Child Care Assistance: Are subsidies or tax credits better?

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Abstract

We evaluate price subsidies and tax credits for child care. We focus on partnered women's labor supply, household income and welfare, demand for child care and government expenditure. Using Australian data, we estimate a joint, discrete structural model of labor supply and child care demand. We introduce two methodological innovations: a more flexible quantity constraint that total formal and informal child care hours are at least as large as the mother's labor supply and maternal child care explicitly included in the utility function as a proxy for child development. We find that tax credits are more effective than subsidies in terms of increasing average hours worked and household income. However, tax credits disproportionately benefit wealthier and more educated women. Price subsidies, while less efficient, have positive re-distributional effects.

JEL CODES: C15; C35; H24; H31; H53; J22.
KEYWORDS: Child care; Labor supply; elasticities; discrete choice model.

Policy points

- Child care price subsidies and tax rebates both increase labor supply of mothers, demand for formal care, and disposable income of households.
- Within the broad framework of the Australian tax and transfer system, tax rebates have greater impacts on labour supply and household income, both because the impact per dollar spent is greater and because the return in government revenue is higher.
- At the current levels at which subsidies to childcare are provided in Australia, price subsidies are more redistributive than tax rebates. Tax rebates, however, are less expensive than price subsidies.

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1 Introduction

Many governments subsidize child care. For example, in some European countries, child care services are provided through universal public programs (OECD (2007)). In the US, although most child care is provided by the private market, various programs exist which subsidize child care, particularly for low income families. In Australia, the federal government pays over half of child care costs of most households through a combination of a means-tested price subsidy (Child Care Benefit, CCB) and a universal subsidy program, originally introduced as a tax rebate for expenditure on child care (originally called Child Care Tax Rebate, CCTR, which later became Child Care Rebate, CCR). The most emphasized reason for public subsidisation of child care is to encourage women with young children to enter the labor market. Improving child outcomes and distributional considerations related to equitable access to quality child care are two other oft-cited justifications.[1] Public assistance comes with costs, including higher taxes. Evaluating the economic effects of child care assistance is thus important for both governments and citizens.

Modeling the relationship between child care costs and labor supply presents a variety of challenges which we discuss in section 2. It can be difficult to determine the correct price of child care. Correctly estimating the labor supply response of women to changes in child care price requires modeling the tax and transfer system and other institutional features in their full complexity. The role of paid, formal child care and unpaid, informal child care both need to be considered. Families purchase child care so that they can go to work but they also purchase child care because they care about quality education for their children and models should allow for both aspects.

In this paper, we take on these challenges by estimating a joint, structural labor supply and child care demand model for partnered women (we include couples in de facto relationships and in formal marriages and refer generically to these two groups as 'partnered' or 'married'). Our modeling recognizes the close relationship between

[1] For example, the Henry Tax Review, Commonwealth of Australia (2009), p. 583, states "assistance to access high-quality and affordable child care is important to the workforce participation of parents, providing them with the means to support and provide opportunities for their children."

decisions to work and child development. We use local area average prices to remove the effect of the household's specific choice of child care quality from the cost-of-working component of child care. Our model incorporates the Australian tax and transfer system including all of the major welfare programs which affect married households' labor supply and child care demand decisions. We improve on previous models of this type by incorporating a new, more flexible, hours constraint that the sum of formal and informal (which can include paternal) child care must be greater than or equal to the number of hours worked by the mother and by including maternal care explicitly in the utility function. We show that these modeling innovations make a substantive difference to the estimated elasticities.

Using our estimates, we provide a set of labor supply and child care demand elasticities for Australia. The advantage of our approach is that the structural model allows for welfare analysis and for comparison of alternative policies through simulation. As an example, we compare and contrast a child care price subsidy to a tax rebate for child care expenditure. We find that the tax rebate is more efficient and effective in increasing women's labor supply. However, child care price subsidies re-distribute the benefits towards those households with less education and less income whereas tax credits disproportionately benefit the already better off. Our modeling approach and results highlight the importance of accounting for the specific features of child care assistance, the tax system and welfare regimes in policy evaluation. As Australian institutions are a hybrid of U.S. and European ones, our results should be of interest to many. We believe that our overall conclusions about the trade-offs between tax rebates and price subsidies apply widely even if the estimates we present are specific to Australia.

In the next section, we provide some background and discuss, in more detail, the nature of the modeling challenges. In section 3 we briefly discuss child care arrangements in Australia before proceeding to discussion of our modeling approach and data (sections 4 and 5). We discuss parameter and elasticity estimates in section 6 and evaluate the relative performance of tax credits and price subsidies in section 7 before concluding.

2 Background

Assessing child care assistance programs depends upon correctly estimating the responses of women's labor supply and child care demand to child care costs. The literature over the last 15 years shows that female labor supply and child care demand respond negatively to child care prices, but the range of estimated elasticities is quite wide. Labor supply elasticity is estimated to be between 0 to -1.26 (see Blau (2003) or Breunig, Gong and King (2012)). Estimates of own price elasticities for child care vary equally widely, ranging from -0.07 in Blau and Hagy (1998) to -1.0 or more in, for example, Connelly and Kimmel (2003), Powell (2002), and Cleveland, Gunderson and Hyatt (1996).[2] Blau (2003) notes that the variation in estimates is likely a result of differences in specification and estimation. The complexity of the underlying economic problem and inadequate data both contribute to the specification and estimation issues.

Determining a correct price for child care may be difficult. Some problems are related to data availability. We may only observe total costs for child care, making it difficult to deal with the price heterogeneity for children of different age groups in households with more than one child. We may only observe hours worked by the mother, not hours in care. In a labor supply equation, a child care price that is constructed using working hours will be endogenous by construction as it induces spurious correlation between price and hours. Some studies deal with these problems by restricting the scope of analysis to full-time working mothers or families with only one child with the implicit assumption that hours worked are equal to formal child care hours, e.g. Connelly (1992). Breunig et al. (2012) illustrate with a simple linear labor supply model that a good measure of child care price is indeed crucial to the results and found that measurement error was, at least partly, responsible for previous authors' failure to find a relationship between child care price and women's labor supply in Australia.

Another complexity is that the observed price a family pays for child care reflects both a 'cost of working' aspect and a 'child care quality' aspect. Quality may be difficult or impossible to observe.[3] Another endogeneity problem arises because choice of child

[2] See Baker, Gruber and Milligan (2008) for additional references and discussion.

[3] Further discussion can be found in Anderson and Levine (2000), Blau (2003) and Baker et al. (2008).

care quality may be correlated with unobserved preferences relating to working hours. Child care price is not observed for those who do not use child care. Informal care, an important alternative to paid, formal care, is often unreported or when it is there is no price assigned to it.

Labor supply and child care decisions are closely related, but households use child care for purposes beyond freeing up time for paid work. These include child development, socialization and education, and freeing up time for leisure or home production activities of the parents. This relationship needs to be accounted for in modeling. For example, Duncan, Paull and Taylor (2001a) found that failure to take into account the 'quantity constraint' on child care (young children need to be taken care of at all times) may lead to overestimation of labor supply elasticities. This restriction has been ignored in most studies. In a few studies where it is included, the restriction is imposed in a strong way that violates the observed data. For example, Duncan et al. (2001a) constrained the number of paid (or formal) child care hours to be greater than the number of hours worked by the mother, ruling out the possibility that informal care is used during mother's working hours. Kornstad and Thoresen (2006, 2007) assume that mother's work hours must be exactly equal to paid child care hours. Figure 1 shows that more than half of the observations in our data violate the second assumption while one-third violate the first assumption.

Another problem is that the details of institutional features of child care assistance, the welfare system and the tax system are often difficult to model and hence are 'abstracted away' in economic analysis.[4] Yet, some institutional features may be too important to ignore and child care subsidies are often intertwined with other aspects of the welfare system. As Atkinson (1999) (page 89) points out, incorporating or ignoring such institutional features may lead to very different results. Child care subsidy programs may be complicated and nonlinear as they are often designed to achieve multiple policy objectives such as labor force participation and redistribution and often reflect political compromises rather than first-best policy. In our case, Child Care Benefit (see section

[4]Child care price effects on labor supply estimated in the literature are generally assumed to be linear while most subsidies are non-linear, Blau (2003).

3 below) is means-tested, depends upon the number of children and number of hours in care, and the labor market and training status of the parents.

Our approach will be to estimate a joint, discrete structural model of child care demand and women's labor supply. This type of discrete model, first proposed by Van Soest (1995), allows us to restrict working and child care hours to those points commonly observed in the data and to incorporate the tax and transfer system as well as institutional features of child care assistance. This approach also allows us to calculate net and gross price elasticities.

Specifying and directly estimating the utility function has been done by others, for example, Blau and Robins (1988); Ribar (1992, 1995); Blau and Hagy (1998); Duncan et al. (2001a); and Kornstad and Thoresen (2006, 2007). Only the last two papers allow for a non-linear budget constraint as we do. We also introduce two novel features. The first is that we assume that families directly derive utility from maternal care. Maternal care enters the utility function because it contributes to child development.[5] We impose no assumption about the relative quality of maternal care relative to other types of care. Kornstad and Thoresen (2006, 2007) allow the choice set to depend upon the mode of child care but restrict utility to depend only upon leisure and consumption. The second novel feature we introduce is that we allow mother's work hours to be less than, equal to or greater than hours of formal child care. This relaxes the constraints which have been placed on the relationship between work hours and formal child care hours in previous studies. We achieve this additional flexibility by including time constraints for both mothers and children in determining the household budget set and defining *informal care to facilitate mothers' work* ('informal care' in what follows) as making up any shortfall between mother's work hours and formal child care. We discuss this set-up in detail in section 4.3. We show how the elasticities change under different hours restrictions and the exclusion of maternal care from the utility function in section 6.3.

The impact of child care subsidies and tax credits on child care demand and female labor supply has been investigated previously, for example, Apps, Kabátek, Rees

[5]We do not observe measures of child development. In our model, maternal hours spent caring for children is assumed to affect child development and hence, enters the household utility function.

and van Soest (2012), Averett, Peters and Waldman (1997), Doiron and Kalb (2005), Michalopoulos, Robins and Garfinkel (1992), Viitanen (2005), and Wrohlich (2011). Apps et al. (2012) adopt a similar approach to this paper in estimating a joint structural model, but without our improvements to the hours constraint. They emphasize the consequences of household heterogeneity in estimating the model, but specify and estimate a household welfare function rather than a utility function.

Finally, we are careful in our treatment of the child care price. We use local median prices in the labor supply equation. We justify this, describe the price construction in detail and provide interpretation of our approach below. Next, we describe the economic environment relating to child care and Australia's child care subsidy schemes.

3 The Australian context

3.1 Macroeconomic environment

The last fifteen years in Australia has seen an increase in female labour force participation and a very rapid growth in the number of children in formal child care. According to Australian Bureau of Statistics (2015), female labour force participation increased from 54.1% in January 2010 to 58.5% in January 2015. Productivity Commission (2014) states, on page 91, "Over the 15 years to 2011, there has been an almost doubling in the number of children attending formal early childhood and education (ECEC) services–far in excess of the growth in the population of children."

Child care provision, which was primarily public in the 1980s, has become primarily private (over 70% of child care places are in privately owned and operated centres). The price of child care has increased at a rate higher than inflation over this time. At the same time, child care is heavily subsidised.[6] We turn to a description of these subsidies next.

[6] Baxter (2013) provides details of these trends.

