Fertility and the user cost of home ownership: Evidence from regional panel data

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Abstract

Cross-sectional data yield the interesting result that fertility rates and home ownership rates tend to correlate positively, while time-series data suggest an inverse (or no) relationship between them. Although these associations can be explained by observed economic variables, doubt remains as to whether these links are due to the existence of omitted regional and time effects. Thus, controlling for regional-specific fixed effects and nationwide common time effects, this paper tests the link between the user cost of home ownership, which is the purchase price of housing, and total fertility rates. The empirical results, which use a panel of Japanese regional aggregate data, suggest that the impact of user costs on fertility considerably decreased when compared with the pooled OLS regression result without controlling for the above effects, but remained significantly negative. In the Japanese context, the association between the number of children and home ownership seems to be complementary.

JEL classification: C23, J13, R21

Key words: Fertility, home ownership, user cost, panel data

1 Introduction

A growing literature has examined whether home ownership is associated with child-bearing. Mulder (2006) and later (Mulder & Billari, 2011) pointed out there are opposing forces at work. On the one hand, home ownership may encourage a family to have children, because it tends to ensure a stable family environment. On the other hand, there might be a negative relationship between home ownership and child-bearing, because the cost of home ownership might compete with the cost of rearing children.

Under the budget constraint, every family faces a trade-off between acquiring a home and child-bearing. When the purchase price of housing decreases, a family is more easily able to purchase housing. However, the purchase stretches the family's budget constraint, and the family may feel less able to afford to have children. The second contribution by Mulder seems to suggest this relationship. Decreasing the price of owner-occupied housing, however, need not always discourage fertility. If the family prefers to have both a home and children, as suggested by the first contribution by Mulder, affordable housing costs may boost both home ownership and fertility.

Economists define two goods as (gross) complements when the price of one and the demand for the other changes in the opposite direction, while the two goods are (gross) substitutes when the price of one and the demand for the other changes in the same direction. To consider whether the association between the number of children and home ownership are complements or substitutes, this paper focuses empirically on the link between the user cost of home ownership and total fertility rates. The user cost of housing is the potential cost of owning a house (see, e.g., Green and Malpezzi, 2003). It includes out-of-pocket costs and the opportunity cost of equity. A capital gain from the rising asset value of housing will in time reduce these costs. On the other hand, the total fertility rate is the hypothetical number of children a woman would have over her reproductive years, generally between the ages of 15 and 49.

Panel data from 47 Japanese prefectures from 1998 to 2009 are used to test for this connection by controlling for both time effects for the year and fixed effects in each district. For Japan as a whole, total fertility rates have been slowly declining for some time. This decline can be

explained by observed economic variables. However, unobserved factors such as the preferences, the norms, and the environment for raising a child may also impact on this phenomenon. At the same time, it is well known that families who reside in expensive locations tend to have fewer children. This can be explained by observed economic variables, but again, unobserved factors affecting the costs of raising a child are generally different across regions. To examine how a bias is created by not controlling for the above effects, we estimate a pooled OLS regression without these effects as a benchmark. The results suggest that the association between the number of children and home ownership appears to be complementary, because the coefficient of the user cost is significantly negative. The absolute value of the negative gradient substantially decreased, but the complementary relationship remained significant, even after controlling for a time trend and location specifics.

The rest of the paper is organized as follows. Section 2 provides a literature review of fertility and home ownership, while Section 3 introduces the theoretical model. Section 4 describes the econometric model, data, and estimated results. Finally, Section 5 concludes.

