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Abstract

We estimate the causal effects of childcare availability on the maternal employment rate using prefecture panel data constructed from the Japanese quinquennial census 1990-2010. We depart from previous papers on Japan by controlling for prefecture fixed effects, without which the estimates can be severely biased upward. Contrary to popular belief, childcare availability is *uncorrelated* with maternal employment when prefecture fixed effects are controlled. Evidence suggests that this is because households shift from using informal childcare provided by grandparents to the accredited childcare service, as more and more households do not live with grandparents. If this change of the household structure did not occur, the growth of childcare availability would have increased the maternal employment rate by two percentage points, which accounts for about 30% of the growth in the maternal employment rate from 1990 to 2010.

Keywords: childcare; female labor supply; maternal employment; nuclear family; three-generation family

JEL Codes: J13, J21, J22

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1 Introduction

Maternal employment hinges on quality, affordability, and availability of childcare. In countries where the childcare market is regulated and heavily subsidized, high quality and affordable childcare service is provided, but the supply often falls short of the demand. Expecting that supporting working mothers raise the low fertility rate, the Japanese government has implemented a series of pro-family policies, including an expansion of capacity of accredited childcare centers since early 1990s. In this paper, we estimate the causal effects of childcare availability on the maternal employment using the prefecture panel data from the Japanese quinquennial census 1990-2010.

Even though mother's employment is a prerequisite for enrollment in an accredited childcare center in Japan, whether childcare availability significantly increases maternal employment is not immediately obvious. If working mothers substitute the accredited childcare service for an informal childcare arrangement such as the one provided by grandparents, the maternal employment rate will remain unchanged. Indeed, Fitzpatrick (2010) and Havnes and Mogstad (2011) find that an expansion of childcare services did not raise the maternal employment rate in the U.S. and Norway, respectively, because the new childcare mostly crowded out informal childcare arrangements.

Most previous studies on Japan that estimate the effect of childcare availability on female labor market outcomes rely on the cross-sectional variation between prefectures.[1][2] Examples include, but are not limited to, Shigeno and Ookusa (1999), Higuchi, Matsuura, and Sato (2007), Unayama (2011), and Abe (2013). While the reported positive correlation is suggestive, it may not necessarily imply the causal effect of childcare availability on the female labor market outcomes. Maternal labor supply is affected not only by childcare availability, but also by the local industry structure, economic conditions, commuting time, traditional family value, and preference for women working. Because the traditional family value and preference for women working are unobserved and hard to control, the observed positive correlation between childcare availability and maternal employment may be driven by the unobserved characteristics, rather than indicating a causal relationship.

This paper departs from the previous studies on Japan by controlling for unobserved prefecture fixed effects. Using the ratio of childcare capacity to population of children under 6 as a proxy for childcare availability, we plot the growth of childcare availability and that of the maternal

[1] A similar approach is also taken by Brilli, Del Boca, and Pronzato (2013) for the study on Italy.

[2] An exception is Lee and Lee (2014). Using aggregate data at the country level on childcare availability, the female labor force participation rate, and the fertility rate from 1971 to 2009, they try to establish Granger-causality using a time-series econometrics technique. Our identification strategy is very different from Lee and Lee (2014) in that we use variations in the growth of childcare availability across prefectures. Moreover, Lee and Lee (2014) do not include the household structure or the nuclear household share in their VAR model. Our analysis shows that the household structure strongly affects the maternal employment rate and has changed over time significantly. Omitting this variable in the VAR model might affect their estimation results.

employment rate at the prefecture level, in a five-year period. By focusing on the growth, instead of the level, we can observe the relationship between childcare availability and maternal employment in the absence of prefecture fixed effects. Hence, this approach provides more credible evidence for the causal effects than the previous approach that relies on the cross-sectional variations alone. Our approach is essentially the difference-in-differences estimator, which is adopted by Berlinski and Galiani (2007), Baker, Gruber, and Milligan (2008), Lefebvre and Merrigan (2008), Havnes and Mogstad (2011), and Nollenberger and Rodriguez-Planas (2013).[3]

Contrary to popular belief, the growth of childcare availability is *uncorrelated* with the growth of the maternal employment rate. In contrast, the levels of these variables are positively correlated, which implies that the estimates identified by cross-sectional variations alone are upward-biased. A possible explanation for the uncorrelatedness is substitution of the accredited childcare service for the informal childcare arrangements. Because the childcare provided by grandparents is the most common form of informal childcare arrangement in Japan, we analyze nuclear households and three-generation households separately. This analysis enables us to shed light on the role of informal childcare provided by the grandparents in determining the maternal employment rate. We find that the growth of childcare availability is strongly and positively correlated with that of the maternal employment rate for nuclear households, whereas they are uncorrelated for three-generation households. The results suggest that the household structure is the key to understanding the relationship between childcare availability and maternal employment.

These findings are essentially unchanged when we run either the first-order difference regressions with observed characteristics or the OLS with prefecture fixed effects. Although we do not observe the household's choice of childcare mode in the census, households seem to have substituted the accredited childcare service for informal care by grandparents. The key factor behind this substitution is a change of the household structure. Namely, an increasing number of households do not include grandparents any more. The logical question then is whether the childcare expansion induced this shift from three-generation households to nuclear households or not. We try to answer this question by examining the relationship between childcare availability and the nuclear household share, but do not find compelling evidence to provide a satisfactory answer.

To evaluate the relative roles of childcare availability, household structure, and other factors, we apply our estimates to decomposition of the maternal employment growth from 1990 to 2010, which increased from 34% to 41% despite the long-term recession. We find that the growth of childcare availability would have raised the maternal employment rate up to about two percentage points if the household structure and other factors were kept constant. This positive effect was en-

[3] An alternative approach to avoid an endogeneity bias is based on the Regression Discontinuity Designs. Gelbach (2002), Fitzpatrick (2010), and Goux and Maurin (2010) exploit an age-dependent eligibility rule for childcare enrollment and identify the causal effect.

tirely offset by the declining share of three-generation households. This offsetting effect was more strongly pronounced in small or less densely populated prefectures, because the three-generation household share decreased there more rapidly.

Fitzpatrick (2010) and Havnes and Mogstad (2011) find a null effect of childcare expansion on maternal employment in the U.S. and Norway because it crowded out informal childcare arrangements. In contrast, Nollenberger and Rodriguez-Planas (2013) find a positive effect of childcare expansion in Spain. They argue that crowding out did not occur in Spain, because the female labor force participation rate was low, the traditional family values were rooted, and the childcare supply was insufficient. The labor market institutions and circumstances surrounding childcare in Japan are more similar to Spain, but our results are more in line with those for the U.S. and Norway, which may seem counterintuitive. The key to understanding the different results between Japan and Spain is the household structure. In Spain, the share of three-generation households was much lower than that in Japan, and hence, the informal childcare by grandparents was uncommon and not crowded out.

Our results for Japan suggest that neither the low female labor force participation rate nor the traditional family value themselves are the determinants of a positive causal effect of childcare availability on maternal employment. In Japan, the traditional family values require the eldest son to live with his parents. Even though the traditional family values do not encourage mothers to work outside the home, this requirement eventually makes wives' labor force participation rate high due to the availability of childcare by grandparents. Then, as the traditional family value became less influential, more and more households did not live with grandparents, which in turn lowered the maternal employment rate. This negative effect offset the effect of improved childcare availability during the same period. Note that this offsetting effect was more strongly pronounced in small prefectures where the traditional family value is more rooted. Our analysis indicates that prevalence of informal childcare is the key determinant of whether maternal employment increases with childcare availability or not.

We assess robustness and credibility of our finding that childcare availability increases the maternal employment rate for nuclear households. We find that this result is robust to an inclusion of prefecture-specific trends in the maternal employment rate. We also address two potential threats to identification. The first threat is households moving between prefectures for better childcare availability. Our evidence from Japanese Panel Survey of Consumers indicates that moving for childcare is very rare: at most 1% of households with children under 6 moved from other prefecture for the reason of better childcare availability at the most recent move. The second threat is prefecture-level shocks such as changes in local labor market conditions and pro-family policies that coincide with the changes of childcare availability. We address this issue by examining the employment rate of mothers whose youngest child is between 6 and 14 because they should not

be directly affected by childcare expansion. The result indicates that their employment rate is uncorrelated with childcare availability. We conclude that these two potential threats to identification are negligible.

The rest of the paper is structured as follows. In Section 2 we describe the institutional background and data. In Section 3, we show graphical evidence for the effects of childcare availability on maternal employment. Section 4 lays out the econometric model and presents our estimation results. In Section 5 we discuss potential sources of a simultaneity bias for our results. In Section 6 we apply our estimates to study the roles of childcare availability and the household structure in determining the employment growth of mothers. We conclude in Section 7.

2 Background and Data

2.1 Childcare Policies in Japan

Childcare service is strictly regulated in Japan. For a childcare center to be accredited and subsidized by the national and municipal governments, it must satisfy the criteria for capacity, area and the number of teachers per pupil, etc. Because accredited childcare centers are subsidized, the average monthly fee for a child is low, at 25,556 JPY (about 250 USD),[4] although different fees are charged depending on regions and the household income. Non-accredited childcare centers satisfy lower quality standards than those for accredited childcare centers. While some municipality governments subsidize non-accredited centers, the national government does not subsidize them, which makes their fee higher. Their average monthly fee for a child age 0 is 46,330 JPY (about 460 USD) and that for child age 5 is 34,161 JPY (about 340 USD).[5]

According to the Comprehensive Survey of Living Conditions 2010[6], 92% of childcare centers are accredited and the remaining 8% are non-accredited. Because non-accredited childcare centers are not subsidized and of lower quality, they are uncommon except for the large prefectures such as Tokyo and Kanagawa where the supply of accredited childcare is far exceeded by the demand. For example, the share of non-accredited childcare centers is 10% in Tokyo and 16% in Kanagawa, while it is nearly zero in small prefectures including Gunma, Toyama, Fukui, Yamanashi, Nagano, Wakayama, and Tottori.

