Preliminary Draft [Please do not cite]

May, 2009

The Effect of Child Care Center Availability on Child Care Arrangements and Maternal Labor Supply

Chikako, Yamauchi[1]
Economics Program
Research School of Social Sciences
Australian National University

Abstract:
This study investigates how the availability of child care center places affect child care arrangements and maternal labor supply. In order to take into account possible endogenous entry by childcare providers, the community- and cohort-specific number of center-based childcare places per child is instrumented by the community-level cohort size at birth, to which a household's youngest child belongs. An unanticipated increase in birth cohort size can create capacity constraint, and childcare providers are unlikely to be able to adjust their service levels in the short run. The results show that a new center-based care place increases the usage of center-based care and maternal employment as a part-time worker, among households where the youngest is aged less than two years. These results are similar to previous findings on the effect of subsidized childcare, which often brings about lower price and greater availability. In light of this, the present findings imply that an increase in center availability per se, without an increase in subsidy, has the impact of facilitating maternal labor supply.

JEL Codes: J13, J22
Key words: child care, labor supply, center

[1] Address: Economics Program, RSSS, H.C. Coombs Bldg., The Australian National University, Canberra, ACT 2000, Australia; Telephone: +61-2-6125-2355; Fax: +61-2-6125-0182; Email: chikako.yamauchi@anu.edu.au. This paper uses unconfidentialised unit record file from the Household, Income and Labor Dynamics in Australia (HILDA) survey. The HILDA Project was initiated and is funded by the Commonwealth Department of Families, Community Services and Indigenous Affairs (FaCSIA) and is managed by the Melbourne Institute of Applied Economic and Social Research (MIAESR). The findings and views reported in this paper, however, are those of the author and should not be attributed to either FaCSIA or the MIAESR.

1. Introduction

Recently, there has been growing concern regarding the limited accessibility of non-parental child care as a possible constraint to maternal labor supply and early childhood education (OECD, 2006). This issue has become increasingly important as the expectation grows for governments to help women balance their work and family commitments. Such an expectation is particularly strong in aging societies where mothers are seen as potential contributors to social security funding. In addition, growing interest in early childhood education is likely to amplify demand for high-quality child care. Such demand, in turn, is likely to make concerns about availability more serious for center-based care, which tends to be provided by more highly qualified staff than home-based care.

This paper examines how the availability of center-based child care affects child care arrangements and labor supply of mothers with small children in Australia. In particular, it utilizes the rapid expansion of the number of center-based child care places between 2002 and 2004 (an increase of more than 35,000, or an 18% increase), which was mainly driven by the growth of the private sector. In order to take into account possibly endogenous entry by child care providers and migration by households, community fixed effects are controlled. In addition, the key availability measure of this paper, the community- and cohort-specific number of center-based care places per child, is instrumented by the community-specific cohort size at birth. Since it takes a few years to construct a new center, providers are unlikely to be able to adjust for unanticipated changes in demand due to cohort size fluctuations within a few years since birth. Thus, I identify the effect of the availability of center-based child care places by examining how the behavior of households with small children

differs from one cohort to the other within a community, as those cohorts face differential availability of center-based care per child of the same age as their youngest.

Results show that an increase in the availability of center-based care places induces the use of center-based care among households with 0-1 year-olds. This does not accompany a significant substitution from other types of care. In addition, increased center availability facilitates maternal labor supply as a part-time worker. On the other hand, the weak first-stage results for households with older children (2-4 year-olds) preclude the identification of the effect of center care availability for this group. This is likely to be because providers can adjust their service levels in the long run. The results for very small children are consistent with previous studies on the positive impact on maternal labor supply of subsidized / public child care, which often brings about lower price and greater availability. In light of these previous results, the finding in this paper suggests that, even without a reduction in fees, an increase in the availability of center-based childcare has an impact of facilitating maternal labor supply. These results imply that public efforts to ensure accessibility of child care are likely to contribute to maternal economic participation.[2]

Previous studies on childcare utilization and maternal labor supply have focused on the impact of newly introduced subsidies or construction of subsidized preschools.

[2] For example, some governments let the market provide services with a minimum standard set by regulation, and encourage providers to operate in areas with limited supply by offering start-up assistance. Other governments directly provide free or low-cost childcare, managing the geographic allocation of care facilities (OECD, 2002, 2003, 2004, 2005, and 2007). Consideration of childcare policy formulation necessitates knowledge of the impact on parents' behavior and children's well-being, and it could be that the benefit from the effect of childcare availability on children's outcomes is overwhelming. Since the data used in this study do not provide information on the latter, this paper focuses on parental, particularly maternal, labor supply and childcare utilization.

The recent study by Baker, Gruber and Milligan (2008) examines the effect of the subsidized child care system for 0-4-year-olds, introduced in the Canadian province of Quebec. The study indicates that, following the introduction of subsidized child care, compared to the rest of the country, Quebec exhibited an increase in overall usage of child care among married mothers by 15 percentage points, one-third of which was due to a shift away from non-subsidized care toward subsidized care. The study also identifies an increase in married mothers' labor force participation by 8 percentage points.

More mixed evidence has been found in the U.S. on the effect of subsidized child care on labor supply of married mothers. Utilizing the staggered introduction across the US states of preschool for 5-year-olds into the public school system, Cascio (2009) shows that the initiative increased utilization of public subsidized schools by 11-24 percentage points. While take-up was observed widely, no labor supply effect was found for married mothers in her study. On the other hand, using the 1980 US census, Gelback (2002) finds a positive effect on labor supply for married mothers of 5-year-olds eligible for free preschool service, compared to mothers of 5-year-olds who were not yet eligible for it. On the other hand, both Cascio (2006) and Gelbach (2002) find that single mothers who do not have children younger than five show an increase in labor force participation.[3]

Evidence of the positive effect on maternal labor supply has also been observed in other countries that introduced public preschool for somewhat younger children. Schlosser (2005) examines Israel's recent attempt to provide new preschools for Arab

[3] Blau and Tekin (2007) also reported the positive effect of subsidy receipt on labor supply of single mothers with 0–12-year-olds.

3-4-year-olds between 1999 and 2003, which increased their attendance by 60 percentage points. She shows that labor force participation of Arab mothers in towns designated for provision of new preschools increased by 7-12 percentage points, compared to towns in the control group. In addition, Berlinski and Galiani (2006) find that, in Argentina, regions with an additional increase in the number of public preschool places per child exhibited an increase of 89 percentage points in the probability of attendance among 3-5-year-olds, and a 7-14 percentage point increase in the probability of mothers participating in the labor force.[4]

The present research departs from the abovementioned previous studies in that it focuses on the effect of the availability of center-based care in a setting where no change has been introduced to the subsidy system. While there is a significant body of evidence regarding the impact of a subsidized child care system, the effect of facility availability *per se* has not been fully investigated.[5] However, it has been shown the availability of educational facilities can affect attendance (e.g., Card (1995), Currie and Moretti (2003) and Duflo (2001)). The differences between my results and the results based on the previous studies also facilitate our understanding of the mechanism through which the subsidized child care/preschool system works. Since a

[4] Earlier studies also investigated the effect of childcare cost on utilization and maternal labor supply, chiefly based on a cross-sectional, structural-estimation approach. Most likely reflecting the lack of an exogenous variation in the cost of childcare, they provided more mixed evidence. Studies using a relatively exogenous variation suggest the small but positive effect on utilization and mothers' labor supply. These studies are reviewed by, for example, Anderson and Levine (2000), Blau (2003), Blau and Currie (2004), and Baker et al. (2005). Existing evidence for Australia is also based on cross-section analysis, and the price elasticity is estimated to be positive, but smaller than the range reported in other countries (Doiron and Kalb, 2005, Kalb and Lee, 2008, Rammohan and Whelan, 2005, 2007).

[5] Blau (1993, 2001) investigated the supply of childcare focusing on labor supplied by childcare workers. Roles played by the local availability of center-based child care have not been studied. Another set of studies focuses on the rationing of supply in settings where childcare is mainly publicly provided (Gustafsson and Stafford, 1992 and Del Boca and Del Vuri, 2007). These studies, however, examine whether price responsiveness differs in rationed areas and areas with enough supply of public childcare, without directly testing the impact of availability. Based on the cross-section data from Germany, where hardly any private providers operate, Kreyenfeld and Hank (2000) find no relationship between the availability of care and mothers' labor supply.

public child care/preschool system usually provides households with not only increased availability but also reduced fees, the similar positive impact of the availability of center-based care *per se* on utilization and maternal labor supply, found in this study, suggests that an increase in center care availability without a fee reduction still has the effect of enhancing mothers' employment opportunity.

