Child care availability, quality and affordability: are local problems related to maternal labour supply?

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Abstract

We examine whether responses to survey questions about child care availability, quality, and cost, aggregated at the local geographical level, have any explanatory power in models of maternal labour supply. We find that married women who live in areas with more reports of lack of availability, low quality, or costly child care work less than women in areas with fewer reported difficulties with child care. We find this effect on both the hours of labour supplied and on the part-time/full-time choice. We find few effects for lone parents.

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I Introduction

There is broad-ranging concern in Australia about the availability, quality, and price of child care. There have been calls (see ABC (2009)) for additional public funding to increase availability and affordability of child care, particularly following the collapse of ABC Learning, a large private child care centre operator. The public debate is often framed around the need for child care policy to be focused on allowing (sometimes even encouraging) women with young children to enter the labour force (see ABC Radio (2006)). Policies such as Child Care Tax Rebate and Child Care Benefit provide subsidies for child care usage primarily for work-related purposes. Australian Human Rights Commission (2009) tells women that "childcare can be expensive and hard to get." Thus, "it is important to think about childcare while you are pregnant to make sure that you can access childcare when you return to work." The Parliament of the Commonwealth of Australia (2006) documents reported problems with quality, accessibility and affordability of child care in Australia and worried about "its impact on women's ability to participate in paid work at an optimum level."

Clearly the availability and quality of child care, in addition to price, could affect parental decision-making about labour supply, particularly in the highly subsidized and regulated child care market. On the one hand, child care is a cost of working. However, parents rarely approach the problem of finding child care as a simple cost-minimization exercise. Rather, child care is viewed as an important input to child development. Parents who might want to work will be unwilling to leave their child in a poor child care environment. Furthermore, parents who have decided to work and to place their child in care might be willing to spend more than the minimum in order to place their child in high-quality care, available at a convenient location.

But whether availability, quality and affordability of child care are empirically significant issues in Australia in preventing parents from working is not so obvious and there is a paucity of empirical research in Australia which comprehensively investigates these multiple aspects of child care. This paper makes some progress in identifying the role that availability and quality, along with cost, might play in labour supply choices of married women and lone parents.

We simultaneously examine these multiple aspects of child care using the Household,

Income and Labour Dynamics in Australia (HILDA) survey which has asked some respondents questions about child care availability, quality, and cost. We can expect that in areas where child care supply is lacking that individuals will report more problems with availability than in areas with plentiful supply. Likewise for quality and cost. Our approach will be to take these assessments of child care supply conditions and aggregate them at the local level. In order to purge possible bias from the correlation between an individual's unobserved preferences for working and her evaluation of local child care conditions, the aggregated measures are constructed separately for each individual using responses from other households in the same area. We then estimate participation and labour supply models including these local area average responses. The question we address is whether these average responses are correlated with women's participation and work hours decisions.

For married women we find robust evidence that local problems with availability, quality and cost are associated with working fewer hours and in particular, being more likely to work part-time instead of full-time. We do not find much evidence that there are effects on the decision to work or not to work. The results contradict the existing consensus that Australian mothers are not very responsive to changes in the child care environment, in particular, to the cost of child care.

The rest of the paper includes a discussion of our data sources in section III, our estimates of the basic linear labour supply model in section IV, and the results using the subjective measures of child care availability, quality, and cost in section V. We conclude in the final section.

II Background

A small empirical literature for Australia has mainly investigated the price elasticity of maternal labour supply, which has been found to be small and often not statistically different from zero. Doiron and Kalb (2005) and Kalb and Lee (2008) find that work hours for married women (lone parents) decrease by .02 (.05) per cent in response to a one per cent increase in formal 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 maternal labour supply is not responsive to the cost of child care in Australia. This is in contrast with the evidence from other countries, where studies find significant, negative effects of child care price on female labour supply.[1]

None of these studies, nor any Australian study to our knowledge, have attempted to address non-price factors. Outside of Australia, research shows that the importance of non-price factors varies from country to country but given the important differences across countries in child care institutions, it is difficult to generalize from these studies. A handful of papers, exclusively for European countries where child care markets are characterised by low availability of center-based child care (and high subsidisation), model access restrictions to child care, for example, Gustafsson and Stafford (1992) for Sweden; Kornstad and Thoresen (2007) for Norway; Del Boca and Vuri (2007) for Italy; Wrohlich (2006) for Germany; and Lokshin (2004) for Russia. Most of these papers use the discrete choice labour supply model of Van Soest (1995) and model rationing of formal child care by limiting the choice set of rationed households. A general conclusion from these papers is that lack of availability is a factor hindering labour supply of women with young children and that increased availability to center-based child care would lead to increases in labour supply of women with young children in these countries.

In Australia, where 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, 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 are included, about half of children under three are in formal child care (based upon the authors' calculation using the three most recent waves of HILDA). However, availability of child care could be a local problem even in the absence of a national-level problem. For example, overall affordability of child care can be affected through transportation costs if a place in a centre is only available in an area far from home.

[1] A recent example is Baker et al. (2008) for Canada. Anderson and Levine (1999) and Blau and Currie (2006) review the international literature.

