we will not be able to calculate correct prices for these households. In the sensitivity analysis we will however investigate if the estimates are affected by including single parent households. The reason for focusing on children aged 1–9 is that the share of children attending child care is low for older children, see *Figure 1*. In the empirical analysis we will investigate the importance of children's age further. Finally, we exclude parents younger than 16 and older than 64, since people of that age typically do not participate in the labour force.

[16] Full-time wages are available for all workers in the public sector and for a random sample of workers in the private sector. In order to make the estimates nationally representative we weight the sample using the sampling weights. We estimate wage-equations for the full sample, regardless of whether they have children or not. Results from the wage-equations are available from the authors upon request.

of child care for each household.[17] In the main part of the analysis we will use hourly child care price, defined as the monthly full-time price divided by the number hours per month for full-time attendance, as measure of the price of child care

We investigate the effects of prices on two different labour supply outcome variables; whether the individual is employed or not and the share of full-time conditional on employment. It is not obvious how to measure employment. We base the decision on the individual's observed actual yearly earnings, where we define an individual as employed if he/she earns more than 50 percent of the minimum wage according to collective agreements.[18] Turning to the other outcome variable, share of full-time, this is only observed for those employed.[19]

Table 2 gives summary statistics for the variables used in the empirical analysis. Three things are worth pointing out. First, there are no large changes in average labour supply between 2001 and 2003. If anything, the fraction employed and the average share of full-time seems to have fallen slightly over the period. Second, males typically work full-time, whereas females work fewer hours a day. Third, price of child care is considerably lower in 2003, and so is the variation across individuals. Given the nature of the reform, where a universal cap on prices was introduced, this is expected.

[17] This is done under the assumption that all children aged 1–9 in the household attend publicly provided child care. Given that we use predicted rather than actual wages when calculating child care prices, one might worry about measurement errors. However, since predicted wage is a generated variable, the error component is orthogonal to the predicted values by construction. In the analysis we use predicted child care prices, which are non-linear transformations of the predicted wages. In order to check whether these transformations causes any measurement error problems, we have estimated the "first-stage" relationship between predicted child care prices and true child care prices for a sample of working parents. We find a point estimate for predicted child care prices of 0.99. Hence, measurement errors should not be a problem.

[18] The minimum wages are taken from Skedinger (2005). In 2003 the minimum wage was approximately SEK 125,000 on a yearly basis. We have elaborated with different threshold values as well as letting the thresholds differ by gender, age and education. This did however not change the results.

[19] As for the wage data, this information is available for all workers in the public sector and for a random sample of workers in the private sector. We use the sampling weights to make these numbers nationally representative.

Table 2 Summary statistics, full sample

	Females		Males	
	2001	2003	2001	2003
Outcome variables				
Employed	0.696	0.689	0.841	0.835
	(0.460)	(0.463)	(0.366)	(0.371)
Share of full-time *	0.813	0.811	0.975	0.972
	(0.221)	(0.223)	(0.115)	(0.121)
Price variable				
Hourly child care price	14.736	6.684	14.736	6.684
	(5.478)	(2.227)	(5.478)	(2.227)
Household variables				
Predicted household income	40,926	41,365	40,926	41,365
	(7,347)	(7,503)	(7,347)	(7,503)
Number of children	1.542	1.522	1.542	1.522
	(0.653)	(0.644)	(0.653)	(0.644)
Age of youngest child	4.553	4.392	4.553	4.392
	(2.691)	(2.709)	(2.691)	(2.709)
Individual variables				
Age	35.464	35.583	38.236	38.328
	(5.694)	(5.685)	(6.559)	(6.544)
Born abroad	0.167	0.171	0.163	0.168
	(0.373)	(0.376)	(0.369)	(0.373)
Primary Schooling	0.111	0.105	0.149	0.136
	(0.315)	(0.306)	(0.356)	(0.343)
Secondary schooling	0.586	0.568	0.626	0.622
	(0.493)	(0.495)	(0.484)	(0.4850)
Tertiary schooling	0.303	0.327	0.226	0.243
	(0.460)	(0.469)	(0.418)	(0.429)
No of obs	348,544	334,927	348,544	334,927
	/178,621*	/170,389*	/144,577*	/138,462*

Notes: *Only for those employed and covered by the wage data (weighted with sampling weights). The hourly child care price and predicted household income is measured in SEK. 1 SEK corresponded in 2003 to 0.11 euro or 0.13 USD.

5.2 Construction of the matched sample

An important assumption in our empirical approach is that we can account for all variables that simultaneously determine prices of child care and labour supply. The prices in both 2001 and 2003 were based on a few household characteristics: the number of children, the age of each child and the household income.[20] All these variables are included in the data. However, the exact functional form of these variables in the labour supply model is not known. To account for all direct effects of these variables on the outcome, we therefore create a set of dummy variables for all possible combinations of values and variables. We are then able to compare identical households in different municipalities before and after the reform. This is analogous to exact matching, where each household type in 2003 is matched with a household of the same type in 2001 in a given municipality.[21] All such pairs of household types are then matched to identical pairs in other municipalities.

In practise, unrestricted exact matching is not possible, since predicted income is a continuous variable. If we were to define the household types down to the very last krona, we would soon run out of degrees of freedom. To address the dimensionality problem, we have to impose some type of income restriction. Therefore, we assume that households with predicted income in the same SEK 500-interval are comparable.[22] We thus let households with the same number of children, in the same age-categorises, with the same predicted income in SEK 500s define a household type.[23] Since we exploit variation in the price of child care before and after the reform, we can only use household types that appear in both periods in a given municipality. Also, since we will compare the change in labour supply and prices before and after the reform,

[20] As argued above we will use predicted household income rather than actual income.
[21] We do not want to compare the same household in 2001 and 2003, since both child care prices and parents' labour supply decisions might change as children age.
[22] We have also tried to match households in the same SEK 100 intervals. This reduces the sample substantially, but do not affect the estimates much.
[23] Arguing that households with the same predicted household income could act quite different depending on whether the income is equally generated by the woman and the man or whether one of the spouses has higher potential income than the other, we have also matched households on variables determining predicted wages (i e own and spouse's education, own and spouse's age). This does not change the results.

each household type must appear in at least two municipalities.[24] We are able to find matches for about 88 percent of the sample.[25] In particular, have not found matches for households with many children and households with very low or very high predicted household income. Thus, the matching excludes the more extreme observations. In all, we have been able to find matches for almost 2,500 different household types.

Since households are matched in SEK 500-intervals, and since the price of child care is based on the exact income, there might still be within household type variation in the price of child care in a given municipality and at a given time. Since the within-municipality variation in the price of child care might be endogenous, we take the mean of all variables for each household type for all municipalities and periods. Each observation is then weighted by the number of observations in each household type and municipality in 2003. This eliminates all within household type variation, and the effects are only identified from variation in the change in child care prices across municipalities.

5.3 Graphs

Before turning to the empirical analysis, let us look at some descriptive figures. *Figure 3* and *Figure 4* show the distribution of child care prices before and after the reform. The hourly price is typically higher in 2001 than in 2003; in 2001 some households pay more than 30 SEK per hour, whereas in 2003, no one pays more than 15 SEK per hour. There is also substantial variation in the price of child care in 2001, while the child care price reform made parents pay similar prices in different parts of the country. The spikes in *Figure 4* illustrate the cap on the price for different number of children.

[24] However, given that the household type has been found in both periods in a given municipality, this restriction is much milder.
[25] The corresponding figure for individuals with wage data is 80 percent.