2 Literature Review

Mulder & Billari (2011) examined the association between total fertility rates and home ownership in Western countries. They constructed home ownership regimes based on the share of owner-occupied housing and access to mortgages for the purpose of interpreting cross-national differences in fertility. Using their data, Panel A of Figure 1 depicts the positive correlation between total fertility rates and access to mortgages. This suggests that a country with the easiest access to mortgages also may have the highest home ownership, and that is complementary with raising a child. Therefore, as shown in Panel B of Figure 1, total fertility rates are higher in countries where the share of home ownership is higher.[1] A similar phenomenon can be observed inside a country as well. For example, using US data, Lovenheim & Mumford (forthcoming) demonstrated the negative correlation between birth-rates and house prices. A higher cost of

[1] This relationship becomes much stronger when Southern European countries such as Italy, Spain and Greece are excluded. In these countries, many adult children continue to live in their parents' homes. Because home ownership is difficult for the younger generations, both marriage and having children are delayed (Mulder & Billari, 2011).

living may imply lower home ownership, which is again complementary with having a child. The positive relationship between fertility and home ownership (in other words, the negative relationship between fertility and living costs), was supported by Mulder & Wagner (1998; 2001), Kulu & Vikat (2007), Öst (2011), and Hui et al. (2012). Mulder & Wagner (1998) used the retrospective lifetime data available for West Germany and The Netherlands to examine the association between first-time home ownership and family formation. Empirical results appeared to indicate that the transition to first-time home ownership is connected with the number of first and second children in West Germany. In The Netherlands, however, most housing is purchased by childless couples. Their study focused empirically on the link from having children to the likelihood of becoming a homeowner. Yet, at the same time, Mulder & Wagner (2001) considered a reverse causality, and found that couples are more likely to become parents after becoming homeowners in both West Germany and The Netherlands. Using Finnish individual-level information, Kulu & Vikat (2007) also demonstrated empirically that couples who live in or transfer to single-family houses are more likely to have children than those residing in rental apartments. Hui et al. (2012) collected aggregate annual time series data in Hong Kong, China, and found that an increase in housing prices leads to a decrease in fertility. Öst (2011) employed Swedish individual-level data, and examined the effect of the user costs of owner-occupied housing on the decision about having children. Her results showed that home user costs have a significantly negative impact on the fertility of younger cohorts. She suggested that this is because those cohorts face severe housing market situations compared with the older cohorts in Sweden.

Panel B of Figure 1, however, suggests that cross-sectional estimates of the effect of home ownership on fertility potentially contain positive biases, because some omitted variables may encourage both fertility and home ownership. For example, as suggested by Dettling and Kearney (2011), let us suppose that families with lower preferences for children prefer to locate to areas with better amenities. These districts generally have higher living costs, and accordingly, access to home ownership is difficult. As a result, unobserved amenities tend to create a positive correlation between fertility and home ownership.

To address this issue, Lo (forthcoming) constructed regional panel data in Taiwan, and

estimates the influence of home ownership on fertility using the fixed-effects model with the intercept variable. The varying intercept is used to control for heterogeneity across the region. In contrast to the above, his results indicated that home ownership and fertility seem to compete and crowd each other out. The negative relationship between fertility and home ownership was also supported by Murphy & Sullivan (1985). They argued that homeowners in the UK tend to have fewer children than renters and also to have them later.

This paper follows Öst (2011) and Lo (forthcoming) by using a regional panel data set from Japan. We stress the following two points. First, both time-invariant regional-specific effects and regional-invariant time-specific effects are incorporated into the estimation model. Öst (2011) did not consider both of these because her data are single-year data. Lo (forthcoming) considered the regional-specific effects, but did not take account of common time effects. The negative or no relationship between fertility and home ownership may be observed over time in several developed countries, because, usually, total fertility rates have declined (Feyrer et al., 2008), whereas home ownership rates have risen or are unchanged (Scanlon & Whitehead, 2004). On the one hand, in the negative association case, there is a possibility that omitted time-specific variables may induce this phenomenon. For example, suppose that families plan to decrease fertility and housing costs have shown a downward trend. Because access to home ownership is easy in this case, ignoring fixed-time effects tends to produce negative biases between fertility and home ownership. On the other hand, in the irrelevance case, decreasing fertility may be explained not by home ownership, but by omitted time-specific variables.