Thanks to regulations, the quality is high and the price is affordable, but the accredited childcare service is not available for all households in need. Insufficient supply of the accredited childcare has been considered an obstacle for mothers' entering the labor market and a cause of the low fertility rate in Japan. The Japanese government implemented a series of policies for raising the fertility

[4] See Table 7 on page 8 of Ministry of Health and Wealth (2009)

[5] See Table 12 on page 14 of Ministry of Health and Wealth (2009)

[6] See Table 18 in Volume 3.

rate since the mid 90's. The Angel Plan (1994-1998) and the New Angel Plan (1999-2003) are agreements between ministers and intended to support working mothers. They include an expansion of childcare capacity, extension of childcare service hours including weekends and holidays, and subsidies to promote the take-up of parental leave and shorter working hours. However, these plans do not have legally binding power, and consequently, they failed to increase the capacity of accredited childcare. Indeed, it decreased by 10% from 1990 to 2000, even though the childcare capacity per child population slightly increased due to the low fertility rate. In 2003, the Japanese government enacted the Basic Act for Measures to Cope with Society with Declining Birthrate, which is legally binding. Since then, the capacity of the accredited childcare centers increased by a significant 12.2% from 2000 to 2010.

2.2 Measuring Childcare Availability

Our key explanatory variable is an index of childcare availability at the prefecture level, which is defined as the ratio of the capacity of the accredited childcare to the population of children under 6. As we explained above, the share of accredited childcare centers is 92% in 2010, and hence, the proposed index roughly measures overall availability of center-based childcare. In this paper, childcare capacity and enrollment statistics cover accredited childcare centers only. We draw childcare capacity data from annual Report on Social Welfare Administration and Services[7] and child population data from the Japanese quinquennial census 1990-2010. We emphasize that our measure of childcare availability is based on capacity, not on enrollment. Because capacity is a supply side factor and does not pick up households' willingness to use, we interpret our index as a measure of childcare supply relative to child population.

Alternative measure of the childcare availability is the number (or proportion) of children on the waiting list for accredited childcare[8]. However, there are two reasons against using the waiting list as a good measure. First, in 2003, the government changed the definition of waitlisted children, which makes the statistics before and after 2003 not comparable. Second, although the size of the excess demand can be useful for measuring availability, the waiting list does not measure the excess demand. If parents expect a very low chance of getting accepted by an accredited childcare center, they are unlikely to submit an application to avoid a time cost of application. For example, city of Yokohama declared that no child was waitlisted in April 2013, but the application increased by

[7] Childcare capacity data are also available from Survey on Social Welfare, but data are not comparable before and after 2007.

[8] Yet another possible measure of childcare availability is proposed by Unayama (2011) who studies the relationship between childcare availability and job continuity at marriage. His index is the ratio of childcare capacity to the number of women age 20-39. His rationale is that the number of women age 20-39 measures the potential number of children. Our index based on the actual number of children directly measures the current availability, which we think is more relevant for decisions by mothers who currently have children under 6.

4,114 or 8% in the following year.[9] This anecdote suggests that the actual excess demand for the accredited childcare is greater than the number of waitlisted children.

As mentioned in the introduction, the causal effect of childcare availability on maternal employment is identified by the variation in the growth (instead of the level) of the childcare availability index across prefectures. It is worth describing how the variation was generated during the sample period. Since early 1990's, a series of policies including The Angel Plan, the New Angel Plan, and the Basic Act for Measures to Cope with Society with Declining Birthrate promoted raising the childcare capacity across the country. In large prefectures such as Tokyo, the capacity was increased as intended by the policies, but in small prefectures it remained almost constant, because the child population has been rapidly decreasing. Note that childcare availability improved even in small prefectures, since the child population decreased, but the capacity remained unchanged.[10] The childcare capacity does not decrease proportionately to the child population for two institutional reasons. First, there is a regulation that the minimum capacity of an accredited childcare be 60 children.[11] This minimum capacity requirement directly prevents the operators of the childcare centers from downsizing. Second, the Japanese dismissal law strongly protects workers, which prevents childcare centers from firing them to reduce their capacity.[12]

2.3 Household and Prefecture Characteristics

We draw our data on household and prefecture characteristics from the Japanese quinquennial census from 1990 to 2010.[13] Our analysis focuses on households with two parents and children under age 6. These households are categorized by the census into three groups. The first household type is a nuclear household in which only two parents and children reside. The second household type is a three-generation household that consists of two parents, children, and grandparents. The third household type is other household that consists of two parents, children, and other adults such as relatives. This last type is only about 0.02% of all two-parent household with children under 6.

In the census, employment is identified by whether an individual performed paid work or not from September 24th to 30th of the year. If an individual did not work but was on leave, she/he is considered employed by the census. The employment status of the husband and wife of the household is reported. We also calculate the average ages of the father and mother, although we cannot observe the joint distribution of their employment status and age at the prefecture level.

As a measure of local economic condition, we construct an unemployment rate for individuals

[9] See Yokohama (2014) for their press release.

[10] See Section 6 for details.

[11] Nihon-Jidou-Mondai-Chousakai (1978) documents how the minimum capacity is determined.

[12] See p. 512 in Yamakawa (2007)

[13] All of our data from the census 1990-2010 are publicly available and downloadable from www.e-stat.go.jp.

age 15 and over at the prefecture level.

2.4 Summary Statistics

Table 1 reports the mean of each variable by year and household type using the number of households as weight. Note that the means are different between the household types, because the numbers of nuclear households and three-generation households in a given prefecture are different. Our childcare availability index, which is defined as the ratio of childcare capacity to population of children under 6, steadily increased over time from 0.248 in 1990 to 0.338 in 2010 on average over all types of households. The average of the capacity-population ratio for nuclear households is lower than that for three-generation households, which reflects the fact that the share of nuclear households is higher in the metropolitan area where childcare service is less available.

Table 1: Characteristics of Prefecture and Household with Children Under 6

	1990	1995	2000	2005	2010
All HH					
Cap./U6-Pop.	0.248	0.265	0.269	0.302	0.338
% Employed	0.341	0.329	0.334	0.372	0.412
Age	31.580	31.757	32.142	32.883	33.720
Age of Husband	34.454	34.517	34.564	34.953	35.632
% Husband Empl.	0.988	0.985	0.976	0.965	0.941
Unemp. Rate	0.030	0.043	0.048	0.060	0.064
% Nuclear HH	0.712	0.752	0.804	0.837	0.865
Nuclear HH					
Cap./U6-Pop.	0.241	0.258	0.263	0.296	0.332
% Employed	0.274	0.280	0.300	0.347	0.396
Age	31.560	31.632	32.049	32.886	33.763
Age of Husband	34.373	34.313	34.382	34.879	35.614
% Husband Empl.	0.988	0.984	0.976	0.965	0.941
Unemp. Rate	0.031	0.044	0.048	0.060	0.064
3-Generation HH					
Cap./U6-Pop.	0.266	0.285	0.293	0.331	0.376
% Employed	0.511	0.478	0.476	0.499	0.517
Age	31.628	32.147	32.537	32.884	33.458
Age of Husband	34.652	35.146	35.327	35.346	35.750
% Husband Empl.	0.990	0.986	0.975	0.968	0.945
Unemp. Rate	0.028	0.039	0.044	0.057	0.064

Source: Census 1990-2010.
Note: Unit of observation is the prefecture. The number of households is used as weight.

The employment rate of mothers with children under 6 rose from 34.1% in 1990 to 41.2% in 2010; a remarkable employment growth given the long-term recession. This increase is largely driven by the growing employment rate of mothers in nuclear households: it increased from 27.4% in 1990 to 39.6% in 2010. Although the employment rate of mothers in three-generation households is as high as 51.1% in 1990, it decreased to 47.8% in 1995 and gradually returned to the 1990 level by 2010.

Husbands' employment rate decreased from 98.8% in 1990 to 94.1% in 2010. In contrast to women, we find little difference in male employment rate across household type.

Mothers' average age increased from 31.580 in 1990 to 33.720 in 2010 while that of husbands increased from 34.454 in 1990 to 35.632 in 2010. The rise in parents' age reflects the fact that men and women delayed childbirth in the past few decades. We find little difference in parents' age across household types.

The average local unemployment rate rose from 3% in 1990 to 6.4% in 2010.[14] Despite nuclear and three-generation households tending to reside in different regions, we find little difference in local unemployment rates faced by the nuclear and three-generation households.