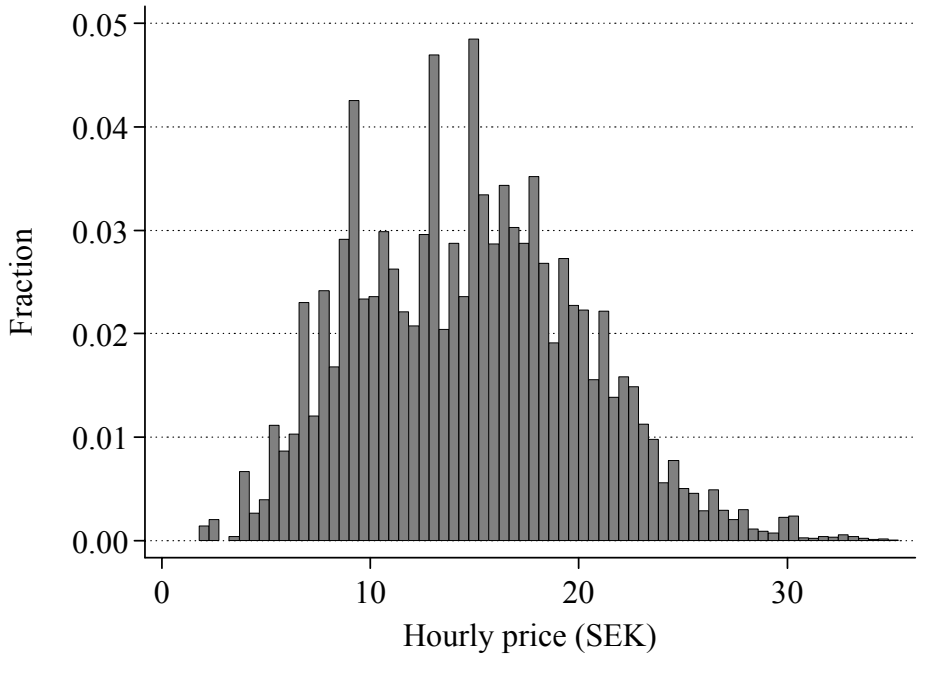


Figure 3 Distribution of the hourly child care price, 2001

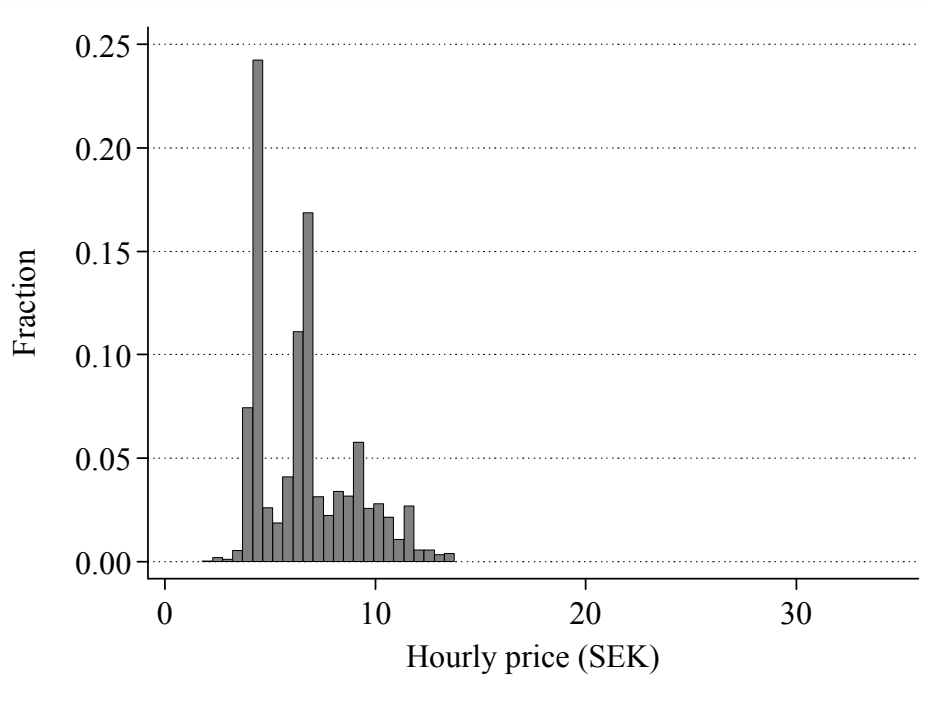


Figure 4 Distribution of the hourly child care price, 2003

Figure 5 illustrates how prices have changed between 2001 and 2003, as a result of the child care price reform. There are a few households whose price has actually increased, but for the lion share of the households child care has become a lot cheaper. For a typical household, the hourly price of child care has decreased with about 8 SEK.[26] The child care price reform, thus, generated much variation in the change of the price. Some households experienced quite substantial reductions in the child care price, while other (seemingly similar) households did not experience much change at all. It is this feature of the reform that we will exploit to estimate the effect of child care prices on labour supply.

[26] Note, however, that this is the hourly price at 40 hours of attendance.

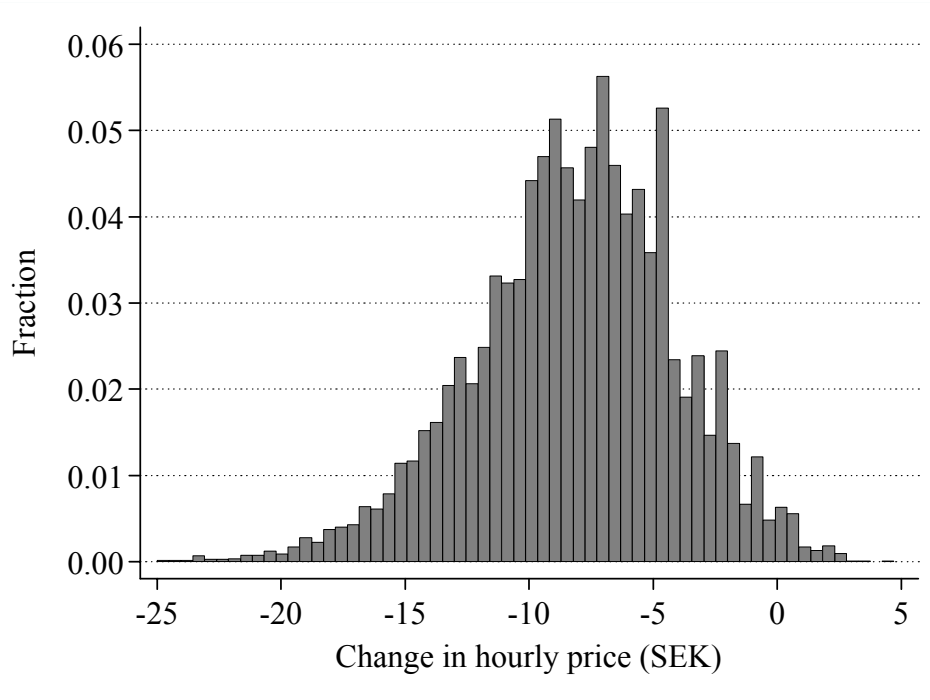
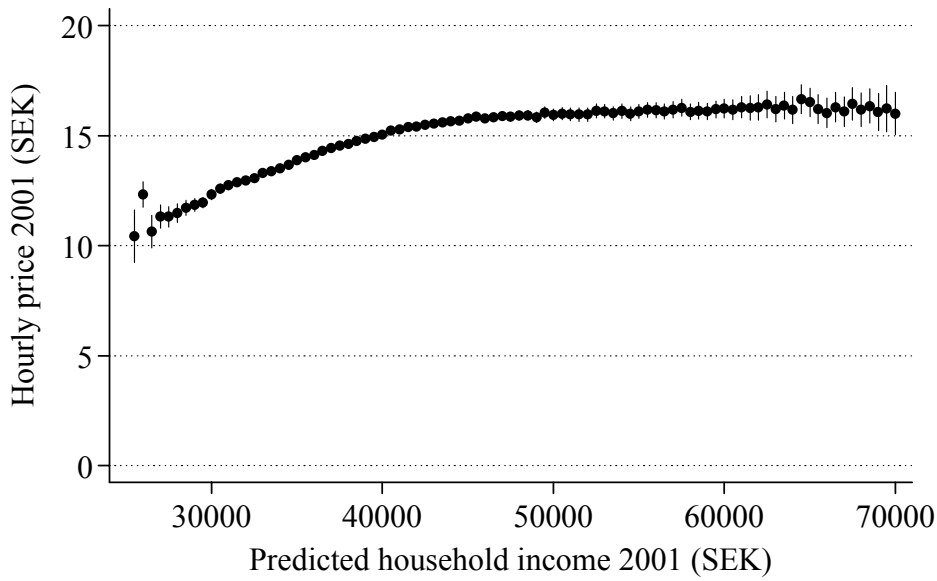


