Partnered women's labour supply and child care costs in Australia: measurement error and the child care price

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Abstract

We show that measurement error in the constructed price of child care can explain why previous Australian studies have found partnered women's labour supply to be unresponsive to child care prices. Through improved data and improved construction of the child care price variable, we find child care price elasticities that are statistically significant, negative and in line with elasticities found in other developed countries.

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1 Introduction

The purpose of this paper is to examine the responsiveness of partnered[1] women's labour supply to the price of child care in Australia. We show that the way in which child care prices are constructed can have very large impacts on findings, which is an important methodological point for researchers studying the effects of child care prices in any context. We find, in contrast with previous studies of Australia, that partnered women decrease their labour supply in response to an increase in the price of child care. We show that measurement error in the construction of the child care price is the main factor which explains the difference between our findings and previous Australian studies.

Four recent studies in Australia have found that the child care price elasticity of labour supply of partnered women is very small and generally not statistically different from zero. Doiron and Kalb (2005) and Kalb and Lee (2008) find that work hours for partnered women decrease by .02 per cent in response to a one per cent increase in child care prices. Rammohan and Whelan (2005) find slightly larger, but statistically insignificant elasticities while Rammohan and Whelan (2007) find no effect of child care price on the choice between part-time and full-time work. These results have produced a consensus that partnered mothers' labour supply is not responsive, on average, to the cost of child care in Australia.

As we discuss in section 2.2 below, studies of women's labour supply response to changes in child care price have often had to deal with incomplete information about hours spent in child care or costs of child care. This has led researchers to construct approximate child care price measures which potentially suffer from measurement error. In this paper, we will show the degree to which this measurement error can influence results, focusing on the case of Australia.

The Rammohan and Whelan studies have followed Connelly (1992) in calculating child care price as the ratio of total child care costs divided by mother's hours worked. This measure is then used to estimate a child care price equation from which family-specific prices are predicted and included in a labour supply or participation model.

This measure of the child care price suffers from two problems.

- If the total child care costs in the data reflect child care used both for times during

[1] Throughout we use 'partnered' to refer to women who are either married or in a de facto relationship.

which the mother is working and times for which the mother is not working, the constructed price will tend to overstate the hourly child care price.[2]

- This price ignores the heterogeneity of child care. Full-time day care for a one-year-old and after-school care for an eight-year-old are not the same good nor do they have the same price.

Using newly available, more detailed data on child-specific hours spent in child care, we are able to construct a more accurate child care price for each child. We use these child-level prices to construct local area average prices for three different age groups of children: 0-2 year-olds, 3-4 year-olds, and 5-13 year-olds. Child care price for each of these age groups is allowed to enter separately into women's labour supply decisions. Through this process, we eliminate the two main sources of measurement error discussed above. Most importantly, the estimated elasticity of women's labour supply responsiveness to the price of child care of -0.29 which results from using this improved price is statistically significant, near the mean of what has been found in other OECD countries, and strikes us as much more economically plausible than the previous estimate of zero.

To further demonstrate that our results are driven by construction of the price variable, we also compare our method of constructing the price with that used in the previous studies. When we use total child care costs divided by mother's hours worked, we find very small and statistically insignificant elasticity estimates.

In the rest of the paper, we present a joint model of partnered women's labour supply and household child care demand in section 2. We discuss modeling options in 2.1 and methodological issues relating to price, quality, and informal care in 2.2, both in the context of our model and the international literature. We finish with a brief discussion of the Australian child care context. We discuss our data in section 3 and specifically our construction of the child care price in section 3.3. We present our results in section 4 and conclude in the final section.

[2]Some studies, such as Connelly (1992), use hours of child care specifically for working purposes, but other studies and some data sets do not make this distinction.

2 Model

We begin by presenting a model of women's labour supply and child care demand. In the context of this model, we discuss the relevant literature in section 2.1, focusing on the different modeling assumptions which have been made in previous work. In section 2.2 we discuss four important data and methodological issues, again with reference to this model and approaches that have been taken in the previous literature on the effect of child care prices on women's labour supply. We finish in section 2.3 with a discussion of child care in Australia with attention to the government subsidy system which constitutes an important part of the model.

We model the joint household decision regarding mother's labour supply and hours of formal child care demanded for each child. We treat the husband's working hours, leisure, and time taking care of children as fixed. While this is somewhat restrictive, it still provides a good approximation of the Australian situation. Women undertake the vast majority of at-home care of children and women's labour supply in general is much more responsive to the presence or absence of children in the household than men's labour supply.

The household with K children and characteristics X is assumed to maximize utility

$$U\left(y, l_m, c_m^1, \ldots, c_m^K, X\right) \tag{1}$$

by choosing consumption, y, mother's leisure, l_m, and parental child care by the mother, c_m^k for each child. We assume that mothers can care for more than one child at a time and the total length of time that mothers spend on parental child care, c_m, is thus the same as the longest of the hours spent on any one child, $c_m = \text{Max}\left(c_m^1, \ldots, c_m^K\right)$. Mother's leisure is defined as the difference between total waking hours, T, and time spent working, h_m, or taking care of children such that $l_m = T - h_m - c_m$. Children need to be taken care of during all waking hours, T_k^*. Parental child care is the difference between total hours and non-parental child care, c^k. Thus, for each child k, $c_m^k + c_f^k = T_k^* - c^k$ where c_f^k is time where the father is taking care of the child. Since we treat c_f^k as fixed, we can normalize the model by combining the two constant terms $T_k = T_k^* - c_f^k$ so the time constraint for child care becomes $T_k = c_m^k + c^k$. (This equation, in words, means: during waking hours, when the child is not being cared for by the father, the child must either

be cared for by the mother or placed in non-parental child care.)

The family is also subject to a budget constraint which is affected by the tax and welfare system and the child care subsidy system. Post-tax income (from mother's wages, w, and other income, y_0, which includes non-labour income and father's wage income) must be greater than consumption plus expenditure on child care, which is determined by the child care price, p^k, which may differ for each child k. This provides

$$y \leq \tau\left(y_0 + w\left(T - l_m - c_m\right), X\right) - \nu\left(\sum_{k=1}^{K} p^k\left(T_k - c_m^k\right), X\right) \tag{2}$$

where τ and ν capture the rules of the tax and transfer and child care subsidy systems. These may depend upon family characteristics as well as upon total income and child care expenditure. The household's problem is to choose total consumption, mother's hours worked, and hours of paid child care for each child to maximize (1) subject to (2).