The present research contributes to the international comparison of different child care regimes. While there is growing interest in subsidized child care centers and preschools, critics argue that such a scheme necessitates a substantial tax burden and organized local government service. Countries that are unlikely to meet these requirements may find it more suitable to pursue a mixture of market child care provision and public provision of more targeted subsidies and quality assurance (OECD, 2007). Since the beginning of the 1990s Australia has pursued this combination of state and market approach, during which time the supply of child care has expanded mainly due to growth in the private sector (OECD, 2002; Press and Haynes, 2000). This paper provides evidence of the effect of this market-driven supply of child care.

The remainder of this paper is presented as follows: in Sections 2 and 3, I describe the data used in this study and child care institutions in Australia. In Sections 4 and 5, the conceptual framework and identification strategy are discussed. Sections 6 presents the results and conclusions are drawn in Section 7.

2. Data

This study utilized the 2002-2004 Household Income and Labor Dynamics in Australia (HILDA) Survey, which constitutes nationally representative longitudinal household data collected since 2001. The 2002-2004 panels are used in this paper because the Australian child care policy framework changed after 2004,[6] and the questionnaire on child care usage significantly changed after 2001. Mothers of at least one child aged 0-4 years[7] are extracted from each wave. When pooled together, they comprise three cohorts of mothers with young children.

This household (mother)-level data is merged with the information on community-level information based on the area of each household's residence. A community is defined by Statistical Local Area (SLA), which contains one or more Census Collection Districts.[8] The summary statistics of household- and community-level variables are depicted in Table 1 (See Appendix 1 for details).

3. Child care Institutions in Australia

3.1 Types of Child care

The major, formal pre primary-school facilities can be categorized into two groups: center-based care and home-based care. Center-based care includes Long Day Care (LDC) and Kindergarten/Preschool. LDC is a center-based form of child care service and typically looks after children who have not yet started school. Staff members are more likely to have qualifications in early childhood education or child care,

[6] A new program, the Child Care Tax Rebate, was introduced in 2005, which is likely to reduce out-of-pocket childcare expenditure for middle- and high-income households. In order to focus on the effect of the availability of center-based care, I study the period in which the policy framework remains unchanged.

[7] Mandatory education starts from the age of six. Five-year-olds who turn six during an academic year therefore begin attending primary school.

[8] As of 2001, there were 1353 SLAs, which contained 37,209 Census District (CD)s in Australia. An urban CD had about 220 dwellings, while the number for rural CD depended on population density (Australian Bureau of Statistics, 2001).

compared to home-based caregivers.[9] While kindergartens and preschools are administratively categorized as educational as opposed to child care facilities,[10] they both provide the same service in terms of freeing up mothers' time for work or other activities. Further, kindergarten or preschool services are sometimes offered at child care facilities, and some preschools offer a child care service as well. Thus, in this paper, these two institutions are included in the category if center-based care. Home-based care (the second type of formal child care) includes Family Day Care (FDC), which is provided by registered carers at their homes or the child's home.[11] In addition to these two types of formal service, informal care is provided by grandparents, relatives, friends, neighbors, and unregulated nannies.

Between 2002 and 2004, an average of 57% of households used some type of non-parental care for at least one hour per week. Center-based care was used by 31% of households, while home-based and informal care was used by 15% and 37% of households, respectively (Table 1).[12] The proportion of households using some form of non-parental care exceeds the proportion of households in which mothers work (47%), suggesting that some households use non-parental care for purposes unrelated to maternal work. The average user of non-parental child care uses it for 18 hours per week. The figure is similar for formal care users; 17 hours among center-based care

[9] For example, 61% of 52,865 Long Day Care staff hold a qualification, while 31% of 10,669 Family Day Care carers hold one (Department of Education, Employment and Workplace Relations, 2006).
[10] One year before primary school, children who turn five can attend kindergarten, which operates five days a week. Two years before primary education, children who turn four can go to preschool, which provides about 10-12 hours of preparatory classes over two or three days a week. These pre-primary-school services have different names in each state. For example, the program one year before primary school is termed kindergarten in New South Wales (NSW) and the Australian Capital Territory (ACT), while it is termed preschool in Queensland. The program two years before primary school is called preschool in NSW and ACT, and kindergarten in Queensland.
[11] The description of LDC and FDC is based on the Department of Family and Community Services (2005).
[12] Usage of different types of care is not mutually exclusive; one household can use multiple types of care for at least one hour each.

users and 18 hours among home-based care users. The average informal care users spend 8 hours per week with informal care providers. In the analysis, I use the weekly number of care hours by assigning 0 to non-users.

3.2 Measure of center-based child care availability

The availability of center-based child care is measured by the estimated number of places available at center-based providers per child in each age group. First, the information on the number of center-based providers was collected from the website of the National Childcare Accreditation Council for each year and community. In order to derive the number of childcare places by age, the number of providers was multiplied by the state-level, per-provider average number of children aged 0, 1, 2, 3, or 4, who are taken care of at center-based providers. These averages are based on the 2002 and 2004 Child Care Census. They indicate a typical number of children of each age who are looked after at one provider. The resulting figure for each age group was then divided by the number of children of the same age group living in the area, which was interpolated from the 2001 and 2006 Census.[13] On average, there were 0.24 places per child aged 0-4 (Table 1). In the analysis, I assign the number relevant to the youngest child in a household. For example, if the youngest child is aged 0, the number of center-based childcare places for 0 year-olds per child aged 0 is assigned to the household. The average number per child is 0.06 (0 year-olds), 0.22 (1 year-olds), 0.37 (2 year-olds), 0.44 (3 year-olds), and 0.35 (4 year-olds).

[13] See Appendix 1 for details. Since the number of childcare places per center does not vary within state and year, the measure used in this paper under- (over-)estimates the number of places per child in an area with an above- (below-) average number of children per center. However, to the extent that this non-classical measurement error is time-invariant, it is differenced out in the fixed effects estimation. This is true if a new center in a certain area is a similar size to existing centers in the area. This is likely the case, as population size, an indicator for demand size, did not change drastically within three years of the analysis period. The measure also does not capture a change in the maximum number of children existing centers accommodate. However, conversations with some center managers suggest the scope for this adjustment could be small because of limitations of space and staff to match the increased number of children.

Some of these places were provided by private (for-profit) centers, while others were provided by community-based (not-for-profit) centers.[14] Although the data source does not allow the disaggregation of centers based on management structure, the variation during this period was dominated by the increase in supply from the private sector. Between 2001 and 2004, the growth rate of the total number of center-based child care places was 24% for the private sector, and 7% for community-based providers.[15]

3.3 Child care Policy Framework

As this paper focuses on center openings and their impact on household behavior, it is important to note the child care policy environment did not change during the analysis period. The major child care policy at the federal level, which accounts for a large proportion of public expenditure on children's services, did not change between 2002 and 2004.[16] The policy consisted of a price subsidy, quality assurance, and direct support for providers, the details of which are provided in Appendix 2. The only change during the period was the repeal of the state regulation on licensing in two of the seven states/territories.[17] In order to control for the possible effect of this change as well as other common state-level changes, the regression analysis incorporates

[14] Community-based providers are owned by not-for-profit entities such as local governments, community/religious organisations, charities and non-profit organisations (Australian Institute of Health and Welfare (AIHW), 2007; the Department of Family and Community Services, 2004).
[15] The share of childcare places provided by the private sector rose from 68 percent (of the total of 193,809 in 2001) to 72 percent (of the total of 229,603 in 2004) (AIHW, 2005).
[16] For example, in the 2006/07 fiscal year, the Australian Government accounted for 78 percent of total government expenditure on children's services (A$3.03billion) (Steering Committee for the Review of Government Service Provision, 2008).
[17] The states of Queensland and New South Wales introduced new childcare regulations in 2003 and 2004, respectively. These state governments set regulations regarding the approval of premises, construction plans, applicants, and staff. For example, requirements are set based on the number of children in care, the size of rooms, the number of staff and their qualifications, and health/safety (Department of Family and Community Services, 2005).

heterogeneous year effects.[18] The source of variation explored in this paper is not those arising from changes in the policy framework, but changes in center availability across communities over time.

4. Conceptual framework

The availability of child care can affect household decision-making about child care usage and labor supply in various ways. Households located close to centers are more likely to take advantage of newly available services because, first, they can reduce the effective hourly price that parents need to pay by decreasing transportation costs.[19] Second, an additional child care center in the neighborhood can increase the marginal benefit of using center-based care as perceived by parents. For example, a nearby service may be utilized by neighboring households, who can provide information about the quality of care offered at the center, reducing parents' uncertainty. At the same time, information relating to the possible benefits of using center-based care, such as providing social interaction with peers and learning opportunities, may become more widely shared among the local community. Proximity to centers can also provide parents with the security that they can collect their children in the event of an emergency. Third, the increased availability of child care can facilitate greater competition among providers, which may result in a reduction in the average fee level and an improvement in the average quality.