Figure 5 Distribution of the change in hourly child care price, 2001–03

Both before and after the reform, the price of child care is a function of household income. This is illustrated in *Figure* 6 and *Figure 7*, which show the average child care price for different household income levels.[27] As can be seen from the figures, there is a positive relation between household income and price for child care in both periods. In 2003, the graph flattens after 38,000 SEK, as expected from the price structure imposed by the reform. Also before the reform, the correlation between income and price decreases at certain income levels. This is because several municipalities imposed caps on prices even before the reform, although the exact income where the cap was imposed differed between municipalities (it varied between 22,300 and 73,800). *Figure*

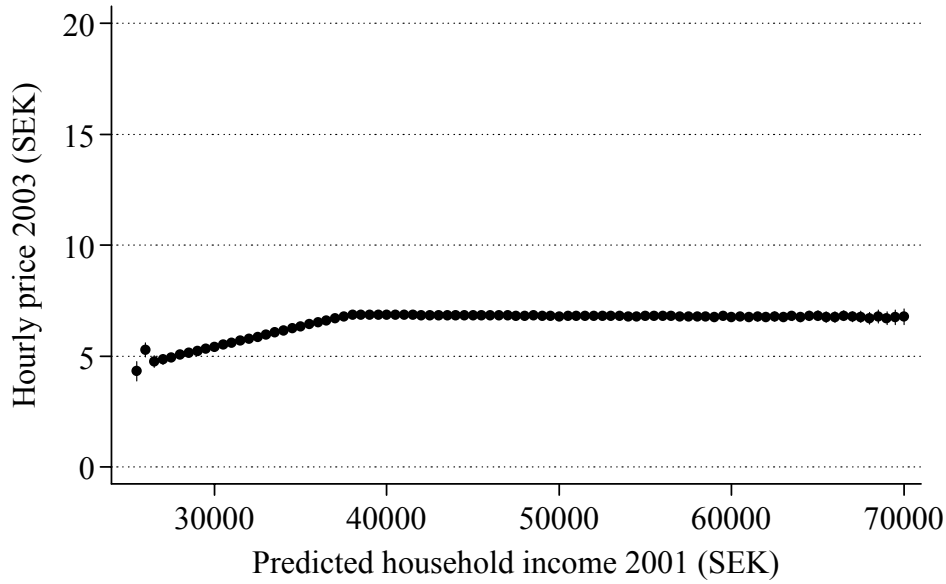
[27] To abstract from any correlations between predicted household income and other child care price determinants, the outcomes in *Figure 6–Figure 16* have been standardized with respect to the number and age of the children in the household.

8 shows how the change in price is related to predicted household income in 2001. As can be expected from the structure of the reform, it is households with the highest income that has gained the most from the reform**.**



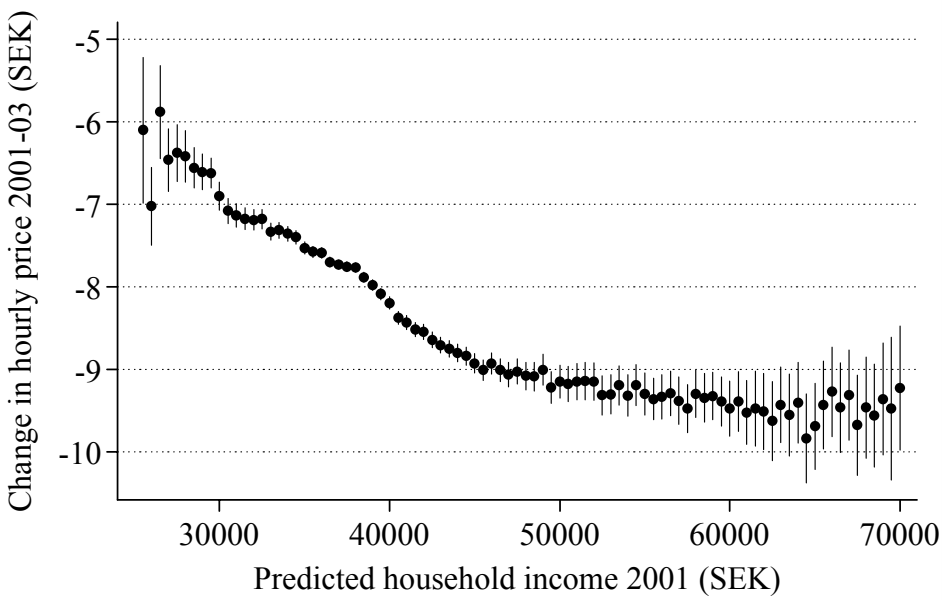
Notes: The figure shows the mean hourly child care price by predicted household income (in SEK 500 intervals). The price is standardized with respect to the number and age of the children. The solid lines show the mean +/- 1.96 standard errors.

Figure 6 Average hourly price 2001 by predicted household income 2001



Notes: The figure shows the mean hourly child care price by predicted household income (in SEK 500 intervals). The price is standardized with respect to the number and age of the children. The solid lines show the mean +/- 1.96 standard errors.

Figure 7 Average hourly price 2003 by predicted household income 2001



Notes: The figure shows the mean change in hourly child care price by predicted household income (in SEK 500 intervals). The price is standardized with respect to the number and age of the children. The solid lines show the mean +/- 1.96 standard errors.

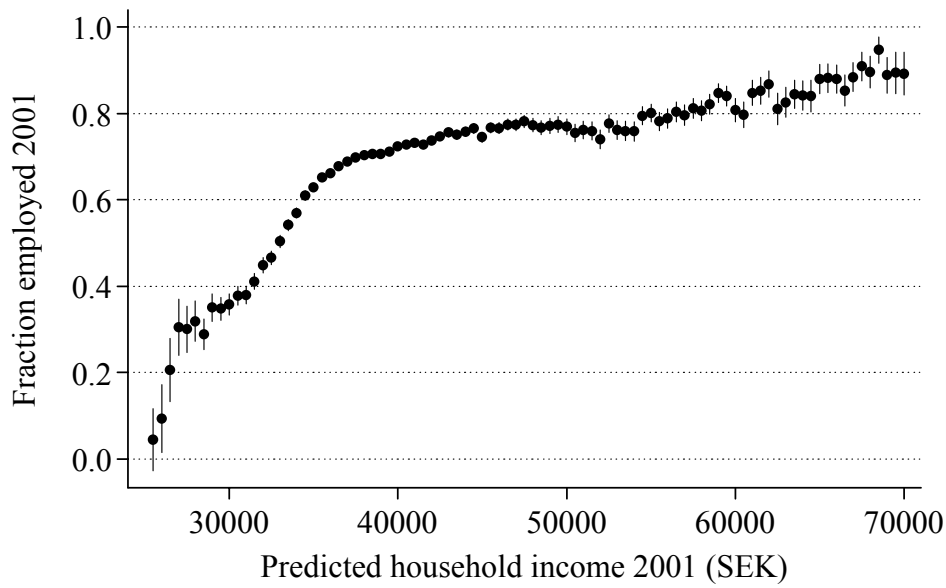
Figure 8 Change in average hourly price 2001–03 by predicted household income 2001

Child care prices are determined by the number of children, age of the children and household income. Many of these determinants are also closely related to labour supply. For instance, most empirical studies on female labour supply find a strong positive correlation between employment and the age of the youngest child. The same type of underlying relation applies to predicted household income as well. *Figure 9* and *Figure 10* show the fraction employed by predicted household income for females and males, respectively. There is a strong a positive correlation, indicating that those with highest potential income also are those that are working.[28] The pattern is, however, not as pronounced for the average share of full-time as shown in *Figure 11* and *Figure 12*. This is

[28] This follows from the fact that predicted income is a function of age, and that age is positively correlated with employment.