The other non-price factor which often draws attention is the quality of child care. Early literature, primarily in the US where quality has been of great concern, studied the demand for child care quality by investigating 'choice of mode' (see for examples, Leibowitz et al. (1988); Lehrer (1989); Hofferth and Wissoker (1992); Blau (1991); and Hagy (1998).) In an influential paper, Blau and Hagy (1998) model labour supply, demand for child care modes, hours, and non-price attributes such as quality simultaneously. They find that a decrease in child care price causes a decrease in the demand for quality-related attributes. Findings from the more recent literature indicate that the price elasticity and income elasticity of quality are low in child care (Blau and Mocan (2002) and Blau (2001, Chapter 4). 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.

Mocan's results might suggest that our measures of child care quality, based on parental perception, may not reflect quality as assessed by education experts. However, as we show below, the measures of child care availability, affordability and quality are highly correlated with each other, suggesting that the measures are informative about the overall severity of an underlying problem with the supply of satisfactory child care.

III Data

We use data from the in-confidence version of the Household, Income and Labour Dynamics in Australia Survey (HILDA).[2] The HILDA Survey is an annual panel survey of Australian households and we use the sixth wave from 2006. There are around 7,500 households and around 13,000 responding individuals in each wave.

We use the HILDA data in two ways. Data on wages and hours from wave six of the HILDA survey are used to estimate labour supply models for married women and lone parents. We also use wave six of HILDA to generate local, geographical averages of responses to questions on child care availability, quality and cost. These questions are only asked of a sub-sample of respondents (families with children under age 15 who

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

either used or considered using child care in the previous twelve months) and we use the data from *all* respondents who answer these questions. We first describe the data we use for the labour supply models and then the data we use on subjective child care questions.

(i) Married females

Of the 7,139 total households and 12,905 total responding persons in wave six, 4,243 households have at least one individual who reports being partnered. From this group, after removing 62 households where unrelated people are living together, 172 multi-family households, 350 households without partner information and 76 same-sex couples, we are left with 7,166 partnered persons living in 3,583 households for whom we have partner information.

In order to ignore the decisions to study and to retire in our modeling, we further restrict the sample by removing households where either partner is less than 25 years of age or greater than 59 years of age; where either partner is retired; where either partner is a full-time student; where either partner is disabled; where either partner is self-employed or works in a family business; or where either partner reports working, but has zero wage. We further made the decision to drop 11 observations where the woman reported working more than 60 hours per week.[3] The sample used for analysis thus consists of 1,521 married women.

Table 1
Sample sizes by labour force status

Labour force status	**Married women**	**Lone parents**
Full-time employed	602	192
Part-time employed	549	137
Unemployed and not in the labour force	370	133
Total	1,521	462 (including 54 males)

[3]Wages of these 11 are well below the average wage for married women and are probably the result of positive measurement error in hours. This measurement error induces a negative correlation in observed hours and wages (because the measurement error affects hours positively and wages negatively) and such extreme observations can introduce large bias into our labour supply estimates.

Table 2
Definition of variables used in labour supply models

Variable	**Definition**
$ln\,(wage_i^*)$	natural log of shadow price of time
$ln\,(wage_i)$	natural log of hourly wage
age	$age/100$
kidspreschool	=1 if household has preschool age child
schoolkids	=1 if household has school age child
olderkids	=1 if children over 18 in household
nonreskids	=1 if household has non-resident children (under age 18)
homeowner	=1 if own home or paying off mortgage
$wage\_p$	partner's gross weekly wage earnings divided by 1000
poorenglish	=1 if self-assessed English ability is poor
university	=1 if university graduate
schoolincomp	=1 if did not complete year 12
$exper$	$experience/100$
$exper^2$	$(experience/100)^2$

Table 3
Descriptive statistics

Variable	**Married Women**	**Lone parents**
hours	24.1 (17.4)	24.2 (18.7)
hours (workers only)	31.9 (12.4)	34.0 (12.6)
$ln\,(wage_i)$ (workers only)	3.09 (0.42)	3.01 (0.43)
age	0.40 (0.085)	0.43 (0.084)
kidspreschool	0.26	0.15
schoolkids	0.43	0.58
olderkids	0.26	0.48
nonreskids	0.14	0.26
homeowner	0.23	0.16
partner's wage ($wage\_p$)	1.22 (0.74)	n/a
poorenglish	0.0099	0.012
university	0.33	0.21
schoolincomp	0.26 (0.44)	0.31 (0.46)
experience ($exper$)	0.17 (0.091)	0.17 (0.11)
Sample size	1521	462

Notes: Means with standard errors in parentheses. Standard errors suppressed for indicator variables. For wage and partner wage data we use the imputed gross weekly salary and wage income for all jobs. Source variable in HILDA is FWSCEI.

(ii) Lone parents

There are 733 households with un-partnered parents in wave six. Applying the same sample exclusions rules as above, our analysis sample consists of 462 lone parents, of whom 54 are men. While our primary focus in this paper is on *maternal* labour supply, we do include both male and female lone parents in our study as single fathers are likely to face the same difficulties in balancing work and child care as single mothers. Only 12 per cent of lone parent households are headed by a male and dropping them does not fundamentally change the results presented in sections IV and V below.

Table 1 presents the labour force status of our final sample of 1,521 married women and 462 lone parents. Table 2 presents definitions of the variables used in estimating the labour supply models of sections IV and V. Table 3 provides descriptive statistics for these variables separately for our sub-samples of married women and lone parents.