3.2 Child care subsidy system

Like many other countries, Australia only subsidizes formal child care.[7] The primary subsidy is Child Care Benefit (CCB), a means-tested program, indexed to the Consumer Price Index (CPI), which reduces the hourly cost of formal child care. CCB decreases with family income but is available to all households at every income level. In 2005, the standard subsidy was $2.88 per hour (up to 50 hours per week) for a single child. This represents 59% of the average price in 2005. The minimum hourly rate in 2005 was $0.483 (10% of the average price) for households with combined income over $95,683 per annum.[8] CCB depends upon the number of children in care and the number of paid child care hours–the hourly rate is higher if more children are in care or if less than 38 hours of care are used. In addition, CCB has loosely-enforced work and training requirements–in households where at least one of the parents is not working or participating in training/education, the maximum subsidized number of hours is limited to 20 (rather than 50). Thus, CCB has a complicated structure, which we incorporate into our model, that depends on a variety of household characteristics. Because CCB is primarily paid directly to providers, take-up rates are nearly 100 per cent.

Child Care Tax Rebate (CCTR), which is not means-tested, provided a tax rebate which could be claimed by families with children in accredited care. It was announced by the Howard Government during the election campaign in late 2004. The essence of CCTR was that families were able to claim 30 per cent of their out-of-pocket costs (that is, costs in excess of CCB payments received) for approved child care up to a maximum of $4000 per child per annum. This cap was indexed to CPI. Households were able to claim CCTR for the 2004-2005 Financial Year, but could only do so after filing their 2005-06 Financial Year tax return. CCTR has undergone a number of changes since its inception. Since the 2006-2007 Financial Year[9] CCTR has been changed into a transfer payment which households can receive even if they incur no tax liability. Since the 2008-

[7] Formal child care in Australia takes three main forms: Long Day Care centres; Family Day Care; and In-Home Care. An accreditation system operates for all three types and families of children in accredited centers are eligible to receive child care assistance. See Department of Education, Employment and Workplace Relations (2008).

[8] All dollar amounts in Australian dollars. Current exchange rates with the U.S. are near parity.

[9] The financial year in Australia is 1 July to 30 June.

2009 Financial Year, CCTR was increased to cover 50 per cent of the out-of-pocket child care costs after CCB and was paid quarterly. Only a year later, indexation was removed from the per-child cap which now stands at $7,500 per year. The program was renamed Child Care Rebate (CCR) in 2009. The main difference between the original CCTR and CCR is that CCTR was a tax rebate so was only of value for those with a tax liability. CCR is a subsidy available to those with or without a tax liability. It differs from CCB in that it is not means tested.

These subsidies are part of a larger, quite complicated system of progressive tax and transfer payments. For our population, the important payments include: Family Tax Benefit Part A, a tax credit for households with children which is means-tested and capped; Family Tax Benefit Part B, an additional tax credit for families when one partner does not work; Parenting payments for low-income families with children; Newstart Allowance, an unemployment benefit which is essentially a minimum income payment that does not depend upon any insurance scheme and which is paid indefinitely. There is also a low-income tax offset similar to the earned income tax credit in the U.S.[10]

In the next section we describe the structural model that we will use to identify the key elasticity parameters which we can use to assess the effects of these subsidy programs. We also provide new evidence on the relative effectiveness of price subsidies vs. tax credits.

4 Model and Estimation

4.1 The discrete choice model of labor supply and child care

Our empirical model is based on the discrete neo-classic labor supply model developed by Van Soest (1995). We extend the model to include maternal child care as an explicit argument of the household utility function and to define the budget constraint over discrete pairs of working hours and formal child care hours. Households are assumed to maximize utility over consumption, leisure of the mother, and maternal care, by

[10] Centrelink (2011) lists 35 separate payments which currently comprise the Australian welfare system. Most of these are quite small or do not apply to our population. See also footnote 16.

choosing mother's hours of work and hours of formal child care.[11]

We incorporate into the model, via a series of hours constraints, the following assumptions on the relationship between mother's hours worked and child care hours:

- Total (formal plus informal) child care hours are at least as large as the mothers hours of work. During waking hours, children are cared for in one of three possible ways: by the mother, in formal child care or in informal child care.

- Child care serves a child development purpose and the family may explicitly use child care for this reason. Thus, the household may choose to use formal child care regardless of whether the mother is at work or not. We allow formal care hours to exceed mother's working hours.

- Informal care (including paternal care[12]) is calculated as the difference between mother's working hours and hours in formal child care. This implies that informal care, as defined in our model, is only used to facilitate work. If formal child care hours equal or exceed mother's working hours, informal child care is zero; otherwise, informal child care equals mother's hours worked less hours in formal child care. Informal care can not be modeled as an independent choice because of the adding up constraint which requires that children be cared for at all times, thus we do not use the reported hours of informal child care which are available in the data. To satisfy simultaneously the time endowment constraint of the mother and the hours in care constraint of children, it is impossible to allow hours of formal and informal care to vary freely without imposing some structure on the relationship between the two. Below, we show that informal hours as defined in our model match the reported hours of informal care in the data fairly well.

- We assume that the father's work hours are fixed–i.e. there is no labor supply response of fathers to changing child care subsidies or changing work hours of the mother. This is assumed for tractability of the model but also corresponds to

[11]Early work on child care, while done in a framework of utility maximization, abstracted from the non-linearity of the tax and transfer system by specifying a linear labor supply model, for example Connelly (1992), or estimated a reduced form model (e.g. Ribar (1995) and Blau and Hagy (1998)).

[12]Informal care could be provided by the father, but we do not explicitly model this.

evidence that mothers still bear a disproportionate share of time in taking care of children–Sayer (2005); Kalenkoski, Ribar and Stratton (2005).[13]

- An important implication of the above is that formal care may be used to facilitate leisure, education, or work for the mother whereas informal care can only be used to facilitate work.

These assumptions reflect the inter-linkage between labor supply and child care and the dual purpose of child care as an input into child development and a cost of working. They provide sufficient restrictions to allow for model estimation yet relax the constraints imposed previously in the literature. Previous papers either assumed that (i) formal hours of child care exactly equals mother's hours of work; or (ii) formal hours of child care exceed mother's working hours. Both are violated in our data, however, in the results section we estimate the model under these alternative, more restrictive hours constraints and examine how our results are affected.

Our approach allows us to study the relationship between formal care and mother's working hours. It allows us to answer questions about the relationship between child care prices and subsidies and demand for formal care and female labour supply. Because of our treatment of informal care as a residual to cover the gap between mother's work hours and formal child care hours, our approach does not allow us to study questions about shared care arrangements between mothers and fathers; about the use of informal care for purposes other than freeing up time for mother's work or the trade-off between formal and informal care.[14]

One final simplifying assumption is that we do not model child care usage of school-aged children. In our sample, 42 of 422 households with both pre-school and school-aged

[13] Kalenkoski et al. (2005) also confirm a common finding that while women's market work responds to the presence of children, men's market work does not. Kimmel and Connelly (2007) model women's time spent in a variety of activities including home production and childcare and similarly treat father's behavior as fixed.

[14] In practice, households will choose between formal and informal care based upon their own circumstances. The presence of family members nearby will make informal care inexpensive. Informal care may be very expensive if families have little information about potential care-givers. Supervision of such potential care givers may involve exorbitant cost. Families, depending upon their circumstances, may have different views on the relative quality of formal and informal care. Although we have limited ability to observe these factors, we include information about immigrant status and the presence of other family members in the household to partially control for the differential costs and availability of informal care.

children used formal care for school-aged children, on average 7 hours per week. This simplification, while somewhat unrealistic, makes the model easier to estimate. However, we test this assumption by estimating two alternative models and we find that our results are insensitive to this change.[15]

4.2 Model notation

Before providing the formal specification of the model, we introduce all notation and abbreviations we use in section 4.3 below.

- U: household utility
- y: general consumption net of child care costs
- l_m: mother's hours of leisure
- c_m: mother's hours spent on child care
- v: vector of natural logs of y, l_m, c_m
- A: matrix of utility function parameters
- b: vector of utility function parameters
- τ: function which captures tax and transfer system
- ψ: function which captures child care subsidy system
- y_0: sum of household non-labour income and father's income
- w: mother's wage
- h: mother's working hours
- c_{fp}: hours of formal child care purchased by household for pre-school children
- c_{fs}: hours of formal child care purchased by household for school-aged children
- p_{fp}: hourly price of formal child care for pre-school children
- p_{fs}: hourly price of formal child care for school-aged children
- X: vector of household characteristics
- T_m: mother's time endowment
- T_c: time during which children need to be cared for
- π: parameters of the wage equation
- z: vector of mother's characteristics that determine labour productivity

[15] First, we model demand for before- and after-school care for school-aged children as being determined by child care demand for the pre-school child. For example, if formal hours of child care for the pre-school child are 40 and the school-aged child spends 30 hours in school per week, then the school-aged child is in care for 10 hours per week. Secondly, we estimate the model using households with pre-school children only. These estimates, and the simulated elasticities, are available from the authors. In neither case do the substantive results presented below change. Our preferred results are the ones we present below as the sample of households with pre-school children only is about forty per cent smaller.

4.3 Model specification

The household is assumed to maximize utility by choosing mother's working hours h and formal child care hours c_{fp} of her young children (the average hours if more than one child) from a set of discrete options:

$$\max_{h,c_{fp}} U(v) = v'Av + b'v, \quad v \equiv (\log y, \log l_m, \log c_m) \tag{1}$$

$$s.t. \;\; y \leq \tau(y_0 + wh, X) - N_p\psi(p_{fp}c_{fp}, y_0 + wh, X) - N_s\psi(p_{fs}c_{fs}, y_0 + wh, X) \tag{2}$$

y is general consumption net of child care costs which is determined through the budget constraint (2) by asset income and father's income (both captured in y_0), the mother's wage (w) and working hours, and the tax/welfare system which is captured by the function τ and which depends upon household characteristics, X.[16] c_{fs} is the formal child care hours of her school aged children, which is assumed to be fixed at the observed hours. N_p and N_s are the number of pre-school and school-aged children and p_{fp} and p_{fs} are prices of formal child care for pre-school and school-aged children, respectively. The function ψ captures child care subsidies which depend upon child care costs (price multiplied by usage) and household characteristics.

For p_{fp} and p_{fs} we use local average prices, constructed as described in subsection 5.2 below. 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 child care may depend upon quality, which we don't observe, but which will be correlated with price. This creates an omitted variable problem since omitted quality is correlated with included price. The quality of child care which is chosen may also be correlated with unobserved preferences which affect working hours. By using local area averages, we are essentially using a quality-adjusted price. Our modeling assumption is that households use the average price level as the signal in deciding the amount of child care to purchase. This is akin to assuming that shifts in median prices affect all quality levels.

[16] In τ, we include Newstart Allowance (NSA), Parenting Payment Partnered (PPP), Family Tax Benefits A and B, together with income tax, Medicare Levy, Pharmaceutical Payment and Low Income Tax Rebate (LITO).

Preferences about quality determine the difference between the average price and the price the household actually pays.

Mother's leisure, l_m, is specified as the difference between her time endowment ($T_m = 70$) and time spent working or caring for children

$$l_m = T_m - h - c_m \tag{3}$$

c_m, time spent on maternal care, is specified as

$$c_m = \min\{T_c - h, T_c - c_f\} \tag{4}$$

where $T_c = 60$ is the time during which children need to be cared for either by the mother, through the formal market or informally. Informal care, as defined above, makes up the gap when the mother's work hours are greater than purchased hours of formal child care. Importantly, and a novel feature of our modeling of the hours constraint, households can choose less formal child care than the mother's working hours. With shadow prices for leisure and maternal child care provided by the wage and the market price of formal child care, we can separately value these time inputs. This is important for identification as described in 4.4 below.