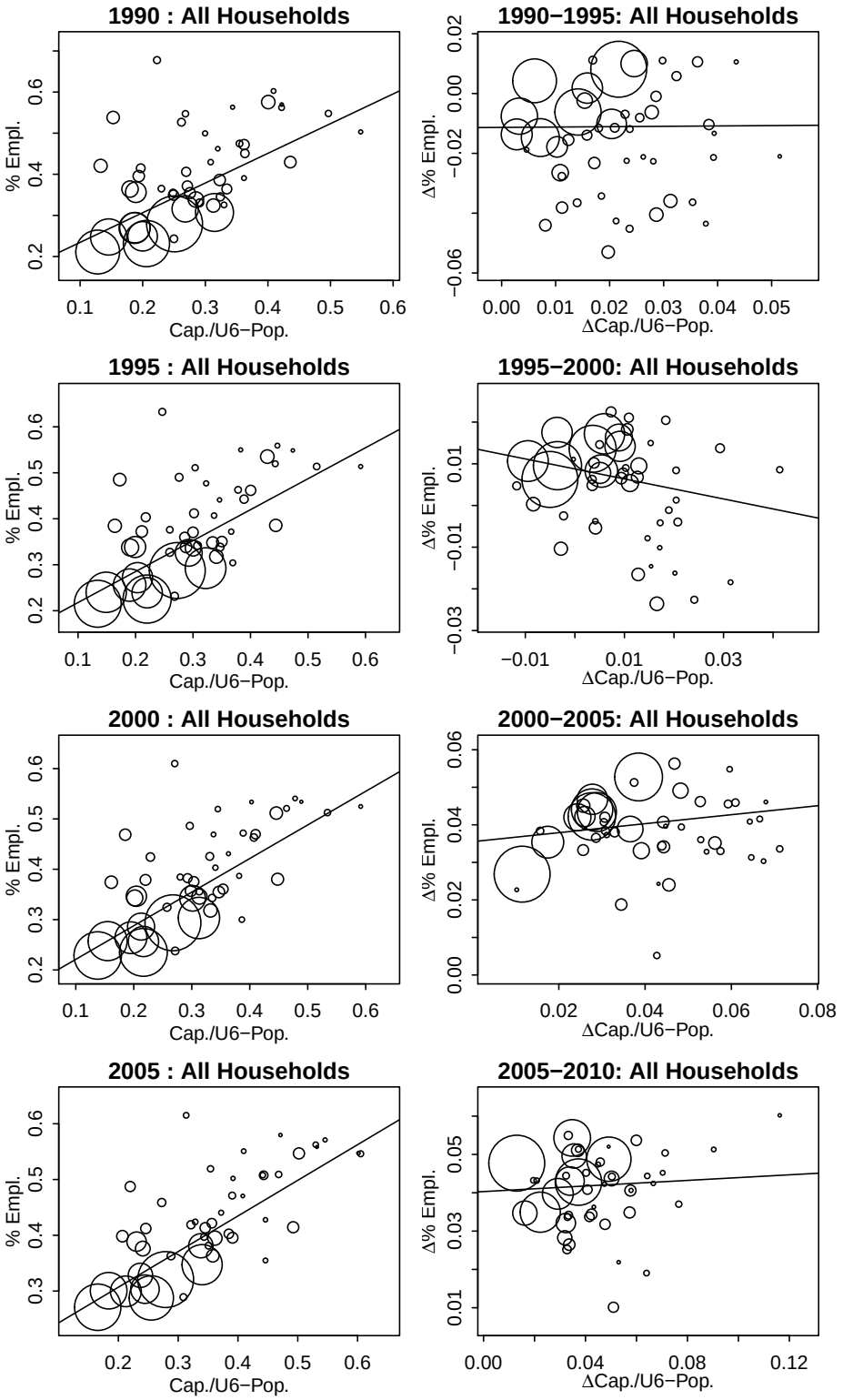
3 Graphical Examination of Data

We show sets of scatter plots of the maternal employment rate and the childcare availability index. The objective of the scatter plots is to clarify what variation of the data enables us to identify the causal effect of childcare availability on maternal employment. They also help us determine if the regression results in the following section are driven by outliers and/or by data from specific years.

The panels on the left column in Figure 1 show the scatter plots of the childcare availability index and the maternal employment rate for all household types including nuclear, three-generation, and other households. The radii of the circles reflect the population weights. The fitted lines are based on the bivariate weighted regressions. The positive correlation is clearly visible and statistically significant in all years, which is consistent with the findings of previous studies on Japan mentioned above. Note that the positive correlation may not be interpreted as a causal effect of childcare availability on the maternal employment rate, because it may be driven by unobserved prefecture characteristics such as the traditional family value, preference for maternal work, industry structure, commuting time, etc.

To remove these prefecture fixed effects, we plot changes in childcare availability and changes in the maternal employment rate over a five-year period, on the panels on the right column in Figure 1. By looking at the changes, instead of the levels, we can assess the relationship between

[14]Note that the highest national unemployment rate during this period is 5.5%. The average of local unemployment rate in 2005 and 2010 exceed this number, because we weight by the number of household with children under 6.



Source: Census 1990-2010

Note: Unit of observation is the prefecture. For the panels on the left column, the horizontal axis shows the childcare availability index or the capacity-population ratio, while the vertical axis shows the maternal employment rate. The panels on the right column show the 5-year changes in these variables. The radii of the circles reflect the population weights. The fitted lines are based on the bivariate weighted regressions.

Figure 1: Childcare Availability and Maternal Employment (All Households)

childcare availability and maternal employment in the absence of prefecture characteristics that are constant over the five-year period. Surprisingly, we find no statistically significant relationship in all of the four periods. The comparison of the two sets of graphs indicates that the positive correlation between childcare availability and maternal employment is not a causal relationship, but driven by the prefecture characteristics.

Why doesn't the maternal employment rate respond to childcare availability? Our finding is similar to those of Fitzpatrick (2010) and Havnes and Mogstad (2011). They find that an expansion of childcare did not increase maternal employment in the U.S. and Norway, because it crowded out informal childcare arrangements by unlicensed caregivers such as babysitters. In Japan, childcare by grandparents is the most prevalent form of informal childcare arrangement. Longitudinal Survey of Newborns in the 21st Century asks who is the main caregiver for children under 3.[15] According to the survey, among children who are looked after by someone else but their parents, 73.3% of the children are enrolled in childcare centers, 25.9% of the children are looked after by grandparents, and only 0.9% of the children are under other informal childcare arrangements including babysitters and nannies.

Hence, we suspect that households substitute the accredited childcare for the care by grandparents. Unfortunately, we do not observe household's choice of childcare mode in the census, but we can still shed light on the relationship among the accredited childcare, the care by grandparents, and maternal employment. Evidence from Comprehensive Survey of Living Conditions 2010 indicates that the share of children who are looked after by grandparents[16] tends to be higher in prefectures where the share of three-generation households is high. The correlation coefficient for the two is as high as 0.80, which suggests that children in three-generation households are likely to be looked after by their grandparents.

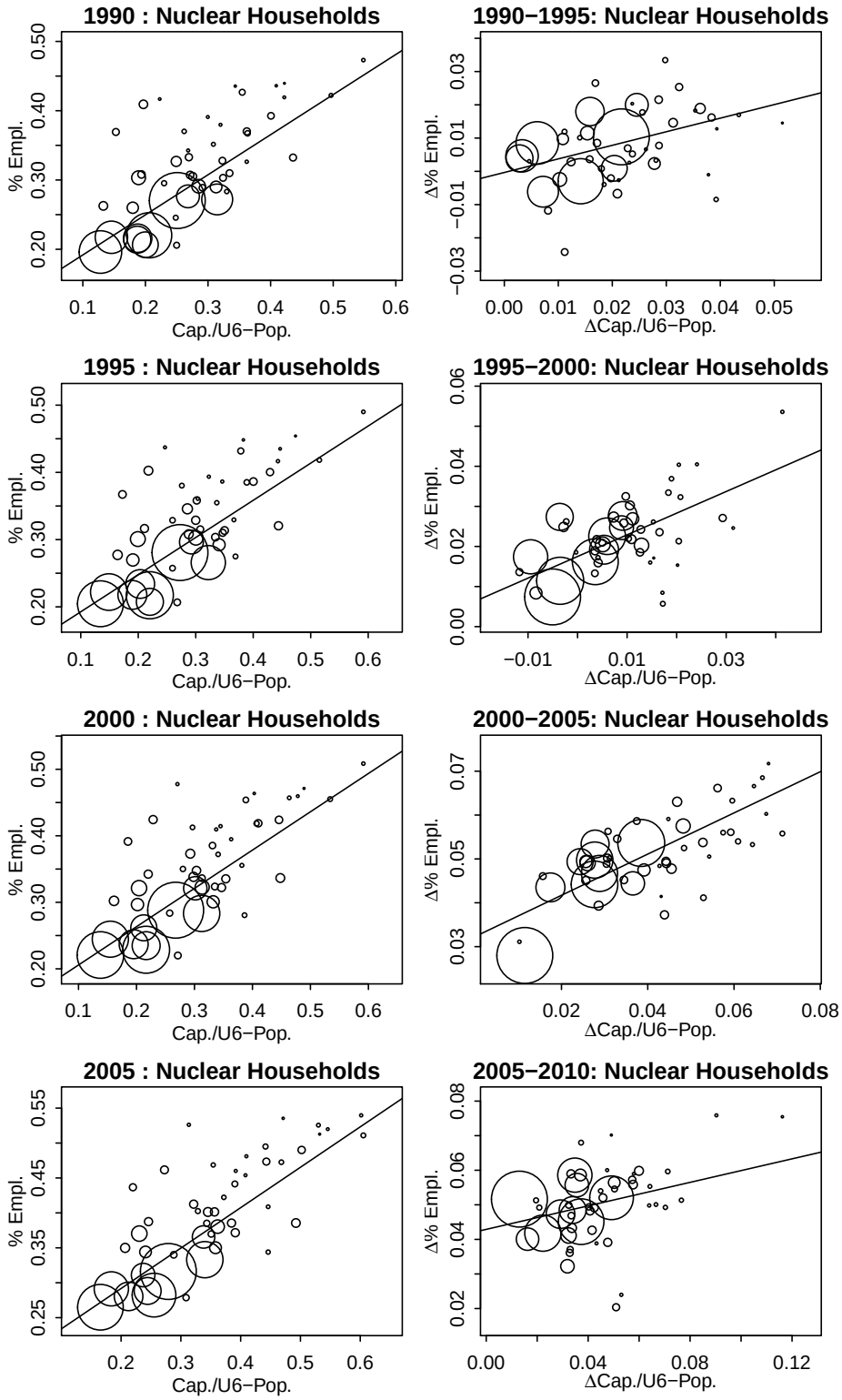
We analyze nuclear and three-generation households separately. The panels on the left column in Figure 2 show scatter plots of the childcare availability index and the maternal employment rate for nuclear households. The panels on the right column shows 5-year changes in these variables. The positive correlation is clearly visible in all panels and it is statistically significant, which implies that nuclear households increased their maternal employment rates as childcare became more available. The scatter plots also show that the correlation is not driven by outliers and that there is significant variation in changes in the childcare availability index.