(iii) Child care data

There are three questions on quality, four on availability and one on cost that are asked of all people with children aged 14 and younger who indicate that they have used or thought about using child care in the last 12 months. The questions are asked on the household questionnaire, so we only have a response from the individual who fills out that part of the questionnaire.[4]

Possible responses to each question range from 0 ("Not a problem at all") to 10 ("Very much a problem"). Table 4 lists the questions and mean response for each question. There are 807 households who are in-scope for these questions, but not all households responded to all questions, thus the sample size varies on a question-by-question basis. Figure 1 provides an example of the distribution of responses for the question about whether households had any difficulty with the cost of child care. Twenty-five per cent of the 765 individuals who answered this question said they had "no difficulty" whereas just over nine per cent said that cost was "very much a problem", a response of 10. "No difficulty" (0) is the most common response for every question. The mean level of

[4]We also considered using data from the Growing Up in Australia: Longitudinal Study of Australian Children (LSAC). However, the subjective questions on child care usage were only asked of those who considered using child care but did *not* use child care and sample sizes are so small as to be useless for our purpose. See Sanson et al. (2002) for details.

reported difficulties with cost is much higher than for quality or availability. This may be evidence that these non-price factors may not be as serious a problem as in some other countries. For all questions, we observe similar patterns of the middle response (5) being chosen more frequently than its neighbors (4) or (6) and the most extreme response (10) being chosen more than (8) or (9).[5]

In Table 4 we also present the mean for three additional variables which we create using averages across multiple questions. The 'any quality question' is the average across all responses to the three quality questions; the 'any availability question' is the average across all responses to the four availability questions; and the 'any child care difficulty question' is the average across all responses to any of the questions.

Table 4
Average responses to questions about child care difficulties

Question	**Number of Observations**	**Mean response**
Questions relating to quality		
Difficulty in finding quality child care	776	2.54
Difficulty in finding right person to care for my child	795	2.75
Difficulty in finding care that my children are happy with	763	2.35
Any quality question	2334	2.55
Questions relating to availability		
Difficulty in finding care for hours needed	797	2.90
Difficulty juggling multiple child care arrangements	586	2.77
Difficulty finding a place in the child care centre of choice	640	2.56
Difficulty finding child care in the right location	654	2.27
Any availability question	2677	2.64
Question relating to cost		
Difficulty with the costs of child care	765	4.21
Average over all questions		
Any child care difficulty question	5776	2.81

Correlation between individual responses to the questions about difficulties with child care is very high. For example, correlation between responses to "Difficulty finding a

[5]See Cassells et al. (2005) for a detailed descriptive study of the HIDLA child care data.

place in the child care centre of choice" and "Difficulty finding child care in the right location" is .83. Even across broad categories (quality, availability, cost) correlation is high. The correlation between the response to "Difficulty in finding quality child care" and "Difficulty finding child care in the right location" is .72. The weakest correlations are between the response to the cost question and the responses to the other questions, but even then the correlations remain relatively high. Correlations between the cost question and the availability and quality questions range from .42 to .53.

We use the in-confidence version of HILDA which includes data on respondents' postcode. We match this postcode to the Australian Bureau of Statistics 3-digit Statistical Division (SD) (1-digit state/territory code combined with 2-digit SD code).[6] The 807 households who respond to the child care questions of Table 4 are distributed across 53 SDs. For each SD, we calculate, for each respondent in HILDA, the average response to the child care questions from Table 4 for all *other* respondents in the same SD. For 42 of the 53 SDs, this gives us five or more responses to each child care question. For 7 SDs, we only have one response, and thus we can not create average responses for other respondents for these SDs. We explore below the consequences of dropping and of using observations from these SDs. By construction, these local averages will be different for each individual in the sample.

As with the individual responses, the correlation between average responses within the geographical aggregates to the different child care questions is also very high. So, for example, the average response to the "any quality question" and the average response to the "any availability question" within SD is .91. The correlation between the question about cost and the "any quality question" is .51.[7] In the models of section V where we include these variables simultaneously, we will need to exercise caution in interpreting the results given the high degree of co-movement between these local area averages.

IV Baseline Labour Supply models

In what follows, we group the unemployed, marginally attached and not in the labour force into one group of non-workers for the purpose of estimating models of the proba-

[6] SD are described in Australian Bureau of Statistics (2005).

[7] The household correlations are documented in Appendix Table A1 and the correlations within SD are presented in Appendix Table A2.

bility of working and of working full-time and labour supply models.[8] The main results in section V below are invariant to exclusion of one or the other group of non-employed.

(i) Probability of working

We first estimate a simple reduced form probit model for the probability of working excluding any information about child care. Table 5 presents the results of this model for married women and for lone parents. The estimates correspond to typical results from participation models in the Australian literature and the variables have the expected signs and magnitudes.

Table 5
Probit results: probability of working
Marginal effects (standard errors)

Variable	Married Women	Lone Parents
Age	-1.99^{**} (0.23)	-1.85^{**} (0.42)
Poor English	-0.36^{**} (0.15)	-0.52^{**} (0.21)
University	0.064^{**} (0.025)	0.031 (0.059)
School incomplete	-0.116^{**} (0.031)	-0.071 (0.053)
Experience	3.30^{**} (0.45)	3.25^{**} (0.76)
Experience squared	-1.66 (1.27)	-1.83 (2.19)
Preschool kids	-0.28^{**} (0.033)	-0.26^{**} (0.082)
School age kids	-0.016 (0.023)	-0.11^{**} (0.051)
Older children	0.052^{*} (0.027)	0.052 (0.051)
Non-resident kids	0.097^{**} (0.028)	0.070 (0.050)
Home owner/paying mortgage	-0.021 (0.029)	-0.045 (0.067)
Partner's earnings	-0.025^{*} (0.014)	
Male		-0.032 (0.084)
Sample size	1521	462
Log likelihood value	-616.5	-194.5

*Notes: ** statistically significant at the 5 per cent level (or higher).*
** statistically significant at the 10 per cent level (or higher).*

[8]Married women who are defined as "not in the labour force" transition to employment at fairly high rates, but only about half as much as married women who are defined as "unemployed." They also tend to take up employment at higher wages than the unemployed, so there appears to be something fundamentally different about their non-employed status.See Breunig and Mercante (2010) who document these facts for this data set.