These factors are likely to induce parents to utilize center-based care. While this demand increase could be accompanied by a decrease in demand for other types of

[18] The state-specific year effect is included for the state of Victoria in addition to the two states that introduced new childcare regulations. The remaining four states and territories have too few observations to include their own year effects.
[19] For the formal model of maternal employment and childcare usage decisions, see Blau (2003).

care, if overall usage of non-parental child care increases, it can increase maternal time that can be devoted for work. This paper does not aim to disentangle the various pathways through which child care availability may affect household decision making; rather, it provides evidence of the overall impact of new center openings.

5. Empirical Strategy

For comparison, I start with the following pooled OLS model indicating the correlation between the availability of center-based care places and an outcome variable.

$$(1) Y_{ijst} = a + bN_{ijt} + d_1X_{ijt} + d_2Z_{jt} + S_s + T_t + S_s*T_t + e_{ijst} \qquad (t = 2002\text{-}2004)$$

The outcome variable, Y_{ijst}, includes indicators of maternal labor supply and child care usage for a household *i*, living in community *j* in state *s*, in year *t*. The outcome is assumed to depend on the household-specific availability of center-based child care places, N_{ijt}, controlling for household- and community-level characteristics, X_{ijt} and Z_{jt} (See Table 1), as well as state effects, year effects, and the interaction between those two effects. The parameter of interest, *b*, indicates how childcare utilization and maternal labor supply differ across communities with different levels of center-based care availability, controlling for the observables. Next, I extend the model by introducing community (SLA)-level unobserved fixed effects, u_j, as follows:

$$(2)\ Y_{ijst} = a + bN_{ijt} + d_1X_{ijt} + d_2Z_{jt} + T_t + S_s*T_t + u_j + e_{ijst}$$

The simple state effects are dropped. Under this specification, the parameter of interest, *b*, indicates how the behavior of a cohort of mothers with 0-4-year-olds differs compared to the previous cohort of mothers, particularly in communities where a new center-based care place becomes available per child, netting out the controls. This difference-in-differences specification is comparable to recent studies (Baker et al., (2008), Cascio (2006) and Schlosser (2005)), and is similar in particular to the specification used by Berlinski and Galiani (2006).

Since the major expansion of the supply of center-based childcare was driven by the private sector, it is possible that providers entered in communities where demand was growing. Also, households with preference for center-based care might have moved to areas which had a larger number of such care places available. Suppose that the supply of childcare places in an area, S_{jt}, depends on providers' expectation for demand and the cost of operating a childcare center in that area. Also, suppose that expected demand depends on characteristics of the area observed in the past (for example, average household income, housing value, and demographic composition) and unobserved factors. That is, $ED_{jt} = ED(Z^2_{jt-1}, v^1_{jt})$, where Z^2_{jt-1} is a vector of past community characteristics and v^1_{jt} is an unobserved factor. The expected cost is likely to depend on the wage rate and the rental cost in the previous period, C_{jt-1}, which are assumed to be given. Then, the total number of childcare places is a function of $(ED(Z^2_{jt-1}, v^1_{jt}), C_{jt-1}, v^2_{jt})$ or $(Z^2_{jt-1}, C_{jt-1}, v_{jt})$. On the other hand, the total number of children of a certain age (the denominator of the availability measure) is the sum of the cohort size at birth, B_{jt}, and the size of net migration, MI_{jt}. If migration depends on characteristics of the community in the previous period, Z^2_{jt-1}, and an unobserved factor, w_{jt}, the number of children is a function of $(Z^2_{jt-1}, B_{jt}, w_{jt})$. These assumptions

indicate that the number of childcare places per child of a certain age can be rewritten as follows:

$$(3)\ N_{jt} = S(ED(Z^2_{jt-1}, v^1_{jt}), C_{jt-1}, v^2_{jt}) / [B_{jt} + MI_{jt}(Z^2_{jt-1}, w_{jt})] = g(Z^2_{jt-1}, C_{jt-1}, B_{jt}, w_{jt}, v_{jt})$$

Eq.(3) shows that, if an unobserved factor affecting care providers' expected demand in a certain region, v_{jt}, is correlated with unobserved factor affecting market care usage of a household in that region, e_{ijt}, then N_{jt} is correlated with the error term. For example, providers may adjust their supply levels by using their knowledge about average growth in preference for market childcare that is not controlled by Z^2_{jt-1}. It would be misleading to entirely attribute the association arising from such a reverse causality to the effect of supply on demand. Similarly, if unobserved factor influencing migration by families with young children, w_{jt}, is correlated with e_{ijt}, it could analogously produce a source of bias. For instance, families with desire to start using market childcare might move to areas where the average preference for market childcare is growing, creating a downward bias through a negative correlation between per child availability of childcare and the error term.

Under the assumption that a household's unobserved preference is uncorrelated with the size of the area-specific cohort at birth to which the child belongs to, the birth cohort size can be used as an instrumental variable to purge a possible bias discussed above. Birth cohort size is mechanically correlated with per child availability of childcare places, but not through possibly endogenous migration by families with children. Childcare providers might adjust their supply levels according to birth cohort size, but the scope for this is likely to be limited in the short-run. Constructing

a new centre takes one and a half to three years. Within-centre adjustment such as hiring of new staff is also likely to be limited, unless providers have been significantly under its maximum capacity, due to the regulations which specify the number of children who can be accommodated given space.

Based on Eq.(3), and including the control variables in Eq.(2), the reduced-form first-stage equation is specified as follows:

$$(3') \; N_{jt} = b_0 + d_1 X_{ijt} + d_2 Z_{jt} + b_1 Z^2_{jt-1} + b_2 C_{jt-1} + b_3 B_{jt} + T_t + S_s * T_t + u_{jt}$$

The initial second-stage equation does not include a possible effect of the past characteristics of an area (Z^2_{jt-1}, C_{jt-1}) on current childcare usage. However, it is unclear whether the average household characteristics, such as the past average household income, are uncorrelated with current preference for market childcare among parents. The robustness of the results is examined by allowing these characteristics to have direct effects on current childcare usage. Thus, the full specification for the second-stage equation is as follows:

$$(2') \; Y_{ijst} = a + bN_{ijt} + d_1 X_{ijt} + d_2 Z_{jt} + d_3 Z^2_{jt-1} + d_4 C_{jt-1} + T_t + S_s * T_t + u_j + e_{ijst}$$

Under this specification, the identification assumption is $C(B_{jt}, e_{ijt} | X_{ijt}, Z^1_{jt}, Z^2_{jt-1}, C_{jt-1}, T_t, S_s * T_t, \mu_j) = 0$. Intuitively, this assumes that a parent's unobserved preference for childcare is not correlated with the area-specific cohort size of her child at birth, once the following are controlled: area fixed effects, current household characteristics, and past and current characteristics of the area. This means that, even if preference for

market childcare differs across mothers whose child belongs to a cohort of various sizes, to the extent that this tendency is time-invariant, it is controlled by fixed effects. Some communities may experience disproportionately rapid economic growth, which may affect both fertility and demand for childcare. These changes however are likely to be controlled by the past community characteristics such as the average levels of income and housing value. Summary statistics for these and other control variables are shown in Appendix Table 1. Other controls include rental costs for care providers, which are proxied by the sales of commercial and retail property as well as their median price per square meter are used. For wage cost proxies, average annual gross earned income is used. Additional community-level household characteristics include housing price, household weekly income, population size, the share of population by indigenous status, immigration status, and language use status. The shares of different age groups as well as the share of partnered individuals aged 20-49 are included.

In the analysis, a mother / household is used as a unit of observation. This facilitates the comparison of the results for maternal labor supply and child care utilization. For households with more than one child aged 0-4 (32% of the sample), usage is defined as using a certain type of care for at least one of their children for one hour; the number of child care hours is defined as the total time the children spend at a certain type of child care in a usual week, divided by the number of children.