Figure 3 shows scatter plots for three-generation households that consist of grandparents, parents, and children.[17] The panels on the left column show a strong positive correlation between the childcare availability index and the maternal employment rate in all years. However, this positive

[15]The survey collects the information on the main caregiver for children age 3 and above, but it is not comparable to the information for children under 3.

[16]See Table 18 in Volume 3.

[17]Other individuals such as relatives may or may not live together.



Source: Census 1990-2010

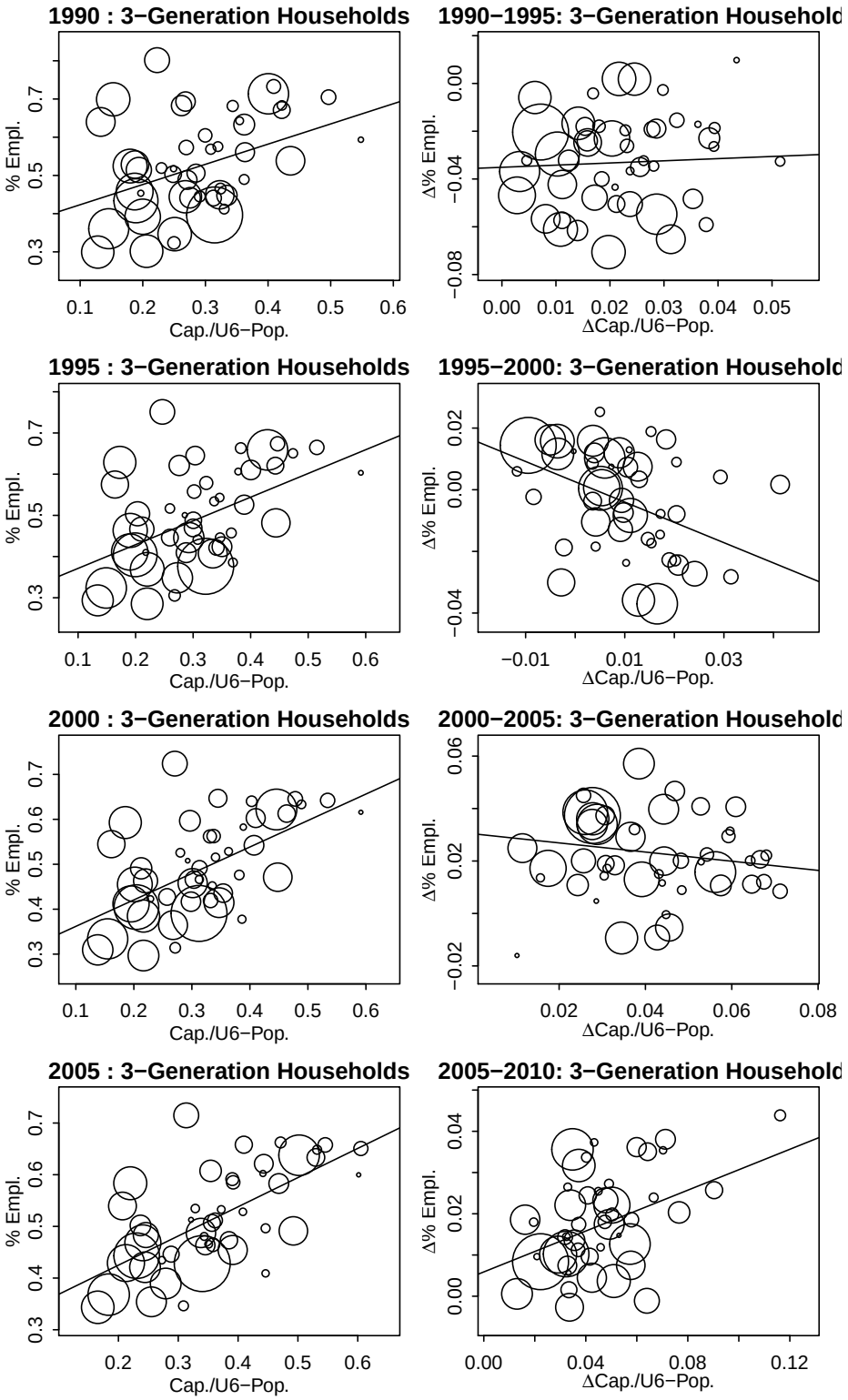
Note: Unit of observation is the prefecture. For the panels on the left column, the horizontal axis shows the childcare availability index or the capacity-population ratio, while the vertical axis shows the maternal employment rate. The panels on the right column show the 5-year changes in these variables. The radii of the circles reflect the population weights. The fitted lines are based on the bivariate weighted regressions.

Figure 2: Childcare Availability and Maternal Employment (Nuclear Households)

correlation is not a causal relationship, because we find no clear relationship between the 5-year changes in these two variables, as shown in the panels on the right column of Figure 3. The correlation for 1995-2000 is significantly negative, while that for 2005-2010 is significantly positive. For other periods, no statistically significant correlation is found.

We find that the effects of childcare availability are heterogeneous between nuclear and three-generation households. Many previous papers point out that mothers in three-generation households are more likely to participate in the labor market than those in nuclear households. In those papers, the effect of childcare availability is assumed homogeneous. Allowing for heterogeneous treatment effects between nuclear and three-generation households is important for prediction, because the share of nuclear households varies across years and prefectures significantly.

Our analysis here takes the household structure as given, but women whose labor force attachment is strong might choose to form a three-generation household, rather than a nuclear household, because informal childcare may be available in three-generation households. Sasaki (2002) addresses this issue and estimates the effect of co-residence with the parents or in-laws on the wife's labor force participation. He instruments co-residence by whether the husband is the eldest son or not, because the traditional Japanese family value obligates the eldest son to reside with his parents. Sasaki (2002) finds that his OLS estimate for the effect of co-residence is essentially the same as the IV estimate. This implies that co-residence can be taken exogenous to the wife's labor force participation, which justifies our approach.



Source: Census 1990-2010

Note: Unit of observation is the prefecture. For the panels on the left column, the horizontal axis shows the childcare availability index or the capacity-population ratio, while the vertical axis shows the maternal employment rate. The panels on the right column show the 5-year changes in these variables. The radii of the circles reflect the population weights. The fitted lines are based on the bivariate weighted regressions.

Figure 3: Childcare Availability and Maternal Employment (Three-Generation Households)

4 Regression Analysis

4.1 Econometric Model

We further analyze the causal effects of childcare availability using regression models. Consider the following econometric model

$$Y_{kt} = \beta_0 + \beta_1 CCA_{kt} + \beta_2 X_{kt} + \theta_k + \xi_t + \varepsilon_{kt}, \quad (1)$$

where Y_{kt} is the maternal employment rate in prefecture k in year t, CCA_{kt} is our measure of childcare availability given by the ratio of capacity to child population, X_{kt} is a vector of observed characteristics of household and prefecture, θ_k is prefecture fixed effects, ξ_t is year fixed effects, and ε_{kt} is an error term that is uncorrelated with other variables. The fixed effects θ_k and ξ_t are allowed to be correlated with other variables including CCA_{kt}. The prefecture fixed effects capture unobserved household and prefecture characteristics including the traditional family value and preference for maternal employment. The year fixed effects capture factors that affect maternal employment equally across prefecture. For example, the effects of a nation-wide secular rise in female wages and changes in parental leave and other labor legislation[18] by the national government are included in the year fixed effects.

Our preferred estimator for the parameter of interest β_1 is the first-difference estimator. Taking 5-year differences, Equation (1) can be converted into

$$\Delta Y_{kt} = \beta_1 \Delta CCA_{kt} + \beta_2 \Delta X_{kt} + \Delta \xi_t + \Delta \varepsilon_{kt}, \quad (2)$$

where $\Delta Y_{kt} = Y_{kt} - Y_{kt-5}$ and other variables are similarly defined. We estimate Equation (2) by the OLS. As a robustness check, we also add prefecture fixed effects to Equation (2), in order to account for a possible prefecture-level trend in the maternal employment rate. In all our regression models we use the number of households as weights and report standard errors clustered at the prefecture level.

Although we could measure childcare availability at the municipality level, we choose to measure it at the prefecture level because it reduces the endogeneity bias. Our identification assumption for Equation (2) is that the error term is uncorrelated with the growth of childcare availability ΔCCA_{kt} at the prefecture level. A possible threat to this assumption is migration for the reason of better childcare availability. In Section 5.1, we show evidence that inter-prefectural migration for better childcare availability is extremely rate. This exogeneity assumption may be questionable if childcare availability is measured at the municipality level, because intra-prefecture migration is

[18] See Asai (2012) and Yamaguchi (2014) for the employment effects of parental leave legislation.

more common.

A potential downside of using observations at the prefecture level, rather than the municipality or individual level, is a lack of variation in the explanatory variables. This lack in variation may result in unstable estimates or large standard errors, but as we show in Figures 1-3 in Section 3, there is a large variation in the level of and the growth in the childcare availability index. Indeed, as shown below, the standard errors are small.