Second, similar to Öst (2011), we use the costs of home ownership instead of home ownership rates, because we focus on whether the association between the number of children and home ownership is one of complements or substitutes.

Lovenheim and Mumford (2011) and Dettling and Kearney (forthcoming) hypothesized that housing costs may have a positive impact on birth-rates among homeowners because an increase in the housing price raises housing wealth. Lovenheim and Mumford (2011) used regional US data, while Dettling and Kearney (forthcoming) used individual-level information on US women. In addition, Lovenheim and Mumford (2011) considered the housing price itself, whereas Dettling

and Kearney (forthcoming) examined housing price changes. Even though there are differences between the data sets, controlling for both regional fixed and time effects, both papers provided support for the hypothesis. Using the user cost of home ownership also has the advantage of implicitly incorporating the capital gain effect of housing on fertility. As mentioned in the previous section, user cost is defined so that it is negatively associated with home price changes. Therefore, when a capital gain is expected, user cost decreases. If children and home ownership have a complementary relationship, then the capital gain from housing increases fertility, which may support the hypothesis of Lovenheim and Mumford (2011) and Dettling and Kearney (forthcoming).

3 The Theory of Children and Housing

Our set-up for explaining fertility relies on a simple static model. Because the association between the number of children and home ownership is the main focus, in this section we concentrate on this factor. Thus, unlike the model of Becker (1960), which is well known in textbooks on family economics (see, e.g., Bryant & Zick, 2006), the bearing and raising of children, a process involving mothers' time, is disregarded. Of course, it will be considered in the empirical section below.

Mulder (2006) introduced the benefits of home ownership because the quality and tenure security of owner-occupied housing are on average better than for those in rental accommodation. Similar to Ben-Shahar (1998), we define q as the variable endogenously selected by a family, representing the ability to own a house. Because existing studies have considered the effect on the ratio/probability of home ownership, this setting may be relevant. In addition to q, the family also determines the number of children N and a bundle of other goods Z to maximize the utility. Therefore, the well-behaved utility function can be written as follows:

$$U(N, q, Z; \boldsymbol{\Theta}), \tag{1}$$

where $\boldsymbol{\Theta}$ is a vector of preference shifters.

Owner-occupied housing is a tenure, in which a housing unit is owned by an owner who implicitly leases it to himself or herself. As the owner of housing, the family obtains a profit, Π,

as shown:

$$\Pi = R - UC, \tag{2}$$

where R is rental revenue and UC is a user cost. The provability is q, and the family obtains Π and includes it in the budget constraint. On the other hand, as the imputed tenant, the family must pay a rental cost with the provability q. Let us suppose that raising a child requires P_c units of money and the price of Z is normalized to one. Then the budget constraint can be written as follows:

$$I + q\Pi = P_c N + qR + Z, \tag{3}$$

where I is the income of the family. Substituting (2) for (3), we have:

$$I = P_c N + qUC + Z. \tag{4}$$

Maximizing (1), given the budget constraint (4), gives the following (money–income held constant) child demand function:

$$N = N(UC, \mathbf{\Omega}), \tag{5}$$

where $\mathbf{\Omega}$ includes other factors apart from the user cost of housing such as $\mathbf{\Theta}$, I, and P_c.

A purpose of this paper is to test $\partial N/\partial UC$. Children and housing are classified as (gross) substitutes when an increase in UC increases the demand for children ($\partial N/\partial UC > 0$), while they are classified as (gross) complements when an increase in UC decreases the demand for children ($\partial N/\partial UC < 0$). Then, what happens when UC increases? The Slutsky equation with respect to change in UC can be written as follows:

$$\frac{\partial N}{\partial UC} = \frac{\partial N^U}{\partial UC} - q\frac{\partial N}{\partial I}, \tag{6}$$

where N^U is the income-compensated child demand function.