The parameters of the utility function are summarized in A, a symmetric 3×3 parameter matrix with entries A_{ij} , and a vector $b = (b_1, b_2, b_3)'$. b_1 is a constant, but b_2 and b_3 are specified to allow both observed and unobserved individual and household characteristics to affect utility:

$$b_k = \sum_{t=1}^{T_k} \beta_{kt} x_t^k + \epsilon^{p_k}, \quad (k = 2, 3), \tag{5}$$

where $x^k = (x_1^k, \ldots, x_{T_k}^k)'$ are vectors of exogenous characteristics including age of the mother and the youngest child, number of children in each age group, education of the parents, immigrant status and other characteristics that describe the family composition such as the presence of extra female adults in the household. Immigrant status and the presence of extra female adults are used as proxies for the presence of other potential care-takers at home (or nearby) which may capture differences in costs and benefits of informal care. In the case of multiple children, maternal child care is measured as the average number of maternal care hours for all preschool children in the household and the impact of the number of children on utility is through b_3. That is, the number of children affects the marginal utility of maternal care by shifting b_3. We control for child care quality by adding, from administrative data, the average number of qualified staff per child in formal day care centers at the state-level. Local-level information on quality would be preferable, but is not available. The terms ϵ^{p_k} may be interpreted as random preferences due to unobserved characteristics.

The choice set for working hours and formal child care hours are defined as

$$h \in 0, s, 2s, \ldots, (m-1)s, \tag{6}$$

and

$$c_f \in 0, r, 2r, \ldots, (g-1)r, \tag{7}$$

where s and m describe all possible alternatives of working hours, and r and g describe all possible alternatives of formal child care hours. In this paper s is set to 8 hours, m is set to 8, r is set to 10 hours for young children to reflect the typical length of child care sessions in this age group, and g is set to 6. Thus, the household chooses from a choice set with $m \times g = 48$ working/formal child care hour combinations, allowing a wide range of part-time and half-day possibilities for both work and formal care.

To the utility of each alternative in the choice set, we add random disturbances μ_j (as in Van Soest (1995), as in the multinomial logit model (Maddala (1983)) which can be interpreted as alternative-specific unobserved utility:

$$U_j = U_j(y_j, l_{mj}, c_{mj}) + \mu_j, \quad (j = 0, \ldots, m \cdot g), \tag{8}$$

where $\mu_j' s$ are independently and identically distributed with a type I extreme value distribution, and are independent of all X and the other unobservable terms in the model. This multinomial approach is somewhat restrictive in not allowing correlation across choices but these assumptions are commonly employed.

The mother chooses alternative j if U_j is the largest among all the alternatives. Conditional upon ϵ^{p_k}, X, and w, the probability that alternative j is chosen is

$$Pr[U_j \geq U_i, \text{ for all } i] = \frac{exp(U(y_j, l_{mj}, c_{mj}))}{\sum_{i=1}^{m \cdot g} exp(U(y_i, l_{mi}, c_{mi}))}. \tag{9}$$

To predict wage rates for non-workers and workers whose wages are missing in the data and to allow for correlation between wage rates and unobserved utility preferences (ϵ^{p_k}), a standard wage equation is simultaneously estimated with (1) and specified as:

$$\log w = \pi' z + \epsilon^w \tag{10}$$

where z is a vector of the mother's characteristics which determine labor productivity including education and potential experience (see Table 2B). We also include a variable equal to one if the mother lived with both of her parents when she was 14 (to capture stability while growing up) and current area of residence measured by capital city and state variables which are omitted from the utility function and serve the role of exclusion restrictions. π is a vector of parameters to be estimated. ϵ^w is an unobserved term, assumed to be normally distributed with mean zero, independent of z, but is allowed to be correlated with ϵ^{p_k}.

Following Gong and Van Soest (2002) fixed benefit of not working (FB) is added to income at zero hours of work. Thus the utility of all alternatives at zero hours of work are replaced by $U(y_0 + FB, l_{m0}, c_m)$ where l_{m0} is the mother's leisure at zero work hours. FB is specified as

$$FB = \delta' t \tag{11}$$

where t is a vector of exogenous variables and δ is a vector of parameters. Positive fixed benefits can be interpreted equally as fixed costs associated with working.

4.4 Identification

Identification of the model is achieved in several ways. Given the specification of the utility function, the child care price provides a shadow value of maternal child care, hence our detailed attention to the construction of this variable. Mother's wage provides a shadow value for maternal leisure. These two variables are sufficient to identify the parameters in the utility function. The wage equation is identified through the assumption of normality of the unobservables. We exclude age and number of children and father's education from the wage equation. These should not affect mothers' labour productivity. Regional dummies are included in the wage equation and excluded from the two utility parameters.[17] These exclusion restrictions provide additional identification although they are not necessary.

As an additional source of identification, but again one that is not strictly necessary, we also impose several exclusion restrictions on the equations which determine the utility parameters. Variables which capture mother's education, whether the couple is educated or born in Australia as opposed to outside of Australia, presence of older children in the household, the average age of pre-school children and state-level controls for child care quality are all included in the equation which determines the utility of maternal child care and excluded from the equation that determines the utility of maternal leisure. Note that age of youngest child is assumed to affect both equations.

4.5 Estimation

If all wages were observed and without random preferences, the model could be estimated by maximum likelihood with the likelihood contribution given by equation (9). With unobserved wages, the wage equation (10) also needs to be estimated. With the presence of unobserved preferences in leisure and maternal child care, maximum likelihood estimation would require evaluation of the three-dimensional integral defined over the distribution of the error terms ϵ^{w}, ϵ^{p_2}, and ϵ^{p_3}. Numerical integration in more than two dimensions can be difficult to solve. In this paper, we use Simulated Maximum Likelihood (SML) to avoid this multi-dimensional numerical integration. Denoting the probability of working hours h_j and using c_{fj} hours of formal child care conditional on ϵ^{p_2}, ϵ^{p_3}, and wage rate[18] by

$$Pr[h = h_j, c_f = c_{fj}|w, \epsilon^{p_2}, \epsilon^{p_3}] \ (j = 1, \ldots, m \cdot g), \tag{12}$$

The exact likelihood contribution for someone observed to work h_0 and use c_{f0} hours of formal child care with observed gross wage rate w_0 is then given by

$$L = \int\int Pr[h = h_0, c_f = c_{f0}|w_0, \epsilon^{p_2}, \epsilon^{p_3}] f_1(\epsilon^{p_2}|w_0) f_2(\epsilon^{p_3}|w_0) \mathrm{d}\epsilon^{p_2} \mathrm{d}\epsilon^{p_3} f(w_0), \tag{13}$$

[17] The regional dummies we use control for whether individuals are in a capital city, other urban area or rural area; child-care prices are calculated at the LFSR-level which is a much finer geographical area.

[18] Throughout, we condition on 'other household income' (earnings of the husband and household non-labor income), child care price, and other exogenous explanatory variables x, z, and t. These are suppressed in our notation.

Or, if the wage rate is not observed, the exact likelihood contribution is

$$L = \int\int\int Pr[h = h_0, c_f = c_{f0}|w, \epsilon^{p_2}, \epsilon^{p_3}] f_1(\epsilon^{p_2}|w) f_2(\epsilon^{p_3}|w) f(w) \mathrm{d}\epsilon^{p_2} \mathrm{d}\epsilon^{p_3} \mathrm{d}w, \qquad (14)$$

where $f_k(\cdot|w)$, $(k = 1, 2)$ are the conditional density functions of ϵ^{p_k} given w, and $f(w)$ is the density of the wage rate (or of ϵ^w). The three error terms ϵ^w, ϵ^{p_2}, and ϵ^{p_3} are specified to follow a joint normal distribution of which the parameters are to be estimated:

$$\begin{pmatrix} \epsilon^w \\ \epsilon^{p_2} \\ \epsilon^{p_3} \end{pmatrix} \sim N(0, \Sigma), \text{ where } \Sigma = \begin{pmatrix} \sigma_w^2 & & \\ \sigma_{wp_2} & \sigma_{p_2}^2 & \\ \sigma_{wp_3} & 0 & \sigma_{p_3}^2 \end{pmatrix} \qquad (15)$$

The numerical multi-dimensional integral is approximated by a simulated mean: for each individual, we take R draws from the distribution of the error terms (ϵ^w, ϵ^{p_2}, and ϵ^{p_3}) and compute the average of the R likelihood values conditional on these draws. The integral equation (13) is thus approximated by

$$L = \frac{1}{R} \sum_{r=1}^{R} Pr[h = h_0, c_f = c_{f0}|w_0, \epsilon_r^{p_2}, \epsilon_r^{p_3}] f(w_0), \qquad (16)$$

and equation (14) is replaced by

$$L = \frac{1}{R} \sum_{r=1}^{R} Pr[h = h_0, c_f = c_{f0}|w_r, \epsilon_r^{p_2}, \epsilon_r^{p_3}], \qquad (17)$$

where $\log w_r = \pi' z + \epsilon_r^w$ and $(\epsilon_r^w, \epsilon_r^{p_2}, \epsilon_r^{p_4})$ are based upon draws from the distribution of $(\epsilon^w, \epsilon^{p_2}, \epsilon^{p_4})$. The draws are taken from Halton sequences using the procedure described in Train (2003). The estimator resulting from random independent draws is inconsistent for fixed R, but will be consistent as R tends to infinity with the number of observations of the sample.[19] Many studies (see e.g., Caflisch (1995), Sloan and Woźniakowski (1998), Bhat (2001), Train (2003), Sándor and Train (2004)) show that using 'quasi-random' draws which are designed to provide better coverage than independent draws, simulation can be more efficient in terms of reduced simulation errors for a given number of draws. In particular, Bhat (2001), Train (2003), and Sándor and Train (2004) all tested Halton sequences for mixed logit models and found their use to be vastly superior to random, independent draws.

[19]If $\sqrt{n}/R \to 0$ and with independent drawings across observations, the method is asymptotically equivalent to maximum likelihood (see Lee (1992), or Gourieroux and Monfort (1993) for references).

4.6 Calculation of elasticities and policy effects

Labor supply and child care demand behavior of households may be described by their corresponding elasticities. Due to the complexity of the model, simulation is required to derive elasticities and to estimate policy effects. When calculating elasticities, hours of work and child care are calculated as 'expected hours', computed as a probability weighted sum of hours over all possible values. Wage, gross child care price, and income elasticities for each observation are derived by increasing each quantity by one per cent and calculating the percentage change in average hours or the employment rate. The net child care price elasticity is calculated as the ratio between the percentage change of hours or employment rate and the percentage change in the net child care price. The net price change we use in the calculation corresponds to a one per cent change in the gross child care price. From these, we calculate average elasticities for the whole sample and for selected sub-samples. The standard errors of the estimated elasticities and policy effects are obtained using Monte Carlo methods with 100 repetitions.[20] Further discussion of calculating these quantities may be found in Gong and Van Soest (2002).