(ii) Probability of working full-time

When we introduce the child care variables in section V below, we also want to consider whether child care might affect the decision to work full- or part-time. If we consider the subset of workers, we can estimate the determinants of working full-time. Table 6 presents these results for married women and lone parents. Again, the coefficients have the expected signs and magnitudes.[9]

Table 6
Probit results: probability of working full-time
Marginal effects (standard errors)

Variable	Married Women	Lone Parents
Age	-2.21^{**} (0.37)	-1.47^{**} (0.65)
Poor English	0.37^{*} (0.13)	n/a
University	0.11^{**} (0.036)	0.18^{**} (0.067)
School incomplete	-0.125^{**} (0.040)	-0.0349 (0.072)
Experience	1.49^{**} (0.75)	-0.90 (1.13)
Experience squared	-0.26 (1.76)	-5.23^{*} (2.93)
Preschool kids	-0.39^{**} (0.035)	-0.27^{**} (0.12)
School age kids	-0.25^{**} (0.033)	-0.33^{**} (0.068)
Older children	0.021 (0.038)	0.072 (0.072)
Non-resident kids	-0.064 (0.049)	-0.079 (0.077)
Home owner/paying mortgage	-0.070^{*} (0.040)	-0.13 (0.085)
Partner's earnings	-0.083^{*} (0.024)	
Male		0.41^{**} (0.048)
Sample size	1151	328
Log likelihood value	-686.7	-175.1

Notes: We drop the one lone parent observation with poor English. See notes to Table 5.

(iii) Labour Supply

To obtain a baseline model of labour supply, we estimate the model of Heckman (1974). As our main interest is in exploring the question of whether the level of reported diffi-

[9] We can also model employment status as an ordered variable with not working, working part-time and working full-time in that order. The signs and significance of the coefficients in that model are the same as what is reported in Tables 5 and 6. Results available from authors upon request.

culties (both price and non-price) with the supply of child care in the local area have labour supply effects, we chose this model because it is widely applied, well-understood, and tends to give reasonable estimates across a wide range of countries and time periods. As we discuss in section VI, our approach does not provide for the estimation of child care elasticities, so the fact that this labour supply model is not a frontier model is not problematic for the question we are asking. We are confident that this model is useful in determining whether there is any relationship between local reported difficulties with child care and labour supply.

The model we estimate is

$$\begin{aligned} ln\left(wage_i^*\right) =& \alpha_1 + \alpha_2 hours_i + \alpha_3 kidspreschool_i + \alpha_4 schoolkids_i + \alpha_5 olderkids_i \\ &+ \alpha_6 nonreskids_i + \alpha_7 homeowner_i + \alpha_8 wage\_p_i + u_i \qquad (1) \\ ln\left(wage_i\right) =& \beta_1 + \beta_2 age + \beta_3 poorenglish + \beta_4 university + \beta_5 schoolincomp \\ &+ \beta_6 exper + \beta_7 exper^2 + \epsilon_i \qquad (2) \end{aligned}$$

where the variables are as defined in Table 2 and $wage^*$ is the 'shadow' or reservation wage. This model jointly estimates hours and participation by assuming that $wage^* = wage$ for individuals who work and $wage^* > wage$ for individuals who do not work. Variables such as the presence of children in the household and partner's wage would be expected to have a positive impact on the reservation wage and thus a negative impact on hours and participation. For details, see Heckman (1974).

For lone parents, there is no partner so the variable relating to partner's income is excluded from equation (1). We do add a control for whether the lone parent is male or not. For lone parents we thus estimate a system defined by

$$\begin{aligned} ln\left(wage_i^*\right) =& \alpha_1 + \alpha_2 hours_i + \alpha_3 kidspreschool_i + \alpha_4 schoolkids_i + \alpha_5 olderkids_i \\ &+ \alpha_6 nonreskids_i + \alpha_7 homeowner_i + \alpha_9 male_i + u_i \qquad (3) \end{aligned}$$

and equation (2). We estimate the models by full information maximum likelihood. The results for married women and lone parents are presented in Table 7.