Labour supply and child care demand of the household will be governed by the first-order conditions of that maximization problem, specifically the K equations

$$\frac{U_{l_m}}{U_y} = \frac{U_{c_m^k}}{U_y} - \nu' p^k = \tau' w, \;\; k = 1, \ldots, K \tag{3}$$

where $U_s, \; s = y, l_m, c_m^k$ are marginal utilities with respect to its argument, $\nu' p^k$ is the marginal child care costs for an additional hour of child care taking into account the child care benefit system and $\tau' w$ is the marginal, after tax income for an additional hour of work taking into account the tax and transfer system.

The optimal labour supply and child care demand for each child k can be derived from these first-order conditions and can be written as

$$h^* = h\left(y_0, w, p^1, \ldots, p^k, X\right) \tag{4}$$

$$c^{k*} = c^k\left(y_0, w, p^1, \ldots, p^k, X, Q_i\right) \tag{5}$$

where Q_i are child-specific characteristics for the i-th child. Equation (5) provides K child care demand functions all of which depend upon all of the child care prices.

2.1 Modeling options and previous literature

If child care is ignored as an argument of the utility function, the terms $\frac{U_{c_m^k}}{U_y} - \nu' p^k$ will be absent and the marginal utilities in (3) and the resulting labour supply equation (4) will be mis-specified. This approach, treating child care only as an expense to free up

time for parents to work, might be called the 'costs of working' approach. Child care is ignored as a choice variable and the price of child care is included only in X.

Several papers follow this 'cost of working' approach. Averett, Peters and Waldman (1997) estimate labour supply for married mothers using the National Longitudinal Surveys of Youth; Blundell, Duncan, McCrae and Meghir (2000) conduct simulations based upon a labour supply model estimated from data from the Family Resources Survey (1994-1996); in Australia, Doiron and Kalb (2005) and Kalb and Lee (2008) use data from the Australian Bureau of Statistics Survey of Income and Housing Costs and data from the Household Income and Labour Dynamics in Australia (HILDA) survey. Results from these studies vary, with Averett et al. (1997) reporting a very large participation elasticity (-0.78) but Doiron and Kalb (2005) and Kalb and Lee (2008) finding elasticities for both hours and participation of zero for married women and small hours (-0.16) and participation (-0.09) elasticities for lone parents. (Blundell et al. (2000) do not report any elasticities.)

In models which attempt to account for both factors, labour supply and child care demand are chosen simultaneously. Most studies have taken this 'simultaneous approach'. One option is to take the 'direct approach' of explicitly specifying a form for the utility function (1), and the budget constraint (2). Estimates of the preference parameters (which determine utility) are then used to obtain the optimal labour supply and child care demand equations (equations (4) and (5)) either by tangency rules or, more commonly, by simulation. The advantage of this approach is that it makes policy evaluation possible in complicated environments (where τ and ν are highly non-linear). The disadvantage is that it relies upon untestable hypotheses about the form of the utility function. In some cases, mis-specification of the utility function may be innocuous, whereas in others it may produce mis-leading results.

Papers which have taken this direct, simultaneous approach include Heckman (1974a), Blau and Robins (1988), Michalopoulos, Robins and Garfinkel (1992), Ribar (1995) and Blau and Hagy (1998) for the U.S.; Powell (2002) for Canada; Andren (2003) for Sweden; Kornstad and Thoresen (2007) for Norway; and Wrohlich (2006) for Germany. These studies find participation elasticities ranging from 0 for single mothers in Sweden to -0.38 for married women in the U.S. (Blau and Robins (1988)). The average participation

elasticity is around -0.14 across the seven studies which report a participation elasticity. Only Andren (2003), Kornstad and Thoresen (2007) and Wrohlich (2006) report hours elasticities and these are higher than the participation elasticities. Participation elasticities for these three studies average -0.06 whereas the hours elasticities average -0.16.

The 'indirect approach' uses equations (4) and (5) as the starting point and specifies reduced forms for these equations which are then estimated. The main advantage of this approach is that it addresses the problem in a simple and straightforward way. The main drawback of this approach is that estimates are only valid in relatively simple tax and welfare systems or if the sample is homogeneous in terms of tax rates and welfare system rules which households face. Because it ignores the complexity of the tax and welfare systems, it is impossible to recover net price elasticities directly from these models without further information or assumptions regarding the relationship between net and gross price elasticities.

Table 1
Summary of elasticity estimates from literature

	Elasticity of participation			Elasticity of hours worked		
	Average (Range)	Number of zeros	Number of studies	Average (Range)	Number of zeros	Number of studies
Married Mothers						
International	-0.34 (-0.92,-0.04)	0	10	-0.34 (-0.74,-0.12)	0	4
Australian	-0.01 (-0.02,0)	2	3	-0.01 (-0.02,0)	2	3
All	-0.27 (-0.92,0)	2	13	-0.20 (-0.74,0)	1	7
Single Mothers						
International	-0.29 (-0.58,0)	1	4	-0.16	0	1
Australian	-0.12 (-0.19,-0.05)	0	2	-0.11 (-0.16,-0.05)	0	2
All	-0.23 (-0.58,0)	1	6	-0.12 (-0.16,-0.05)	0	3

Table reproduced from Gong, Breunig and King (2010)

Papers which have adopted the 'indirect' approach include Connelly (1992), Ribar (1992), Kimmel (1998), Anderson and Levine (1999) for the U.S.; Powell (1997) for Canada; and (Rammohan and Whelan, 2005, 2007) for Australia. Participation and hours elasticities from the non-Australian studies average -0.34. The two Australian

studies find zero participation elasticities and small and insignificant hours elasticities.

In addition to varying in methodological approach, sample restrictions vary widely across the studies, some studies use married women, others single women, and others a mix of the two. In general, with the exception of the Australian studies, there does seem to be evidence of significant, negative effects of child care price on female labour supply. In a working paper, we undertook a comprehensive review of recent studies. We reproduce Table 1 from that working paper here. Blau and Currie (2006) have also recently reviewed the international literature.

2.2 Data and methodological issues

The two data issues mentioned earlier–the absence of hourly child care price data and the heterogeneity of child care–and dealing with unobservable child care quality and the presence of informal (usually unpaid) child care constitute important challenges for the applied researcher. We discuss these general data and methodological issues and conclude this sub-section with a discussion of some additional, specific issues which arise in the Australian literature.

There is a general lack of information about child care prices and usage in survey data. Lack of proper child care information forces researchers to construct various measures of price. Without observing any child care price directly, Heckman (1974b) normalises the price of formal child care to 1 and 'estimates' the price of informal child care (relative to formal care) using demographic variables and an interesting array of identifying assumptions. Connelly (1992) only has child care costs for households where the mother is working and no information on child care hours. She constructs the 'child care price' by dividing child care costs by hours worked of the mother. This approach is followed by several studies including (Rammohan and Whelan, 2005, 2007) for Australia. However, this measure cannot be reasonably construed as the 'child care price' because it varies with hours worked even if the true child care price is constant. Powell (1997) only has access to data about work-related child care and constructs a price similarly. With the exception of Blau and Hagy (1998), Doiron and Kalb (2005) and Kalb and Lee (2008) (which use external data sources for prices) all of the studies mentioned in section 2.1 have to predict the 'price' for non child care users using information from

the users of child care.