5 Data

5.1 Data source and sample

Data for the main analysis are drawn from waves five and six of the 'in-confidence' version of the Household, Income and Labour Dynamics in Australia Survey (HILDA) which cover the period 2005 - 2006. We also include the seventh wave when we construct the child care price. The HILDA Survey is an annual panel survey of Australian households which was begun in 2001.[21] There are approximately 7,000 households and 13,000 individuals who respond in each wave. Our 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

[20]We cluster standard errors from the model at the individual level. The Monte Carlo draws are made from this cluster robust covariance matrix and the standard errors of the elasticities and simulations thus reflect the clustering. There is almost no difference in the standard errors corrected for clustering and those which assume an independent sampling scheme–perhaps not surprising given the average cluster size is 1.53.

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

and non-employment related reasons. Secondly, we choose to pool across three waves of data to achieve a sufficiently large sample size for the construction of our local average child care price. Details are described in Section 5.2 below. We use median child care prices within Labour Force Survey Regions (LFSR) as defined by the Australian Bureau of Statistics (ABS).[22] 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, we use data from the fifth and sixth waves for estimation because child care policies in Australia were roughly constant over these two years.[23] 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 before 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 the end of the sample period (about 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. A final consideration which favours this choice of sample period is that ABS created a child care price index, which we use to make the price comparable across waves. This index is only available from 2005.

We focus on the labor supply of partnered mothers of working age (younger than 65) with at least one young child (0 and 5 year old who are not yet at school) and the demand for formal child care in these households. In waves 5 through 7 of the HILDA survey there are 20,342 total observations on 7,741 women. We exclude observations on women without young children. We also remove a small number of observations where there are multiple families in the same household. It is harder to justify our assumption that households behave as unified economic units for these multi-family households. We are left with 2,585 observations on women with young children in single-family households We remove 414 observations on single mothers. We exclude 515 observations on women

[22]Labour Force Survey Regions are described in ABS (2005). Australia's six states and two main territories are divided into 77 labour force regions with populations ranging from around 100,000 up to about 500,000.

[23]We also estimate the model over three waves of data, five to seven, and found similar elasticity estimates.

who are beyond working age, self-employed, full-time students or disabled. We omit 30 observations that have missing values for key variables of interest, primarily working hours. The final sample is 1,526 observations over three waves. We use all of these for generating the child care price and the observations from the first two waves (1,015 observations on 664 unique women) to estimate the model.

We present sample statistics in the second column of Table 1. In the third column of Table 1, we present the sample statistics for a sub-sample of 593 mothers of young children in households in which there are no school-aged children present. This sub-sample is used for the sensitivity analysis described in footnote 15. From the second column of Table 1, about 43 per cent of households with young children use formal child care. Hours spent in child care for the young children are about 18 hours per week. About 57 per cent of the mothers were employed and the average working mother works 25 hours per week at an hourly wage of $24 (at the June 2005 price level). The characteristics of the mothers in the sub-sample are broadly similar to that of the whole sample except they are younger and slightly better educated.

5.2 Child care price

In the HILDA survey, parents report the number of hours c^f_{kht} spent in child care for each child (k) in the household (h) for each of three types of formal child care (t)–long day care, family day care, and other formal paid care. These reports reflect hours spent at the child care center, not necessarily hours paid for. Thus, we calculate hours paid by rounding up to multiples of five hours for young children and multiples of three hours for school-aged children to reflect typical lengths of paid sessions. Long day care centers and family day care centers 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. The net cost of child care Q^s_{ht} from the survey is not reported by families for each child but is reported for each type of care and is split by school-aged ($s = 1$) and young ($s = 0$) children. For families who have one young child, we know the cost of child care for each type of care for that child. For families that have more than one young child, 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 spend 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

$$\tilde{q}_{sht} = Q^s_{ht} \frac{c^f_{kht}}{\sum_{m=1}^{M} c^f_{mht}} \tag{18}$$

With the information we have on child care usage by each child, gross family income, child and family characteristics, and CCB eligibility rules, we are able to construct the gross cost of child care for each child for each type of care. We combine this with the hours of child care information to calculate a gross per-child price for each type of care.

We take all of these individual child prices and calculate two median prices for each Labour Force Survey Region (LFSR): one for children who are not yet in school and one for school-aged children. We treat the thee types of care equally in taking the median. We impute this median price to each household in the LFSR. For any LFSRs for which we have less than 4 prices, we combine the LFSR with a neighboring LFSR. After doing this, for pre-school children, we have sixteen observations per LFSR on average. Appendix Figure A1 shows a kernel density estimate of prices. The distribution is normal in the main, but there is a long right-hand tail which may arise from mis-reporting of either total child care costs or hours. This justifies our use of median price. Appendix Figure A2 shows a histogram of the number of prices used in calculating the median price by number of LFSRs. The 24 prices and larger column hides a wide spread as we have two LFSRs where we have more than 50 prices. There is substantial variation across LFSRs. Appendix Figures A3 and A4 show the distribution of mean and median prices by LFSR. The average mean price (giving equal weight to each LFSR) is about 5.2 for pre-school children, a bit higher than the average median of 4.86 reported in Table 1, consistent with the skewness in Figure A1. Breunig et al. (2012) construct child care prices in the same way and show that this method of constructing prices does well in matching state-level average prices from administrative data.[24] Using means rather than medians does not substantively change the analysis.

[24] Administrative data is *only* available at state level which does not provide sufficient variation for identification.

An alternative to using median prices in each LFSR would be to estimate the price for each locality, controlling for average hours of childcare and the average level of household factors which affect the quality choice. This approach, taken by Duncan, Paull and Taylor (2001b) assumes that relative prices over quality and quantity are fixed across markets but are allowed to shift upwards or downwards based upon an LFSR-specific component. We employed this method as well as using median prices and we find very little difference in the results–e.g., none of the elasticities reported in Table 4 change significantly.

In both cases, what is important is that the price that is included in the labour supply equation represents a 'cost of working' component of child care. Our approach can be justified through a two-step process that families might take in thinking about the child care purchasing decision. First, families look at typical child care prices (median) in their LFSR to get a rough idea of what it will cost them to purchase an hour of child care at average quality to facilitate mother's work. Then, in a second step, they decide how much additional (or less) quality to purchase than the median. The Duncan et al. (2001b) approach can be similarly justified, with families using a 'quality-adjusted' price measure. Empirically in this case, these work out to be very similar.

Variation in prices come from three sources: different average quality across LFSRs, different costs across LFSRs, and demand factors such as local wage and income levels. We do not have good measures of quality and when we implement the regression approach of Duncan et al. (2001b) the relationship between total spent on child care (which includes quality) and observable individual characteristics is very weak (the R-squared in about 6%). Prices are higher in urban areas than rural areas and higher in more expensive neighborhoods. This is not surprising, as child care is non-tradeable across regions so higher incomes will, at least partially, pass through to higher child care prices. It is hard to disentangle these three effects. As child care in Australia is highly regulated in terms of staff qualifications and child-to-carer ratios, we believe that most of the cross-LFSR variation is generated by cost and demand factors.

6 Results

6.1 Parameter Estimates

Our Simulated Maximum Likelihood (SML) results are based upon 30 draws per household. We present parameter estimates for the utility function in Table 2A. The parameters A_{ij} and b_i determine the shape of the utility function but their interpretation is non-trivial. The signs of the parameters in b determine the direction in which characteristics affect preferences. A positive b_2 (b_3) for a variable implies a positive effect of that variable on the marginal utility of leisure (maternal care). Unlike in a standard labor supply model where a positive effect on leisure could be interpreted equally as a negative effect on labor supply, a positive effect on leisure must be interpreted as a *combined* negative effect on labor supply and maternal care. It is consistent with the model that one of these effects could be positive and one negative with the combined effect being negative. Number of children, mother's age, and father's education all have significant effects on preferences. In general, the direction and magnitude of the impacts of the variables on labor supply or formal care can not be ascertained directly from the parameter values, but rather need to be calculated through simulation.

The parameters in the fixed benefit equation (Table 2B) can be linked more directly to the mother's labor force participation–a positive parameter indicates that the corresponding variable has a positive effect on the benefits of not working and thus a negative impact on participation. For example, the older the youngest child, the more likely she is to participate in the labor force. The number of school-aged children also plays a significant role–more young children (including school-aged) leads to lower participation. Unobserved preferences for maternal care play a significant role as well and they are positively correlated with unobserved heterogeneity in the wage equation. The variance of the unobserved preference for leisure is imprecisely estimated, though.

The parameter estimates of the wage equation are presented in the last column of Table 2B. These results are consistent with a standard Mincer equation for Australia.[25] Higher education brings a wage premium of about 45 per cent for mothers of preschool

[25]See Breusch and Gray (2004); Leigh (2008); and Breunig, Cobb-Clark and Gong (2008).

children, relative to their counterparts who only finished Year 12 and women who speak a language other than English earn less than those who do not.

Overall, the model produces an upward-sloping and reasonable labour supply curve and negative, plausible relationships between child care price and demand for formal care and working hours of women. The main focus of the paper is on the child care price elasticities of labour supply and child care demand (see section 6.2 below) and the subsequent comparison of different child care subsidy policies. We omit detailed discussion of the relationship between the covariates and household utility.[26]

6.2 Simulation Results

6.2.1 Fit of the model

With simulation, we check the model's goodness of fit. First of all, although we did not impose the restriction that the derivative of utility with respect to income be positive, it is required for the model to be coherent with the utility maximization framework. We check this, ex post, by calculating derivatives of the utility function with respect to income. They are indeed positive for all observations.

Secondly, in Table 3 we check model performance by comparing simulated labor supply, child care demand, and net child care costs with the observed data. From the table we can see that the simulation results resemble nicely the observed data. It is important to point out that the average of the estimated net child care costs, which are calculated based upon the median price in the local areas, is extremely close to that of the observed net costs in the data. This may suggest that price of the local area is a reasonable measure upon which households make their decisions. Also, although informal care is treated as the residual between hours of work and formal care in the model in order to satisfy adding-up constraints, the average of simulated hours of informal care (which is the gap between the simulated hours of formal care and work hours) is reasonably close to reported (observed) hours of informal care from the data. It may imply that our assumption about the role of informal care may not be as strong as it first appears. These two findings give us confidence in the performance of the

[26]Our results are similar to other structural models. Van Soest (1995) and Kalb (2002), for example, examine the relationship between covariates and household utility through simulation.

model. In table A1, we look at the key hours variables by mother's education, number of young children, husband's education and non-labour income. We compare the actual and simulated values of hours of work, hours of formal childcare and hours of informal childcare. Simulated and actual hours match extremely closely for all sub-groups. As for the total sample reported in Table 3, we slightly over-predict hours of formal child care but the differences are small for most sub-groups. The model matches hours of formal childcare best for those families where either the mother or father has tertiary education and least well for those families with more than one young child and those families where the father has no tertiary education.

6.2.2 Elasticities

Table 4 presents average elasticities of labor supply and child care demand with respect to wage, income, gross child care price and net child care price calculated for each household and averaged across the full sample. In Table 5, we present elasticity estimates for selected sub-samples of interest. While we prefer the net elasticities for our main purpose of evaluating policy alternatives, we report gross elasticities for comparability with previous studies and because gross price changes are often easier to observe.

First of all, it is worth noting that the estimates of wage and income elasticities of labor supply in Table 4 are comparable to previous Australian estimates, e.g. Breunig et al. (2008). For mothers with preschool children, the average wage elasticities of hours worked and employment are 0.42 and 0.27 and the income elasticities of hours worked and employment are -0.14 and -0.08, respectively. They are all significant at the 5 per cent level and consistent with reasonable model performance.