The signs of the coefficients are in line with what is found in the Australian literature and in keeping with our a priori expectations. The labour supply elasticity of hours with respect to wages can be derived from the estimates from the coefficient on *hours*. An

exogenous wage increase is equivalent to a shift in the intercept of the market wage equation. For women who work (where $wage_i^* = wage_i$),

$$\frac{\partial hours_i}{\partial \beta_1} = \frac{1}{\alpha_2}. \tag{4}$$

For married women, our estimate of this partial effect is $\frac{1}{.0191} = 52.36$. 52.36 is the increase in hours from an increase of 1 unit in the natural log of wage. If wages increase

Table 7
Labour supply results: coefficient estimates (standard errors)

Parameter	**Variable**	Married Women	Lone Parents
β_1	Constant	3.21^{**} (0.05)	3.06^{**} (0.11)
β_2	Age	-1.47^{**} (0.15)	-1.24^{**} (0.29)
β_3	Poor English	-0.249^{**} (0.087)	-0.39 (0.17)
β_4	University	0.21^{**} (0.023)	0.15^{**} (0.042)
β_5	School incomplete	-0.103^{**} (0.019)	-0.075^{**} (0.034)
β_6	Experience	3.28^{**} (0.35)	2.66^{**} (0.57)
β_7	Experience squared	-4.06^{**} (0.77)	-1.90^{*} (1.15)
α_1	Constant	2.46^{**} (0.073)	2.47^{**} (0.10)
α_2	Hours	0.0191^{**} (0.0019)	0.0164^{**} (0.0027)
α_3	Preschool kids	0.35^{**} (0.042)	0.21^{**} (0.061)
α_4	School age kids	0.108^{**} (0.023)	0.15^{**} (0.044)
α_5	Older children	-0.032 (0.023)	-0.0038 (0.036)
α_6	Non-resident kids	-0.034 (0.029)	-0.018 (0.036)
α_7	Home owner/paying mortgage	0.05^{**} (0.024)	0.043 (0.042)
α_8	Partner's earnings	0.052^{**} (0.014)	
α_9	Male		0.052^{**} (0.014)
σ_u		$.378^{**}$ (0.008)	$.402^{**}$ (0.017)
σ_ϵ		$.539^{**}$ (0.025)	$.464^{**}$ (0.028)
ρ		$.776^{**}$ (0.036)	$.759^{**}$ (0.073)
Sample size		1521	462
Log likelihood value		-5791.4	-1701.7

Notes: α_j and β_k refer to the coefficients from equations (1)/(3) and (2). σ_u and σ_ϵ are the estimated standard deviations of the error terms in these two equations and ρ is the estimate of the correlation between these two error terms. Also, see notes to Table 5.

by one per cent (a change of .01 units of the log of natural wage), labour supply increases by 0.52 hours per week. The same partial effect for lone parents is 0.61. Elasticities for lone parents are larger than those for married women and this is consistent with what is generally found in the literature.

V Models augmented with child care data

For the models of Tables 5 to 7, we add information about the average responses to questions about child care availability, quality and cost aggregated at the local level. Difficulty finding child care, concerns about child care quality, and affordability problems all raise the cost of working. We thus expect participation to be negatively correlated with responses to the questions regarding quality, availability and cost of Table 4.

One might consider using a woman's own response to these questions directly in her own labour supply equation. The problem with this approach is that there is likely to be correlation between the unobservables which determine the response to questions about difficulty, quality, and cost and the decision about whether or not to work. Someone for whom child care quality is never good enough for their child, for example, is also very likely to be not working outside the home.

We avoid this endogeneity problem by using average responses to the child care questions within the Statistical Division (SD) in which the person lives. To avoid the reflection problem, we create the average response variable for each individual separately, leaving out her own response, as described in section III(iii) above. Thus, an individual's labour supply will be modeled as depending upon the average response in that individual's SD constructed without her own response. SD-level averages are therefore constructed separately for each individual. For seven SDs, the only respondent to the child care questions is the individual whose labour supply we are modeling and in that case we drop all observations from that SD from our estimation sample.[10] For individuals who have no resident children under the age of 15, we set the child care variable

[10] We drop the individual who responded to the child care question *and also* any other observations in the SD. This latter group includes households who do not use child care and who did not respond to the child care questions. Excluding some observations from an SD on the basis of whether or not households used child care would introduce selection, so it is cleaner to simply drop all observations from these SDs. This involves dropping at most (depending upon the question) 8 out of 462 observations from the lone parent sample and dropping at most 43 out of 1,521 observations from the married women sample. We report on what happens if we include these observations in section V(iv) below.

equal to zero since child care problems in their geographical area should have no effect on their labour supply decisions. This is equivalent to imposing that the coefficients of the child care variables are zero for these individuals.

We re-estimate the two probability models (working and working full-time) and the labour supply model, incorporating the child care questions. We do this in three ways: (a) we include the 'any difficulty' question which combines information from all three quality questions, all four availability questions, and the cost question; (b) we simultaneously include the 'any availability', 'any quality', and cost questions; and (c) we introduce each question one-by-one in the models. For the models where we include all three variable simultaneously, we will be interested in the joint significance of the three variables. The individual coefficients and their $t-$values are not very informative due to the high correlation (see discussion in section III(iii) and Appendix Table A2) between the three variables.

The three panels of Tables 8 and 9 present these results for the reduced form probit models of working and of working full-time. Table 10 presents the results for the structural labour supply model. Since we have a strong prior belief that difficulties with the local supply of child care should have negative effects on labour supply, we present one-sided significance tests in the tables. We briefly discuss the results in the following three sub-sections and provide a more comprehensive discussion in section VI.

(i) The probability of working

We find only some evidence that local difficulties with child care have an effect on the decision to work (Table 8). The 'any quality' question is negatively significant at the 10 per cent level when we simultaneously include cost, quality and availability problems in the model. However, the three variables are jointly insignificant and the 'any difficulty' question, while the expected sign, is not statistically significant. In the case where we include the variables one-by-one in the model, reported cost difficulties, two of the quality and one of the availability questions are significantly negative. For lone parents, the 'any difficulty' question is significantly negative at the 10 per cent level.