6. Results

6.1 Evidence from the OLS and Fixed Effects models

The results of the OLS model estimation (Eq.(1)) are shown in Table 2. Not surprisingly, they indicate that communities with a larger number of center-based care

places per child tend to have more users of formal care (both center-based and home-based). These community are also more likely to have working mothers. For example, Columns 1-4 indicate that communities with an additional center-based care place per child of a certain age exhibit a 22 percentage point higher probability of using that type of care for households where the youngest child belongs to that age group. This estimate amounts to 62% of the average probability. An additional center-based care place is also associated with a 6 percentage point higher probability of using home-based care - 40% of the average probability. A possible explanation for the association between the availability of center-based care and usage of home-based care is selective entry of center-based care providers into communities with high demand for formal care in general. In terms of the number of hours a child spends at formal care, Columns 5-8 show that an additional center-based care place is associated with a four- and one-hour increase per week at center- and home-based care, respectively. Greater usage of formal care coexists with higher workforce participation among mothers. Communities with an additional childcare place also have a 15 percentage point higher share of mothers who are working, and their average weekly work time is higher by four hours (Columns 9-11). In other words, the increase in the probability of maternal labor force participation associated with an additional center-based care place per child is about 68 percent of the increase in the probability of using center-based care.

These OLS results could include a possible bias due to unobserved heterogeneity across communities discussed above. If such a bias stems from time-invariant, community-level factors, the community-level fixed effects model (Eq.(2)) is likely to provide consistent estimates. The results, depicted in Table 3, indicate findings that

mirror those shown in Table 2. For instance, communities which gain over time an additional center care place for a certain age group experience a 34 percentage point increase in the probability of using center care for households where the youngest child belongs to that age group (Column 2). An additional center-based care place is also accompanied by a 10 percentage point increase in the probability of using home-based care (Column 3). The fact that home-based care usage increases with the supply of center-based care provides an indication that providers' entry might be correlated with a time-variant unobserved factor affecting growth in demand for non-parental childcare. The results for the number of weekly care hours also indicate that communities with an increasing supply of center-based care tend to have an increase in the usage of not only center-based care (7 hours per week) but also other types of care (about 2 hours per week). (Column 5-8). The results continue to exhibit positive correlation between changes in maternal labor supply and changes in center care availability as well. Communities with a growing availability of center-based care exhibit a 27 percentage point increase in the probability of work and an 8 hour increase in the average weekly work time. The estimate for maternal labor force participation amounts to 79 percent of the estimate for center-based care usage, suggesting that, most mothers who start to use center-based care commence working.

The results of a modified version of fixed effects model (Eq.(2)), which allow differential estimates for households with and without very small children (0-1 year-olds), reveal a significant concentration among households with very small children and households with educated mothers of the positive association between the availability of center-based care and the usage of center-based care as well as

maternal labor force participation (shown in Table 4).[20] The results in the upper panel indicate that an additional place for children aged 2-4 is associated with a 16 percentage point increase in the probability of using center-based care, while the equivalent estimate for children aged 0-1 is 39 percentage points. On the other hand, the increase in the use of home-based care, associated with increasing supply of center-based care, is not found for very small children. The share of working mothers also increases by 31 percentage points when a community receives an additional center-based place for 0 or 1 year-olds. Mothers of these very small children are likely to enter the labor force as a part-time worker as the probability of being a full-time worker is unchanged by changes in the availability of center-based care. A breakdown by maternal educational attainment (shown in the lower panel) depicts stronger associations among educated mothers. In particular, while an additional center-based place per child is associated with an increase in the maternal labor force participation rate by 50 percentage points, the equivalent estimate for mothers who completed or dropped out of high school is 15 percentage points.

6.2 Evidence from the Instrumental Variable model

The fixed effects model results in the previous section might be still subject to a possible bias if the entry of care providers and household migration are correlated with an unobserved time-variant factor. One way to purge such a bias is to use the Instrumental Variable model (Eqs.(2') and (3')), by utilizing changes in the availability of center-based care induced by exogenous fluctuations in birth cohort size. The results of the first stage equation are depicted in Appendix Table 2,

[20] Compared to partnered mothers, single mothers exhibit stronger association between changes in the availability of center-based care and changes in center-based care utilization and labor supply. However, most likely due to the small sample, few differences are estimated to be significant (not shown).

separately for the sample of households where the youngest child is very small (0-1 year-olds) and relatively old (2-4 year-olds). It shows that changes in the excluded instrumental variable, the natural log of the size of a birth cohort, are significantly associated with changes in the number of center-based care place per child belonging to that birth cohort, only among households with very small children. The results imply that a one percent increase in the size of a cohort at birth significantly decreases the number of center-based care places per child in that cohort by 1.2 percent (evaluated at the median), controlling for community fixed effects and changes in the other covariates. On the other hand, for households with older children, the effect is insignificant and the sign is opposite. Theses results are consistent with the fact that birth cohort shocks cannot be accommodated in the first few years, but in the long-run, either providers can adjust the level of their services, or households seeking for childcare can migrate to other areas with higher availability.[21]

The results of the second-stage estimation (Eq.(2')) are depicted for the sample of households with 0-1 year-olds with different sets of control variables in Appendix Table 3, using the weekly number of hours a child spends at center-based care as the outcome variable. The significance level of the excluded instrument, the natural logarithm of birth cohort, consistently exhibit reasonably high partial correlation with the availability measure. Also, the estimated effect of the availability of center-based care is generally consistent across different specifications. This pattern is found generally for all the outcome variables. However, both the point estimate and standard error are large. An additional center-based child care place per child of a certain cohort is estimated to increase the average weekly center-based care hours by 41

[21]The second-stage results for households with older children (not shown) are very inaccurate, most likely due to the weak first-stage results.

hours for households with 0 or 1 year-olds (Column 6). While these are very large estimates, the 95 percent confidence interval implies the estimate falls between 1.7 and 81 hours. This includes the confidence interval based on the fixed effects model estimation – 3.3 and 11 hours.

The results for all the outcome variables are depicted in Table 5 based on the full specification indicated in Column 6 of Appendix Table 3. Based on the differences in the first-stage results between households with and without very small children, the second-stage results are also estimated separately for those two samples. The results for households with very small children (upper panel) suggest that, while an additional center-based care place increases the average number of hours a child spends at centers (Column 6), its impact on the use of the other types of care is relatively limited and insignificant (Columns 7 and 8). A possible explanation for these results is that, once unobserved heterogeneity including providers' selective entry is controlled, the effect of center-based care availability is concentrated in the increased usage of center-based care. Similarly to the results for the weekly number of care hours, the results for the probability of using different types of care (Columns 1-4) indicate large point estimates and standard errors. For example, the effect on the probability of using center-based care is estimated to exceed one; however, it is inaccurately estimated and not significantly different from zero. Altogether, the results are inconclusive about the exact magnitude of the effect. However, they tend to indicate the positive effect of center-based care availability on the average number of hours during which children are exposed to that center-based care.

Analogously, the positive impact is found on maternal labor supply, though the results do not provide clear evidence on the exact magnitude. The point estimate suggests that an additional center-based care place per child increases the probability of working for mothers by 271 percentage points (Column 9). However, due to the large standard error, this estimate cannot be statistically distinguished from one. The estimate of one implies that one more seat at center-based facility per 10 children is likely to lead to one out of 10 mothers participating in the workforce. Similarly, the point estimate for the effect on the average work time indicates an increase of 78 hours, but this is indistinguishable from an increase of 20 hours per week (Column 11). Given that the effect on the probability of working at a full-time basis is not significant, the results for labor supply altogether might be taken as an indication for the positive effect on participation as a part-time worker.[22]

6.3 Robustness of the IV results

The results of the Instrumental Variable model estimation could suffer from a bias if mothers of a child who belongs to a large cohort (thus, a larger number of center-based care places per child) are systematically different in their preference for childcare usage or labor supply. One way to informally check this possibility is to see whether mothers' observed characteristics are correlated with the size of cohort to which their child belongs to. Table 6 shows the results of SLA fixed effects model which include the full set of covariates used in Table 5. It demonstrates that mothers whose child belongs to a large cohort are less likely to be college graduates, and more likely to have a large number of children aged 0 or 1. However, other maternal or

[22] When the sample of households with very small children is limited to those with partnered mothers, the effect on labor supply becomes insignificant and point estimates shrink by 39-76 percent, while the usage of center-based care remains unchanged. While these provide an indication that the labor supply effect is stronger for single mothers, the estimates for the whole and limited samples cannot be statistically distinguished.

household characteristics, such as partner status and household composition, are not correlated with the size of their child's cohort. While this is not a formal test, the results provide an indication that mothers' unobserved characteristics related to their educational attainment might be associated with the size of the cohort their child belongs to. For example, the results in Table 5 could have resulted if college graduates are more likely to prefer center-based care and employment.

In order to investigate this possibility, I estimate the same Instrumental Variables model for the sample of households with very small children without including those with mothers who completed college or higher education. If the results in Table 5 are solely driven by a possible correlation between the cohort size and maternal preference related to their educational attainment, the results without mothers who graduated college are likely to show few significant effects. However, the results, shown in the upper panel in Table 6, suggest the pattern which is consistent with those found in Table 5 (though the coefficients and standard errors are more inaccurately estimated). These results provide an indication that the main results in Table 5 are unlikely to be entirely driven by unobserved heterogeneity correlated with the cohort size.