A second issue is that in most studies households are assumed to face a single 'price' for all types of child care for children of all ages. In many studies this price is constructed by dividing total child care costs by total child care hours, aggregating over children from very different age groups. The implied assumption is that child care for different children in the household is a homogeneous good and can be represented using a single price. If true prices are different for each child, each price should have its own effect on the mother's labour supply. It is also important to note that the 'price' constructed as the average hourly cost in the household is different from the average hourly price. It is the latter which should enter into the households' decision-making process. Treating the average hourly cost as a 'price' is erroneous and causes biased estimates when households have more than one child. The consequences may be less pronounced for more homogenous samples–for example considering a sub-sample of only pre-school children, as in Blau and Hagy (1998).

A third issue, and undoubtedly an important one from the families' point of view, is that of the heterogeneous quality of child care. Arguably, the household chooses not only hours of child care but also quality of child care. Since child care quality is unobserved, but correlated with price, an omitted variable problem is created which may lead to biased estimators. Taking quality into account, and having adequate data on quality, are demanding tasks and Blau and Robins (1988) and Blau and Hagy (1998) are the only studies to model it to a satisfactory degree.[3] They use a 'quality-adjusted' price at the local market level predicted from additional data on child care providers.

Fourthly, an important feature of the child care market is the existence of informal child care which provides an (imperfect) substitute for formal care. Although the focus in most studies is on formal child care, the treatment of informal child care in modelling may also be expected to impact the results. In some studies such as Connelly (1992) informal care is ignored, while in other studies it is modeled explicitly, such as Heckman (1974b), and Blau and Robins (1988) and Blau and Hagy (1998).

The Australian studies suffer from additional data and modeling limitations. (Ram-

[3]Mocan (2007) shows that although consumers attach high importance to child care quality, they often fail to get the right perception of child care quality because of information asymmetry. In particular, child care providers are informed about the level of quality of their services, but the parents have difficulty in distinguishing between the quality levels of alternative centers.

mohan and Whelan, 2005, 2007) use a sample of 1138 married women where only about 190 paid for child care. In addition, the child care costs used in the analysis are the costs 'net' of government subsidies, which are partly determined by the labour supply of the parents. Doiron and Kalb (2005) and Kalb and Lee (2008) use average state-level prices (from the administrative Child Care Census data described in section 3.3 below) which fail to capture the bulk of price variation which is within-state, not across state. Hence it is not surprising that the estimates they report have very low precision. Another issue in these two studies is that child care usage is first predicted conditional on observed labour supply. Household labour supply is then simulated from a model where households maximise their utility subject to a budget constraint from which these predicted child care costs are subtracted.

2.3 The Australian context

In our paper, we focus on modeling demand for formal child care. Formal child care consists of three types of care: Long Day Care centres; Family Day Care; and In-Home Care. 'Long Day Care' refers to centre-based care and preschool programs primarily for not-yet-in-school-aged children (with the exception of school holiday programs). Long Day Care centres have relatively skilled staff and those that provide preschool programs have at least one trained teacher on staff. About two-thirds of Long Day Care centres are run by private operators while the remaining centres are run by local government or community organizations. About one-third of not-yet-in-school-aged Australian children in care are in long day care centres.[4]

Fifteen percent of not-yet-in-school-aged children are in some form of formal home-based care. 'In-Home Care' involves registered carers who come to the child's own home whereas 'Family Day Care' refers to registered carers who take care of several children in their own home. Home-based carers often have a mix of pre-school and before- and after-school care for school-aged children. Many public and private schools also offer before- and after-school care which also qualifies for the subsidies described below.

Just over one-third of children are in informal care which consists of relatives or unregulated caregivers. Some informal care is paid for directly, while other forms of informal care may not be paid for or may carry non-pecuniary costs. The official data

[4]See Department of Education, Employment and Workplace Relations (2008).

give us little insight into this part of the child care market. We do not model demand for informal care, but include variables in the model for formal child care which are related to the presence or absence of informal care options.

Both home-based care and long day care centres are inspected and accredited by the Australian government. Accreditation allows parents access to the government subsidy program for child care and very few centres are not accredited. The primary subsidy is Child Care Benefit (CCB), a means-tested program which reduces the hourly cost of child care. Benefits are paid either to families or directly to the child care provider. The current maximum subsidy is $3.68 per hour and this decreases with family income. CCB is not paid to families with one child in care who make over $134,443 per annum. This cut-off is slightly higher for families with more children. (See **?**.)

Child Care Rebate (CCR), which is not means-tested, is a tax rebate which can be claimed by families with children in accredited care. The maximum claimable tax rebate is $7,500 per child per year. CCR is a relatively new program which was announced at the beginning of our sample period (see discussion in section 3 below).

Child-care providers can set their own fees. Entry into the child care provision market is free and open as evidenced by the rapid growth of privately-provided child care places in the last 10 years, thus lack of availability is probably not as severe as in Europe. For example, Wrohlich (2006) states that in 2002, there were only 3 slots in child care centers for every 100 children under three in former West Germany. In Australia, although availability of child care makes headlines, about one third of children under three use center-based care and if children using family day care (where children are in care at a licensed carer's home, excluding relatives) are included, about half of children under three are in formal child care (based upon the authors' calculation using our data and the government child care census).[5]

3 Data

Data used for the main analysis are drawn from waves five, six, and seven of the 'in-confidence' version of the Household, Income and Labour Dynamics in Australia Survey (HILDA) which cover the period 2005 - 2007. The HILDA Survey is an annual panel

[5]Breunig, Gong, Mercante, Weiss and Yamauchi (2011) examine the relationship between local problems with reported child care availability and women's labour supply.