Table 8

Effect of SD average responses to questions about child care on decision to work

Marginal effects (standard errors)

Question	Average response within SD: Married women	Average response within SD: Lone parents
Results with one summary measure of any difficulty		
Any difficulty question	$-.0140$ (.0117)	$-.0363^{+}$ (.0239)
Results with simultaneous controls for availability, quality and cost		
Any quality question	$-.0515^{+}$ (.0348)	.0064 (.0553)
Any availability question	.0298 (.0288)	$-.0443$ (.0476)
Difficulty with the costs of child care	.0026 (.0113)	.0024 (.0232)
p-value for test of joint significance	0.35	0.40
Results with variables introduced one-by-one into model		
Questions relating to quality		
Difficulty in finding quality child care	$-.0203^{*}$ (.0111)	$-.0357^{*}$ (.0208)
Difficulty in finding right person to care for my child	$-.0109$ (.0111)	$-.0224$ (.0224)
Difficulty in finding care that my children are happy with	$-.0146$ (.0133)	$-.0219$ (.0225)
Any quality question	$-.0179^{+}$ (.0120)	$-.0322^{+}$ (.0228)
Questions relating to availability		
Difficulty in finding care for hours needed	$-.0068$ (.0104)	$-.0315^{+}$ (.0199)
Difficulty juggling multiple child care arrangements	$-.0018$ (.0097)	$-.0318^{+}$ (.0196)
Difficulty finding a place in the child care centre of choice	$-.0137^{+}$ (.0098)	$-.0192$ (.0189)
Difficulty finding child care in the right location	$-.0107$ (.0104)	$-.0291^{+}$ (.0200)
Any availability question	$-.0106$ (.0107)	$-.0375^{*}$ (.0219)
Question relating to cost		
Difficulty with the costs of child care	$-.0125^{+}$ (.0090)	$-.0095$ (.0182)
Sample sizes	1478 to 1513	454 to 460

Notes: *** *statistically negative at the 1 per cent level (or lower).*
** *statistically negative at the 2.5 per cent level (or lower).*
* *statistically negative at the 5 per cent level (or lower).*
$^{+}$ *statistically negative at the 10 per cent level (or lower).*

Table 9

Effect of SD average responses on decision to work full-time
Model excludes those who are not working (full-time work=1; part-time work=0)
Marginal effects (standard errors)

Question	Average response within SD: Married women	Average response within SD: Lone parents
Results with one summary measure of any difficulty		
Any difficulty question	$-.0594^{***}$ (.0119)	.0088 (.0373)
Results with simultaneous controls for availability, quality and cost		
Any quality question	$-.0555$ (.0572)	$-.0732$ (.0910)
Any availability question	.0266 (.0491)	.0827 (.0760)
Difficulty with the costs of child care	$-.0340^{+}$ (.0197)	$-.0029$ (.0342)
p-value for test of joint significance	0.016^{***}	0.73
Results with variables introduced one-by-one into model		
Questions relating to quality		
Difficulty in finding quality child care	$-.0452^{***}$ (.0203)	$-.0071$ (.0327)
Difficulty in finding right person to care for my child	$-.0386^{*}$ (.0196)	$-.0099$ (.0348)
Difficulty in finding care that my children are happy with	$-.0849^{***}$ (.0241)	$-.0072$ (.0360)
Any quality question	$-.0597^{***}$ (.0224)	$-.0013$ (.0360)
Questions relating to availability		
Difficulty in finding care for hours needed	$-.0400^{**}$ (.0188)	.0236 (.0307)
Difficulty juggling multiple child care arrangements	$.0285^{*}$ (.0170)	$-.0374$ (.0293)
Difficulty finding a place in the child care centre of choice	$-.0521^{***}$ (.0182)	.0279 (.0286)
Difficulty finding child care in the right location	$-.0468^{***}$ (.0187)	.0232 (.0315)
Any availability question	$-.0449^{***}$ (.0202)	.0209 (.0346)
Question relating to cost		
Difficulty with the costs of child care	$-.0497^{***}$ (.0155)	$-.0115$ (.0268)
Sample sizes	1125 to 1144	324 to 328

Notes: See notes to Table 8.

Table 10

Effect of SD average responses to questions about child care on shadow price of women's time

Coefficient estimates (standard errors)

Question	Married women	Lone parents
Results with one summary measure of any difficulty		
Any difficulty question	.0273*** (.0115)	.0188 (.0183)
Results with simultaneous controls for availability, quality and cost		
Any quality question	.0599* (.0324)	−.0033 (.0420)
Any availability question	−.0323 (.0269	.0144 (.0345)
Difficulty with the costs of child care	.0053 (.0105)	.0077 (.0178)
p-value of likelihood ratio test of joint significance	0.03**	0.77
Results with variables introduced one-by-one into model		
Questions relating to quality		
Difficulty in finding quality child care	.0301*** (.0111)	.0213+ (.0159)
Difficulty in finding right person to care for my child	.0207* (.0108)	.0142 (.0169)
Difficulty in finding care that my children are happy with	.0315*** (.0130)	.0071 (.0173)
Any quality question	.0312*** (.0119)	.0161 (.0175)
Questions relating to availability		
Difficulty in finding care for hours needed	.0159+ (.0101)	.0157 (.0153)
Difficulty juggling multiple child care arrangements	.0087 (.0092)	.0293* (.0155)
Difficulty finding a place in the child care centre of choice	.0243*** (.0098)	−.0004 (.0140)
Difficulty finding child care in the right location	.0205** (.0102)	.0096 (.0150)
Any difficulty question	.0207** (.0105)	.0159 (.0167)
Question relating to cost		
Difficulty with the costs of child care	.0227*** (.0087)	.0115 (.0139)
Sample sizes	1478 to 1513	454 to 460

Notes: See notes to Table 8.