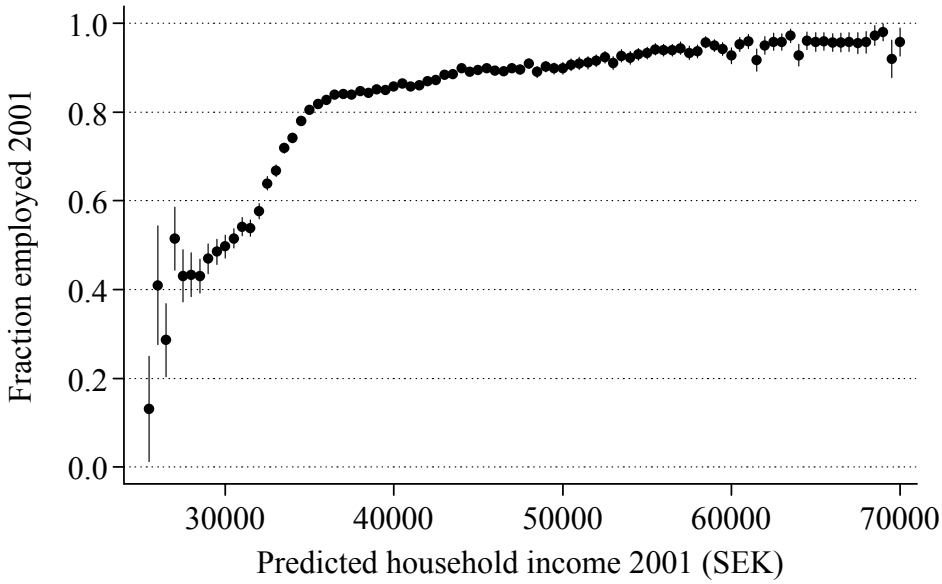
especially true for males; they typically work full-time regardless of predicted household income.

Given that many of the child care price determinants are directly related to the outcomes that we intend to study, it is crucial to account for all such differences in the empirical analysis. Otherwise, our estimates might be biased, and it is not trivial to say in which direction the bias will go. We address this problem by matching households that are identical with respect to the determinants of the child care price (i e, households with the same number and age of the children and with the same household income (in SEK 500s)).



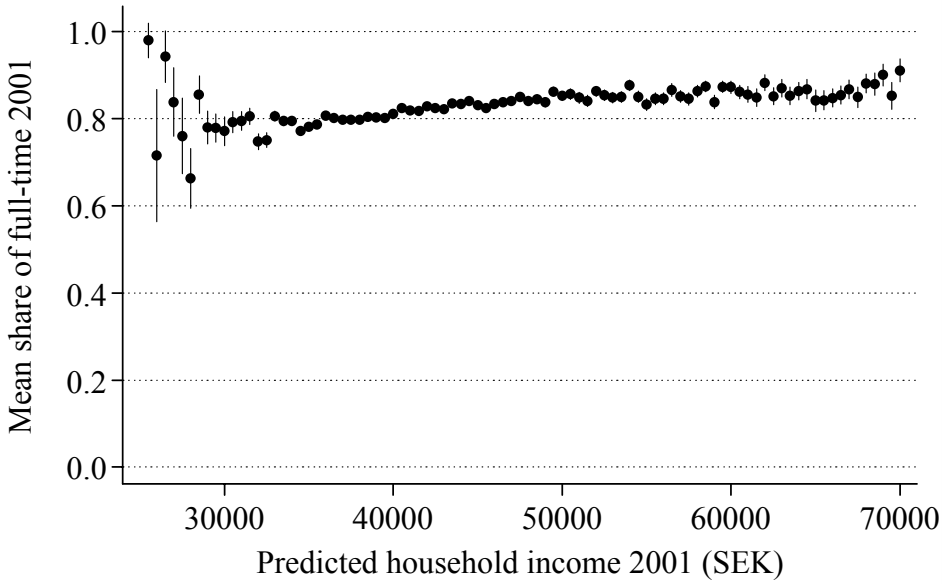
Notes: The figure shows the fraction employed by predicted household income (in SEK 500 intervals). The fraction employed is standardized with respect to the number and age of the children. The solid lines show the mean +/- 1.96 standard errors.

Figure 9 Fraction employed by predicted household income 2001, females



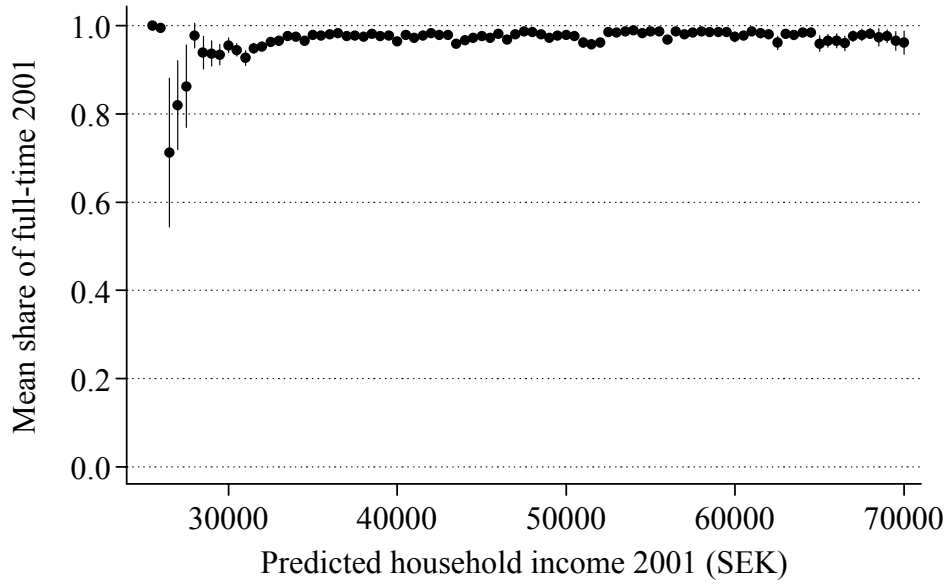
Notes: The figure shows the fraction employed by predicted household income (in SEK 500 intervals). The fraction employed is standardized with respect to the number and age of the children. The solid lines show the mean +/- 1.96 standard errors.

Figure 10 Fraction employed by predicted household income 2001, males



Notes: The figure shows the mean share of full-time by predicted household income (in SEK 500 intervals). The share of full-time is standardized with respect to the number and age of the children. The solid lines show the mean +/- 1.96 standard errors.

Figure 11 Average share of full-time among employed by predicted household income 2001, females

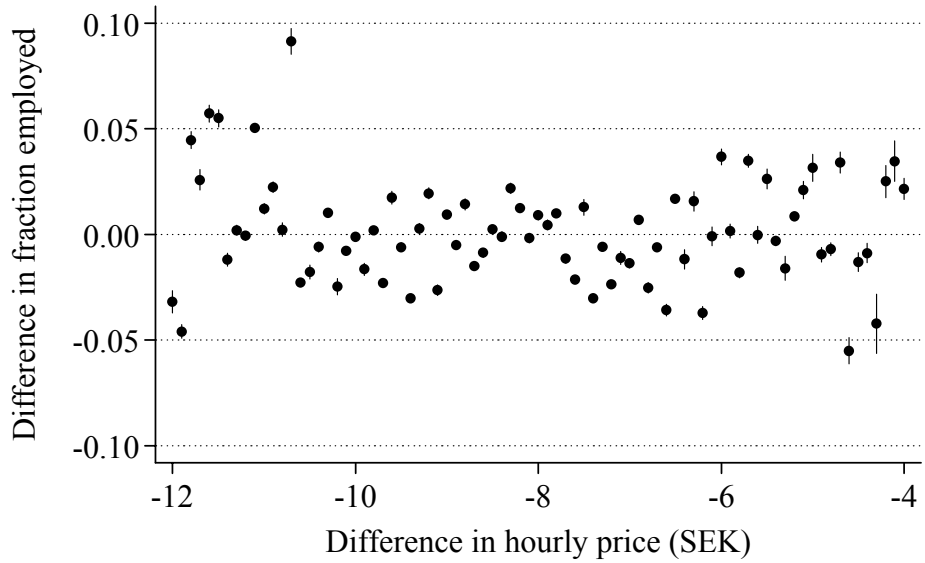


Notes: The figure shows the mean share of full-time by predicted household income (in SEK 500 intervals). The share of full-time is standardized with respect to the number and age of the children. The solid lines show the mean +/- 1.96 standard errors.