survey of Australian households which was begun in 2001.[6] There are approximately 7,000 households and 13,000 individuals who respond in each wave. The choice of data is based upon the following three considerations. First, and most importantly, the HILDA data from wave five onwards collected child care usage data separately by child and separately for employment and non-employment related reasons. In the first four waves, data was more aggregated within the household. Secondly, we choose to pool across three waves of data to achieve a sufficiently large sample size. This is important in the construction of our local average child care price. We use median child care prices within Labour Force Survey Regions (LFSR) as defined by the Australian Bureau of Statistics (ABS).[7] In order to construct this local average price we need a reasonable number of observations in each LFSR. Pooling across these three waves achieves sufficient sample size to estimate a median for each LFSR. Lastly, child care policies in Australia were roughly constant over this period. In particular, there were no major changes to the Child Care Benefit scheme during this period. The Child Care Tax Rebate (CCTR), now called Child Care Rebate, was announced at the beginning of the sample period. However, the way in which the rebate was originally structured through the tax system meant that families did not receive the rebate, in the form of a lump sum payment, until two years after making the expense. Given this time lag and the lump-sum nature of the payment, we assume that this program did not affect people's decisions during our sample period. This assumption seems confirmed in the data–see footnote 13. A final consideration which favours this choice of sample period is that the Australian Bureau of Statistics (ABS) created a child care price index, which we use to make the price comparable across waves. This index is only available from 2005.[8]

We focus on the labour supply of partnered mothers and demand for formal child care of children under age 13. We eliminate mothers who are retired or who are full-time students. After discarding observations with missing values for any variables used in our model, we are left with a sample of 4,184 mothers and their 7,682 children across the

[6] See Watson and Wooden (2002) for more details.

[7] Labour Force Survey Regions are described in Australian Bureau of Statistics (2005).

[8] A net child care price index has been available since the 1980s. The gross child care price index required here has only been available since 2005. See "Child Care Time Series Table" in "Appendix Child Care Services in the CPI. Treatment of Child Care Services in the Australian Consumer Price Index (CPI)" in Australian Bureau of Statistics (2010).

three waves from 2005 to 2007.[9]

For validation of our results and for comparison with earlier Australian studies, we also use data from waves two, three and four (2002 through 2004) of the 'in-confidence' version of HILDA. Child care data for this period are less detailed; in particular non-employment related child care usage is aggregated within each household for two age groups: not-yet-in-school and school-aged children. For the wave two through four data, we thus only select households with at most one child in each age group. This allows us to match employment and non-employment related child care usages and costs to particular children for comparability with the main sample from waves five to seven. This results in a smaller sample of 2,111 mothers and 2,661 children.

Another issue with the data from 2002 to 2004 is that, since the ABS Gross Child Care Price Index is not available for this period, we use the Consumer Price Index (CPI) as the child care price deflator. This is likely to contribute to measurement error in the child care price variable in the pooled data. The child care policy environment is also a little different in this earlier period compared with the later period. The most important difference is that the Child Care Tax Rebate had not yet been announced in this period. These data issues need to be kept in mind when comparing the results from the two samples. We return to these points in our discussion.

3.1 Labour supply, wage and non-labour income

In this section, we discuss the key variables used in the analysis such as labour supply, wages, and child care usage and costs. A number of demographic variables describing family's and children's characteristics are included in the model; we also include variables such as immigration status and the presence of additional female adults in the household to proxy the availability and the shadow price of informal child care. Sample statistics for the mothers and the children are presented in Table 2.

Average weekly hours worked by the partnered mothers in our sample is 18 hours. About 67 per cent of the 4,184 mothers worked at the time of interview. The average hourly wage was $22.5 for the mothers and $25.9 for the fathers (in June 2005 terms).

[9]Exact details of the sample selection procedure are available from the authors.

Table 2
Descriptive statistics: Analysis sample from HILDA Waves 5 through 7 pooled

Variable	**Mothers**	**Children**
Hours worked per week	18.2 (17.0)	
Hours spent in child care (if in child care)		15.5 (12.2)
Proportion in child care		0.23
Hourly wage rate (at June 2005 prices)	22.5 (26.0)	
Hourly median child care price (at June 2005 prices)	4.7 (0.8)	
Age	36.6 (6.9)	6.0 (3.8)
Indicator, mother has higher education		0.28
Indicator, mother has vocational education		0.25
Indicator, mother finished Year 12 only		0.20
Indicator, mother did not finish Year 12		0.27
Indicator, father has higher education		0.23
Indicator, father has vocational education		0.41
Indicator, father finished Year 12 only		0.17
Indicator, father did not finish Year 12		0.19
Indicator, has younger sibling present in household		0.43
Indicator, has older sibling present in household		0.60
Indicator, male		0.50
Indicator, in school		0.60
Number of children aged 0-5	0.83 (0.8)	
Number of children aged 6-12	0.98 (0.9)	
Number of children aged 13-15	0.25 (0.5)	
Age of youngest child	4.83 (3.9)	
Indicator, other female adult in household	0.08	
Indicator, mother or partner foreign born (but not both)	0.23	
Indicator, mother and partner foreign born	0.12	
State of residence indicator variables		
New South Wales (NSW)	0.29	
Victoria (VIC)	0.25	
Queensland (QLD)	0.21	
South Australia (SA)	0.08	
Western Australia (WA)	0.09	
Tasmania (TAS)	0.03	
Northern Territory (NT)	0.01	
Australian Capital Territory (ACT)	0.02	
Sample size	4,184	7,862

Notes: Means with standard errors in parentheses. Standard errors suppressed for indicator variables.

The wages of non-working parents are not observed and for some working parents they are missing. For these individuals, we predict wages using a standard Mincer wage equation and the Heckman (1979) procedure. The explanatory variables include age and its square, a set of education dummy variables, country of birth and family characteristics at the age of 14. Estimates of the wage equations correspond to typical estimates from the Australian literature (see for example Breunig, Cobb-Clark and Gong (2008)) and are available from the authors upon request.

Mothers' labour supply decisions and preferences for child care can be expected to depend upon the income of the father and unearned household income. As described in section 2, we only look at the mother's work decision and treat father's labour supply and earnings as fixed. The average of combined non labour income and fathers' earnings is $1,042 per week for the 2005 - 2007 sample (in June 2005 terms).

3.2 Child care usage

Of the 7,682 children in the 2005 - 2007 sample, 4,640 were school-aged children (between the ages of five and twelve years) and 3,042 children were not yet in school (less than five years of age) at the time of the survey. A summary of formal child care usage by these children is given in Table 3.[10]

Table 3
Formal child care usage in couple households from HILDA (2005-2007)

Age group	**Children using formal care in each hour category per week (%)**					**Children in formal care**	**Average hours attended**	**Number**
Hours per week:	1-9	10-19	20-29	30-39	40+	(%)		
Not-yet-in-school	22.0	37.2	21.4	9.5	9.8	38.8	19.7 (12.3)	3,042
School-aged	75.3	20.8	3.3	0.5	0.0	12.4	6.9 (5.7)	4,640
All	39.5	31.9	15.5	6.6	6.6	22.9	15.5 (12.2)	7,682

Average hours are only for those who attend. Standard deviations in parentheses.