Secondly, the average labor supply elasticities of both gross and net child care price are statistically significant and negative. The average gross child care price elasticities of hours of work and employment for the mothers are -0.11 and -0.08, respectively. The net price elasticities of hours of work and employment of the mothers with preschool children are -0.08 and -0.06, respectively. As expected, they are slightly smaller than the gross price elasticities due to means-testing of CCB.

Thirdly, as expected, child care demand is negatively impacted by its own price. The results in Table 4 also show that both child care demand and labor supply elasticities with respect to wage are positive and with respect to child care price they are both negative. The two cross-price elasticities have the same sign as the own price elasticities (wage elasticity of labor supply and child care price elasticity of child care) which implies that labor supply and child care are complements.

In Table 5, elasticities for a few sub-samples are presented. The sample is partitioned according to education level and 'other household income' of the mothers, and the number of children in the household. 'Other household income' is defined as the sum of spouse's labor income (held constant in our modeling) and total household non-labor income. Labor supply and child care demand responses differ by demographic group. Labor supply of women with higher education (and hence higher wages) or in households with higher income levels is slightly less responsive to the gross child care price than those with lower education or from households with lower income. For example, the average labor supply elasticity of gross child care price for women with higher education is -0.10 while for those without higher eduction, it is -0.13.[27] Comparing women above and below median 'other household income', produces similar results. Similar to the results for labor supply elasticities, gross child care price elasticity of employment is also smaller for women with higher education or with higher 'other household income' than those with lower education or with lower 'other household income'.

However, it seems that the differences are due mainly to the means-testing of the CCB program—the differences become smaller in terms of net child care price elasticities. The elasticity is -0.078 for women with tertiary education and -0.085 for women without tertiary education. Means testing implies that for women with higher education (hence higher wages) and income, a change in the gross child care costs corresponds to a smaller change in the net child care costs for these women relative to the poorer and less educated women who see a higher change in net costs due to the subsidy regime.

Child care price elasticities also differ by family type. In households with multiple children, elasticities of child care price are larger than those in single child households.

[27] We can reject that these differences are zero at the 5 per cent level using bootstrapped confidence intervals.

In multiple children households, child care costs form a larger part of the budget and the effect of the same child care price change in magnitude is therefore larger. We plotted curves of labor supply, child care demand and costs against wage and child care price and found few surprises. Labor supply curves are backwards bending after wages reach high enough levels. The relationships between labor supply and child care demand with child care price are downward sloping and roughly linear.[28]

6.3 Impact of hours constraint and inclusion of maternal care in the utility function

Above, we have emphasized the importance of the more flexible hours constraint that our model allows. To see the effect of this more flexible constraint in our estimates, we estimate two alternative model specifications. First, we restrict formal child care hours to be greater than or equal to mothers' hours of work ($h \leq c_f$) as in Duncan et al. (2001a). In this specification, observed formal child care hours are replaced by mothers' hours of work if they are less than mothers' labour supply. Second, we restrict formal child care hours to equal mothers' labour supply ($h = c_f$), as in Kornstad and Thoresen (2006, 2007). Consequently, in this specification, the utility function only depends upon leisure and income and maternal care does *not* enter the utility function. If hours of formal care can only be driven by work hours, then there is no substitution for other types of care. Formal care is removed from the utility function as a choice parameter.

Elasticities for these two alternative specifications are presented in Table 6. As before, model estimates are used to simulate labour supply elasticities. Comparing the estimates in Table 6 with those of Table 4, we can see that the elasticity estimates with respect to child care price are much larger in these specifications than in our preferred model. For example, the estimate of mothers' labour supply elasticity with respect to the net child care price, assuming formal child care hours are at least as large as mothers' hours of work, is -0.187, nearly double the benchmark model. These results provide evidence that restricting combinations of mother's work hours/formal care hours (or ignoring the effect of maternal care in the utility function) may lead to overestimating the labour supply elasticity with respect to child care price. Allowing more flexibility

[28]These plots are available from the authors upon request.

in these hours combinations translates into lower price elasticities. The intuition is that in the two alternative models, a spuriously strong relationship between maternal labour supply and formal care is imposed so that the responses to child care costs via change in child care demand is (wrongly) attributed to mother's labour supply.

7 The Effects of Child Care Assistance Programs

Using our estimates from section 6, we can contrast the effects of a child care price subsidy and a tax rebate for expenditure on child care on mother's employment and working hours, child care demand and out-of-pocket costs, household disposable income and welfare and net government revenue.

In order to compare a price subsidy to a tax rebate we need to choose settings for both policies. We compare a benchmark case of no child care assistance first to a scenario with a price subsidy (without any tax rebate) and then, secondly, to a scenario with a tax rebate (without any price subsidy). For policy settings we use the CCB and CCTR programs as they appeared in Australia in 2005 (see section 3):

- Child Care Benefit (CCB)

  Maximum child care benefit is $2.88 per hour which tapers to a minimum rate of $0.483 per hour following the rules of the 2005 CCB. If one of the parents is not working or studying, the subsidy only applies to a maximum of 20 hours of child care per week.

- Child Care Tax Rebate (CCTR)

  A rebate that can be applied to tax liability for 30% of 'out-of-pocket' child care costs (after CCB) capped at $4,000 per child. CCTR could only be claimed for people with a positive tax liability; an implicit working requirement.

Both CCB and CCTR cover all types of formal care including long day care centres and family day care. They can not be used for informal care or nannies.

In Table 7 we present the simulated average effects of each of these two child care assistance programs, considered separately. Net government revenue takes into account both the assistance paid and changes in tax revenue. Program (CCB or CCTR) effects are calculated and presented in columns 3 and 4 as the difference in the quantity of interest between a scenario with the child care assistance program and a scenario with no government child care assistance (column 2). In the second last column, the difference between the two child care assistance programs is presented. In the final column, we present the effects of Child Care Rebate (CCR), the non-means-tested subsidy which replaced CCTR, as described above. We use the 2014 CCR rules except we set the rebate rate at 30% (instead of the current program value of 50%) for comparability with the CCTR column. CCR produces labour supply and child care demand effects that are very similar to CCTR but at a slightly higher cost due to the weaker work requirement. We do not discuss CCR further. We present the effects as the amount per dollar of child care assistance for comparability across the two programs. All of the numbers in the table are averages across households and thus account for participation rates in the programs.

From Table 7, we see that both CCB and CCTR significantly increase the labor supply of mothers, demand for formal child care, and household disposable income. On average, every dollar of CCB increases hours worked by the mother of 0.016, hours of formal child care by 0.037 and household disposable income by $0.902. It also reduces net child care costs by 76 cents. The two programs are quite similar in their effect on increased rates of employment and and child care usage. As a result of increased labor supply, which brings extra tax revenue and reduces welfare payments, the cost to the government is less than the subsidy paid (the cost is 73 cents per dollar for CCTR and 86 cents per dollar for CCB). Total government outlay can be calculated by multiplying the amount of subsidy per household by the number of partnered households with young children. Net government cost (which reflects increased tax revenue but which omits any administrative costs) can be found by multiplying this number by the net tax revenue per dollar of child care assistance in the second last row. The final row provides the actual dollar amount of subsidy received per household on average including the zeros.

There are four important, and statistically significant, differences in the effects of CCB and CCTR:

1. Despite having similar employment effects, CCTR's effect on hours worked is 63%

larger.

2. Hours of informal care decrease significantly under CCB but not under CCTR. This is evidence of a crowding-out effect of the price subsidy.

3. Household budgets improve by an additional 11 cents (about twelve per cent) under the tax credit relative to the price subsidy.

4. As a consequence of the first and third effects enumerated here, the net cost to taxpayers per dollar of subsidy is 13 cents lower under CCTR relative to CCB.

These results would appear to provide strong support for a tax credit relative to a price subsidy from an efficiency point of view. If the primary goal of the government is to increase female labor supply, CCTR is the more effective and cost efficient program. Under CCTR, higher educated women face a larger net price change than under CCB. This occurs because of means testing of CCB and also because higher educated/income women benefit disproportionately from the tax rebate. This results in a larger labour supply effect for more highly educated women under CCTR than under CCB.

A more nuanced picture emerges if we consider distributional effects. In Table 8, we evaluate the effects of the programs as in Table 7, but we split the sample (in the top panel of the table) into women with and without tertiary education. In the bottom panel, we split the sample into two based upon whether 'other household income' is above or below the median. This shows that CCB is more generous for lower income households.

For example, under CCB, women with tertiary education (who are generally higher wage earners) receive \$17.07 of subsidy on average, about equal to the \$16.44 received by women without a tertiary education. Under CCTR, more educated women receive over 50% more (\$18.60 compared to \$11.99). The difference of the two schemes over the income distribution is more clearly illustrated in the last panel of Table 8. The results show that the higher income families receive \$7 more government subsidy under CCTR than under CCB, while the lower income families receive \$6 less subsidy under CCTR (the difference is not quite statistically significant). Yet, even for women with low education or below median other household income, the effects on labor supply and household disposable income are larger under CCTR than CCB. The costs to government are also lower under CCTR. For example, for the women from lower income households, each dollar of CCTR only costs the government 64 cents, compared with 81 cents for CCB. Again, there are similar 'crowding-out' effect for all groups with CCB.

We ignore, in our analysis, administrative costs associated with the programs. One might expect that such costs are higher for the more complex CCB. As discussed by Drèze and Malinvaud (1994), welfare programs increase the size of government at a risk of inefficiency; their funding enhances the amount of revenue to be raised and thus the magnitude of tax distortions. It is conceivable that it is likely to be more so, the more complicated the program. This provides an additional argument in favor of tax credits relative to the price subsidy we model which includes varying rates, complex rules and means testing.

We assume that it doesn't matter who actually receives the child care benefit or rebate. Our model imposes this assumption since household utility is being maximized as if everyone in the household agreed about the household's decisions. Non-labour income, such as CCTR, is treated identically irrespective of who actually receives it. In practice, it is mostly the mothers. We also ignore questions of take-up, which could effect CCTR particularly. Also, the timing of payments and annual nature of reimbursement could dampen the effectiveness of CCTR. In an ex-poste evaluation of the introduction of CCTR using natural experiment methods, Gong and Breunig (2014) find labour supply effects of the introduction of CCTR for women from higher-income families, so at least for this group there is evidence that take-up and delayed payment did not prevent the program from having at least some effect.[29]

It is also important to compare household welfare across the two programs. The comparisons here are partial equilibrium–we do not impose revenue neutrality nor do we consider feedback from the supply side of the economy. The model assumes that all demand is met and that increased subsidies don't simply get soaked up by child care

[29] It was not possible in that study to estimate an effect for women from lower-income families as these households were subject to a range of policy changes simultaneously.

centres raising prices. The way in which the government raises the required additional revenue, particularly how the additional tax burden is shared across households with and without children, will have welfare implications which we do not include in these comparisons.

We summarize our welfare comparison in Figures 2, 3 and 4. The welfare gain is calculated as the increase in utility relative to the benchmark scenario for each household per dollar spent on CCB or CCTR. These utility changes are calculated based upon the model and include all changes in utility, not just work and income effects. Figure 2 presents a non-parametric estimate of the welfare gain from a dollar of CCB graphed against 'other household income'.[30] Figure 3 presents the same for CCTR and Figure 4 presents the difference between the two. Interestingly, welfare gains are higher for both programs for lower income families (above some threshold) and then decrease in 'other household income'. The redistributive effects of CCB can be seen clearly in Figure 4: those in the lower part of the income distribution benefit more from CCB than CCTR. Those in the upper part of the income distribution benefit roughly equally from the two programs.