Two of the quality and four of the availability questions are significantly negative when included one-by-one, but the quality, difficulty, and cost questions are jointly insignificant when included simultaneously in the model. In summary, the effect of local reported difficulties with the quality, availability, and cost of child care appears to have only a weak negative relationship with the probability of working.

(ii) Probability of working full-time

The results for working full-time as opposed to working part-time are much clearer than those for the participation model (Table 9). For married women who work, we find a very strong negative relationship between local reported difficulties with the quality, availability, and cost of child care and the probability of working full-time. This result holds if we include the variables one-by-one or simultaneously in the model. Conversely, for lone parents who work, we find no relationship between the full-time/part-time decision and local reported difficulties with the quality, availability, and cost of child care at any level of regional aggregation.

(iii) Labour Supply

We augment the model of equation (1) with information about the quality/availability/cost of child care in the same way as we did for the participation models of the previous section. The model of equation (1) becomes

$$\begin{aligned} ln\,(wage_i^*) = \alpha_1 + \alpha_2 hours_i + \alpha_3 kidspreschool_i + \alpha_4 schoolkids_i + \alpha_5 olderkids_i \\ + \alpha_6 nonreskids_i + \alpha_7 homeowner_i + \alpha_8 wage\_p_i + \alpha_{10} AVG_{SD,(-i)} + u_i \quad (5) \end{aligned}$$

where $AVG_{SD,(-i)}$ is the average response level (leaving out the ith person's response) in the SD for those cases where there are at least two responses to the question. The wage equation (2) remains unchanged. For lone parents, the shadow wage equation, (3), is transformed in similar fashion. If child care difficulties matter for labour supply, we expect α_{10} to be positive, as difficulties with child care make going to work relatively less attractive, equivalent to raising the reservation wage.

Results for married women and lone parents are presented in Table 10. For lone parents, two questions are statistically positive at fairly weak levels. None of the models have statistically significant coefficients for the 'any difficulty' question or for the joint

inclusion of cost, quality and difficulty problems. We can conclude that there is little or no relationship between local reported difficulties with the quality, availability, and cost of child care and labour supply. This is consistent with what we found above for the part-time/full-time results.

For married women, the child care variables are strongly significant in the structural labour supply model. The any difficulty question is significant at the one per cent level. The three variables on availability, quality and cost, when included simultaneously, are significant at the three per cent level. All of the individual questions except the question on 'difficulty juggling multiple child care arrangements' are significant when included one-by-one in the model. These results are consistent with the results of the reduced form model of the probability of working full-time.

(iv) Robustness of results

We estimated the participation and labour supply models with a wider set of explanatory variables including household wealth variables, additional educational categories, and public tenancy. These were all insignificant in the models of section IV and V and do not affect the results of section V. We also estimated the baseline model with dummy variables for the different states/territories and capital city. None of these were significant. We did not include them in subsequent models. This latter result does provide some assurance that results from the local averages of responses to child care questions are not being driven simply by state or capital city differences.

We re-estimated all of the models of Tables 8 through 10 using three alternative levels of aggregation, 9-digit Statistical Local Area (SLA), 5-digit Labour Force Region (LFR), and a combination of Major Statistical Region (MSR) and Section of State (SOS) information.[11] SLAs are quite small and for half of all SLAs we only have one response to the child care questions forcing us to use only half the sample. Unsurprisingly, therefore, SLA-level results are generally insignificant. Results for LFR and MSR/SOS are very similar to what is reported here for SD. Our preferred level of aggregation from a theoretical point of view is SD. SLA is clearly too small. People seek and obtain work well outside of the SLA in which they live, but almost never outside of the SD in which

[11] See Australian Bureau of Statistics (2005) for definitions of these local regions. These results are available in a detailed working paper. Link to be provided on publication.

they live (except for boundary cases.) There appears to be a misconception that LFR is designed to capture the geographical area in which people look for work. However, LFRs are chosen such that they have equal sample sizes and with no reference to natural areas in which people live and work (and seek child care).[12] A quick inspection of LFRs in the major cities around Australia show that they make arbitrary divisions between neighboring suburbs which are clearly in the same region when it comes to commuting for work or choosing a school or a child care centre. The main advantage of SDs is that they treat the main urban centers as a single unit. While the SD is fairly wide and may include areas that are far from where a person lives, they are usually within commuting distance and at least some people seek child care close to work when they work far from home. Lastly, we believe that SD is the right level of aggregation to capture local supply and demand forces which determine quality, availability, and cost of child care.

We re-estimated all of the models of Tables 8 through 10 including the SDs where we only have one response to the child care questions. In this case, we set the response equal to zero for that individual (since when we use our leave-one-out calculation there are zero observations) and we include a dummy variable equal to one if an observation is in an SD with only one response to the child care questions. The results are virtually unchanged and we can conclude that dropping these few observations does not have an important impact on the outcomes.