As would be expected, children not yet in school use much more formal child care than school-aged children. About 40 per cent of not-yet-in-school children used formal care and the average hours attended by those using formal care was approximately 20 hours per week. This is a little bit more than the 18 average hours worked by the mothers in

[10]For school-aged children, only care during non-vacation periods is considered.

the sample. Only about 12 per cent of school-aged children used formal child care and, on average, these users spent about seven hours per week in care. Together with thirty hours at school, this is approximately the hours of a full-time worker.

To get an idea of how the child care information from the HILDA survey compares to administrative data, Table 4 presents information on child care usage from the 2006 Child Care Census (Department of Education, Employment and Workplace Relations (2008)). Because the Child Care Census data does not distinguish between partnered couples and single parent families, the comparable HILDA data are for these two groups combined (not just for partnered couples).[11]

Table 4
Formal child care usage in all households with children
HILDA (2005-2007) compared to 2006 Child Care Census

Age group	**Children using formal care in each hour category per week (%)**					**Children in formal care**	**Average hours attended**	**Number**
Hours per week:	1-9	10-19	20-29	30-39	40+	(%)		
Not-yet-in-school								
HILDA	21.0	36.6	21.0	10.8	10.6	39.6	20.2 (12.1)	3,538
Census	25.7	33.4	20.9	10.3	9.6	-	-	-
School-aged								
HILDA	72.1	23.1	4.1	0.7	0.0	12.9	7.2 (5.7)	5,841
Census	56.5	35.5	3.9	2.0	2.1	-	-	-
All								
HILDA	38.9	31.9	15.1	7.3	6.8	23.0	15.6 (12.4)	9,379
Census	35.1	34.0	15.7	7.8	6.3	-	15.5	-

Average hours are only for those who attend. Standard deviations in parentheses.

The pattern for not-yet-in-school children matches the Child Care Census data better than that for school-aged children, with the Child Care Census data showing fewer school-aged children using lower hours of care than in the HILDA data. This may be due to our weighting assumption described in footnote 11, which may somewhat

[11] In order to construct this table, we have to manipulate the child care census data as the government does not provide a breakdown of hours of child care by age. The data is provided by type of care (long day care; family day care; before- and after-school care) and the census provides a summary of hours attended by all children and a proportion of children that are school-aged in each type of care. Using this proportion, children in each type of care were weighted into the school-aged and not-yet-in-school groups, under the working assumption that the number of hours in care is independent of age. This assumption is only employed in constructing Table 4 and does not affect any of our results reported elsewhere.

overestimate the usage by school-aged children. Overall, the data we use seem fairly close to the administrative data.

3.3 Child care prices

One key aspect of this paper is the construction of the hourly child care price. In the HILDA survey, we have the number of hours (h_{kht}) spent in child care for each child (k) in the household (h) for each type of child care (t)–long day care, family day care, and other formal paid care.[12] Net cost of child care ($\widetilde{c}_{sht}$) is not provided for each child but is provided for each type of care and is split by school-aged ($s = 1$) and not-yet-in-school ($s = 0$) aged children. For example, for families who have one child in the not-yet-in-school-aged category, we know the cost of child care for each type of care for that child. For families that have more than one child in the not-yet-in-school-aged category, we only know the total amount spent on that group of children for each type of care.

Since we know the hours that each child is in care for each type of care, we split the cost in proportion to the hours spent in that type of care. We assume that families are spending the same amount per hour on each child within the same age range for each type of care. We calculate the net child care cost per child as

$$\widetilde{c}_{kht} = \widetilde{c}_{sht} \times \frac{h_{kht}}{\sum_{k=1}^{K} h_{kht}} \tag{6}$$

In the HILDA survey, only child care costs net of 'regular child care benefits' is available. However, with the information we have on child care usage by each child, gross family income, child and family characteristics, and Child Care Benefit (CCB) eligibility rules, we are able to construct the gross cost of child care for each child for each type of care, (c_{kht}).[13]

[12] This last category is mostly in-home care as described in section 2.3. Households in the data report hours of child care used. We calculate hours paid by rounding up to multiples of five hours for not-yet-in-school-aged children and multiples of three hours for school-aged children to reflect typical lengths of paid sessions. Long day care centres and family day care centres typically operate 50 hours per week, and typical part-time arrangements are at least in units of half-days. For school-aged children, typical after-school care sessions are 3 hours.

[13] These gross costs ignore the Child Care Tax Rebate (CCTR) which was only paid in the latter part of our sample period. Furthermore, when CCTR first came out, it was paid twelve to eighteen months after the original child care expenditure was made, so we think it unlikely that families would have deducted this yet-to-be-reimbursed amount from the reported cost of child care. Finally, if we calculate the prices as if the household were reporting costs after accounting for CCTR, we find child care prices that are widely out of line with the administrative data reported in Table 5.

We then calculate a gross per-child price for each type of care

$$p_{kht} = \frac{c_{kht}}{h_{kht}} \tag{7}$$

We take all of these individual child prices and calculate three median prices for each Labour Force Survey Region (LFSR): one for 0-2 year-olds, one for 3-4 year-olds, and one for school-aged children. Figure A3 in the appendix shows the number of observed prices for each LFSR in our data. We impute this median price to each household in the LFSR rather than use a child care price equation as some studies have done. For school-aged children, we have, on average, fourteen observations per LFSR. For 3-4 year-olds, we have eleven observations per LFSR on average and for 0-2 year-olds we have ten observations per LFSR on average. There is substantial variation across LFSRs.

Table 5
Comparison of hourly gross child care prices as constructed from HILDA (2005-2007) and from 2006 Child Care Census

	Not-yet-in-school Children			School-aged Children		
	HILDA		Child Care Census	HILDA		Child Care Census
	Median	Mean	Mean	Median	Mean	Mean
NSW	4.31	4.54	4.56	5.10	5.40	4.16
VIC	4.44	4.55	4.39	4.00	4.78	3.40
QLD	4.31	4.43	3.98	4.59	5.51	3.52
SA	4.17	4.19	4.14	4.48	5.12	3.52
WA	4.15	4.28	4.14	5.55	5.66	4.57
TAS	4.86	4.86	4.18	5.39	5.80	4.77
NT	5.00	4.59	4.04	4.87	4.88	5.36
ACT	5.72	5.16	4.88	5.41	6.78	4.93
All	4.33	4.49	4.31	4.62	5.26	3.68

Child care census hourly prices for not-yet-in-school children are the averages of long day care centres and family day care weighted by the number of children in each type of care.
Child care census hourly prices for school-aged children are the averages of the before- and after-school care per session fee divided by their typical session lengths (3 hours for after-school care and 1.5 or 2 hours for before-school care.)