7. Conclusion

This study has investigated the impact of the local availability of cohort-specific, childcare center places per child on childcare arrangement and maternal labor supply among households with at least one child aged 0-4. In order to account for possibly endogenous entry of care providers, community fixed effects are controlled. In addition, the community- and cohort-specific number of center-based childcare place

per child is instrumented by the community- and cohort-specific size of cohort at birth to which a household's youngest child belongs. As expected, the first-stage results show strong correlation between cohort size and the number of center-based childcare places per child only for children aged 0 or 1. By the time children become two years of age, childcare providers are likely to be able to adjust their service levels, eliminating possible capacity constraint arisen from a deviation in birth cohort size in the short run. While mothers whose child belongs to a larger cohort tend to be less educated, controlling for maternal educational attainment does not change the main results. Other maternal characteristics are shown to be uncorrelated with the cohort size once community fixed effects and other covariates are controlled.

The major findings are that an increase in center-based care availability induces the use of center-based care and maternal labor supply among households with very small children (0-1 year-olds). The results are robust against controlling for a range of community characteristics on which providers might base their expectation, such as the total population size, demographic composition, rental and wage costs, and average income and wealth levels in the previous year. However, due to the wide confidence intervals, the results do not provide conclusive evidence on the magnitude of the effects. For example, while the point estimates for the maternal labor supply effect and the childcare usage effect are large, the results are indistinguishable from those which imply that an additional childcare place per 10 children induces one mother to participate in the labor force as a part-time worker, and increases the average number of hours a child spends at center-based care by 20-40 hours.

The findings for very small children provide a unique comparison with the previous studies which demonstrate the positive effect of subsidized childcare / preschool on utilization and maternal employment. Since the introduction of subsidized childcare typically accompanies fee reduction and greater availability, the results can be seen as the combined effect of both. On the other hand, the present study shows the effect of an increase in the availability of center-based care *per se*. It is possible that an increase in the number of centers operating in one area brings about more competition and lower fees. However, the analysis period of 2002-2004 experienced an increase in the real cost of childcare at 7 percent,[23] while availability expanded. Thus, the findings in this paper imply that, even with no substantial fee reduction, an increase in the availability of child care centers has had the effect of enhancing maternal labor supply. A possible explanation for this is that there was unmet demand for childcare among mothers with very small children, who took advantage of greater availability of center-based care places.

[23] Based on the 2002 and 2004 Census of Child Care Services, which provides the state-level average gross fee charged by childcare centers for children aged 1, 2, and 3 years. The national real average weekly fee for full-time usage (weighted by the number of attending children) increased from A$541 to A$581, or US$389 to US$417 based on A$1=US$0.719 as of April, 2009.

References

Anderson, Patricia and Phillip Levine (2000) "Child Care and Mothers' Employment Decisions," in David Card and Rebecca Blank (eds.) *Finding Jobs: Work and Welfare Reform*, New York: Russel Sage Foundation.

Australian Bureau of Statistics (2001) Statistical Geography Vol.1 Australian Standard Geographical Classification (ASGC).

Australian Institute of Health and Welfare (2005) *Australia's Welfare 2005*.

Australian Institute of Health and Welfare (2007) *Australia's Welfare 2007*.

Australian Capital Territory Government, 2000, "ACT Center-Based Children's Services: Conditions for Approvals in Principle and Licenses" (downloaded on October 24th, 2008).

Baker, Michael, Jonathan Gruber and Kevin Milligan (2005) "Universal Childcare, Maternal Labor Supply and Family Well-Being," *NBER Working Paper* 11832.

Baker, Michael, Jonathan Gruber and Kevin Milligan (2008) "Universal Childcare, Maternal Labor Supply and Family Well-being," *Journal of Political Economy*, 116(4): 709-745.

Berlinski, Samuel and Sebastian Galiani (2006) "The Effect of a Large Expansion of Pre-Primary School Facilities on Preschool Attendance and Maternal Employment," *Labor Economics*, 14, 665-680.

Blau, David (1993) "The Supply of Child Care Labor," *Journal of Labor Economics*, 11(2) 324-347.

Blau, David (2001) *The Child Care Problem: An economic analysis*, New York: Russell Sage Foundation.

Blau, David (2003) "Child Care Subsidy Program" Robert Moffit ed., *Means Tested Social Programs*, University of Chicago Press for NBER: Chicago.

Blau, David and Janet Currie (2004) "Preschool, Day Care, and Afterschool Care: Who's Minding the Kids," *NBER Working Paper* 10670.

Blau, David and Erdal Tekin (2007) "The Determinants and Consequences of Child Care Subsidies for Single Mothers in the USA" *Journal of Population Economics* 20: 719-741.

Card, David (1995) "Using Geographic Variation in College Proximity to Estimate the Return to Schooling," in *Aspects of Labor Market Behavior: Essays in Honour of John Vanderkamp*, ed. By Louis N. Christofides, E. Kenneth Grant, and Robert Swidinsky. Toronto: University of Toronto Press, 201-222.

Currie, Janet and Enrico Moretti (2003) "Mother's Education and the Intergenerational Transmission of Human Capital: Evidence from College Openings," *Quarterly Journal of Economics*, 118(4) 1495-1532.

Cascio, Elizabeth (2006) "Public Preschool and Maternal Labor Supply: Evidence from the Introduction of Kindergartens into American Public Schools," *NBER Working Paper* 12179 (forthcoming on *Journal of Human Resources*)

Del Boca, Daniela and Daniela Vuri (2007) "The Mismatch between Employment and Child Care in Italy: the Impact of Rationing," *Journal of Population Economics* 20:805-832.

Department of Education, Employment and Workplace Relations (2006) Australian Government Census of Child Care Services.

Department of Family and Community Services (2004) 2004 Census of Child Care Services.

Department of Family and Community Services (2005) Child Care Services Handbook 2005-06.

Doiron, Denise and Gyonne Kalb (2005) "Demands for Child Care and Household Labor Supply in Australia," *Economic Record*, 81(254) 215-36

Duflo, Esther (2001) "Schooling and Labor Market Consequences of School Construction in Indonesia: Evidence from an Unusual Policy Experiment" *American Economic Review*, 91(4) 795-813.

Gelback, Jonah (2002) "Public Schooling for Young Children and Maternal Labor Supply," *American Economic Review*, 92(1) March 307-322.

Gustafsson and Stafford (1992) "Child Care Subsidies and Labor Supply in Sweden" *Journal of Human Resources* 27(1) 204-230.

Herbst, Chris, M. and Erdal Tekin (2008) "Child Care Subsidies and Child Development," *NBER Working Paper* 14474.

Hill, Jennifer, Jane Waldfogel and Jeanne Brooks-Gunn (2002) "Differential Effects of High-Quality Child Care," *Journal of Policy Analysis and Management*, 21(4), 601-627.

Kalb, Gyonne and Wang-Sheng Lee (2008) "Childcare Use and Parents' Labor Supply in Australia" Australian Economic Papers, 47(3), 272-95.

Kreyenfeld, Michaela and Hank, Karsten (2000) "Does the Availability of Child Care Influence the Employment of Mothers? Findings from Western Germany," *Population Research and Policy Review* 19, 317-337.

Loeb, Susanna, Margaret Bridges, Daphna Bassok, Bruce Fuller, Russell W. Rumberger (2007) "How Much is Too Much? The Influence of Preschool Centers on Children's Social and Cognitive Development," *Economics of Education Review*, 26, 52-66.

Loeb, Susanna, Bruce Fuller, Sharon Lynn Kagan, and Bidemi Carrol (2003) "Child Care in Poor Communities: Early Learning Effects of Type, Quality, and Stability," *Child Development*, 75(1), 47-65.

Magnuson, Kathrine, A., Christopher J. Ruhm, and Jane Waldfogel (2004) "Does Prekindergarten Improve School Preparation and Performance?" *NBER Working Paper* 10452.

National Childcare Accreditation Council (2006) *Quality Improvement and Accreditation System Handbook*, 4th ed.

New South Wales Department of Community Services, 2008, Children's Services License Application Guide (downloaded on October 24th, 2008).

Northern Territory Government, "Standards: Northern Territory Child Care Centers (6-16 Places and 17-75 Places)" (downloaded on October 24th, 2008).

OECD (2002, 2003, 2004, 2005) Babies and Bosses: Reconciling Work and Family Life, Vol.1, 2, 3, 4.

OECD (2006) Starting Strong II: Early Childhood Education and Care.