4.2 Maternal Employment

Table 2 reports the results for the first-difference estimator. We pool observations across years, but no specific period drives the results, as evidenced by the scatter plots in Figures 1-3. All standard errors are clustered at the prefecture level. The population for columns (1) through (4) is mothers of children under 6 in nuclear households. When the 5-year changes are stacked and regressed without any additional controls, the coefficient is 0.775 (column 1). Once year dummies are included as a control, the coefficient drops to 0.352 (column 2). This is because both maternal employment and childcare availability increase over time. As additional control variables, we include in the regression the average age of mothers, that of fathers, and the local unemployment rate at the prefecture level. Adding these controls modestly lowers the coefficient of interest to 0.316 (column 3), which is statistically significant.

The estimate in column (3) might be biased because we have a small number of control variables and omitted variables might generate a prefecture-specific trend in the maternal employment rate. We address this concern by allowing for prefecture fixed effects for 5-year changes in the maternal employment rate. The result in column (4) indicates that allowing for a prefecture-specific trend does not change the coefficient for the childcare availability measure from our baseline specification in column (3).

We also estimate the employment effects of childcare availability for mothers in three-generation households. As already suggested by the scatter plots in Figure 3, the employment of mothers from three-generation households does not respond to changes in childcare availability: the estimated treatment effect is -0.077 and statistically insignificant (column 5). One possible explanation for this result is that three-generation households do not enroll their children in the accredited childcare because the informal care by grandparents is already available. Another possible explanation is that three-generation households substitute the accredited childcare for the grandparents' care. Either way, their maternal employment rate does not increase with childcare availability.

In columns (6) and (7), the results for all types of households are presented. The effect of childcare availability is essentially zero (the estimated coefficient is 0.011 in column 6). When we add the change in the nuclear household share as a control variable, the coefficient is 0.184 and

statistically significant (column 7). The comparison of the two regression models implies that the changes of the childcare availability index and the nuclear household share are positively correlated. If the rise in the nuclear household share is a result of better childcare availability, further expansions of childcare will lead only to more nuclear households, without necessarily raising maternal employment. If the increase in the share of nuclear households occurs independently from a change in childcare availability, childcare expansion can raise maternal employment as long as the pace of expansion is fast enough to exceed the negative effect from the increase of the nuclear household share. We address this issue in Section 4.3.

Our results are in line with those by Fitzpatrick (2010) and Havnes and Mogstad (2011) who find that an expansion of childcare crowded out informal childcare arrangements in the U.S. and Norway, respectively. In contrast, Nollenberger and Rodriguez-Planas (2013) report that crowding out did not occur in Spain where some of the labor market institutions are comparable to those of Japan. For example, the gender gap is large, the female labor force participation rate is low, and the traditional family values are rooted in these two countries. Given this similarity, our results may seem somewhat counterintuitive.

The key difference between Japan and Spain, however, is prevalence of three-generation household. Iacovou and Skew (2010) report that, in Spain, only about 6% of children under 18 live with grandparents in 2007. This number is about the average of the OECD countries, which is 6.6%. Although we cannot construct exactly the same statistic for Japan, we find that 22.6% of children under 20 (instead of 18) live with their grandparents, according to the 2005 census. This number is one of the highest among the OECD countries. The high share of three generation households in Japan explains why the maternal employment rate does not increase with childcare availability, despite the fact that female labor force participation rate is low. The comparison of the results across countries suggests that prevalence of informal childcare arrangement is the major determinant of the effect of childcare availability on maternal employment.

4.2.1 Assessing Endogeneity Bias Due to Omitting Prefecture Fixed Effects

To assess the extent of the endogeneity bias due to omitting prefecture fixed effects, we estimate Equation (1) by OLS with and without prefecture fixed effects. Table 3 reports the estimation results.

For nuclear households, the estimated coefficient for childcare availability is 0.516 (column 1) when prefecture fixed effects are omitted, while it is 0.322 (column 2) when they are included in the regression. This difference means that the estimate is upward-biased by 60% if prefecture fixed effects are omitted. For the three-generation households, the coefficient changes more dramatically. When prefecture fixed effects are omitted, the coefficient for childcare availability is positive and significant at 0.439 (column 3). However, it is negative at -0.243 (column 4) when prefecture

Table 2: Effects of Childcare Availability on Employment Rate (First-Difference)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Household Type	Nuclear	Nuclear	Nuclear	Nuclear	3-Gen	All	All
ΔCap./U6-Pop.	0.775***	0.352***	0.316***	0.320***	−0.077	0.011	0.184***
	(0.053)	(0.039)	(0.042)	(0.066)	(0.115)	(0.078)	(0.055)
ΔAge			−0.021	−0.015	0.003	−0.011	0.012
			(0.015)	(0.016)	(0.027)	(0.023)	(0.019)
ΔHusband's Age			0.017	0.015	0.002	0.016	−0.012
			(0.017)	(0.017)	(0.024)	(0.020)	(0.019)
ΔHusband's % Empl.			0.132*	0.060	0.057	0.042	0.164**
			(0.073)	(0.103)	(0.105)	(0.059)	(0.072)
ΔUnemp Rate			−0.268**	−0.248	−0.517	−0.088	−0.233
			(0.126)	(0.173)	(0.416)	(0.265)	(0.203)
Δ % Nuclear HH							−0.441***
							(0.065)
(Intercept)	0.013***	0.001	0.008**	0.005	−0.028***	−0.009*	0.005
	(0.001)	(0.002)	(0.003)	(0.004)	(0.008)	(0.005)	(0.004)
R^2	0.465	0.864	0.873	0.903	0.658	0.795	0.849
Adj. R^2	0.462	0.861	0.867	0.864	0.643	0.785	0.842
Num. obs.	188	188	188	188	188	188	188
Year FE		✓	✓	✓	✓	✓	✓
Prefecture FE				✓			

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Source: Census 1990-2005

Note: The dependent variable in all models is 5-year changes in the employment rate at the prefecture level. The number of households is used as weight. Standard errors are clustered at the prefecture level.

fixed effects are included. When all types of households are pooled, the coefficient for childcare availability is positive and significant at 0.567 (column 5), but it is negative at -0.147 (column 6) and insignificant.

The comparison of regression results with and without prefecture fixed effects warns us that the omitted variable bias can be severe. Indeed, the extent of the bias can be large enough to change the sign of the estimates.

Table 3: Effects of Childcare Availability on Employment Rate (OLS)

	(1)	(2)	(3)	(4)	(5)	(6)
Household Type	Nuclear	Nuclear	3-Gen	3-Gen	All	All
Cap./U6-Pop.	0.516^{***}	0.322^{***}	0.439^{***}	-0.243	0.567^{***}	-0.147
	(0.064)	(0.058)	(0.093)	(0.158)	(0.083)	(0.110)
Age	0.148^{***}	-0.018	0.317^{***}	0.037	0.221^{***}	-0.001
	(0.054)	(0.020)	(0.071)	(0.039)	(0.078)	(0.032)
Husband's Age	-0.150^{***}	0.013	-0.366^{***}	-0.032	-0.250^{***}	0.015
	(0.051)	(0.021)	(0.065)	(0.039)	(0.077)	(0.028)
Husband's % Empl.	-0.210	0.250^{***}	-1.313^{***}	-0.324	-0.685^{*}	0.164
	(0.262)	(0.087)	(0.287)	(0.341)	(0.355)	(0.144)
Unemp Rate	-0.435	-0.283^{**}	-3.135^{***}	-1.297	-2.469^{*}	-0.235
	(1.064)	(0.141)	(0.951)	(1.050)	(1.367)	(0.544)
(Intercept)	0.839	0.018	4.448^{***}	0.799^{**}	2.576^{***}	-0.284
	(0.635)	(0.260)	(0.803)	(0.396)	(0.950)	(0.371)
Year FE	✓	✓	✓	✓	✓	✓
Prefecture FE		✓		✓		✓
R^2	0.771	0.994	0.651	0.977	0.620	0.984
Adj. R^2	0.761	0.993	0.637	0.970	0.605	0.979
Num. obs.	235	235	235	235	235	235

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Source: Census 1990-2005
Note: The dependent variable in all models is the maternal employment rate at the prefecture level. The number of households is used as weight. Standard errors are clustered at the prefecture level.

4.3 Household Structure

There is an economic benefit of forming a three-generation household for the parents, because grandparents may provide informal childcare. However, if quality childcare is provided by the local government at an affordable price, this economic benefit of three-generation household decreases. As a result of the improved childcare availability, some parents may want to form a nuclear household for more privacy and independence. Whether childcare expansion affects the household structure or not is an important question for the welfare of families beyond maternal employment.

To explore this issue, we regress 5-year changes in the nuclear household share on 5-year changes in the childcare availability index. Table 4 reports the estimation results. Without any control, the coefficient is negative (column 1), but with year dummies, the coefficient turns positive and significant (column 2). Adding changes in age, husband's age and his employment rate, and the local unemployment rate has little effect on the coefficient (column 3). However, once we allow for a prefecture-specific trend by including prefecture dummies, the coefficient is very small at 0.015 (column 4) and insignificant.

Despite the theoretical prediction, our data and econometric model do not reject the hypothesis that childcare availability has no effect on the household structure. However, we admit that our analysis is not compelling enough to deny the theoretical prediction, either. We consider that more credible exogenous variation in childcare availability and better data that contain more details on household characteristics are necessary to establish conclusive evidence on this issue.