The prices we use are constructed from the survey data as described above. Price data is available through the Child Care Census data for 2006 (mid-way through our sample period) but only at the state level. Table 5 compares *gross* prices constructed from the HILDA survey data with this administrative data. It appears that our method of constructing prices and incorporating the child care subsidy system match the administrative data, at least on average, fairly well. It is surprising that prices for school-aged

children in the data are higher than for not-yet-in-school children when the administrative data show the opposite. Failure to match the means in the child care census should not have any effect on the estimated elasticities (although it could affect the estimated constant) provided that the variation across LFSRs matches the variation in the true underlying data. Without access to detailed administrative data, we can not check this assumption.

4 Results

4.1 Empirical specification and estimation

We use the 'indirect approach' of specifying the labour supply and child care demand equations which arise from the utility maximization problem. This choice is motivated by simplicity and comparability with (Rammohan and Whelan, 2005, 2007). The empirical counterparts to equations (4) and (5) which we estimate are

$$h^* = \eta^w ln(w) + \eta^{p0}\overline{ln(p_{02})} + \eta^{p3}\overline{ln(p_{34})} + \eta^{p5}\overline{ln(p_{5+})} + \eta^I y_0 + \eta^{pI}\left(y_0\overline{ln(p)}\right) + \mathbf{X_h}\boldsymbol{\beta} + u_h \tag{8}$$

$$c^{k*} = \theta^{p0}\overline{ln(p_{02})} + \theta^{p3}\overline{ln(p_{34})} + \theta^{p5}\overline{ln(p_{5+})} + \theta^I y_0 + \theta^{pI}\left(y_0\overline{ln(p)}\right) + \mathbf{X_c}\boldsymbol{\alpha} + u_c \tag{9}$$

where the ηs and θs are scalar parameters to be estimated. $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ are vectors of parameters to be estimated (both of which include constant terms). Control variables included in $\mathbf{X_h}$ and $\mathbf{X_c}$ are things that shift preferences for leisure and child care demand. We include variables such as the presence of other female adults in the household, migration status of parents, and presence of older siblings in the family which might affect the availability and shadow cost of informal child care. We include the age distribution of all children in the family, which is an important determinant of female time allocation preferences. We do not model informal child care and its price explicitly due to the fact that much informal child care is non-paid.

For the child care price variables, $\overline{ln(p_i)}$, we use the median price within the local labour force statistical region where the household resides for 0-2 year-olds, 3-4 year-olds, and school-aged children. The median price is calculated from the survey data as described in section 3.3 above.

Using a local average price is important to overcome endogeneity issues associated with using a household-level price measure. Households simultaneously choose work hours, amount of child care, and the quality of child care. Chosen hours of work and childcare may depend upon quality, which we don't observe, but which will be correlated with price. This creates on omitted variable problem since omitted quality is correlated with included price. By using local area averages, we are essentially using a quality-adjusted price. Our modeling assumption is that households react to the average price level irrespective of the quality they choose. This is akin to assuming that shifts in median prices affect all quality levels. Finally, we also control for child care quality by adding variables from the administrative data which capture the average number of qualified staff per child in formal day care centres. These variables are only available at the state level however.

We make several assumptions which make estimation simpler. Firstly, we restrict the effects of child care prices in the labour supply equation to be the same for all types of childcare ($\eta^{p0} = \eta^{p3} = \eta^{p5}$). In the child care demand equations, we restrict the cross-price effects (for child care prices other than the one that applies to that particular child) to be zero. We also restrict the effect of other explanatory variables in those equations to be the same for each child. This assumption, that parameters for each child are identical, allows us to pool the child care demand equations together. Thus, in practice, we only estimate one child care demand equation with the restriction $\theta^{p0} = \theta^{p3} = \theta^{p5}$. This approach *allows* for the heterogeneity of child care prices for different types of care, but restricts the *effect* of price changes on child care demand to be equal. The resulting single parameter can be viewed as an average effect of child care price changes. Separate estimation of three different child care equations (one for 0-2 year-olds, one for 3-4 year-olds, and one for school-aged children) provides very similar parameters but larger standard errors due to the fairly small sample sizes for each age group. We only report the results for the restricted model with one child care equation.

Equations (8) and (9) are specified as tobit models to account for the substantial number of observations with either zero hours worked or zero hours of formal child care or both. We estimate them separately by maximum likelihood.[14] We obtain standard

[14] Asymptotically, joint estimation should only affect efficiency, not consistency.

errors by clustered bootstrapping which takes into account the correlations between observations in the same household.

4.2 Results

Our key finding is that labour supply elasticities with respect to child care price for both hours worked and participation are negative, statistically significant, and similar to the international averages presented in Table 1. Table 6 summarizes our estimated elasticities for an average partnered mother with one child under age 13.[15] For a typical partnered mother, for every one per cent increase in the average child care price, her rate of employment would decrease by 0.29 per cent, and her hours worked would decrease by 0.65 per cent (from column 3 of Table 6). The 95 per cent confidence intervals are $(-0.12, -0.44)$ for the employment elasticity and $(-0.32, -0.98)$ for the hours worked elasticity.

Parameter estimates of the labour supply (8) and child care demand (9) equations for the 2005 - 2007 sample are presented in Tables A1 and A2 of the appendix. Because we are pooling across three waves of a panel data set, we have multiple observations on some women. To account for this, we use the clustered bootstrap in our estimation of the standard errors. Model I suppresses the interaction terms between child care price and non-labour income (we set $\eta^{pI} = \theta^{pI} = 0$ in equations (8) and (9)) whereas Model II includes these terms which allow different child care price effects across income groups. We prefer Model II as the interaction terms between child care price and other private income are jointly significant, indicating that the effects of child care price and other private income on labour supply and child care demand are different for different income groups. Other private income is significantly negative in the child care demand equation, but is statistically insignificant in the labour supply equation. Other variables have the expected sign and significance–see the appendix.

We also estimate a model where we interact the number of children in the household with the child care price in the labour supply equation. The results are not substantially different than what is reported here. We also estimated the model using only the observations in LFSRs where we have 15 or more observed child care prices in the LFSR. The

[15] We calculate the elasticity at the sample mean of the participation propensity (for the employment elasticity) and the sample mean of hours worked (for the hours elasticity).

point estimates for the hours and employment elasticities are both statistically significant and not much different from what is reported above: -0.73 (instead of -0.65) and -0.33 (instead of -0.29). These additional results are available from the authors upon request.