First, as the second term in (6), an increase in UC induces an income effect where family income has lower purchasing power. If children are normal goods, as empirically demonstrated by Black et al. (forthcoming), decreasing income causes the family to decrease its fertility. Second, as the first term in (6), an increase in UC induces a substitution effect. The family may face reduced affordability of acquiring housing, because the high UC implies a low rate of return

on that. In other words, q generally follows the law of demand. Although bearing and raising children have become less expensive relative to owning the home through the substitution effect, the family may also hesitate to have a child if the family prefers to have the home and children together. The negative sign of the substitution effect implies that N and q are net complements. Therefore, through the income and substitution effects, an increase in UC unambiguously reduces the number of children, and consequently the goods are (gross) complements. In this case, we may find a positive relationship between N and q.

The family, however, may increase the demand for children through the substitution effect when children and home ownership satisfy similar desires. The positive substitution effect means that N and q are net substitutes. If the positive substitution effect dominates the negative income effect, then an increase in UC increases the number of children. This (gross) substitute relationship may induce that negative association between N and q. In sum, the exact direction of the effect of UC on child demand is theoretically ambiguous, and depends on empirical analysis.

4 Empirical Analysis

4.1 Econometric Model

Because we use regional aggregate data, the number of children N is captured by regional total fertility rates, TFR_{it}, where the subscript i is the region and t a time index. To apply (5) to the data, the following linear demand function is specified:

$$TFR_{it} = \alpha UC_{it} + \mathbf{\Omega}_{it}'\boldsymbol{\gamma} + \varepsilon_{it}, \tag{7}$$

where α is a parameter of primary interest because it captures $\partial N/\partial UC$, $\mathbf{\Omega}_{it}$ is the vector of included covariates that have a parameter vector $\boldsymbol{\gamma}$, while ε_{it} is an idiosyncratic error term.

From the theory, the variables in the right-hand side may explain the regional total fertility rates. If, however, (7) is estimated using a pooled OLS, a result tends to contain some bias as already suggested. Therefore we make the following arrangement. First, both unobserved regional effect μ_i, which may capture differences in behaviour across districts but is constant over time, and unobserved time effect λ_t, which may capture differences in behaviour over time

but is common to all districts, are added. Common time effects are captured by year dummies. Unobservable factors such as preferences, norms, environments ($\boldsymbol{\Theta}$), and the costs of having children (P_c) may be controlled by μ_i and λ_t.

Second, one-year lagged variables are employed on the right-hand side, because this reduces the probability of simultaneous determination. The one-year lagged model also considers the pregnancy gestation period (Lo, forthcoming). Then we specify the following regional fixed-effects model with time dummies:

$$TFR_{it} = \alpha UC_{it-1} + \mathbf{X}'_{it-1}\boldsymbol{\beta} + \mu_i + \lambda_t + \varepsilon_{it}, \tag{8}$$

where $\mathbf{X}_{it-1}$ is the vector of included covariates that have a parameter vector $\boldsymbol{\beta}$.

To understand how (8) corrects the bias, we first estimate the pooled OLS version of (8) without $\mathbf{X}_{it-1}$, μ_i, and λ_t. Then we estimate first the fixed-effects model with μ_i but without $\mathbf{X}_{it-1}$ and λ_t, and then second, the fixed- effects model with μ_i and λ_t but without $\mathbf{X}_{it-1}$. Finally, we estimate the model containing all covariates.

4.2 Data

The data to be used are prefecture-level aggregate data. There are 47 prefectures. Table 1 presents sample statistics for both the dependent and explanatory variables. The data on total fertility rates are compiled by the Ministry of Health, Labour and Welfare every year; for this study, we use the time period from 1998 to 2009 (12 years). Therefore, our analysis sample consists of 564 observations.