8 Conclusions

In this paper, we construct and estimate a model of labor supply and child care demand for partnered women with young children. The model is an extension of the standard discrete structural labor supply model which explicitly includes child care as a separate argument of the utility function. This model enables us to analyze labor supply and child care demand simultaneously. This approach corresponds more closely to how households actually make decisions about work and child care. Unobserved heterogeneity in time allocation preferences is included and is allowed to be correlated with unobservable factors which influence wages. We introduce two important methodological innovations: we explicitly incorporate maternal care into the utility function as a proxy for child development and we impose a more flexible quantity constraint that the number of total

[30] This is just a simple kernel regression of the welfare gain against 'other household income' for our sample of households.

child care hours (formal and informal) is at least as large as the number of hours worked by the mother. We show that both of our modelling innovations matter substantively for the results. It appears that failing to account for informal care may lead to over-estimating the labour supply elasticity with respect to child care price.

The model estimates are used to simulate estimates of the gross and net child care price elasticities for partnered women with children. We find that the net child care price elasticities of hours of work and employment are -0.10 and -0.06, both are statistically significant. Labor supply and child care demand responses to gross child care price changes are highest amongst women with lower wages, lower household income, and lower education. The differences seem to be due to means testing of the CCB. In other words, responses to net cost changes are not very different across income levels. Labor supply and child care are found to be complements, as one might expect.

We do not include administrative costs, possibility of failure to take up CCTR or the effectiveness of retrospective annual payments in our analysis. These could all affect the trade-offs between CCB and CCTR. We allow for a trade-off between formal and informal care though we do not explicitly model informal care.

In terms of child care assistance, we compare a means-tested subsidy (CCB) to a tax rebate (CCTR). With the above caveats in mind, we conclude that:

- Both programs increase labor supply of mothers, demand for formal care, and disposable income of the household.
- For each net dollar spent, CCTR has greater impacts on labour supply and household income, both because the impact per dollar spent is greater and because the return in government revenue is higher.
- In utility / welfare terms (which considers the loss of leisure as well as the gain of higher income and benefits of maternal care), CCB is better or no worse than CCTR for all families with young children.
- CCB is more redistributive than CCTR.
- CCTR is less expensive than CCB.

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Figures

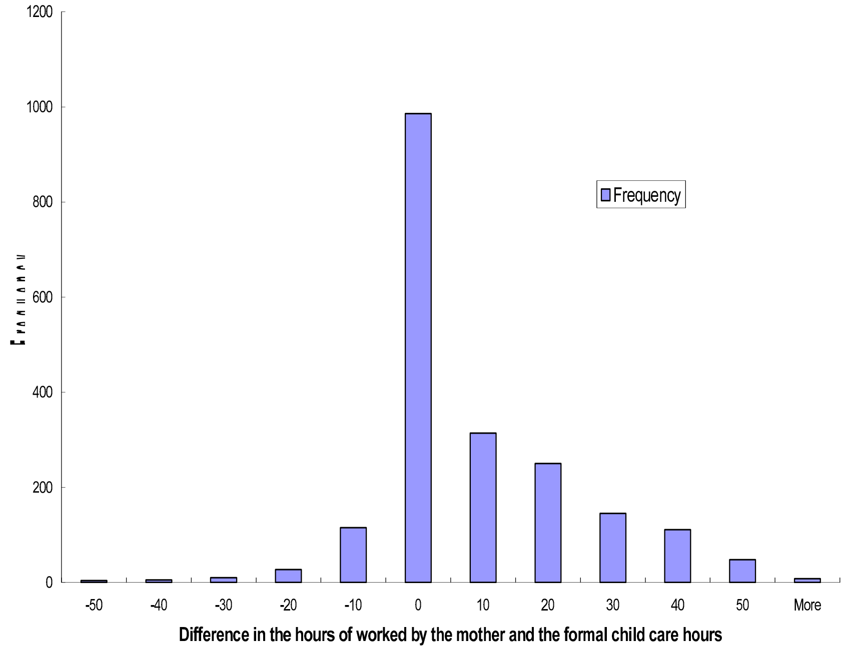

Figure 1. Differences between mothers' hours of work and formal child care

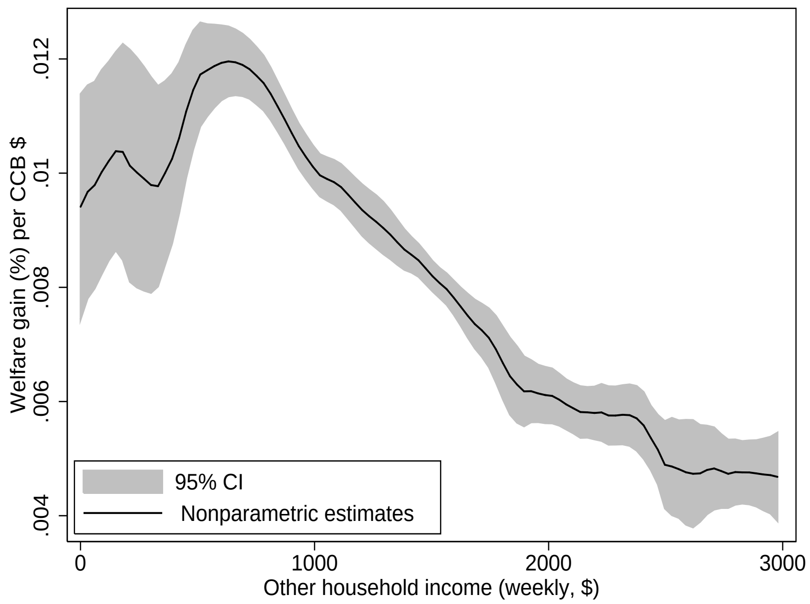

Figure 2. Nonparametric regression of welfare gain per CCB dollar against non-labor income

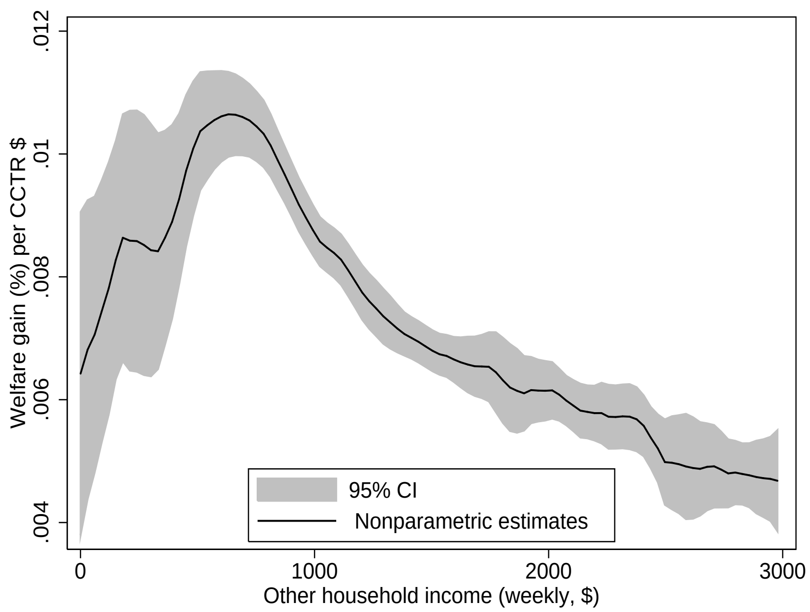

Figure 3. Nonparametric regression of welfare gain per CCTR dollar against non-labor income

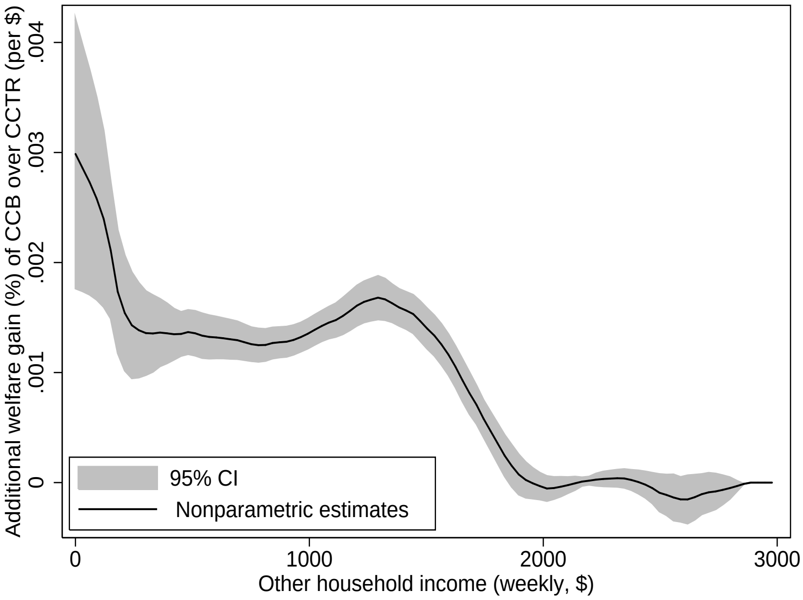

Figure 4. Nonparametric regression of additional welfare gain of CCB over CCTR (per dollar) against non-labor income

Tables

Table 1. Sample statistics

Variables	Whole sample	Pre-sch. children only
Hours worked per week by the working mothers	24.682(13.19)	24.599(13.02)
Labor force participation rate of the mothers	0.571	0.614
Average hours of children using formal child care	18.387(12.90)	18.520(13.14)
Proportion of families using formal care	0.429	0.457
Wage rate of the mother (at June 2005 price)	24.348(16.53)	25.743(17.62)
Other household income[a]	1243.169(1268.96)	1307.078(1344.03)
Median child care prices (at June 2005 price)	4.767 (1.01)	4.856(1.07)
Age of the mother	33.079(5.45)	31.843(5.58)
Dummy, mother received higher edu.	0.333	0.413
Dummy, mother received vocational edu.	0.244	0.241
Dummy, mother finished Year 12 only	0.206	0.214
Dummy, mother did not finish Year 12	0.223	0.132
Dummy, father received higher edu.	0.281	0.307
Dummy, father received vocational edu.	0.422	0.401
Dummy, father finished Year 12 only	0.139	0.162
Dummy, father did not finish Year 12	0.158	0.130
The mother in a sole-parent household at 14	0.195	0.199
The mother not born but educated in Australia	0.148	0.145
The mother not born or educated in Australia	0.052	0.057
The mother speaks a language other than English	0.130	0.118
The mother an Indigenous Australian	0.015	0.013
Couple not born but educated in Australia	0.191	0.201
Couple not born or educated in Australia	0.097	0.082
No. of children aged 0 to 4	1.348(0.56)	1.425(0.56)
No. of children aged 5 to 12	0.593(0.84)	-
No. of children aged 13 to 15	0.097(0.34)	0.056 (0.26)
Age of the youngest child	1.545(1.46)	1.115(1.27)
Dummy, presence of extra female adult	0.027	0.027
Dummy, presence of children older than 12	0.868	0.775
Mean age of the children in the studied group	1.918 (1.35)	1.551(1.26)
% of child care staff w/t exp. (state avg.)	15.8% (4.4%)	15.6% (4.5%)
% of child care staff w/t qual. (state avg.)	66.9% (4.9%)	67.0% (5.0%)
Obs. (number of partnered mothers)	1,015	593

Note: standard deviations in parentheses

[a] Other household income is defined as household income less mother's labor income

Table 2A. SML estimates (utility function)