OECD (2007) Babies and Bosses: Reconciling Work and Family Life. A synthesis of Findings for OECD Countries.

Press, Frances and Alan Hayes (2000) *OECD Thematic Review of Early Childhood Education and Care Policy: Australian Background Report*, The Commonwealth Government of Australia.

Queensland Department of Communities, 2007, "Children's Services Report" (downloaded on October 24th, 2008).

Rammohan, Anu and Stephen Whelan (2005) "Child Care and Female Employment Decisions," *Australian Journal of Labor Economics*, 8(2) 203-25.

Rammohan, Anu and Stephen Whelan (2007) "The Impact of Childcare Costs on the Full-time/Part-time Employment Decisions of Australian Mothers," *Australian Economic Papers*, 46(2) 152-69.

Schlosser, Analia 2005 "Public Preschool and the Labor Supply of Arab Mothers: Evidence from a Natural Experiment," mimeo.

South Australia State Government, 2008, "A Quick Guide to the Licence Application Process" (downloaded on October 24th, 2008).

Steering Committee for the Review of Government Service Provision (SCRGSP) (2008) Report on Government Services 2008, Productivity Commission, Australian Government. http://www.pc.gov.au/gsp/reports/rogs/2008

Tasmania Child Care Unit, Department of Education (2003) "Tasmanian Licensing Standards for Center Based Child Care, Class 1 (0-5 years)" (downloaded on October 24th, 2008).

Toohey, Matthew (2005) "The Effectiveness of Child Care Benefit at Improving Returns to Work for Women," National Center for Social and Economic Modelling, University of Canberra.

Victoria Department of Education and Early Childhood Development (2007) "Children's Services Guide: A Guide to Managing and Operating a Licensed Children's Service in Victoria" (downloaded on October 24th, 2008).

West Australia Government, 2007 "License Application Kit: How to Apply for a Child Care License (Individual Applicant and Body Corporate or Public Authority Applicant)" (downloaded on October 24th, 2008).

Table 1: Summary Statistics

	Obs.	Mean	SD
Household-level Variables			
Outcome variables: childcare usage			
1{Household uses the following type of non-parental care for at least one hour}			
some non-parental	2751	0.57	0.50
center-based	2751	0.31	0.46
home-based	2751	0.15	0.35
informal	2751	0.37	0.48
Average weekly number of childcare hours per child, including non-users as zero			
some non-parental	2751	10.66	14.27
center-based	2751	5.15	10.54
home-based	2751	2.64	8.32
informal	2751	2.87	7.09
Outcome variables: maternal labor supply			
1{Mother works (> 0 hour per week)}	2751	0.48	0.50
1{Mother works (> 20 hour per week)}	2751	0.13	0.34
Average weekly number of work hours (assuming zero hour for non-working mothers)	2751	11.73	15.60
Mother's individual and household characteristics			
Mother's age	2751	32.46	5.81
1{Mother completed high school (Year 12)}	2751	0.21	0.41
1{Mother completed high school (Year 12) and holds a qualification}	2751	0.23	0.42
1{Mother completed a Bachelor's degree or higher}	2751	0.25	0.43
1{Mother does not have a resident partner}	2751	0.19	0.39
1{Mother has long-term health problems}	2751	0.11	0.31
1{Mother is an indigenous person}	2751	0.03	0.17
1{Mother was born outside Australia and speaks English at home}	2751	0.08	0.27
1{Mother was born outside Australia and speaks a non-English language at home}	2751	0.13	0.33
Number of household members with long-term health problems	2751	0.42	0.81
Community (SLA)-level Variables			
Age-specific number of center-based childcare places per child	1149	0.34	0.34
ln(birth cohort size)	1149	5.48	1.10
1{an SLA has data on unemployment rate}	1149	0.96	0.20
1{an SLA has data on unemployment rate} * unemployment rate (%)	1149	5.92	3.19

Sources: The 2001-2004 Household, Income and Labor Dynamics in Australia (HILDA) Survey, the National Childcare Accreditation Council data, the 2001 and 2006 Census, and the Small Area Labor Markets data.

Notes:

- The unit of observations is household*year for the outcome and household-level explanatory variables, while it is the SLA*year level for the SLA-level variables. Child care usage outcomes are available only for 2002-2004, and ln(birth cohort size) is used only for the analysis based on 2002-2004 data.
- A household is regarded as using a certain type of care if it chooses that type of care as an answer to one of the following two questions: (1) while you (and your partner) are working, who looks after the child? (2) in a usual week, what types of care do you use for these children when you (or your partner) are not working? The options for the answers include, for example, 'me or my partner,' 'the child's brother or sister,' 'private or community long day care center,' and 'family day care.'
- Center-based care includes private or community long day care, long day care center at workplace, kindergarten and preschools.
- Home-based care includes family day care - care provided by registered, regulated carers at a carer's home.
- Informal care includes care provided by siblings, relatives, friends/neighbors, and paid sitters. Paid sitters are not included in formal care because it is unclear whether they are approved carers.
- Average weekly number of childcare hours per child is the total number of hours used by all the pre school-aged children divided by the number of the children. Thirty-two percent of the sample have more than one child aged 0-4.
- Work includes paid work, self-employment work, and unpaid work for family members. Work hours include any paid or unpaid overtime, and if a person has more than one job, they include the hours worked in all jobs.
- Educated mothers completed high school and hold a qualification or completed a bachelor degree or higher. For mothers who change the highest educational attainment during the analysis period, their educational attainment is defined to be the highest level attained by the time they appeared for the first time in the HILDA survey.
- Long-term health problems are self-reported. A variable characterizing household composition is not included as it could be jointly determined with child care utilization.
- See Appendix 1 for the definition of the SLA-level variables.

Table 2 Correlation between center care availability and the patterns of child care utilization and maternal labor supply in Australia: 2002-2004
OLS model

	1{Parents use the following type of childcare}				Weekly number of childcare hours per child				Maternal labor supply		
	Some non-parental care	Center-based care	Home-based care	Informal care	Some non-parental care	Center-based care	Home-based care	Informal care	1{Mother works}	1{full-time}	hours of work
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Age-specific center care availability	0.121	0.216	0.058	0.025	6.006	4.288	1.371	0.347	0.146	0.044	4.218
	[0.035]***	[0.048]***	[0.030]*	[0.037]	[1.688]***	[1.540]***	[0.535]**	[0.477]	[0.035]***	[0.024]*	[1.187]***
Observations	2751	2751	2751	2751	2751	2751	2751	2751	2751	2751	2751
SLAs	496	496	496	496	496	496	496	496	496	496	496
F-stat	5.99	7.76	1.73	6.47	5.19	5.19	1.98	2.67	14.95	2.57	8.07

Sources: See the sources listed in Table 1.
Notes:

- The coefficient of the age-specific number of center-based childcare places per child, or *b* in Eq.(1), is shown.
- Standard errors are shown in square brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.
- All the regressions control for maternal characteristics such as three dummy variables indicating maternal educational attainment levels, and five dummy variables indicating mothers with long-term health conditions, single mothers, mothers who are an indigenous person, mothers who were born outside Australia and speak English at home, and mothers who were born outside Australia and speak a non-English language at home.
- The controls also include the number of members with long-term health problems.
- The community (SLA) level characteristics are additionally included. They are a dummy variable indicating areas with data on the unemployment rate and the interaction between this dummy variable and the unemployment rate
- The following three largest states are allowed to take different intercepts and year effects: New South Wales, Victoria, and Queensland. The rest of four states and territories have too small a sample size to define their own intercepts and year effects.

Table 3 Correlation between changes in center care availability and changes is the patterns of child care utilization and maternal labor supply in Australia: 2002-2004 Statistical Local Area (SLA) fixed effects model

	1{Parents use the following type of childcare}				Weekly number of childcare hours per child				Maternal labor supply		
	Some non-parental care	Center-based care	Home-based care	Informal care	Some non-parental care	Center-based care	Home-based care	Informal care	1{Mother works}	1{full-time}	hours of work
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Age-specific center care availability	0.234	0.339	0.102	0.047	12.199	7.424	2.629	2.146	0.267	0.094	7.544
	[0.079]***	[0.095]***	[0.044]**	[0.066]	[2.953]***	[2.049]***	[0.982]***	[0.977]**	[0.082]***	[0.049]*	[2.642]***
Observations	2751	2751	2751	2751	2751	2751	2751	2751	2751	2751	2751
SLAs	496	496	496	496	496	496	496	496	496	496	496
F-stat	2.42	3.18	1.71	1.23	3.14	2.48	1.49	1.54	6.13	1.04	3.52

Sources: See the sources listed for Table 1.