We use the user costs of owner-occupied housing calculated by Yamazaki & Asada (2003) and Yamazaki et al. (2006). Because they discussed how to derive the user costs of home ownership in detail, here we only give the basic equation as follows:

$$UC_{it} = (r_t + \delta_{it} - \pi_{it})P_{it}, \tag{9}$$

where r_t is an interest rate, which uses average contract interest rates on loans and discounts (Bank of Japan), δ_{it} is a depreciation rate, which is obtained from Building Starts (Ministry of Land, Infrastructure, Transport and Tourism), π_{it} is an appreciation rate, which we calculate

as the average housing price change over the past three years using imputed rents (Ministry of Internal Affairs and Communications), and P_{it} is the value of housing, which is again obtained from Building Starts. Actually, the user cost is much more complex than in (9). For example, a preferential tax treatment is considered. Tax treatment depends on government housing policy. See Yamazaki & Asada (2003) and Yamazaki et al. (2006) for a careful derivation.

Panel A of Figure 2 depicts a regional average fertility rate (1998–2009) against regional average user costs (1997–2008) for prefecture i, suggesting that higher user costs tend to lower fertility rates. Similar to Panel B of Figure 1, an interregional comparison indicates that the number of children and home ownership are likely to be complements. We expect, however, that the complementary relationship becomes weak if we control unobserved regional-specific fixed effects by using an intercept variable. In addition, the time-series graph in Panel B of Figure 2, which depicts a national average fertility rate and one-year lagged national average user costs, demonstrates that the complementarity relationship becomes much weaker. Controlling nationwide common time effects thus seems to be important for isolating the effect of user costs on fertility.

Child-bearing is influenced by a number of factors apart from housing (Feyrer et al., 2008). Although this paper mainly focuses on user costs, to reduce the omitted variable bias, we include the following variables.

First, female wages are included. We use the monthly contract cash earnings of regular female employees in the Basic Survey on Wage Structure (1997–2008) compiled by the Ministry of Health, Labour and Welfare. Because total fertility rates are calculated from women aged 15–49, we use female wages in that age range. Increases in female wages increase the opportunity cost of raising children (Becker, 1960), and this reduces the willingness to have children. Because child care remains the primary responsibility of many married women in Japan, the 2005 White Paper on the National Lifestyle issued by the Cabinet Office of Japan suggested that this negative substitution effect is one of the factors producing the declining birth-rate. In this regard, higher female wages are expected to have a negative impact on fertility.[2]

[2]Schultz (1985) identified the negative substitution effect of female wages on the fertility of Swedish women by using the remarkable increase in world butter prices as an instrument variable. At that time, milk processing was female-dominated work in Sweden.

Second, we use the female wage squared, because an increase in female wages may incorporate a positive income effect. The positive income effect generally dominates the negative substitution effect, when married women earn a sufficiently high income. Therefore, the expected sign for the quadratic term is positive.

Third, we examine the male wage and male wage squared. Again, we use monthly contract cash earnings of regular employees by males aged 20–54 in the Basic Survey on Wage Structure (1997–2008). Becker (1960) suggested that if children are normal and if male time is relatively unimportant to fertility, male wages tend to have a positive impact on fertility. This might be true in Japan, because married men bear much less of the share of child-raising responsibilities than their European counterparts (Feyrer et al., 2008). Becker's suggestion implies that the male wage is likely to capture the income effect. Thus, male wage proxies I in this theory. The expected sign of the male wage is positive.[3] We include the quadratic term of male wages, because it allows us to compare gender differences.

Fourth, similar to Öst (2011) and Lo (forthcoming), we control for the unemployment rate. The regional unemployment rates for the prefecture level from 1997 to 2008 are available from the Labour Force Survey (Ministry of Internal Affairs and Communications). Empirical results of Öst (2011) and Lo (forthcoming) demonstrated that the unemployment rate is negatively associated with the child-bearing decision. Lo (forthcoming) argued that people become more unwilling to have a child when the unemployment rate is high. In addition to this psychological cost, we can say that a high unemployment rate in a neighbourhood may increase the opportunity cost of raising children. According to the theory of efficiency wages in macroeconomics textbooks (e.g., Mankiw, 2001), firms operate more efficiently if wages are above the equilibrium level. The unemployment arising from high-efficiency wages challenges employed workers to keep their jobs. Even though the level of efficiency wages is unchanged, an increase in the unemployment rate increases opportunity costs. Japanese working women thus tend to keep their jobs when the unemployment rate is high. This suggests that the expected sign of the unemployment rate may