Figure 12 Average share of full-time among employed by predicted household income 2001, males

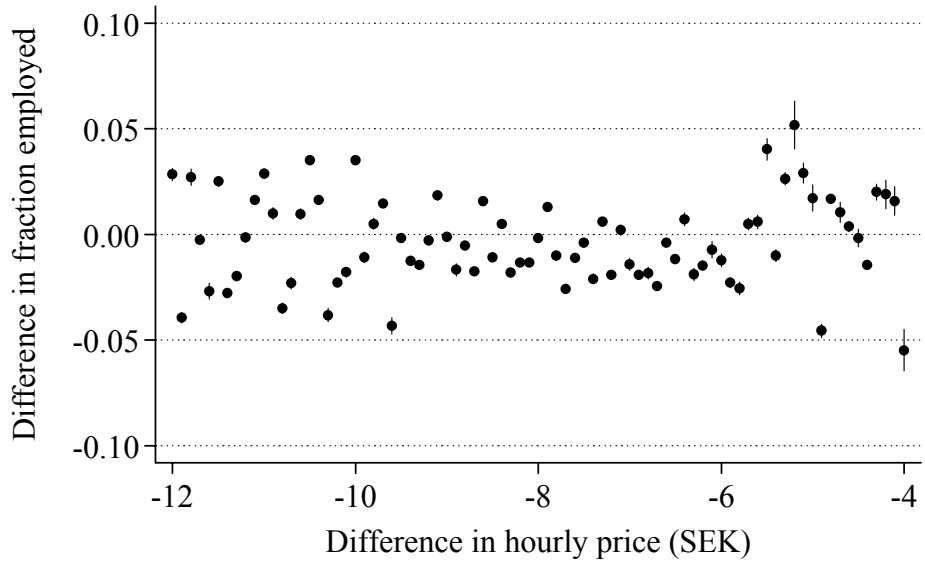
To give a first hint of what results we might expect from the empirical analysis, the remaining figures illustrate how differences in child care prices relates to differences in labour supply.[29] *Figure 13* (females) and *Figure 14* (males) show the average difference in the share employed by the difference in price and *Figure 15* (females) and *Figure 16* (males) show the average difference in the share of full-time by the difference in the price. None of the figures show much action; at first sight there seem to be no correlation between the changes in price for child care and the changes in labour supply.

[29] When constructing these figures we have used the matched sample described in section 5.2.



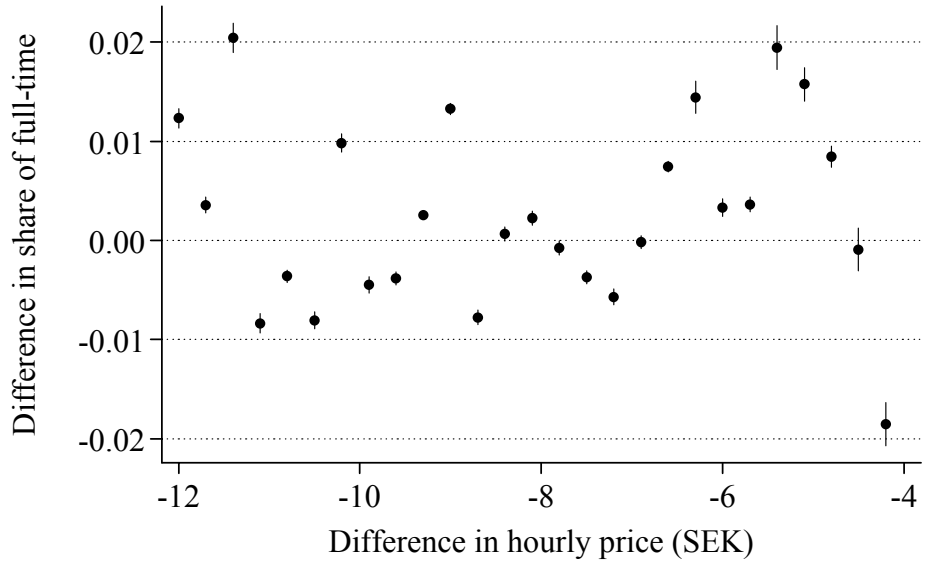
Notes: The figure shows the mean difference in fraction employed by difference in child care price (in SEK 0.1 intervals). Households have been matched with respect to the number and age of the children and household income. The solid lines show the mean +/- 1.96 standard errors.

Figure 13 Average difference in employment 2001–03 by difference in hourly price 2001–03, females



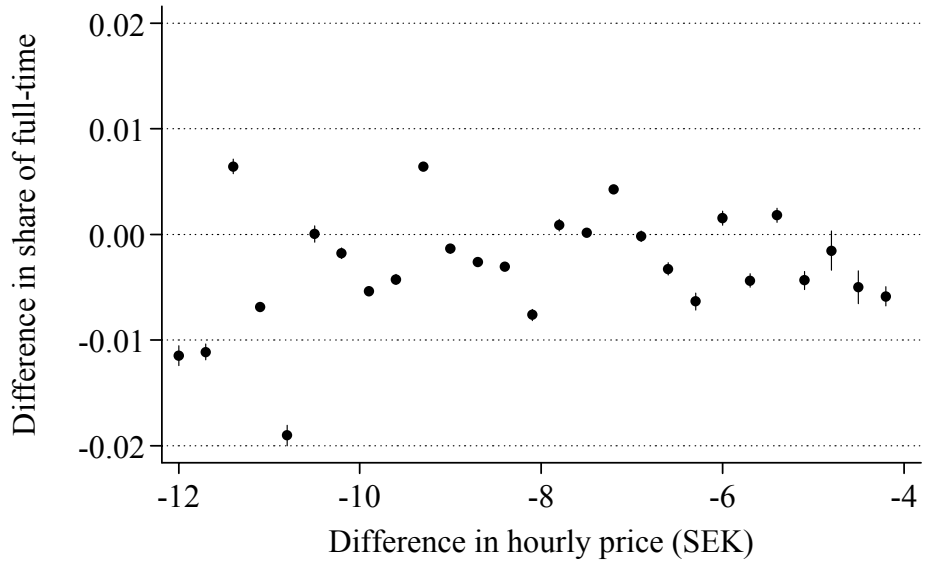
Notes: The figure shows the mean difference in fraction employed by difference in child care price (in SEK 0.1 intervals). Households have been matched with respect to the number and age of the children and household income. The solid lines show the mean +/- 1.96 standard errors.

Figure 14 Average difference in employment 2001–03 by difference in hourly price 2001–03, males



Notes: The figure shows the mean difference in share of full-time by difference in child care price (in SEK 0.3 intervals). Households have been matched with respect to the number and age of the children and household income. The solid lines show the mean +/- 1.96 standard errors.

Figure 15 Average difference in share of full-time 2001–03 by difference in hourly price 2001–03, females



Notes: The figure shows the mean difference in share of full-time by difference in child care price (in SEK 0.3 intervals). Households have been matched with respect to the number and age of the children and household income. The solid lines show the mean +/- 1.96 standard errors.

Figure 16 Average difference in share of full-time 2001–03 by difference in hourly price 2001–03, males

6 Results

Before turning to the difference-in-differences matched regression results, we will present some very raw difference-in-differences estimates using data aggregated at the municipal level. This can be seen as an illustration of our identifying strategy, and the analysis is comparable to studies that exploit between region and time variation only. The idea is to see whether the change in labour supply 2001–03 differs between municipalities that made big or small reductions in the price of child care 2001–03.

The municipality difference-in-differences estimates are presented in

Table 3. We have grouped the municipalities with respect to the average change in the child care price 2001–03, and compared the one-thirds of the municipalities with the biggest and the smallest reduction in the child care prices. In the top panel we calculate the change in child care prices between 2001 and 2003 for the two groups. For example, the hourly price on child care was 10.3 SEK higher in 2001 than in 2003 for the municipalities with the biggest reduction, whereas the reduction was 5.2 SEK in the municipalities with the smallest reduction. The difference-in-differences estimate for child care prices is thus given by the difference of these numbers, i e -0.51 (in 10s SEK).

In panel B/C we calculate the corresponding changes in the fraction of females/males employed. The fraction employed fell for both groups of municipalities between 2001 and 2003. In the municipalities with the biggest price reduction, the fraction females employed was marginally lower in 2003 than in 2001 (it fell from 0.7073 to 0.7055). In the municipalities with the smallest reductions in child care prices, the fraction females employed fell from 0.7019 to 0.6939. The difference-in-differences estimate for female employment is hence 0.0061. The corresponding estimate for males is 0.0037.