Table 4: Childcare Availability and Nuclear Household Share

	(1)	(2)	(3)	(4)
ΔCap./U6-Pop.	-0.143^{*}	0.439^{***}	0.392^{***}	0.015
	(0.086)	(0.095)	(0.082)	(0.056)
ΔAge			0.052^{*}	-0.005
			(0.030)	(0.017)
ΔHusband's Age			-0.064^{**}	0.001
			(0.026)	(0.013)
ΔHusband's % Empl.			0.277^{**}	-0.192^{***}
			(0.114)	(0.054)
ΔUnemp Rate			-0.327	-0.227^{*}
			(0.299)	(0.121)
(Intercept)	0.040^{***}	0.032^{***}	0.033^{***}	0.047^{***}
	(0.004)	(0.004)	(0.007)	(0.004)
Year FE		✓	✓	✓
Prefecture FE				✓
R^2	0.021	0.360	0.429	0.912
Adj. R^2	0.016	0.346	0.403	0.876
Num. obs.	188	188	188	188

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Source: Census 1990-2005

Note: The dependent variable is 5-year changes in the nuclear household share among all households with children under 6. The number of household is used as weight. Standard errors are clustered at the prefecture level.

5 Simultaneity Bias

Although the first-difference regression and OLS with prefecture dummies remove prefecture fixed effects, there might be a simultaneity bias. Namely, there may be a correlation between childcare availability and mothers' unobserved willingness to work even when the time-invariant household and prefecture characteristics are controlled. One possible source of the simultaneity bias is households moving to a prefecture where childcare service is more available. Another possible source is prefecture-level changes in labor market conditions and policies that affect not only mothers of children under 6, but also other demographic groups. For example, pro-family policies unrelated to childcare at the prefecture level might increase the employment of mothers of older children. In this section, we show that these two possibilities are negligible.

5.1 Inter-Prefecture Migration

Popular narrative says that obtaining a spot in an accredited childcare center is extremely hard in Tokyo and that some people even move to other municipality for childcare. For example, in the article from The New York Times, Tabuchi (2013) reports, "Some families are so anxious to get into public day care that they upend their lives, moving to districts known to have the shortest waiting lists." However, very little statistical evidence on this issue has been reported.

We provide evidence that households do not move for childcare, using information on moving from Japanese Panel Survey of Consumers (JPSC). JPSC has started in 1993 with 1,500 women age 24-34, and added a new cohort of 500 women age 24-27 in 1997. JPSC asks these two cohorts about their last five moves, but we focus on the most recent one to avoid a potential recall bias. We analyze the 1993 and 1997 cohorts separately, because JPSC asks slightly different questions. Note that only inter-prefecture moves matter to our analysis because all of our variables are at the prefecture level.

We first examine a sample of 721 women from the 1993 cohort who had children under 6 at the time of the survey in October 1993. Out of 721, 118 women moved from other prefecture than the current one at the most recent move. Out of 118, only 15 women answered that they knew or researched about childcare availability at the current location before moving in. Note that knowing about childcare availability does not necessarily mean that they move for childcare availability. The survey further asks the respondents to choose the closest of the twelve alternatives that describe the reason for the move. Although "child rearing and education" is not in the 1993 survey, we can still exclude answers that are clearly unrelated to child rearing and education. After we exclude 6 individuals who moved for attending school or husband's job transfer, we have 9 individuals who may have moved for childcare availability. This implies that at most only 1% of mothers (9 out of 721) moved to other prefecture for better childcare availability.

We then analyze the 1997 cohort. JPSC asks this cohort if they moved for child rearing or education. There are 133 women who had children under 6 in the 1997 cohort. Out of 133, only 6 women answered that they moved for the reasons of child rearing or education. Our of 6 women, only one moved to a different prefecture. This woman knew or has researched about childcare availability at the current location before moving in. This implies less than 1% of mothers (1 out of 133) moved to a different prefecture for better childcare availability.

Our analysis of two cohorts in the JPSC suggests that inter-prefecture migration for childcare is quite uncommon. Despite that, the media often reports interviews of parents who are desperate for the accredited childcare service. This might look somewhat surprising for some readers, but we consider this to be reasonable given that the cost of an inter-prefecture move can be high. The cost of inter-prefecture moving includes not only moving expenses but also the loss of social networks, familiarity with the local public services, proximity to the current workplace, etc. Perhaps, moving for childcare is beneficial for the highly skilled women despite the significant cost, but only 21% of married women age 30-34 have bachelor's degree or higher, according to the Japanese 2010 census. We conclude that inter-prefecture migration for childcare is rare and it would not bias the estimate of the causal effect of childcare availability.

5.2 Policies and Labor Market Conditions at the Prefecture Level

Childcare expansion is only a part of pro-family policies, and pro-family policies other than childcare expansion are likely to raise not only the employment of mothers of children under 6, but also that of mothers of older children. Because childcare expansion and other pro-family policies are developed by the similar value and philosophy, changes of these policies may be correlated. We are not aware of any major prefecture-level policies that are likely to affect the maternal employment in general, but several small policies may collectively affect it.[19] There may also be changes in other prefecture-level labor market conditions that affect maternal employment. Given that we have only a few time-varying control variables in the regression, our regression results for nuclear households might be driven by those prefecture-level policies and local labor market shocks other than childcare availability.

To address this issue, we conduct a falsification test. Namely, we estimate the effects of childcare availability on maternal employment for households with children age 6-14.[20] Because these older children are not eligible for the accredited childcare service, their mothers' employment is not directly affected by childcare availability. If strong positive effects are found for these mothers, our main results above are likely to be driven not by childcare availability, but by an omitted factor

[19] Nakajima and Tanaka (forthcoming) report that pronatal policies are considerably different across municipalities.

[20] The employment of parents is reported by a different age-window across census years. The employment variable can be constructed from 1990 to 2010 for 3 age-windows including 0-5, 6-14, and 15-17.

that affects all mothers regardless of the age of the youngest child.

Table 5 shows the results from the first-difference estimator. The estimated coefficient for childcare availability is tiny and insignificant for nuclear households (column 1), and it is negative for three-generation households (column 2). When all household types are pooled, the coefficient is insignificant (column 3). This does not change when the nuclear household share is included as a control (column 4). These results indicate that maternal employment for households with children age 6-14 does not respond to childcare availability, which in turn supports the claim that our main result in Section 4.2 is indeed driven by childcare availability.

Table 6 also presents the results from the OLS estimation. When prefecture fixed effects are included along with other control variables, the results are very similar to those from the first-difference estimator (see columns 2, 4, and 6). That is, maternal employment for households with children age 6-14 does not respond to childcare availability. Interestingly, when prefecture fixed-effects are omitted, the estimated coefficients for childcare availability are positive and significant (see columns 1, 3, and 5). Again, estimates can be severely biased if prefecture fixed effects are omitted. The result indicates existence of prefecture fixed effects that affect the maternal employment rate regardless of ages of their children.

Table 5: Responses by Households With Children Age 6-14 (First-Difference)

	(1)	(2)	(3)	(4)
Household Type	Nuclear	3-Gen	All	All
ΔCap./U6-Pop.	0.061	-0.164^{**}	-0.054	-0.023
	(0.074)	(0.065)	(0.079)	(0.081)
ΔAge	0.026^{***}	0.001	0.024^{**}	0.028^{**}
	(0.009)	(0.013)	(0.012)	(0.011)
ΔHusband's Age	-0.033^{**}	-0.019	-0.050^{***}	-0.053^{***}
	(0.013)	(0.019)	(0.018)	(0.017)
ΔHusband's % Empl.	0.634^{***}	0.127	0.361^{***}	0.414^{***}
	(0.118)	(0.101)	(0.114)	(0.106)
ΔUnemp Rate	-0.685^{***}	-1.221^{***}	-0.998^{***}	-0.906^{***}
	(0.170)	(0.301)	(0.183)	(0.194)
Δ % Nuclear HH				-0.145^{*}
				(0.080)
(Intercept)	0.014^{***}	0.024^{**}	0.030^{***}	0.028^{***}
	(0.005)	(0.010)	(0.005)	(0.005)
R^2	0.786	0.442	0.668	0.677
Adj. R^2	0.777	0.418	0.653	0.660
Num. obs.	188	188	188	188
Year FE	✓	✓	✓	✓
Prefecture FE				

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Source: Census 1990-2005

Note: The dependent variable in all models is 5-year changes in the employment rate at the prefecture level. The number of households is used as weight. Standard errors are clustered at the prefecture level.

Table 6: Responses by Households With Children Age 6-14 (OLS)

	(1)	(2)	(3)	(4)	(5)	(6)
Household Type	Nuclear	Nuclear	3-Gen	3-Gen	All	All
Cap./U6-Pop.	0.455^{***}	-0.001	0.428^{***}	-0.206^{**}	0.502^{***}	-0.090
	(0.062)	(0.121)	(0.065)	(0.103)	(0.070)	(0.140)
Age	0.075^{*}	0.016	0.154^{***}	-0.017	0.115^{**}	0.000
	(0.041)	(0.022)	(0.039)	(0.019)	(0.052)	(0.024)
Husband's Age	-0.098^{**}	-0.016	-0.229^{***}	-0.003	-0.175^{***}	-0.030
	(0.047)	(0.025)	(0.037)	(0.026)	(0.059)	(0.032)
Husband's % Empl.	0.939^{***}	0.580^{**}	-0.782	-0.268	0.681^{**}	0.274
	(0.285)	(0.232)	(0.492)	(0.374)	(0.326)	(0.270)
Unemp Rate	-1.823^{**}	-0.303	-3.371^{***}	-1.762^{***}	-3.084^{***}	-0.949^{**}
	(0.892)	(0.326)	(0.884)	(0.632)	(1.057)	(0.420)
(Intercept)	0.778	0.048	5.077^{***}	1.847^{**}	2.783^{***}	1.651^{**}
	(1.046)	(0.620)	(0.673)	(0.808)	(1.050)	(0.717)
R^2	0.724	0.985	0.732	0.983	0.701	0.986
Adj. R^2	0.713	0.980	0.721	0.978	0.689	0.982
Num. obs.	235	235	235	235	235	235
Year FE	✓	✓	✓	✓	✓	✓
Prefecture FE		✓		✓		✓

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Source: Census 1990-2005
Note: The dependent variable in all models is the maternal employment rate at the prefecture level. The number of households is used as weight. Standard errors are clustered at the prefecture level.