Notes:

- The coefficient of the age-specific number of center-based childcare places per child, or *b* in Eq.(2), is shown.
- See the Notes for Table 2.
- Among the covariates listed in the Notes for Table 2, the dummies for three largest states are dropped.

Table 4 Heterogeneity in the correlation between changes in center care availability and changes is the patterns of child care utilization and maternal labor supply in Australia: 2002-2004
[A] Heterogeneity by the age of the youngest child

	1{Parents use the following type of childcare}				Weekly number of childcare hours per child				Maternal labor supply		
	Some non-parental care	Center-based care	Home-based care	Informal care	Some non-parental care	Center-based care	Home-based care	Informal care	1{Mother works}	1{full-time}	hours of work
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Age-specific center care availability	0.034	0.157	-0.003	0.014	3.383	3.155	-1.034	1.262	0.053	-0.001	0.586
	[0.071]	[0.087]*	[0.061]	[0.074]	[2.066]	[1.759]*	[1.155]	[1.007]	[0.082]	[0.052]	[2.748]
Age-specific center care availability	0.261	0.235	0.076	0.135	10.099	5.487	1.672	2.94	0.312	-0.045	6.712
* 1{the youngest child is aged 0 or 1}	[0.108]**	[0.113]**	[0.085]	[0.097]	[3.236]***	[2.509]**	[1.274]	[1.548]*	[0.161]*	[0.088]	[5.483]
Observations	2751	2751	2751	2751	2751	2751	2751	2751	2751	2751	2751
SLAs	496	496	496	496	496	496	496	496	496	496	496
F-stat	3.53	5.02	2	1.2	7.14	4.45	2.69	1.56	7.92	1.48	5.35

[B] Heterogeneity by maternal educational attainment

	1{Parents use the following type of childcare}				Weekly number of childcare hours per child				Maternal labor supply		
	Some non-parental care	Center-based care	Home-based care	Informal care	Some non-parental care	Center-based care	Home-based care	Informal care	1{Mother works}	1{full-time}	hours of work
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Age-specific center care availability	0.374	0.425	0.164	0.135	16.599	9.643	3.423	3.532	0.501	0.205	15.494
	[0.091]***	[0.095]***	[0.052]***	[0.088]	[3.021]***	[2.261]***	[1.162]***	[1.166]***	[0.099]***	[0.079]**	[3.425]***
Age-specific center care availability	-0.207	-0.128	-0.093	-0.13	-6.523	-3.29	-1.178	-2.055	-0.347	-0.165	-11.789
* 1{mother is less educated}	[0.072]***	[0.085]	[0.055]*	[0.071]*	[2.189]***	[1.897]*	[1.205]	[0.826]**	[0.080]***	[0.070]**	[2.656]***
Observations	2751	2751	2751	2751	2751	2751	2751	2751	2751	2751	2751
SLAs	496	496	496	496	496	496	496	496	496	496	496
F-stat	2.61	3.22	1.81	1.32	3.47	2.58	1.5	1.92	7	1.12	4.14

Sources: See the sources listed for Table 1.
Notes:

- The coefficient of the age-specific number of center-based childcare places per child is shown from regression of a modified version of Eq.(2), which allows differential coefficient '*b*' by the age of the youngest child or maternal educational attainment.
- See the Notes for Table 2.
- Among the covariates listed in the Notes for Table 2, the dummies for three largest states are dropped.

Table 5 Effect of center care availability on the patterns of child care utilization and maternal labor supply in Australia: 2002-2004
Instrumental variable model with the Statistical Local Area (SLA) fixed effects

[A] Sample = households where the youngest is aged 0 or 1

	1{Parents use the following type of childcare}				Weekly number of childcare hours per child				Maternal labor supply		
	Some non-parental care	Center-based care	Home-based care	Informal care	Some non-parental care	Center-based care	Home-based care	Informal care	1{Mother works}	1{full-time}	hours of work
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Age-specific center care availability	0.693	1.562	1.927	0.715	82.973	41.258	21.376	20.339	2.711	1.192	77.525
	[1.312]	[1.046]	[1.349]	[1.563]	[28.603]***	[20.199]**	[27.898]	[14.427]	[1.479]*	[0.785]	[39.286]**
Observations	1279	1279	1279	1279	1279	1279	1279	1279	1279	1279	1279
SLAs	289	289	289	289	289	289	289	289	289	289	289
F-stat	2.05	2.06	0.82	0.76	1.76	1.59	0.8	2.47	2.82	1.09	1.94
F-stat(excluded instrument)	12.33	12.33	12.33	12.33	12.33	12.33	12.33	12.33	12.33	12.33	12.33

[B] Sample = Households where the youngest is aged 0 or 1 AND mothers' education is less than completion of college

	1{Parents use the following type of childcare}				Weekly number of childcare hours per child				Maternal labor supply		
	Some non-parental care	Center-based care	Home-based care	Informal care	Some non-parental care	Center-based care	Home-based care	Informal care	1{Mother works}	1{full-time}	hours of work
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Age-specific center care availability	2.215	2.024	4.924	-0.258	125.168	45.671	73.096	6.402	5.268	1.597	130.866
	[2.095]	[1.747]	[2.333]**	[2.177]	[51.625]**	[27.516]*	[32.685]**	[21.522]	[2.722]*	[1.315]	[72.550]*
Observations	906	906	906	906	906	906	906	906	906	906	906
SLAs	238	238	238	238	238	238	238	238	238	238	238
F-stat	1.09	1.71	0.6	0.88	1.13	0.99	0.61	1.3	2.35	0.69	1.05
F-stat(excluded instrument)	8.27	8.27	8.27	8.27	8.27	8.27	8.27	8.27	8.27	8.27	8.27

Sources: See the sources listed in Table 1.
Notes:

- The coefficient of the age-specific number of center-based childcare places per child, or *b* in Eq.(2'), is shown.
- See the Notes for Table 2 for the set of covariates included.
- Among the covariates listed in the Notes for Table 2, the dummies for three largest states are dropped.
- In addition, the full set of covariates listed in Appendix Table 1 is included.

Table 6 Differences in observables across mothers of 0 or 1 year-olds who belong to cohorts of different sizes in Australia: 2001-2004
Statistical Local Area (SLA) fixed effects with a full set of covariates

Outcome variable	ln[cohort size of a child at birth]			
	Coeff.	SE	Obs.	F-stat
Mother's age	-1.657	[2.084]	1395	1.22
1{Mother completed high school (Year 12)}	0.229	[0.293]	1395	0.49
1{Mother completed high school (Year 12) and holds a qualification}	-0.028	[0.238]	1395	0.82
1{Mother completed a Bachelor's degree or higher}	-0.513	[0.298]*	1395	1.3
1{Mother does not have a resident partner}	-0.083	[0.189]	1395	1.3
1{Mother has long-term health problems}	0.124	[0.185]	1395	1.02
1{Mother is an indigenous person}	-0.096	[0.118]	1395	0.56
1{Mother was born outside Australia and speaks English at home}	-0.038	[0.118]	1395	0.71
1{Mother was born outside Australia and speaks a non-English language at home}	0.039	[0.131]	1395	0.66
Number of household members with a long-term health condition	0.624	[0.433]	1395	0.62

Sources: HILDA 2002-2004
Notes:

- The coefficient for the natural log of cohort size of a child at birth is shown in the regression in which maternal characteristic is used as an outcome variable.
- The regression includes SLA fixed effects, the unemployment rate, and the full set of covariates listed in Appendix Table 1.

Appendix Table 1: Summary statistics of additional community(SLA)-level past control variables (2002-2004)

	Obs.	Mean	SD
Rental cost proxies (previous year)			
1{at least ten retail property sales}	1149	0.02	0.13
Median retail property price per square meter ($1000) * 1{at least ten retail property sales}	1149	0.01	0.09
1{at least ten commercial property sales}	1149	0.35	0.48
Median commercial property price per square meter ($1000) * 1{at least ten commercial property sales}	1149	0.21	0.51
Wage cost proxies (previous year)			
1{At least one individual reports wage income for tax purposes}	1149	0.99	0.11
1{At least one individual reports wage income for tax purposes} * average annual gross earned income ($1000)	1149	35.10	7.28
Area characteristics (previous year)			
1{At least ten housing sales}	1149	0.99	0.10
1{At least ten housing sales} *ln[median housing price ($)]	1149	3.10	3.02
Median per capita weekly gross household income ($1000) (Census)	1149	572.56	266.39
Total population (1,000 persons) (Census)	1149	31.87	34.79
Share of indigenous population (Census)	1149	0.02	0.03
Share of individuals born outside Australia (Census)	1149	0.19	0.10
Share of individuals speaking a non-English language at home (Census)	1149	0.12	0.13
Share of 20-49 year-olds who are partnered (Census)	1149	0.64	0.08
Shares of population by age group (0-4)	1149	0.07	0.01
Shares of population by age group (5-9) (Census)	1149	0.07	0.01
Shares of population by age group (10-19) (Census)	1149	0.14	0.02
Shares of population by age group (20-49) (Census)	1149	0.42	0.06

Sources: Australian Property Monitor Data (rental cost proxies), Small Labour Market Survey (wage cost proxies), and the 2001 and 2006 Census (area characteristics).