Finally, we compare the difference-in-differences estimate for child care prices with the difference-in-differences estimate for fraction employed. This produces the Wald-estimates of the effects of child care prices on employment presented at the bottom of panels B and C. For females we find an estimate of -0.0119, and for males -0.0072. Hence, when child care prices increase 10 SEK the share of females employed decrease with 1.2 percentage units. None of the estimates are however statistically significant from zero. *Table 4* presents the corresponding analysis for the share of full-time. The differences in the price of child care between the groups of municipalities are replicated from *Table 3*. In both municipality groups, the share of full-time increases slightly for women.[30] However, the difference for females in municipalities with the biggest reduction in the price of child care is slightly bigger than for females in the other municipalities. This generates a difference-in-differences estimate of 0.0021. The Wald-estimate of the effect of child care price on the share of full-time is, thus, -0.0041, indicating that an increase with 10 SEK decreases the average

[30] This is contrary to the overall tendency of a lower share of full-time in the entire sample (see *Table 2)*. It is females in the remaining 1/3 of municipalities that is experiencing a slight reduction in the share of full-time.

share of full-time among employed women with 0.4 percentage units. The effect is however not significantly different from zero. For men, the share of full-time falls slightly for both municipality groups. The reduction was, however, somewhat bigger in municipalities with the biggest reduction in child care prices, leading to a difference-in-differences estimate of -0.0064. The corresponding Wald-estimate of the effect of child care price on the share of full-time, is 0.0124, but not significantly different from zero. In all, we are not able to find any significant effects of the changes in the price of child care on female or male labour supply at the municipality level.

Our formal analysis improves on these simple municipality level difference-in-differences estimates in several ways. First, we exploit within-municipality variation in the change of the child care price. We also make use of all municipalities, and not just the 2/3 of the municipalities with the biggest/smallest reduction in the price of child care. Together, this will improve the precision of the estimates significantly. Second, and more importantly, we adjust for differences in household characteristics, by matching households that are similar with respect to the child care price determinants (the number and age of the children and predicted household income in 500s). This will eliminate any bias arising from systematic differences in the composition of family types between municipalities. Third, we control for municipality fixed effects and time fixed effects for each household type. Thus, any time invariant differences in the labour supply of parents in a given household type are adjusted for. Also, any common trend in the labour supply of the parents in a given household type is removed.

Table 3 Municipality level difference-in-differences estimates: Fraction employed

	Reduction in child care price 2001–03 in the municipality		
	1/3 biggest	1/3 smallest	Difference
	Panel A: Hourly child care price (10s SEK)		
Year 2003	0.6730	0.6669	0.0061
	(0.0041)	(0.0043)	(0.0059)
Year 2001	1.7073	1.1870	0.5202
	(0.0199)	(0.0185)	(0.0272)
Difference	-1.0342	-0.5201	-0.5141
	(0.0200)	(0.0185)	(0.0272)
	Panel B: Fraction employed, women		
Year 2003	0.7055	0.6939	0.0116
	(0.0044)	(0.0046)	(0.0064)
Year 2001	0.7073	0.7019	0.0055
	(0.0045)	(0.0048)	(0.0066)
Difference	-0.0018	-0.0080	0.0061
	(0.0023)	(0.0037)	(0.0043)
	Wald estimate of child care price on employment, women		
	-0.0119		
	(0.0083)		
	Panel C: Fraction employed, men		
Year 2003	0.8488	0.8382	0.0106
	(0.0045)	(0.0061)	(0.0076)
Year 2001	0.8528	0.8458	0.0069
	(0.0044)	(0.0062)	(0.0076)
Difference	-0.0040	-0.0077	0.0037
	(0.0016)	(0.0021)	(0.0026)
	Wald estimate of child care price on employment, men		
	-0.0072		
	(0.0051)		

Notes: Heteroscedasticity robust standard errors clustered on municipality within parentheses. The municipalities are grouped based on their average reduction in child care prices 2001–03. The observations are weighted with the number of two-parent households with children in the municipality.

Table 4 Municipality level difference-in-differences estimates: Share of full-time

	Reduction in child care price 2001–03 in the municipality		
	1/3 biggest	1/3 smallest	Difference
	Panel A: Hourly child care price (10s SEK)		
Year 2003	0.6730	0.6669	0.0061
	(0.0041)	(0.0043)	(0.0059)
Year 2001	1.7073	1.1870	0.5202
	(0.0199)	(0.0185)	(0.0272)
Difference	-1.0342	-0.5201	-0.5141
	(0.0200)	(0.0185)	(0.0272)
	Panel B: Share of full-time, women		
Year 2003	0.7935	0.7953	-0.0018
	(0.0046)	(0.0055)	(0.0072)
Year 2001	0.7910	0.7949	0.0039
	(0.0047)	(0.0049)	(0.0068)
Difference	0.0024	0.0004	0.0021
	(0.0039)	(0.0046)	(0.0060)
	Wald estimate of child care price on share of full-time, women		
	-0.0041		
	(0.0113)		
	Panel C: Share of full-time, men		
Year 2003	0.9725	0.9755	-0.0030
	(0.0033)	(0.0016)	(0.0037)
Year 2001	0.9795	0.9762	0.0033
	(0.0016)	(0.0024)	(0.0029)
Difference	-0.0071	-0.0007	-0.0064
	(0.0033)	(0.0026)	(0.0042)
	Wald estimate of child care price on share of full-time, men		
	0.0124		
	(0.0081)		

Notes: Heteroscedasticity robust standard errors clustered on municipality within parentheses. The municipalities are grouped based on their average reduction in child care prices 2001–03. The observations are weighted with the number of two-parent households with children in the municipality.

6.1 Model specification

Let us now turn to the result from the econometric analysis described in section 4. *Table 5* presents the results from a number of different model specifications.

Each estimate comes from a separate regression. In the top panel we present the results for females and in the bottom panel for males. The first estimate shows the effect on the probability to be employed (Employment), and the second estimate shows the effect on how much the individual works given that (s)he is employed (Share of full-time).

In column (1) we estimate a simple OLS model for the full sample, controlling for municipality and time fixed effects only. These naïve estimates show a strong correlation between the price of child care and labour supply, especially for women. As argued above, however, many of the child care price determinants might be directly related to labour supply. Hence, these simple estimates cannot be given a causal interpretation. Therefore, in the rest of the table, we will attempt to control for the direct effects of the child care price determinants.

In column (2) we add simple controls for the household characteristics that are used to calculate the child care prices.[31] This model corresponds to equation (1) in Section 4. Adding the price determinant controls, leads to dramatic changes in the estimated labour supply effects of the price of child care. The estimate for female employment, for instance, is reduced by more than 90 percent. For men, the estimated effect changes sign. The estimates, thus, seem very sensitive for adding controls of the child care price determinants. One might, thus, worry that these simple controls are too restrictive to purge the estimates from any direct effects of the child care price determinants on labour supply. Therefore, we will use the most flexible specification available; fixed effects for all possible combinations of values and variables in the price of child care function. This is analogous to exact matching where we match households that are identical with respect to the child care price determinants, but that experienced different changes in the price of child care due to the reform. Since we are able to find matches for 82 percent of the households only, column (3) re-estimate the model in column (2) with the smaller sample. This leads to minor reductions in some of the estimates, probably since this eliminates some of the more extreme observations.

In column (4) we add the household type fixed effects to the model. Thus, we compare households that are identical with respect to the price determinant

[31] The model includes dummy variables for the number of children, dummy variables for the age of the youngest child, linear controls for the age of the older children and a fifth order polynomial of predicted household income.

variables, in different periods and municipalities. This leads to further reduction in the estimates, especially for female employment. Our preferred specification is presented in column (5), where we also let the household type fixed effects differ by municipality and time. This is the difference-in-differences regression matching estimator, which corresponds to equation (5) in section 4. The estimate is the weighted sum of almost 2,500 difference-in-difference estimates at the household type level. Letting the fixed effects differ by municipality and time, reduces the estimates even further. The estimated effect of child care prices on employment is no longer statistically significant for females, but significant for males (at the ten percent-level). The employment effect for men is, however, relatively modest; 10 SEK increase in child care prices, which corresponds to a doubling of the price, decreases the probability of employment with 0.07 percentage points. The economic significance of the estimate is, thus, low. The estimates price effects for the share of full-time are not statistically significant for either females or males. The reduction in child care prices induced by the reform seems to have had no or very small effects on parents' labour supply. *Table 6* presents the elasticities corresponding to our preferred specification in column (5). All the elasticities are low. The largest (and the only one that is statistically significant) is found for male employment. However, also this one is low; a one percent reduction in child care prices implies a 0.9 percent increase in the probability that a man is employed. The price elasticities with respect to employment are also precisely estimated, and we can rule out that they are higher than 2 percent for either women or men. If we compare these elasticities with the one found in the Canadian study (Baker *et al* 2005), we can conclude that the Canadian estimates are much larger (they find an elasticity for females on 0.24).