[3] Black et al. (forthcoming) identified the income effect of male wages on the fertility of US women by using the striking increase in coal prices as an instrument variable. Because coal-mining is a heavily male-dominated occupation, increases in the coal price because of the remarkable change in world energy prices might have a large exogenous impact on male incomes.

be negative.[4]

Finally, similar to Lo (forthcoming), we control for infant mortality rates, obtained from Vital Statistics, 1997–2008 (Ministry of Health, Labour and Welfare). Lo suggests that infant mortality rates have two possible effects on fertility including the replacement effect and the (psychological) cost effect. Thus, the expected sign is ambiguous.

4.3 Estimation Results

Table 2 reports how the final model of (8) modifies possible bias. The first model reports a pooled OLS regression result without both regional fixed effects and time dummies. Moreover, only user costs are included. The second model, on the other hand, reports the results of the fixed-effects model without time dummies. In both Models 1 and 2, it appears that user costs have a significantly negative effect on the fertility rate; thereby, the association between the number of children and home ownership is likely to be complementary. As expected, the coefficient estimated with regional fixed effects has a substantially smaller impact on fertility than without regional fixed effects, suggesting that the correlations between regional fixed effects and user costs are not negligible. In fact, the F-statistic, which tests the null hypothesis that the omitted effect across prefectures is zero ($H_0 : \mu_i = 0$), is statistically significant. Thus, Model 2 seems to be valid.[5]

The third model reports the result of the fixed-effects model that only the user cost is included with time dummies (the reference year is 1998). As expected, the impact of the user cost on fertility becomes weaker, but remains significant. Except for 2000, the year dummies have a significantly negative sign, indicating an unobserved time trend is not negligible in an explanation of fertility decline.

[4] Using Japanese women's individual-level data, Hashimoto and Kondo (forthcoming) examined how fertility is affected by the regional unemployment level. One of their contributions was that they divided their observations into two groups of less educated women and more educated women, because job security differs between them. Their empirical results demonstrated that the effect of the unemployment rate on fertility at entry to the labour market is negative for less educated women and positive for more educated women. For more educated women, a decrease in wages because of a high unemployment rate, relatively lowers the opportunity cost, thereby encouraging greater fertility during economic downturns. For less educated women, increases in the high unemployment rate relatively lowers the income effect because their degree of job security is weak. Accordingly, they decrease their fertility during economic downturns.

[5] We also consider the random effects model. Both the Wu–Hausman and Sargan–Hansen statistics suggest that the null hypothesis of the random effects model is rejected.

The fourth model reports the final model of (8) containing all covariates. All variables in relation to wages are significant and have the expected sign. The squared terms that are divided by 100, however, are substantially small. Therefore, the level of female wages mainly has a negative impact on fertility, while male wages have a positive impact. Similar to Öst (2011) and Lo (forthcoming), unemployment has a significantly negative effect on fertility. The absolute value of the coefficient for the user cost substantially decreases, but again remains significant. In sum, our final estimation model suggests that the association between the number of children and home ownership appears to be complementary, even after we control for the socio-economic and demographic variables and after we adjust for unobserved regional-specific fixed effects and nationwide common time effects.