Parameters of the utility function	Estimates	
$y^2(A_{11})$	-0.087[-0.42]	
$l^2(A_{22})$	-2.083**[-4.18]	
$c_m^2(A_{33})$	0.152[1.06]	
$yl(A_{12})$	-0.229[-1.32]	
$yc_m(A_{13})$	0.062[0.45]	
$lc_m(A_{23})$	-0.461**[-2.59]	
b_1	4.458**[3.23]	
Parameters of the utility function (b_2 and b_3)	b_2	b_3
Constant	0.709[0.33]	3.470[1.26]
Age of the mother	0.511**[1.98]	0.435*[1.92]
The mother speaks a language other than English	-0.899[-1.39]	0.109[0.29]
The mother is an Indigenous Australian	-7.623[-0.18]	1.421[0.93]
The mother not born but educated in Australia	-0.155[-0.30]	
The mother not born or educated in Australia	-0.324[-0.38]	
Mother received higher edu.		-0.516*[-1.87]
Mother received vocational edu.		-0.323[-1.24]
Mother did not finished Year 12		- 0.545[1.63]
The mother in a sole-parent household at age of 14		0.211[0.88]
Age of the youngest child	0.400**[3.19]	-0.140[-0.38]
No. of children aged 0 to 4	0.967**[3.46]	0.298[0.76]
No. of children aged 5 to 12	-0.596**[-2.50]	-0.035[-0.15]
No. of children aged 13 to 15	0.456[1.44]	-0.671*[-1.74]
Presence of extra female adult	1.122[1.47]	0.443[0.54]
Father received higher edu.	0.018[0.04]	-0.453[-1.23]
Father received vocational edu.	0.038[0.09]	-0.081[-0.23]
Father did not finished Year 12	0.084[0.17]	-0.357[-0.85]
Couple not born but educated in Australia		-0.111[-0.52]
Couple not born or educated in Australia		-0.603*[-1.81]
Presence of children older than 12		0.020[0.06]
Mean age of pre-school children		-0.057[-0.16]
% of child care staff w/t exp. (state avg.)		-0.043[-1.48]
% of child care staff w/t qual. (state avg.)		-0.011[-0.34]
Variance of the unobserved preference (σ_p^2)	0.017[0.38]	0.608[0.20]
Cov. of the unobserved preference with wage (σ_{wp})	0.045[0.78]	0.113**[3.00]
Likelihood	-1580.56	
Obs.	1,015	

t-values in brackets; * Significant at 10% level; ** Significant at 5% level.
Standard errors clustered at the level of the individual.

Table 2B. SML estimates (fixed costs and wage equations)

Variables	Fixed cost function	Wage equation
constant	1.080**[4.58]	2.031**[5.44]
Age of the mother	-0.201**[-3.19]	0.471**[2.15]
Age-squared of the mother		-0.051[-1.56]
Mother received higher edu.		0.462**[12.47]
Mother received vocational edu.		0.065*[1.68]
Mother did not finished Year 12		-0.096**[-2.18]
The mother speaks a language other than English	0.138[1.27]	-0.143**[-2.87]
The mother is an Indigenous Australian	–0.263[-1.11]	-0.074[-0.42]
The mother in a sole-parent household at age of 14		-0.039[-0.94]
The mother not born but educated in Australia	0.079[1.01]	-0.008[-0.19]
The mother not born or educated in Australia	0.241*[1.94]	-0.040[-0.67]
Age of the youngest child	-0.077**[-3.33]	
No. of children aged 0 to 4	0.007[0.14]	
No. of children aged 5 to 12	0.138**[2.99]	
No. of children aged 13 to 15	0.231**[2.31]	
presence of extra female adult	0.242[1.45]	
Father received higher edu.	0.051[0.59]	
Father received vocational edu.	-0.101[-1.21]	
Father did not finished Year 12	0.058[0.60]	
Dummy, wave 6	0.045[1.10]	
Regional dummies		Yes
Variance of the wage (σ_w^2)		0.120**[39.61]

t-values in brackets; * Significant at 10% level; ** Significant at 5% level.
Standard errors clustered at the level of the individual.

Table 3. Observed and simulated averages of outcome variables

Variables	Observed	Simulated
Hours of work (all)	14.080(15.78)	14.069(6.53)
Employment (%)	57.1	57.3
Hours of formal care (all)	7.880(12.41)	8.571(3.79)
Use of formal care (%)	42.9	47.1
Hours of informal care	4.439(9.00)	5.561(3.34)
Net child care costs ($)	37.880(73.12)	37.304(23.42)

Standard deviations in parentheses
For informal care, observed hours are those reported in the data but not used in modeling. Simulated informal hours are the gap between simulated work hours and simulated formal care hours.
Average hours include zeros.

Table 4. Elasticities (average over whole sample)

	Labour supply		Child care demand	
With respect to:	Hours	employment	Hours	Use of formal care
Gross child care price	-0.112**(0.03)	-0.076**(0.02)	-0.272**(0.06)	-0.167**(0.03)
Net child care price	-0.081**(0.02)	-0.055**(0.01)	-0.203**(0.05)	-0.125**(0.03)
Wage	0.415**(0.11)	0.268**(0.06)	0.271**(0.05)	0.177**(0.03)
Income	-0.135**(0.05)	-0.082**(0.04)	-0.124**(0.04)	-0.089**(0.03)

Standard errors, clustered at the individual level, in parentheses
** Significant at 5% level; * Significant at 10% level.

Table 5. Elasticities for selected sub-samples

	Labour supply		Child care demand	
	Hours	employment	Hours	Formal care use
With respect to: gross child care price of preschool children				
By mother's education				
Tertiary	-0.101**(0.03)	-0.068**(0.02)	-0.274**(0.06)	-0.163**(0.03)
No tertiary	-0.127**(0.03)	-0.086**(0.02)	-0.269**(0.06)	-0.172**(0.03)
By number of pre-school children				
One child	-0.080**(0.03)	-0.053**(0.02)	-0.205**(0.04)	-0.126**(0.02)
More children	-0.172**(0.03)	-0.119**(0.03)	-0.396**(0.09)	-0.243**(0.05)
By other household income				
hh inc. > median	-0.088**(0.03)	-0.060**(0.02)	-0.227**(0.05)	-0.144**(0.03)
hh inc. < median	-0.136**(0.03)	-0.092**(0.02)	-0.316**(0.06)	-0.190**(0.03)
With respect to: net child care price				
By mother's education				
Tertiary	-0.078**(0.02)	-0.053**(0.01)	-0.218**(0.05)	-0.132**(0.03)
No tertiary	-0.085**(0.03)	-0.058**(0.01)	-0.183**(0.04)	-0.117**(0.02)
By number of pre-school children				
One child	-0.059**(0.02)	-0.039**(0.01)	-0.157**(0.03)	-0.097**(0.02)
More children	-0.122**(0.04)	-0.085**(0.02)	-0.290**(0.08)	-0.179**(0.04)
hh inc. > median	-0.077**(0.02)	-0.053**(0.01)	-0.202**(0.05)	-0.128**(0.03)
hh inc. < median	-0.085**(0.03)	-0.058**(0.01)	-0.204**(0.05)	-0.123**(0.02)

Table 5. continued

With respect to: wage				
By mother's education				
Tertiary	0.442**(0.11)	0.283**(0.06)	0.302**(0.06)	0.196**(0.03)
No tertiary	0.378**(0.11)	0.248**(0.06)	0.229**(0.05)	0.151**(0.03)
By number of pre-school children				
One child	0.408**(0.11)	0.260**(0.06)	0.294**(0.06)	0.198**(0.03)
More children	0.429**(0.11)	0.284**(0.06)	0.227**(0.05)	0.138**(0.03)
By other household income				
hh inc. > median	0.371**(0.11)	0.242**(0.06)	0.252**(0.05)	0.164**(0.03)
hh inc. < median	0.460**(0.11)	0.295**(0.06)	0.290**(0.06)	0.190**(0.03)
With respect to: income				
By mother's education				
Tertiary	-0.174**(0.05)	-0.110**(0.04)	-0.143**(0.05)	-0.103**(0.03)
No tertiary	-0.081**(0.05)	-0.045**(0.04)	-0.097**(0.04)	-0.071**(0.03)
By number of pre-school children				
One child	-0.138**(0.05)	-0.080**(0.04)	-0.125**(0.04)	-0.088**(0.03)
More children	-0.129**(0.05)	-0.086**(0.04)	-0.122**(0.05)	-0.092**(0.03)
By other household income				
> median	-0.216**(0.05)	-0.150**(0.04)	-0.178**(0.06)	-0.134**(0.04)
< median	-0.054**(0.05)	-0.015**(0.04)	-0.069**(0.03)	-0.045**(0.02)

Standard errors, clustered at the individual level, in parentheses
** Significant at 5% level; * Significant at 10% level.

Table 6. Estimated labour supply elasticity of child care prices (using alternative model specifications)

	$h \leq c_f$		$h = c_f$	
With respect to:	Hours	employment	Hours	employment
Gross child care price	-0.187**(0.07)	-0.137**(0.05)	-0.286**(0.06)	-0.187**(0.04)
Net child care price	-0.129**(0.05)	-0.095**(0.03)	-0.222**(0.10)	-0.146**(0.06)
Wage	0.291**(0.12)	0.215**(0.07)	0.368**(0.08)	0.245**(0.05)
Income	-0.095(0.07)	-0.036(0.05)	-0.027 (0.04)	0.045*(0.02)

Standard errors, clustered at the individual level, in parentheses
** Significant at 5% level; * Significant at 10% level.

Table 7. Simulated effects of CCB and CCTR (whole sample)

		Effects of per dollar child care assistance			
	No subsidy	CCB	CCTR	Diff	CCR
Hrs of work	13.822(4.50)	.016**(.004)	.028**(.006)	.012*	.026**(.005)
Employment (%)	56.3(6.4)	.055**(.008)	.053**(.009)	-.003	.051**(.009)
Hrs of formal care	7.885(2.44)	.037**(.007)	.043**(.008)	.006*	.041**(.008)
Formal care use (%)	43.5(4.9)	.168**(.033)	.169**(.031)	.001	.163**(.030)
Hrs of informal care	5.976(4.13)	-.020**(.009)	-.014(.009)	.006*	-.014 (.008)
Disposable income ($)	1309.141(56.14)	.902**(.054)	1.010**(.056)	.108*	1.004**(.049)
Net care costs ($)	49.033(16.62)	-.757**(.049)	-.721**(.053)	.037*	-.736**(.050)
Net tax revenue ($)	232.885(47.88)	-.862**(.032)	-.730**(.057)	.132*	-.759**(.049)
Subsidy ($)	0.0	16.805**(4.26)	15.802**(4.34)	-1.003	23.097**(5.67)

Standard errors, clustered at the individual level, in parentheses
** Significant at 5% level; * Significant at 10% level.
Cells are household averages; hour and dollar values are weekly.
CCR is calculated at the rate of 30% for comparability with CCTR.
Average hours include zeros.