Table 5 The effect of hourly child care price on labour supply, different model specifications

	(1)	(2)	(3)	(4)	(5)
			Females		
Employment	-0.1210***	-0.0103***	-0.0068**	-0.0029	-0.0019
	(0.0060)	(0.0030)	(0.0031)	(0.0029)	(0.0044)
Share of full-time	-0.0348***	-0.0007	0.0007	-0.0027	-0.0037
	(0.0030)	(0.0039)	(0.0048)	(0.0021)	(0.0037)
			Males		
Employment	0.0223***	-0.0119***	-0.0095***	-0.0081***	-0.0067*
	(0.0035)	(0.0029)	(0.0028)	(0.0030)	(0.0038)
Share of full-time	-0.0029***	-0.0015	-0.0027	-0.0004	0.0006
	(0.0012)	(0.0026)	(0.0029)	(0.0011)	(0.0019)
Control variables:					
Municipality fixed effects	X	X	X	X	X
Time fixed effects	X	X	X	X	X
Household variables		X	X		
Household type fixed effects				X	X
- Interacted with municipality					X
- Interacted with time					X
Sample:					
All	X	X			
Matched households			X	X	X

Notes: Results from linear probability models. Child care prices are measured in 10s of SEK. Heteroscedasticity robust standard errors clustered on municipality within parentheses. ***, ** and * denote statistical significance at the 1, 5 and 10 percent level, respectively. Household variables include dummy variables for the number of children, dummy variables for the age of the youngest child, linear controls for the age of the older children and a fifth order polynomial of predicted household income. Matched household indicate that only household types that appear in both time periods and in at least two municipalities are included.

Table 6 Price of child care elasticities

	Females	Males
Employment	-0.0030	-0.0086*
	(0.0069)	(0.0049)
Share of full-time	-0.0049	0.0007
	(0.0049)	(0.0021)

Notes: Heteroscedasticity robust standard errors clustered on municipality within parentheses. * denote statistical significance at the 10 percent level.

Next, we turn to some sensitivity analysis, and thereafter, we investigate whether the effects are heterogeneous with respect to age of youngest child, education, origin and predicted income.

6.2 Sensitivity analysis

Table 7 investigates the sensitivity of the baseline results in column (5). Column (1) in *Table 7* reproduces these results. In column (2) we also include municipality specific time trends. This is typically not possible in a difference-in-differences setting. However, since we have within-municipality variation in the price of child care, we can control for the average change in the labour supply in all municipalities. The estimates are relatively robust with respect to this modification. The only change is that the estimate for male employment increases from 0.0067 to 0.0085 and is now statistically significant at the five-percent level. This means that the statistically significant effect that we found for males in the baseline model was not driven by differences in municipality trends.

In column (3) the baseline model is extended to include a number of individual variables (the individual's predicted wage, spouse's predicted wage, age, dummy variables for educational level and dummy variables for country of birth). These variables do not enter the price-function, but are typically included in standard labour supply models. We argue in section 4 that given that we can match households based on all factors that affect the price, and also control for these factors in a flexible way, we need not to worry about the inclusion of other covariates. With this in mind, the result from column (3) looks

very reassuring, since there are only slight changes in the point estimates (and slightly smaller standard errors).

So far we have estimated the models for two parents-households. Doing this, we exclude a number of households from the sample. Does this matter? In column (4) we investigate what happens if we also include single parent households in the sample. It turns out that the point estimates remain more or less identical to column (1), and so do the standard errors. Hence, focusing on two parent-households does not seem to restrict the analysis, and we will keep this focus in the rest of the paper. We will, thus, continue to use the model in column (1) as our preferred specification.

Table 7 DD regression matching estimates – sensitivity analysis

	(1)	(2)	(3)	(4)
			Females	
Employment	-0.0019	0.0004	-0.0005	0.0004
	(0.0044)	(0.0070)	(0.0042)	(0.0042)
Share of full-time	-0.0037	-0.0027	-0.0040	-0.0044
	(0.0037)	(0.0055)	(0.0035)	(0.0035)
			Males	
Employment	-0.0067*	-0.0085**	-0.0063*	-0.0071*
	(0.0038)	(0.0042)	(0.0036)	(0.0038)
Share of full-time	0.0006	0.0009	0.0008	0.0004
	(0.0019)	(0.0029)	(0.0019)	(0.0019)
Control variables:				
- municipality specific trends		X		
- individual characteristics			X	
Sample:				
- Two parents households	X	X	X	X
- Single parent households				X

Notes: Results from linear probability models. Child care prices are measured in 10s of SEK. Heteroscedasticity robust standard errors clustered on municipality within parentheses. * denote statistical significance at the 10 percent level. The models control for municipality and time specific fixed effects for each household type. Individual characteristics include predicted wage, spouse's predicted wage, age, educational level, country of birth.

It is not obvious how to best specify the price of child care in the model. Above, we have estimated linear effects of the hourly price. There are however alternative measures that might be more informative. In *Table 8* (females) and *Table 9* (males) below we elaborate with different specifications. Column (1) reproduces the result from the baseline model. Column (2) adds hourly prices squared, to see whether the labour supply effect is non-linear in prices. The effect for females remains insignificant whereas for males, the effect now becomes insignificant. Column (3) uses log-prices. These do not have any significant effect on labour supply, neither for females nor for males. One of the effects of the price-cap-reform was that many municipalities choose to give up their part-time prices and instead charged parents the same price regardless of the number of hours used. Trying to take this aspect of the reform into consideration, column (4) controls for hourly price for the first 20 hours as well as for the next 20 hours. Both these measures enter insignificantly. Hence, when specifying price differently, the results for females show no action, none of the estimates are significantly different from zero. For males, on the other hand, it is only the linear specification that is significant from zero. When the price is specified any other way, the effect of the price of child care on male labour supply is no longer statistically significant. In the rest of the paper, we will, nevertheless, continue to use a linear specification, since it is simple and yields precise estimates.

Table 8 DD regression matching estimates of the effect of hourly child care price on labour supply, different price measures, females.

	(1)	(2)	(3)	(4)
		Employment		
Hourly price, 1–40 hours	-0.0019	0.0133		
	(0.0044)	(0.0112)		
(Hourly price, 1–40 hours)^2		-0.0046		
		(0.0035)		
ln(Hourly price, 1–40 hours)			0.0058	
			(0.0473)	
Hourly price, 1–20 hours				0.0009
				(0.0041)
Hourly price, 21–40 hours				-0.0013
				(0.0024)
		Share of full-time		
Hourly price, 1–40 hours	-0.0037	-0.0094		
	(0.0037)	(0.0088)		
(Hourly price, 1–40 hours)^2		0.0017		
		(0.0028)		
ln(Hourly price, 1–40 hours)			-0.0524	
			(0.0384)	
Hourly price, 1–20 hours				0.0009
				(0.0032)
Hourly price, 21–40 hours				-0.0025
				(0.0022)

Notes: Results from linear probability models. Child care price are measured in 10s of SEK. Heteroscedasticity robust standard errors clustered on municipality within parentheses. The model controls for municipality and time specific fixed effects for each household type.

Table 9 DD regression matching estimates of the effect of hourly child care price on labour supply, different price measures, males.