4.4 Discussion

Our empirical results demonstrate that the time dummies have a negative sign. As a result, the association between fertility and home ownership becomes weaker. One explanation for the downward trend is that young cohorts are more likely to derive satisfaction from the quality of their children than from the number of their children, which may have been the main concern of older cohorts. To examine this issue, it is useful to consider the cohort effect. Japan's Ministry of Health, Labour and Welfare releases the total cohort fertility rate every year. We, however, cannot observe it at a regional level. Other explanations for the downward trend might be the increase in average age at marriage and the decline in the number of marriages (Hashimoto and Kondo, forthcoming). In fact, according to The Economist (August 20, 2011), Asian women are marrying later and less often than in the past.[6] Therefore, the effect of time dummies on fertility may differ across age groups. To examine this issue, we use birth-rates by age groups of females of 20–24, 30–34, and 40–44 years at a regional level, which are reported by the National Institute of Population and Social Security Research. The birth-rate by age is defined as the number of live births per 1,000 women in each age group in a given year. Table 3 reports the results of the fixed-effects model, which controlled for user cost and time dummies (reference year is 2002).

[6] See "Asian demography: The flight from marriage," *The Economist*, August 20, 2011, available at http://www.economist.com/node/21526329 (accessed on February 23, 2012).

All of the year dummies are significantly negative for the youngest age group, while they turn significantly positive after 2006 onwards for the middle age group. For the oldest age group, all time dummies are significantly positive. As expected, the empirical results suggest a rise in the average age of fertility. Table 3 also demonstrates that user cost is significantly negative for all age groups. The value of the coefficient suggests that the age group of 20–24 is more likely to be negatively influenced by user costs than other age groups.

5 Conclusions

A growing literature has examined how home ownership is associated with child-bearing. Yet, the attention paid to links from the user cost of home ownership, which is the potential cost of being a homeowner, to fertility has been limited. This paper aims at contributing to the understanding of this connection, which allows us to examine whether the number of children and home ownership are complements or substitutes, by using a regional panel data set from Japan. Data for 564 observations (47 prefectures, 12 years) were used for the analysis. A scatter plot of observations at a regional level (Panel A of Figure 2), which examines interregional comparison, suggests that higher user costs for a prefecture tend to lower total fertility rates. Therefore, a pooled OLS regression result that regresses total fertility rates on user costs produces a negative coefficient. However, at the same time, the scatter diagram also suggests that the negative correlation becomes weaker when we consider heterogeneity across regions. In addition, the time-series graph of observations at a national level (Panel B of Figure 2) demonstrates that the association between the number of children and home ownership seems to be unrelated. Therefore, it suggests the negative correlation becomes much weaker when we consider heterogeneity over time. As expected, the negative effect of user costs on fertility substantially decreased, but remained significant, even after we controlled for both regional-specific fixed effects and nationwide common time effects. This implies that a higher user cost tends to discourage families' reproduction decisions. Thus, in the Japanese context, the number of children and home ownership are likely to be complements rather than substitutes.

One consideration of this paper is that we must take into account the potential simultaneity

between fertility and home ownership (Mulder, 2006; Mulder & Billari, 2011). Öst (2011) considered this issue. Her empirical results suggested that becoming parents and becoming homeowners are decisions that seem to be interdependent for young cohorts. Controlling for simultaneous decisions may have two merits. First, it tends to correct for the bias when this problem is not taken into account, and second, it may tell us what factors make for a positive relationship between fertility and home ownership, and vice versa. Unfortunately, reliable data on regional home ownership rates for consecutive years are not available in Japan, so this issue remains for future research.

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Table 1. Summary statistics

Variable	Mean	Std. Dev.	Min	Max
Total fertility rate	1.40	0.13	1.00	1.83
User cost (per cent)	8.01	1.35	2.35	13.17
Female wage (thousand yen)	220.73	20.63	180.19	300.99
Male wage (thousand yen)	338.37	32.98	264.83	446.97
Unemployment (per cent)	4.15	1.13	1.70	8.40
Mortality (deaths per 1000 individuals)	3.08	0.69	1.40	6.10
Observations		564		