Notes:

- A unit of observation is year * community (SLA).
- The number of observations is smaller than that depicted in Table 1 because the past characteristics are available only for 2002-2004, not 2001-2004.
- The variables extracted from the 2001 and 2006 Census are interpolation. The analysis takes into account the dependence across years within SLA. Also, the specification with and without the Census-based variables show little qualitative difference.

Appendix Table 2: The first-stage results for the Instrumental Variable model with fixed effects (2002-2004)

Outcome = Age-specific center care availability	Youngest aged 0,1	Youngest aged 2-4
	(1)	(2)
ln(birth cohort size)	-0.197	0.043
	(0.06)	(0.05)
Mother's age	0.001	-0.002
	(0.01)	(0.01)
Mother's age^2	0.000	0.000
	(0.00)	(0.00)
Number of household members with long-term health problems	0.008	0.008
	(0.01)	(0.01)
1{Mother is not married or in a de facto relationship}	0.003	0.003
	(0.01)	(0.01)
1{Mother has long-term health problems}	0.006	-0.011
	(0.01)	(0.01)
1{at least ten retail property sales}	0.067	0.049
	(0.08)	(0.07)
Median retail property price per square meter ($1000) * 1{at least ten retail property sales}	-0.267	-0.170
	(0.15)	(0.19)
1{at least ten commercial property sales}	-0.030	0.011
	(0.02)	(0.02)
Median commercial property price per square meter ($1000)	0.005	-0.013
* 1{at least ten commercial property sales}	(0.01)	(0.01)
1{At least one individual reports wage income for tax purposes}	0.130	-0.391
	(0.25)	(0.43)
1{At least one individual reports wage income for tax purposes}	-0.002	0.011
* average annual gross earned income ($1000)	(0.01)	(0.01)
1{At least ten housing sales}	-0.012	-0.025
	(0.05)	(0.05)
1{At least ten housing sales} *ln[median housing price ($)]	0.004	-0.004
	(0.01)	(0.01)
Median per capita weekly gross household income ($1000) (Census)	0.000	0.000
	(0.00)	(0.00)
Share of indigenous individuals (Census)	-1.641	8.166
	(5.18)	(6.94)
Share of individuals born outside Australia (Census)	4.859	3.664
	(3.80)	(3.59)
Share of individuals speaking a non-English language at home (Census)	0.262	-3.021
	(1.99)	(3.11)
Share of partnered individuals aged 20-49	-0.981	-0.830
	(1.72)	(1.46)
Total population	-0.008	0.006
	(0.01)	(0.01)
Share of individuals aged 0-4	2.567	-4.577
	(5.87)	(4.36)
Share of individuals aged 5-9	-6.648	0.736
	(4.32)	(5.72)
Share of individuals aged 10-19	-2.501	0.262
	(2.60)	(3.05)
Share of individuals aged 20-49	7.228	-1.813
	(5.25)	(1.94)
1{an SLA has data on unemployment rate}	0.033	0.002
	(0.03)	(0.03)
1{an SLA has data on unemployment rate} * unemployment rate (%)	-0.006	0.000
	(0.01)	(0.00)
Observations	1279	1239
SLAs	289	257
F-stat	3.91	3.58
F-stat(excluded instrument)	12.33	0.88

Sources: See the sources listed in Table 1.
Note: The coefficient of the age-specific number of center-based childcare places per child, or *b* in Eq.(3'), is shown.

Appendix Table 3: Robustness of the effect of center care availability on utilization of center-based care in Australia: 2002-2004
Instrumental variable model with the Statistical Local Area (SLA) fixed effects
Sample = Households where the youngest is aged 0 or 1

	Weekly number of childcare hours per child					
	(1)	(2)	(3)	(4)	(5)	(6)
Age-specific center care availability	45.627	44.68	45.082	45.517	45.603	41.258
	[22.148]**	[22.130]**	[21.886]**	[22.406]**	[23.309]*	[20.199]**
Included SLA-level past characteristics						
Rental cost proxies		x	x	x	x	x
Wage cost proxies			x	x	x	x
Average housing value				x	x	x
Average household earning					x	x
Demographic composition						x
Observations	1279	1279	1279	1279	1279	1279
SLAs	289	289	289	289	289	289
F-stat	1.84	1.58	1.57	1.58	1.76	1.59
F-stat(excluded instrument)	12.9	12.47	12.53	12.45	12.35	12.33

Sources: See the sources listed in Table 1.
Notes:

- The coefficient of the age-specific number of center-based childcare places per child, or *b* in Eq.(2'), is shown.
- See the Notes for Table 3.

Appendix 1: Sources and definitions of Community (Statistical Local Area (SLA))-level data

- **The age-specific number of center-based childcare places per child**

The information on the location (postcode) and accreditation history of center-based care providers was collected using an automated procedure in May 2006 from the website of the National Childcare Accreditation Council (NCAC). NCAC is responsible for the registration of childcare providers and quality assessment under the federal quality-assurance system. The original information was converted into the year*SLA-level data based on the concordance file that converts the 2006 postcode into the 2001 SLA (The Australian Bureau of Statistics).

To obtain the number of child care places, the number of providers was multiplied by the state-level average number of children looked after in one center-based provider. This information was obtained and interpolated from the 2002, 2004, and 2006 Child Care Census.[24] That is, the total number of children taken care of at all the care providers is computed for each state and age group (0, 1, 2, 3, 4 year-olds). Each of these numbers was divided by the number of providers in each state.

The number of childcare places was then divided by the number of children residing in each SLA by age group. The number of children living in each SLA was interpolated based on the 2001 and 2006 Census (Time Series Profile of the Australian Bureau of Statistics Datapack).

- The unemployment rate

The data for each area and year were extracted from the Small Area Labor Markets (the Department of Employment and Work Relation). Since the data are not available for some SLAs which experienced boundary changes in the December quarter of 2002, a dummy variable is defined for area*year observations where the unemployment rate is available. While this dummy variable takes into account a possible difference in the pattern of childcare utilization and maternal labor supply, the interaction term between the dummy variable and the unemployment rate shows the correlation between the outcomes and the unemployment rate among areas with the data.

Appendix 2: The federal childcare policy in Australia: 2002-2004

This section summarises the major federal childcare policy that was in place in the analysis period. It consisted of a price subsidy, quality assurance, and direct support for providers.

The price subsidy (Child Care Benefit), the largest expenditure item, provided a means-tested hourly benefit to a household using childcare, according to the number of hours used by the child(ren). Thus, a poorer household was able to use the same service at a lower fee, though the childcare expenditure typically occupied a larger proportion of household disposable income (Toohey, 2005). Parents were able to claim this payment for up to 24 hours of care per child without working, and working parents were eligible for up to 50 hours of child care.[25] A more generous subsidy rate was applied to the usage of government-approved care providers, which satisfied the national quality standards set under the Child Care Quality Assurance (CCQA) system.[26] Approved care included LDC, FDC, and preschools/kindergarten that opted into the system. Providers of center-based care examined in this paper were all participating and generally approved under this system.[27]

A small proportion of childcare expenditure was spent on support for providers operating in areas deemed as scarce of supply. These programs provided certain incentives to households and providers. These incentives were in place for the entire analysis period.

[24] The Department of Families, Housing, Community Services and Indigenous Affairs (FaHCSIA) collected the 2002 and 2004 data, and the Department of Education, Employment and Workplace Relations conducted the 2006 Census.

[25] This also applies to parents who are studying, looking for work, or undertaking training for 15 hours or more per week.

[26] To be approved or accredited, providers must satisfy a set of standards related to staff relationships with children and peers, partnerships with families, learning environments, safety, nutrition and health, and management practices (National Childcare Accreditation Council, 2006). Parents using informal care (such as grandparents, relatives, friends and unregulated nannies) can register their providers and receive a lower rate of subsidy. As of 2006, the hourly subsidy was $3.37 for approved care and $0.564 for registered care.

[27] Due to the link to the subsidy program, a majority of childcare providers, including LDC and some preschools, was likely to participate in the scheme. Between 2002–2004, most (95%, based on the data collected by the author) participating providers were accredited.