Table 6
Estimated child care price elasticities from HILDA (2005-2007)

	Labour supply elasticities		**Child care demand elasticities**	
With respect to	**Model I**	**Model II**	**Model I**	**Model II**
Child care price (at mean income)				
Hours	-0.654^{**} (0.17)	-0.653^{**} (0.17)	-0.644^{**} (0.10)	-0.655^{**} (0.10)
Employment	-0.287^{**} (0.08)	-0.287^{**} (0.07)		
Wage	0.350^{**} (0.04)	0.349^{**} (0.05)	0.223^{**} (0.06)	0.227^{**} (0.05)
Non-labour income (at mean price)	-0.001 (0.01)	-0.005 (0.01)	-0.010 (0.01)	-0.014^{*} (0.01)

Labour supply and child care demand elasticities are calculated at average hours worked (18) and of child care usage (15.6). Standard errors are in parentheses.
** significant at 5 per cent level
* significant at 10 per cent level

The other elasticity estimates are all in plausible ranges. Demand for child care is downward sloping, as expected. The labour supply elasticity with respect to wage is about 0.35 which is close to what other Australian studies find.[16] The wage elasticity of child care is positive. If mother's wage increases by one per cent, the family would increase demand for child care for each child by 0.23 per cent. As expected, mother's labour supply and child care demand are strong complements.

Child care price elasticities vary across income groups. Figures A1 and A2 in the appendix show how child care price elasticities of employment and child care demand vary across other income. The child care price elasticity of child care demand is slightly decreasing in income but the elasticity of child care price with respect to labour supply increases slightly with income. This may suggest that, compared to lower income families, in higher income families the mothers' labour supply is more responsive to child care price changes but the demand for child care is less responsive. One interpretation is that, when the child care price changes, females in low income families are more likely to adjust their formal child care demand than their labour supply. Given the wide confidence intervals, we would be cautious about pushing these conjectures too far.

[16] See Breunig and Mercante (2010), for example.

4.3 Role of child care price in explaining previous Australian studies

The previous Australian studies of (Rammohan and Whelan, 2005, 2007) used earlier data from the same survey which we use (HILDA) and followed Connelly (1992) in constructing child care price as the total cost of child care (potentially across multiple children of very different ages in the household) divided by total hours worked by the mother. This measure of child care price has several problems. The first is that it implicitly assumes that the price of child care per hour is the same for children of all ages. In the Australian context, this is certainly not true, with prices for the 0-2 year-olds higher than for the 3-4 year-olds because of the requirement of higher staff-child ratios for the former group. The second problem with this construction is that it assumes that the costs of child care are spread across all hours of work. Thus there is no role for informal care nor for child care usage outside of working hours.

In this paper, we have exploited new data (available only from 2005 onwards in HILDA) which allows calculation of per-child expenditure and provides detailed information on the usage of child care which allows us to calculate prices for each specific age group and to attribute child care costs directly to hours of child care used rather than to hours worked. In order to explore the importance of this improved construction of child care prices and in order to understand whether it drives the differences between our study and the previous literature, we undertake two comparisons. The first comparison is to redo our analysis presented above keeping everything the same but replacing our price measure with a price calculated as (Rammohan and Whelan, 2005, 2007) have: total cost of child care divided by total hours worked by the mother. These results are presented in the second and third columns of the top panel of Table 7.

The difference is dramatic. When we calculate price as total cost of child care divided by total hours worked by the mother we find a very small, positive elasticity which is statistically indistinguishable from zero. A plausible explanation is that the measurement error created by constructing the childcare price in this way causes severe attenuation in the estimated coefficient.

The fourth column of the top panel of Table 7 uses the cost of child care as constructed in (Rammohan and Whelan, 2005, 2007) but estimates a probit model for participation (as is done in those two papers) rather than a tobit model of hours. The

elasticity of -0.009 is similar to what the previous Australian studies found so the difference between our results and their results does not seem to be driven by our later sample period.[17]

Table 7
Estimated participation (employment) elasticities with respect to child care price using alternative price measures, estimation methods and time periods
Partnered women with children

	Approach to construction of child care price variable		
	Our approach	**Connelly approach**	
Model:	**Tobit hours equation**		**Probit equation**
Full sample			
2005-2007	−0.287** (0.08)	0.004 (0.025)	−0.009 (0.03)
Restricted sample			
2002-2004	−0.091* (0.05)	0.060 (0.04)	0.060 (0.05)
2005-2007	−0.222** (0.08)	0.029 (0.03)	−0.017 (0.03)

Labour supply and child care demand elasticities are calculated at average hours worked (18) and of child care usage (15.6). Standard errors are in parentheses.
** significant at 5 per cent level
* significant at 10 per cent level

Our second comparison looks at the earlier time period 2002-2004. For this time period, we do not have detailed per-child information on child care. However, we do know total amounts of child care used and for which purpose (work or non-work) split by school-aged and under school-aged children. So, for families with at most one child under school age and at most one school-aged child, we can construct the price using our preferred method. This subset of households, which we call the 'restricted sample' is about half the size of the full sample.

We select this restricted sample for both the 2002 - 2004 and 2005 - 2007 time periods and we construct child care prices using our preferred method and the method of the previous studies. The resulting employment elasticities with respect to child care price are reported in the second panel of Table 7. Again, our approach of constructing the price, which eliminates substantial measurement error, produces a negative and statistically significant elasticity whereas the total cost divided by hours worked approach of constructing the price produces a statistically insignificant elasticity.

We can not rule out from this examination of the data that the participation (employment) elasticity with respect to child care price has gotten larger over time. The

[17] If we use our preferred price measure in the probit model, we find an even larger and statistically significant participation elasticity of -0.47.

elasticities reported here are gross price elasticities which means that they are conditional on the policy setting and policy has changed over the 2002 to 2007 period. But we can confidently conclude that even in the earlier period, women's labour supply responded to the price of child care in a negative and statistically significant way. We emphasize that the only difference between columns 2 and 3 in Table 7 are the way in which the child care price is calculated.[18]

In summary, neither different time periods not slightly different estimated models (tobit as compared to probit) seem to explain the difference between our results and the previous Australian studies. The difference seems to be primarily due to the way in which the price variable is constructed.

5 Conclusion

In this paper we attempt to answer the question of whether the labour supply of Australian women is truly unresponsive to child care cost as found in previous studies. Using newly available data, we construct a child care price which takes into account the actual hours spent in child care and price heterogeneity for child care for different age ranges. In contrast with previous studies, we find a statistically significant, negative price elasticity of child care with respect to partnered women's labour force participation.

Our preferred estimated elasticity of employment with respect to the gross child care price for an average partnered mother with young children is -0.29, and the corresponding elasticity of hours worked is -0.65. These results correspond to our intuition that child care price must matter for a woman's decision of whether or not to work and of how much to work. The estimated elasticity of employment is in the middle of the range of those found in the international literature, while the elasticity of hours worked is at the high end of the range of international estimates.