6 Growth of Maternal Employment Rate Across Regions

Our analysis so far shows that childcare availability increases the employment rate of mothers of children under age 6 in nuclear households and that the household structure strongly influences the maternal employment rate. In this section, we assess the extent to which childcare availability, the household structure, and other factors separately affected the maternal employment growth from 1990 to 2010.

Table 7 reports the maternal employment rate, the childcare availability index, and the nuclear household share across time and prefecture groups. The statistics are based on all two-parent households with children under 6, regardless of whether they live with their parents or other relatives or not. Our unit of observation is the prefecture and the number of households are used as weight. We separate prefectures in terms of population density as of 2010. The large prefectures include Tokyo, Osaka, Kanagawa, Saitama, Chiba, Aichi, Hyogo, and Fukuoka. The small prefectures include all others.

Table 7: Regional Differences

	% Employed			Cap./U6-Pop.			% Nuclear HH		
	1990	2010	Diff.	1990	2010	Diff.	1990	2010	Diff.
All Prefs.	0.341	0.412	0.070	0.248	0.338	0.089	0.712	0.865	0.153
Large Prefs.	0.261	0.355	0.094	0.212	0.280	0.067	0.811	0.919	0.108
Small Prefs.	0.409	0.470	0.061	0.279	0.397	0.118	0.628	0.810	0.181

Source: Census 1990-2010
Note: Unit of observation is the prefecture. The mean is calculated using the number of households with children under 6 in each year as weight. Large prefectures in terms of population density as of 2010 include Tokyo, Kanagawa, Saitama, Chiba, Aichi, Osaka, Hyogo, and Fukuoka.

We compare the large and small prefectures in 1990. The maternal employment rate was only 26.1% in the large prefectures, while it was 40.9% in the small prefectures. This difference can be partly explained by childcare availability and the household structure. The ratio of childcare capacity to population of children under 6 was 0.212 in the large prefectures, while it was 0.279 in the small prefectures. Given our regression results above, the low childcare availability in the large prefectures can account for some of the difference in the maternal employment rate between the large and the small prefectures. The nuclear household share was 81.1% in the large prefectures, while it was much lower at 62.8% in the small prefectures. The average maternal employment rate for nuclear households was 27.3%, while it was as high as 51.1% for three-generation household (not reported in the table). Given this large difference in the employment rate between nuclear and three-generation households, the difference in the nuclear household share accounts for some of the difference in the maternal employment rate between the large and small prefectures.

The changes from 1990 to 2010 were also substantially different across regions. The maternal employment rate grew at a faster pace in the large prefectures than in the small prefectures (9.4 pt vs 6.1 pt). Accredited childcare became more available in both regions, but the capacity-population ratio grew at a slower pace in the large prefectures (0.067 vs 0.118). This may be intuitive given that the supply shortage of childcare has been a major problem mostly in the metropolitan areas such as Tokyo. The nuclear household share increased in both regions, but the change was more strongly pronounced in the small prefectures than the large ones. Note that this change directly implies a significant drop in the share of three-generation households because 99.8% of households are either nuclear or three-generation households.

We decompose the change in the maternal employment rate from 1990 to 2010 for each prefecture group using the method similar to the Oaxaca-Blinder decomposition. We estimate model parameters by applying the OLS with year and prefecture fixed effects (see Table 3) separately

for each household type. The parameter estimates are used to decompose the overall change into three factor effects: the change in childcare availability, the change in the household structure, the change in other factors.

Table 8 presents the decomposition results. Because decomposition is not uniquely determined, we show decompositions based on four models. Models 1-4 in Table 8 are defined by Equations (3)-(6) in Appendix A.1. The first set of rows shows the decomposition for all prefectures. The growth of childcare availability modestly increased the maternal employment by 1.3-2.1 percentage points out of 7.0, which implies that childcare availability accounts for about 30% of the change in the maternal employment rate. However, this positive effect of childcare availability was completely offset by the change in the household structure. The increase in the nuclear household share decreased the maternal employment rate by 1.1-2.8 percentage points.

The driving factors of the maternal employment growth were considerably different between the prefecture groups. The second set of rows shows the decomposition for the large prefectures. The growth of childcare availability in the large prefectures increased the maternal employment rate by 1.5-1.9 percentage points out of the overall change of 8.8 percentage points. The increase in nuclear households modestly decreased the maternal employment rate by 0.7-1.7 percentage points. Because the nuclear household share was already high in 1990, the increase of nuclear households did not have a strong negative effect on the maternal employment rate.

The third set of rows shows the decomposition for the small prefectures. The growth of childcare availability in the small prefectures increased the maternal employment rate by 1.2-2.4 percentage points out of the overall change of 6.6 percentage points. The increase in nuclear households significantly decreased the maternal employment rate by 1.5-4.0 percentage points in the small prefectures. Because the share of three-generation households decreased at a faster pace in the small prefectures, this effect was more strongly pronounced.

Our decompositions shed light on the difference in the maternal employment growth across regions. The improved childcare availability increased the maternal employment rate from 1990 to 2010 in both prefecture groups. However, this positive effect was completely offset by the decrease of the share of three-generation households. This negative effect of the change in the household structure was particularly strong in the small prefectures, where the three-generation household share was higher, and hence, decreased more rapidly than in the large prefectures.

Table 8: Decomposition of Maternal Employment Growth from 1990 to 2010

	Model 1	Model 2	Model 3	Model 4
All Prefs.				
Childcare	0.021	0.021	0.013	0.013
Household Type	−0.028	−0.029	−0.011	−0.011
Other	0.077	0.078	0.068	0.068
Total	0.070	0.070	0.070	0.070
Large Prefs.				
Childcare	0.019	0.019	0.015	0.015
Household Type	−0.017	−0.017	−0.007	−0.007
Other	0.086	0.086	0.080	0.080
Total	0.088	0.088	0.088	0.088
Small Prefs.				
Childcare	0.024	0.024	0.012	0.012
Household Type	−0.039	−0.040	−0.015	−0.015
Other	0.081	0.082	0.068	0.069
Total	0.066	0.066	0.066	0.066

Source: Census 1990-2010 and authors' calculation. Models 1-4 are defined by Equations (3)-(6) in Appendix A.1.

Finally, we decompose the growth of childcare availability. Our childcare availability index is given by the ratio of capacity to child population, and hence, a change in either capacity or child population affects the availability index. Our exercise here uncovers different reasons for the growth of childcare availability between the two prefecture groups. In Appendix A.2, we describe two different ways to decompose the growth depending on the base year.

Table 9 shows the decomposition results. Models 1 and 2 are defined by Equations (7) and (8) in Appendix A.2, respectively. On average over all prefectures, the capacity-population ratio increased by 9.5 points. The increase in capacity accounts for 2.3-2.7 points, while the decrease in population of children under 6 accounts for 6.8-7.1 points. While childcare became more available in both the small and the large prefectures, the reasons are very different between the two. In the large prefectures, about a half of the overall growth of childcare availability is explained by the increased capacity. In contrast, in the small prefectures, only about 15% of the growth of childcare availability is explained by the increased capacity. In both regions, the decrease in child population is an important factor for the better childcare availability, but it is even more important in the small prefectures.

If the child population continues to decrease, childcare availability will increase without opening new childcare centers or any additional expenses. Indeed, this is exactly what happened in the small prefectures. However, if pro-family policies eventually raise the fertility rate, government expenditures will have to increase just to maintain the current level of childcare availability.

Table 9: Decomposition of Growth of Capacity-to-Child-Population Ratio from 1990 to 2010

	Model 1	Model 2
All Prefs.		
Capacity	0.027	0.023
U6-Population	0.068	0.071
Total	0.095	0.095
Large Prefs.		
Capacity	0.039	0.034
U6-Population	0.029	0.034
Total	0.068	0.068
Small Prefs.		
Capacity	0.017	0.014
U6-Population	0.101	0.105
Total	0.118	0.118

Source: Census 1990-2010 and authors' calculation. Models 1 and 2 are defined by Equations (7) and (8) in Appendix A.2, respectively.

7 Conclusion

Using prefecture panel data from the Japanese quinquennial census from 1990 to 2010, we estimate the effects of childcare availability on maternal employment. We depart from previous papers on Japan by controlling for prefecture fixed effects and find that the estimates identified by cross-sectional variations alone can be severely biased. Indeed, contrary to popular belief, childcare availability is uncorrelated with maternal employment when prefecture fixed effects are controlled. Evidence suggests that this is because households substitute the accredited childcare service for informal childcare by grandparents, as more and more households choose not to live with grandparents. We do not find compelling evidence to determine whether the improved childcare availability leads to more nuclear households or not.

We also analyze nuclear and three-generation households separately. The estimation result

from the first-difference estimator reveals that the employment rate of mothers from nuclear households increases with childcare availability, whereas that of mothers from three-generation household does not. This result is robust to inclusion of a prefecture-specific trend in the maternal employment rate. Moreover, we address two potential sources of a simultaneity bias and find them negligible. First, we show evidence that inter-prefecture migration for childcare is rare. Second, we show that the employment rate of mothers of children 6-14 does not change with childcare availability. This result implies that prefecture-level policy changes and other shocks are not correlated with the changes of childcare availability.