VI Discussion and conclusion

In this paper we show a significant statistical relationship between reports of difficulties, aggregated at the local level, with child care–affordability, quality, and availability–and married women's labour supply. Women in areas which have higher average reports of problems with quality, availability and cost work fewer hours and are more likely to work part-time relative to women in areas with lower average reports of child care difficulties. In a structural labour supply model, these reports are also statistically significant and have a negative effect on participation and hours. By using average reports on subjective measures of difficulties with obtaining child care and excluding the own individual's response, we avoid the problem of correlation between an individual's work choices and

[12] Australian Bureau of Statistics (2004) documents how LFRs are chosen.

her reported problems with child care.

Interestingly, reports of problems with availability, quality and cost are highly correlated and all of the questions appear to have a very strong common element to them. We take this as evidence that people respond to these questions on the basis of overall difficulty with obtaining child care and do not cleanly separate out quality from cost from availability. This makes sense. Imagine a case where a person must choose from a low-quality centre near home and a similarly-priced but high-quality centre far from home. The problem could be expressed as one of quality, one of availability (the unavailability of a high-quality centre near home), or one of cost (the additional expense of commuting to the high-quality centre).

This paper was motivated by two concerns. The first concern is scepticism about the consensus in the Australian literature that women's labour supply is not very responsive to the child care environment, particularly with respect to the price of child care. The second concern is the lack of research on non-price factors of child care such as quality and availability and the relationship of these non-price factors to labour supply decisions. Our results, while exploratory in nature, lead us to question whether the consensus is in fact correct and indicate that further research on non-price factors is likely to be rewarding.

There are several caveats to our results. The first important caveat is that, since the measures we use appear to indicate the overall difficulty in finding satisfactory child care in a convenient location with a reasonable price, the measures do not allow us to clearly separate the issues of child care availability, affordability and quality. Secondly, we are unable to translate these results into economically meaningful quantities such as elasticities. The subjective nature of the questions, and the zero to ten scale on which they are measured, prevent us from being able to quantify our results in the way that would be most useful to policy-makers.

A third important caveat is the nature of the subjective responses to these questions. In an unpublished paper, Yamauchi (2009) notes that increased reports of problems with availability seem *positively* correlated with an increase in the number of centre-based child care places per 100 children age 0-4. It could be that supply growth is lagging behind demand growth. It could likewise be that expectations about availability

differ from community to community and that communities with more availability might have even higher expectations as to how much availability would be desirable. In this respect, variation across localities may reflect variations in expectations rather than real differences in quality, availability or cost.

Nonetheless, our results serve two important purposes in advancing the literature on child care in Australia. Firstly, many of the studies mentioned in section 2 above find no significant effect on labour supply of child care price. Rammohan and Whelan (2007), for example, find no significant effect on the propensity to work part-time in response to higher child care prices. Doiron and Kalb (2005) find a very small elasticity of work hours with respect to the price of child care among married mothers. These studies have led to a consensus that labour supply is not very responsive to child care affordability in Australia. Our paper would suggest that in fact there is something going on between maternal labour supply choices and child care cost, availability and quality, contradicting that consensus.

Secondly, this study shows that subjective evaluations of quality, availability and cost are correlated with maternal labour supply. These descriptive results indicate that future research based on accurate, objective measures of quality, availability, and cost is likely to be fruitful in understanding the relationship between child care and labour supply. Such research could be done with existing administrative data if it were made available to researchers. Data about staff qualifications, length of waiting lists, physical location and number of places would all provide more objective measures of quality and availability. Making use of the potential of this kind of detailed, administrative data is in the interest of both academics and policy-makers as it would significantly help improve our understanding of the relationship between child care and labour supply.

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Appendix

Table A1: Correlation between individual-level responses to child care difficulty questions: HILDA respondents with children under age 15 who used or considered using child care

	qual1	qual2	qual3	avail1	avail2	avail3	avail4	cost1	anyqual	anyavail
qual2	0.80									
qual3	0.67	0.67								
avail1	0.69	0.71	0.60							
avail2	0.56	0.55	0.51	0.58						
avail3	0.70	0.62	0.65	0.59	0.53					
avail4	0.72	0.61	0.66	0.62	0.56	0.83				
cost1	0.44	0.44	0.42	0.46	0.53	0.43	0.42			
anyqual	0.92	0.92	0.87	0.74	0.59	0.72	0.73	0.49		
anyavail	0.77	0.72	0.69	0.84	0.79	0.89	0.90	0.53	0.81	
anydiff	0.87	0.85	0.81	0.82	0.74	0.84	0.85	0.66	0.93	0.94

Table A2: Correlation between SD-level average responses to child care difficulty questions: HILDA respondents with children under age 15 who used or considered using child care

	qual1	qual2	qual3	avail1	avail2	avail3	avail4	cost1	anyqual	anyavail
qual2	0.88									
qual3	0.66	0.58								
avail1	0.77	0.77	0.82							
avail2	0.74	0.82	0.61	0.75						
avail3	0.76	0.61	0.56	0.58	0.51					
avail4	0.83	0.65	0.61	0.69	0.54	0.90				
cost1	0.38	0.47	0.54	0.52	0.51	0.09	0.12			
anyqual	0.95	0.93	0.81	0.86	0.82	0.72	0.78	0.51		
anyavail	0.90	0.82	0.75	0.87	0.76	0.87	0.93	0.3 4	0.91	
anydiff	0.93	0.89	0.81	0.90	0.82	0.78	0.84	0.54	0.98	0.96