	(1)	(2)	(3)	(4)
		Employment		
Hourly price, 1–40 hours	-0.0067*	-0.0088		
	(0.0038)	(0.0097)		
(Hourly price, 1–40 hours)^2		0.0006		
		(0.0033)		
ln(Hourly price, 1–40 hours)			-0.0542	
			(0.0377)	
Hourly price, 1–20 hours				-0.0033
				(0.0038)
Hourly price, 21–40 hours				-0.0034
				(0.0022)
		Share of full-time		
Hourly price, 1–40 hours	0.0006	0.0028		
	(0.0019)	(0.0060)		
(Hourly price, 1–40 hours)^2		-0.0006		
		(0.0016)		
ln(Hourly price, 1–40 hours)			0.0158	
			(0.0249)	
Hourly price, 1–20 hours				-0.0003
				(0.0017)
Hourly price, 21–40 hours				0.0004
				(0.0010)

Notes: Results from linear probability models. Child care price are measured in 10s of SEK. Heteroscedasticity robust standard errors clustered on municipality within parentheses. * denote statistical significance at the 10 percent level. The model controls for municipality and time specific fixed effects for each household type.

6.3 Heterogeneous effects

Next, we will study whether the effects are heterogeneous with respect to the age of the youngest child, education, origin and predicted income. First, we di-

vide the sample according to the age of the households' youngest child and re-estimate our model. Results from these estimations are given in *Table 10* where the first column restates the baseline estimates from column (5) in *Table 5.* Column (2) presents the results for households with the youngest child aged 1–3, column (3) for households with youngest child aged 4–5, and the last column for households with the youngest child aged 6–9.[32] We find that some of the estimates vary somewhat. For example, there is a negative statistically significant price effect on the share of full-time for females with the youngest child aged 6–9 years. For these women, an increase in child care prices with 10 SEK decreases the share of fulltime with 1.15 percentage points. The effect is also significantly lower than for females in households with the youngest child being 4–5 years (but not for households with even younger children). The effect for male employment is primarily driven by males with the youngest child aged 4–5 year. However, this effect is not statistically different from the effects for males with the youngest child in other age intervals.[33]

[32] The reason for dividing the age groups this way is that it follows the price-structure; children aged 4–5 are entitled to 15 hours free of charge pre-school in 2003, and children older than 6 attend out of school care only.

[33] We have also estimated the models for households with only one child. These estimations bring nothing new to the picture and have therefore been excluded from the text. They are, however, available upon request.

Table 10 DD regression matching estimates of the effect of hourly child care price on labour supply by age of youngest child

	Age of youngest child:			
	1–9 years	1–3 years	4–5 years	6–9 years
			Females	
Employment	-0.0019	0.0003	-0.0023	-0.0049
	(0.0044)	(0.0070)	(0.0084)	(0.0056)
Share of full-time	-0.0037	-0.0018	0.0032	-0.0115**
	(0.0037)	(0.0063)	(0.0070)	(0.0045)
			Males	
Employment	-0.0067*	-0.0052	-0.0140*	-0.0046
	(0.0038)	(0.0075)	(0.0077)	(0.0050)
Share of full-time	0.0006	0.0002	-0.0006	0.0023
	(0.0019)	(0.0027)	(0.0041)	(0.0037)

Notes: Results from linear probability models. Child care prices are measured in 10s of SEK. Heteroscedasticity robust standard errors clustered on municipality within parentheses. ** and * denote statistical significance at the 5 and 10 percent level, respectively. The model controls for municipality and time specific fixed effects for each household type.

Next, *Table 11* investigates whether the effect of child care prices depends on educational level or country of birth? Again, the only statistically significant effect is found for male employment. It seems like the negative labour supply effect for men is entirely driven by highly educated fathers. This effect is also significantly higher than the effect for low educated men at the 10% level of confidence. Still, the economic significance of the effects is small; a doubling of the child care price decreases employment among high educated fathers with 1.4 percentage points. When it comes to the labour supply effects for parents of different origin, there are not significant differences between native parents and parents born abroad.

Table 11 DD regression matching estimates of the effect of hourly child care price on female labour supply, by education and origin

	Low education	High education	Born in Sweden	Born abroad
		Females		
Employment	0.0119	-0.0046	-0.0035	0.0084
	(0.0085)	(0.0054)	(0.0047)	(0.0139)
Share of full-time	-0.0150	-0.0022	-0.0029	0.0117
	(0.0102)	(0.0033)	(0.0038)	(0.0143)
		Males		
Employment	0.0007	-0.0136**	-0.0071*	0.0128
	(0.0046)	(0.0057)	(0.0039)	(0.0150)
Share of full-time	0.0006	0.0029	-0.0002	0.0135
	(0.0030)	(0.0026)	(0.0019)	(0.0109)

Notes: Results from linear probability models. Child care prices are measured in 10s of SEK. Heteroscedasticity robust standard errors clustered on municipality within parentheses. ** and * denote statistical significance at the 5 and 10 percent level, respectively. The model controls for municipality and time specific fixed effects for each household type . Low education corresponds to less than three years of secondary schooling and high education to three years of secondary schooling or more.

Finally, *Table 12* investigates whether the effects are heterogeneous with respect to predicted household income, own predicted wage or spouse's predicted wage. One odd result appears for mothers with own predicted wage below the median; a price increase is associated with higher employment. Given the number of estimates that we have presented, we would, however, expect that one out of ten estimates would be significantly at the 10 percent level just by random. Thus, we do not interpret this as a causal effect of the price of child care. For male employment, on the other hand, a systematic pattern emerges. The negative effect of child care prices on employment, seems to be driven by high-skill households, and is largest for males living together with a high-skilled woman, for which an increase with 10 SEK implies a 1.3 percentage points decrease in share of employed. Still, the effects are of small economic significance.

Table 12 DD regression matching estimates of the effect of hourly child care price on female labour supply, by predicted income levels

	Predicted household income		Own predicted wage		Spouse's predicted wage	
	< median	≥ median	< median	≥ median	< median	≥ median
			Females			
Employment	0.0058	-0.0052	0.0155*	-0.0091	0.0024	-0.0097
	(0.0093)	(0.0047)	(0.0083)	(0.0058)	(0.0058)	(0.0058)
Share of full-time	-0.0237*	-0.0018	-0.0091	-0.0019	-0.0123	0.0019
	(0.0135)	(0.0036)	(0.0099)	(0.0036)	(0.0078)	(0.0036)
			Males			
Employment	-0.0006	-0.0096**	-0.0034	-0.0079*	0.0053	-0.0134***
	(0.0063)	(0.0043)	(0.0050)	(0.0046)	(0.0056)	(0.0045)
Share of full-time	-0.0012	0.0007	0.0024	0.0002	0.0000	0.0019
	(0.0086)	(0.0019)	(0.0040)	(0.0019)	(0.0041)	(0.0025)

Notes: Results from linear probability models. Child care prices are measured in 10s of SEK. Heteroscedasticity robust standard errors clustered on municipality within parentheses. ***, ** and * denote statistical significance at the 1, 5 and 10 percent level, respectively. The model controls for municipality and time specific fixed effects for each household type.

7 Conclusions

This paper analyzes the effects of a Swedish child care reform that set a cap on the price that municipalities were allowed to charge parents. Using a difference-in-differences matching regression approach, we compare individuals who are identical with respect to all covariates that affect child care prices, but live in different municipalities. Thereby, they face rather different changes in prices. The estimated effects of child care prices on labour supply are mostly statistically insignificant, and in those cases that they are statistically significant their economic importance is small. Our results are consistent with the result in Wikström (2007) that show that the attendance among children with working parents has not much changed through the 2002-reform.

Our results differ from earlier studies that have relied on natural experiments in, e g, Canada, US, Israel and Argentina. This is perhaps not surprising, since subsidized child care did not exist in most of these countries before the

reforms, whereas highly subsidized child care existed in Sweden already before the reform took place. We interpret our results as dependent of the institutional setting. In countries with a well-developed and highly subsidized child care system, further reductions in the price of child care have small effects on both female and male labour supply. Also, this paper improves the empirical approach used in the earlier studies. Most importantly, since we know and observe the variables that determine prices, we are able to compare household that are identical with respect to these characteristics.

The weak negative employment effect for – in particular high skilled – men is puzzling. The result is, however, stable with respect to model specification, for example the inclusion of municipality specific trends, and to different definitions of household types. We have no reasonable explanation for this effect. However, the municipality level difference-in-differences estimates indicates that the effect is driven by the fact that men in municipalities with the biggest reductions in the price of child care experienced a smaller reduction in the fraction employed than men living in other municipalities. Also, finding effects for males are perhaps not as surprising in Sweden, where fathers can, and actually do, share the responsibility for taking care of the children.

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