We decompose the growth of the maternal employment rate from 1990 to 2010 into the contributions from childcare availability, the household structure, and other factors. We find that the improved childcare availability raised the maternal employment rate up to two percentage points or 30% of the overall growth of the maternal employment rate during this period. However, this positive effect from childcare availability is completely offset by the decrease in the share of three-generation households in which informal childcare by grandparents is available. This negative effect of the change in the household structure was more strongly pronounced in smaller prefecture, because the three-generation household share was high there and decreased rapidly.

Can further expansions of childcare raise the maternal employment rate? One potential concern surrounding this issue is the possibility of a further change in the household structure. If the nuclear household share keeps increasing, more and more households will shift from informal care by grandparents to the accredited childcare, which will offset the effect of childcare expansions. Perhaps, this may not be a major concern, because the decrease of three-generation households is likely to slow down given that the share of three-generation households is already at a low 13.5% in 2010. Another potential concern is that the pace of childcare expansion has to exceed the child population growth in order to keep childcare availability improving. More than 70% of the growth of childcare availability in 1990-2010 is explained by the decreasing child population. If the fertility rate starts to increase due to pro-family policies and other factors, childcare availability will not improve unless the pace of expansion is fast enough. Even larger government expenditure than the current one may be necessary to expand the supply of accredited childcare service in order to overcome these challenges and raise the maternal employment.

The main limitation of the current paper is that we cannot examine detailed labor market outcomes such as wage, earnings, hours of work, and job type, due to lack of data. Understanding the effects of childcare availability on these outcomes will shed light on welfare consequences and opens the door to a cost-benefit analysis. We leave these interesting issues for future research.

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A Decompositions

A.1 Decomposition of the Growth of Maternal Employment Rate

We estimate a linear regression model with year and prefecture fixed effects by OLS separately for each household type. We assume that the parameters are time-invariant. The predicted maternal

employment rate of prefecture k for household type j in year t is given by

$$\hat{Y}_{jkt} = X_{jkt}\hat{\beta}_j,$$

where $\hat{\beta}_j$ is the estimated parameter value for household type j. Let K be the set of prefectures of interest. Let J be the set of all household types. The average employment rate in year t is given by

$$\bar{Y}_t = \sum_{k\in K}\sum_{j=J} \omega_{jkt}\hat{Y}_{jkt},$$

where ω_{jkt} is the weight for household type j in prefecture k in year t.

Let N_{jkt} be the number of type j households in prefecture k in year t. Define N_t to be the aggregate number of households in year t, $N_t \equiv \sum_{k\in K}\sum_{j\in J} N_{jkt}$. The weight ω_{jkt} for household type j in prefecture k in year t is defined by

$$\omega_{jkt} \equiv \frac{N_{jkt}}{N_t}.$$

Let N_{kt} be the number of all households in prefecture k in year t. The weight ω_{jkt} can be decomposed as the product of two weights,

$$\begin{aligned}\omega_{jkt} &= \frac{N_{kt}}{N_t}\cdot\frac{N_{jkt}}{N_{kt}} \\ &\equiv \omega_{kt}\cdot\omega_{jkt},\end{aligned}$$

where ω_{kt} is the weight for prefecture k in year t and ω_{jkt} is the weight for household type j within prefecture k in year t.

The average growth of the maternal employment rate is given by

$$\begin{aligned}\Delta\bar{Y}_t &= \sum_{i\in I}\sum_{j=J}\left(\omega_{jkt}\hat{Y}_{jkt} - \omega_{jkt-1}\hat{Y}_{jkt-1}\right) \\ &= \sum_{i\in I}\sum_{j=J}\left(\omega_{jkt}\hat{Y}_{jkt} - \omega_{jkt}\hat{Y}_{jkt-1} + \omega_{jkt}\hat{Y}_{jkt-1} - \omega_{jkt-1}\hat{Y}_{jkt-1}\right) \\ &= \sum_{i\in I}\sum_{j=J}\left(\Delta\hat{Y}_{jkt}\omega_{jkt} + \Delta\omega_{jkt}\hat{Y}_{jkt-1}\right),\end{aligned}$$

where the first term in the parenthesis is the effect of the growth of the maternal employment rate $\Delta\hat{Y}_{jkt}$ for a fixed weight ω_{jkt} and the second term is the effect of changes in weights $\Delta\omega_{jkt}$. We can equivalently decompose it as

$$\Delta\bar{Y}_t = \sum_{i\in I}\sum_{j=J}\left(\Delta\hat{Y}_{jkt}\omega_{jkt-1} + \Delta\omega_{jkt}\hat{Y}_{jkt}\right).$$

The change in the weight $\Delta\omega_{jkt}$ can be decomposed as

$$\begin{aligned}\Delta\omega_{jkt} &= \omega_{kt}\omega_{jkt} - \omega_{kt-1}\omega_{jkt-1} \\ &= \omega_{kt}\omega_{jkt} - \omega_{kt-1}\omega_{jkt} + \omega_{kt-1}\omega_{jkt} - \omega_{kt-1}\omega_{jkt-1} \\ &= \Delta\omega_{kt}\omega_{jkt} + \Delta\omega_{jkt}\omega_{kt-1},\end{aligned}$$

where the first term on the right hand side is the effect of changes in the prefecture size and the second term is the effect of changes in the household structure. We can equivalently decompose it as

$$\Delta\omega_{jkt} = \Delta\omega_{kt}\omega_{jkt-1} + \omega_{kt}\Delta\omega_{jkt}.$$

The change in the maternal employment rate for household type j in prefecture k in year t is given by

$$\begin{aligned}\Delta\hat{Y}_{jkt} &= \Delta X_{jkt}\beta_j \\ &\equiv \Delta CCA_{kt}\beta_j^{CCA} + \Delta X_{jkt}^{O}\beta_j^{O}\end{aligned}$$

where ΔCCA_{kt} is a change in the childcare availability index in prefecture k in year t and ΔX_{jkt}^{O} is changes in other covariates for household type j in prefecture k in year t.

We have the following four equivalent ways to decompose the average growth in the maternal employment rate,

$$\Delta\bar{Y}_t = \sum_{i\in I}\sum_{j=J}\left(\Delta CCA_{kt}\beta_j^{CCA}\omega_{jkt} + \Delta X_{jkt}^{O}\beta_j^{O}\omega_{jkt} + \Delta\omega_{kt}\omega_{jkt}\hat{Y}_{jkt-1} + \Delta\omega_{jkt}\omega_{kt-1}\hat{Y}_{jkt-1}\right) \quad (3)$$

$$= \sum_{i\in I}\sum_{j=J}\left(\Delta CCA_{kt}\beta_j^{CCA}\omega_{jkt} + \Delta X_{jkt}^{O}\beta_j^{O}\omega_{jkt} + \Delta\omega_{kt}\omega_{jkt-1}\hat{Y}_{jkt-1} + \Delta\omega_{jkt}\omega_{kt}\hat{Y}_{jkt-1}\right) \quad (4)$$

$$= \sum_{i\in I}\sum_{j=J}\left(\Delta CCA_{kt}\beta_j^{CCA}\omega_{jkt-1} + \Delta X_{jkt}^{O}\beta_j^{O}\omega_{jkt-1} + \Delta\omega_{kt}\omega_{jkt}\hat{Y}_{jkt} + \Delta\omega_{jkt}\omega_{kt-1}\hat{Y}_{jkt}\right) \quad (5)$$

$$= \sum_{i\in I}\sum_{j=J}\left(\Delta CCA_{kt}\beta_j^{CCA}\omega_{jkt-1} + \Delta X_{jkt}^{O}\beta_j^{O}\omega_{jkt-1} + \Delta\omega_{kt}\omega_{jkt-1}\hat{Y}_{jkt} + \Delta\omega_{jkt}\omega_{kt}\hat{Y}_{jkt}\right). \quad (6)$$

For all of the four models, the first term in the parenthesis is the effect of changes in childcare availability ΔCCA_{kt}, the second term is the effect of other covariates ΔX_{jkt}, the third term is the effect of changes in prefecture size $\Delta\omega_{kt}$, and the fourth term is the effect of the household structure $\Delta\omega_{jkt}$.

Note that only two possible values exist for the effects of changes in childcare availability and the household structure. Because we are primarily interested in these two, we refer to the sum of

the second and third terms as "others". Equations (3)-(6) correspond to Models 1-4 in Table 8.

A.2 Decomposition of the Growth of Capacity-Population Ratio

Let C_{kt} be the childcare capacity in prefecture k in year t. Let N_{kt}^C be the population size of children under 6 in prefecture k in year t. Our childcare availability index CCA_{kt} is given by

$$CCA_{kt} = C_{kt}/N_{kt}^C.$$

The growth of childcare availability index is

$$\Delta CCA_{kt} = CCA_{kt} - CCA_{kt-1}.$$

We can decompose the growth as follows,

$$\begin{aligned}
\Delta CCA_{kt} &= \frac{C_{kt}}{N_{kt}^C} - \frac{C_{kt-1}}{N_{kt-1}^C} \\
&= \frac{C_{kt}}{N_{kt}^C} - \frac{C_{kt-1}}{N_{kt}^C} + \frac{C_{kt-1}}{N_{kt}^C} - \frac{C_{kt-1}}{N_{kt-1}^C} \\
&= \frac{\Delta C_{kt}}{N_{kt}^C} + \frac{C_{kt-1}}{\Delta N_{kt}^C}, \qquad (7)
\end{aligned}$$

where the first term on the right hand side is the effect of capacity growth and the second term is the effect of the growth of child population. An alternative way to decompose the growth of the childcare availability index is

$$\Delta CCA_{kt} = \frac{\Delta C_{kt}}{N_{kt-1}^C} + \frac{C_{kt}}{\Delta N_{kt}^C}. \qquad (8)$$