Table 8. Simulated effects of CCB and CCTR (subsamples)

		Effects of per dollar child care assistance		
	No subsidy	CCB	CCTR	Diff
By education		Women with tertiary education		
Hours of work	16.248(4.22)	0.013**(0.003)	0.026**(0.005)	0.013
Employment (%)	62.2(5.5)	0.046**(0.007)	0.047**(0.008)	0.001
Formal care hrs/child	8.951(2.41)	0.035**(0.007)	0.040**(0.008)	0.005**
Use of formal care (%)	47.3(4.6)	0.148**(0.030)	0.145**(0.027)	-0.003
Informal care hrs/child	7.315(4.36)	-0.022**(0.009)	-0.015**(0.008)	0.007**
Disposable income ($)	1398.882(65.03)	0.894**(0.056)	1.034**(0.058)	0.141**
Net child care costs ($)	57.625(16.90)	-0.764**(0.049)	-0.727**(0.053)	0.037**
Net gov. tax revenue ($)	354.225(51.56)	-0.883**(0.031)	-0.728**(0.059)	0.155**
Child care subsidy ($)	0.0	17.071**(4.190)	18.595**(4.388)	1.524
		Women with no tertiary education		
Hours of work	10.508(4.96)	0.021**(0.004)	0.032**(0.007)	0.011**
Employment (%)	48.1(7.9)	0.070**(0.010)	0.069**(0.012)	-0.001**
Formal care hrs/child	6.428(2.56)	0.040**(0.008)	0.046**(0.009)	0.006**
Use of formal care (%)	38.2(5.7)	0.194**(0.037)	0.201**(0.037)	0.007
Informal care hrs/child	4.148(3.88)	-0.017(0.010)	-0.012(0.010)	0.005**
Disposable income ($)	1186.559(44.39)	0.914**(0.053)	0.978**(0.055)	0.063**
Net child care costs ($)	37.296(16.68)	-0.748**(0.049)	-0.712**(0.054)	0.036**
Net gov. tax revenue ($)	67.139(43.51)	-0.833**(0.035)	-0.732**(0.055)	0.101**
Child care subsidy ($)	0.0	16.441**(4.626)	11.985**(4.434)	-4.456**
By income		> median 'other household income'		
Hours of work	14.134(4.52)	0.011**(0.003)	0.020**(0.004)	0.009**
Employment (%)	59.0(6.5)	0.032**(0.005)	0.043**(0.008)	0.011**
Formal care hrs/child	8.354(2.47)	0.028**(0.006)	0.031**(0.007)	0.003**
Use of formal care (%)	45.99(4.9)	0.126**(0.027)	0.120**(0.024)	-0.006
Informal care hrs/child	5.806(4.06)	–0.017**(0.008)	-0.012 (0.007)	0.005**
Disposable income ($)	1654.295(65.70)	0.956**(0.048)	1.049**(0.050)	0.093**
Net child care costs ($)	54.185(17.48)	–0.807**(0.044)	-0.783**(0.048)	0.024**
Net gov. tax revenue ($)	581.140(51.23)	–0.913**(0.024)	-0.822**(0.040)	0.092**
Child care subsidy ($)	0.0	10.726**(2.866)	17.442**(4.984)	6.716**
		< median 'other household income'		
Hours of work	13.511(4.51)	0.022**(0.005)	0.037**(0.008)	0.015**
Employment (%)	53.5(6.5)	0.061**(0.009)	0.067**(0.011)	0.006
Formal care hrs/child	7.416(2.42)	0.046**(0.009)	0.054**(0.009)	0.008**
Use of formal care (%)	41.0(5.0)	0.210**(0.039)	0.217**(0.038)	0.008
Informal care hrs/child	6.146(4.22)	-0.023**(0.011)	-0.016(0.011)	0.007**
Disposable income ($)	964.667(47.16)	0.849**(0.061)	0.972**(0.063)	0.123**
Net child care costs ($)	43.892(15.88)	-0.708**(0.054)	-0.659**(0.059)	0.049**
Net gov. tax revenue ($)	-114.685(44.90)	-0.811**(0.041)	-0.638**(0.074)	0.173**
Child care subsidy ($)	0.0	22.872**(5.681)	14.165**(3.744)	-8.707**

Standard errors, clustered at the individual level, in parentheses
** Significant at 5% level; * Significant at 10% level.
Cells are household averages; hour and dollar values are weekly.
CCR is calculated at the rate of 30% for comparability with CCTR.
Average hours include zeros.

Appendix

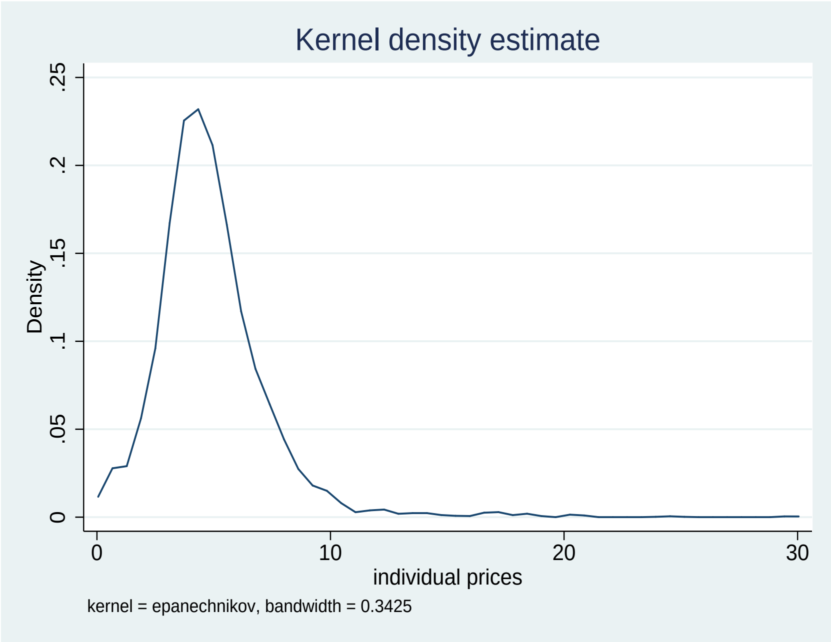

Figure A1. Kernel density estimate of individual child care prices

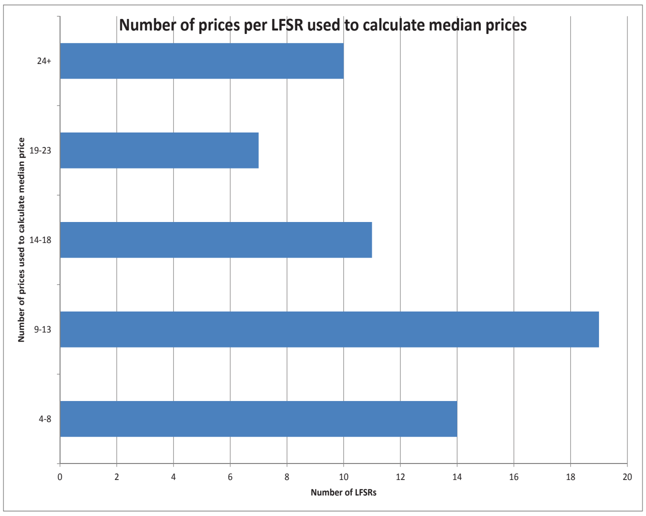

Figure A2. Number of prices used within LFSR

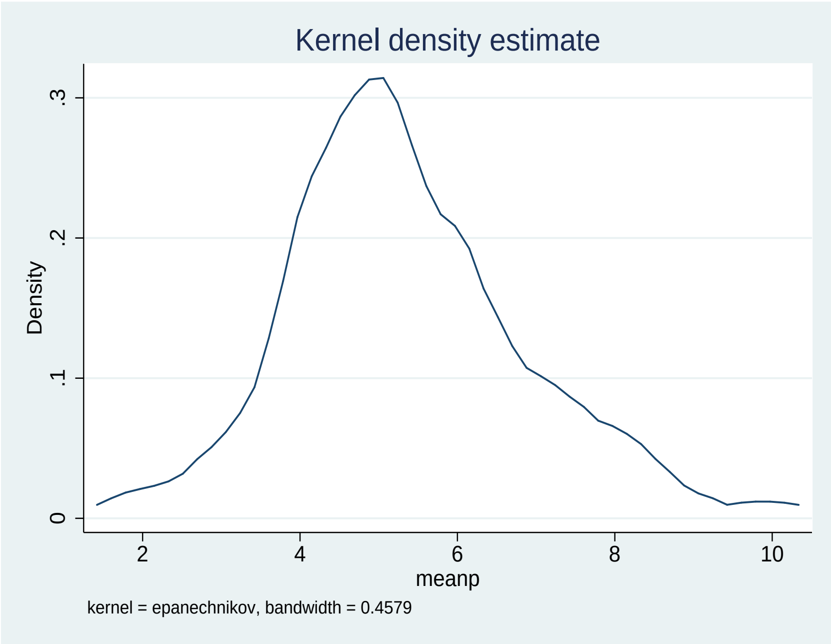

Figure A3. Kernel density estimate of mean child care price in LFSR

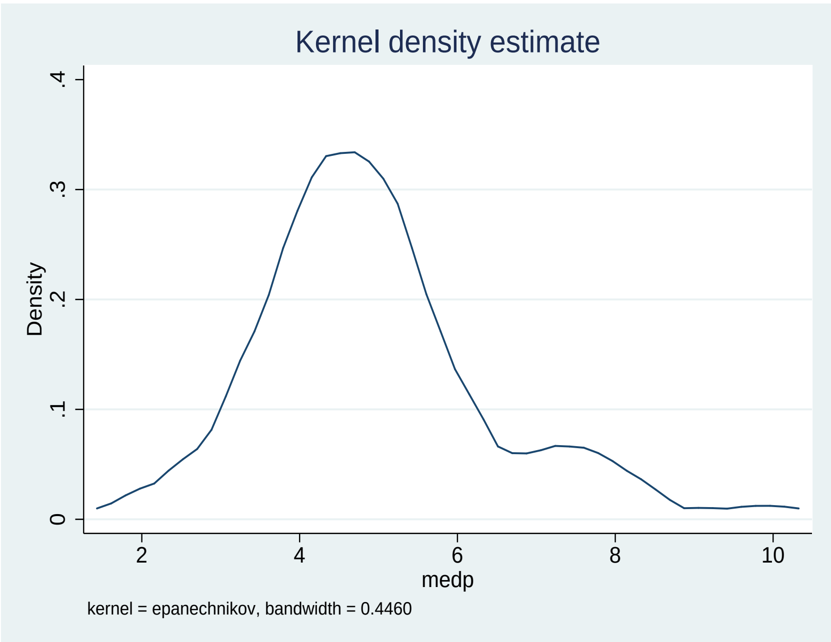

Figure A4. Kernel density estimate of median child care price in LFSR

Table A1. Mean Observed and Simulated hours of work and formal child care by subsamples

		Hours of work		Hours of formal childcare		Hours of informal childcare	
	No. of obs.	Observed	Simulated	Observed	Simulated	Observed*	Simulated#
Tertiary education	586	16.584	16.439	8.975	9.624	5.001	6.845
no Tertiary education	429	10.660	10.832	6.384	7.132	3.674	3.807
$>$ 1 young children	353	10.609	10.776	5.921	7.396	4.036	3.486
One young child	662	15.931	15.825	8.924	9.197	4.656	6.668
Husband with tertiary education	713	14.899	14.947	8.925	8.973	4.456	6.014
Husband no tertiary education	302	12.146	11.996	5.412	7.623	4.400	4.492
$>$median non-labour income	507	13.892	14.214	7.722	8.665	4.945	5.582
$\leq$ median non-labour income	508	14.268	13.925	8.038	8.477	3.936	5.540

*Observed hours of informal care are those reported by families. This data is not used in modeling.

#Simulated hours of informal care are derived gap between hours of work and of formal care simulated from the model.