The actual magnitudes of these elasticities are less important than the key finding of a statistically significant and negative effect of the price of child care on women's labour force participation. It can be expected that the magnitude of the elasticities will vary with time period considered, sample, and econometric technique. Here we have used a

[18]The tobit model parameter estimates of equations (8) and (9) for the various combinations of child care price/sub-sample are quite similar to those provided in Appendix Table A1 and A2. They are available from the authors upon request.

reduced form model. In work that is not yet published, we estimate a structural model using a more restricted sample–see Gong and Breunig (2011). We find effects that are about two-thirds the size of those found here, but importantly, we still find statistically significant elasticities of women's labour supply and child care demand with respect to the price of child care.

We compare our construction of the child care price with the method used in two previous Australian studies for our more recent sample period and on a restricted sample for the time period covered by the earlier studies. In both cases, we find large differences in estimated elasticities. We conclude that using a child care price which is based upon total cost of child care divided by total hours worked by the mother introduces measurement error into the child care price. This measurement error in price appears to be the reason why the studies by Rammohan and Whelan (2005) and Rammohan and Whelan (2007) found that women's labour supply in Australia is non-responsive to changes in child care price. These results suggest that measurement error in the child care price and differences in how child care prices are constructed may be one factor in explaining variation across the international literature.

Our results challenge the consensus in Australia that women's labour supply is unresponsive to the price of child care. Australian policy makers have recently introduced reforms intended to improve child care quality which could substantially increase the price of child care. Unemployment rates in Australia remain at historical lows (just over five per cent) and encouraging women's labour force participation is a commonly cited policy objective. Our study would suggest that simultaneously achieving increased participation and increased child care quality may require additional government subsidy of child care prices.

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Table A1
Tobit estimates of the labour supply equation
Main sample 2005-2007 from HILDA

Variable	**Model I**	**Model II**
ln(wage) of the mother	6.293** [7.52]	6.274** [7.27]
Average median ln(child care price)[a]	−11.775** [4.87]	3.438 [0.97]
ln(other household income)	0.015 [0.06]	2.428* [1.66]
Average median ln(child care price) × ln(other household income)		−1.555* [1.68]
Age of the mother	0.068 [0.80]	0.069 [0.86]
Number of children aged 0 to 5	−4.986** [6.07]	−4.979** [6.62]
Number of children aged 6 to 12	−2.993** [6.55]	−2.986** [5.55]
Number of children aged 13 to 15	−4.871** [6.56]	−4.870** [5.62]
Age of youngest child	1.478** [7.69]	1.473** [7.97]
Indicator, other female adult in household	−2.826** [1.99]	−2.884* [1.86]
Indicator, mother or partner foreign born (but not both)	−0.182 [0.17]	−0.203 [0.20]
Indicator, mother and partner foreign born	−1.165 [0.75]	−1.272 [0.99]
Standard error of model ($\hat{\sigma}$)	22.180 (0.32)	22.171 (0.31)
Constant	9.648* [1.85]	−3.283 [0.03]
State and year dummies included?	Yes	Yes
Likelihood value	-13849.2	-13847.2
Observations	4,184	

[a] The child care price variable is the average of the three local median prices (one for each age group: 0-2, 3-4, and school-aged) as described in section 3.3

Standard errors are calculated via the clustered bootstrap with 200 replications.
$|t|-$values in square brackets; standard errors in parentheses
** significant at 5 per cent level, * significant at 10 per cent level
In model 2, the coefficients on average median ln(child care price) and its interaction with ln(other household income) are jointly significant with a χ^2_2 value of 20.12.
In model 2, the coefficients on ln(other household income) and its interaction with average median ln(child care price) are jointly insignificant with a χ^2_2 value of 2.92.

Table A2
Tobit estimates of the child care demand equation
Main sample 2005-2007 from HILDA

Variable	**Model I**	**Model II**
ln(wage) of the mother	3.550** [3.51]	3.611** [3.54]
Average median ln(child care price)[a]	−10.241** [5.02]	−18.037 [4.51]
ln(other household income)	−0.154 [1.03]	−2.363** [2.53]
Average median ln(child care price) × ln(other household income)		1.428** [2.35]
Age of the child	−0.774* [1.93]	0.779** [2.17]
Indicator, one if child is male	−1.303* [1.79]	1.338* [1.87]
Indicator, one if child is in school	−22.038** [13.17]	−21.963** [13.22]
Indicator, one if younger sibling present	3.115** [2.33]	3.132** [2.55]
Indicator, one if older sibling present	−3.236** [3.00]	−3.249** [3.54]
Number of children aged 0 to 5	−2.160** [2.37]	−2.133** [2.29]
Number of children aged 6 to 12	−2.535** [3.17]	−2.546** [3.28]
Number of children aged 13 to 15	−2.086* [1.68]	−2.048 [1.61]
Age of youngest child	1.113** [2.50]	1.127** [2.82]
Mother's age	0.308** [3.51]	0.308** [3.24]
Indicator, mother received higher education	1.292 [1.02]	1.212 [0.94]
Indicator, mother received vocational education	1.094 [0.91]	1.014 [0.77]
Indicator, mother did not finish year 12	−2.255 [1.49]	−2.327* [1.64]
Indicator, father received higher education	0.466 [0.34]	0.419 [0.29]
Indicator, father received vocational education	−1.930 [1.41]	−1.968 [1.45]
Indicator, father did not finish year 12	−3.047* [1.70]	−3.035** [1.95]
Indicator, other female adult in household	−4.654** [2.49]	−4.605** [2.57]
Indicator, mother or partner foreign born (but not both)	0.277 [0.25]	0.229 [0.22]
Indicator, mother and partner foreign born	−0.503 [0.36]	−0.374 [0.25]
Percentage of child care staff with teaching experience (state average)	−1.853** [5.54]	−1.874** [3.24]
Percentage of child care staff with teaching qualification (state average)	0.366** [2.44]	0.373** [5.86]
Standard error of model ($\hat{\sigma}$)	21.348 (0.53)	21.338 (0.50)
Constant	9.648 [0.86]	−3.283* [1.66]
State and year dummies included?	Yes	Yes
Likelihood value	-9893.4	-9889.7
Observations	7,682	

Notes to Table A2 on next page.

Notes to Table A2

[a] The child care price variable is the average of the three local median prices (one for each age group: 0-2, 3-4, and school-aged) as described in section 3.3

Standard errors are calculated via the clustered bootstrap with 200 replications.
$|t|-$values in square brackets; standard errors in parentheses
** significant at 5 per cent level, * significant at 10 per cent level
In model 2, the coefficients on average median ln(child care price) and its interaction with ln(other household income) are jointly significant with a χ^2_2 value of 45.82.
In model 2, the coefficients on ln(other household income) and its interaction with average median ln(child care price) are jointly insignificant with a χ^2_2 value of 8.68.