Table 2. Estimation results

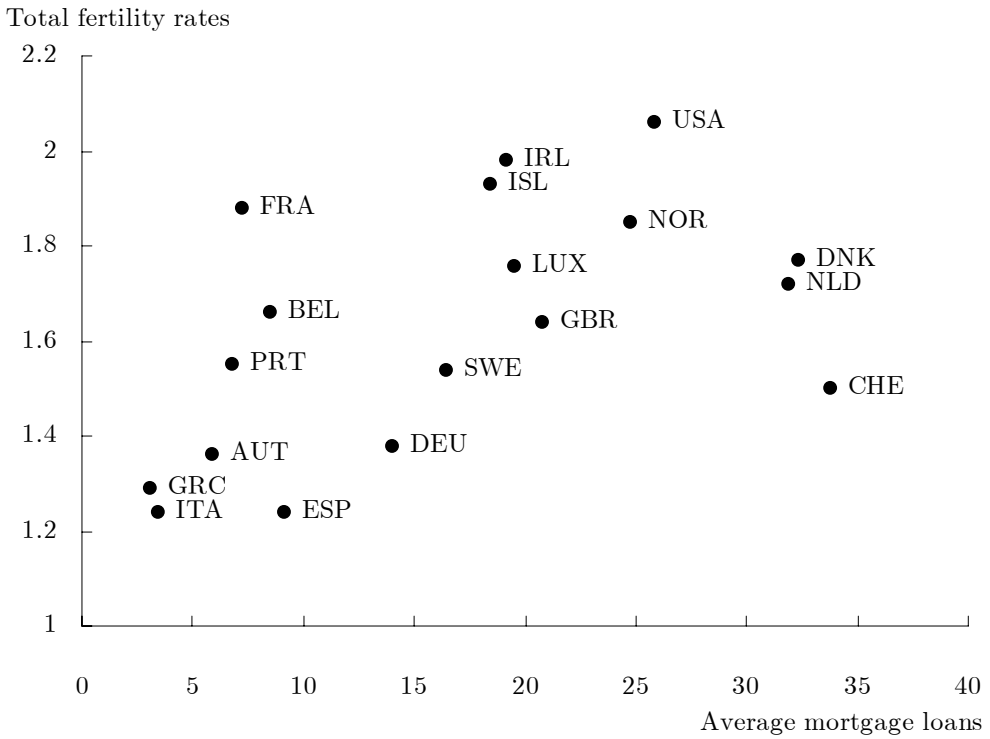
Variable	Model 1	Model 2	Model 3	Model 4
User cost	–0.0238**	–0.0095**	–0.0082**	–0.0039*
	(0.0039)	(0.0024)	(0.0019)	(0.0016)
Female wage				–0.0075*
				(0.0032)
Female wage squared				0.0017*
				(0.0007)
Male wage				0.0087**
				(0.0022)
Male wage squared				–0.0012**
				(0.0003)
Unemployment				–0.0297**
				(0.0067)
Mortality				0.0025
				(0.0029)
1999			–0.0520**	–0.0254**
			(0.0037)	(0.0053)
2000			0.0070	0.0447**
			(0.0042)	(0.0083)
2001			–0.0487**	–0.0073
			(0.0034)	(0.0100)
2002			–0.0754**	–0.0187
			(0.0052)	(0.0126)
2003			–0.1052**	–0.0401**
			(0.0055)	(0.0144)
2004			–0.1171**	–0.0524**
			(0.0058)	(0.0143)
2005			–0.1072**	–0.0577**
			(0.0065)	(0.0112)
2006			–0.0914**	–0.0525**
			(0.0058)	(0.0094)
2007			–0.0783**	–0.0473**
			(0.0077)	(0.0099)
2008			–0.0615**	–0.0362**
			(0.0088)	(0.0104)
2009			–0.0740**	–0.0324*
			(0.0106)	(0.0120)
F-statistic		73.13	205.59	109.55
(*p*-value)		(0.000)	(0.000)	(0.000)

Notes: Sample sizes are 564. Robust standard errors in parentheses. Female (Male) wage squared is divided by 100. ** indicates significant at 1%. * indicates significant at 5%.

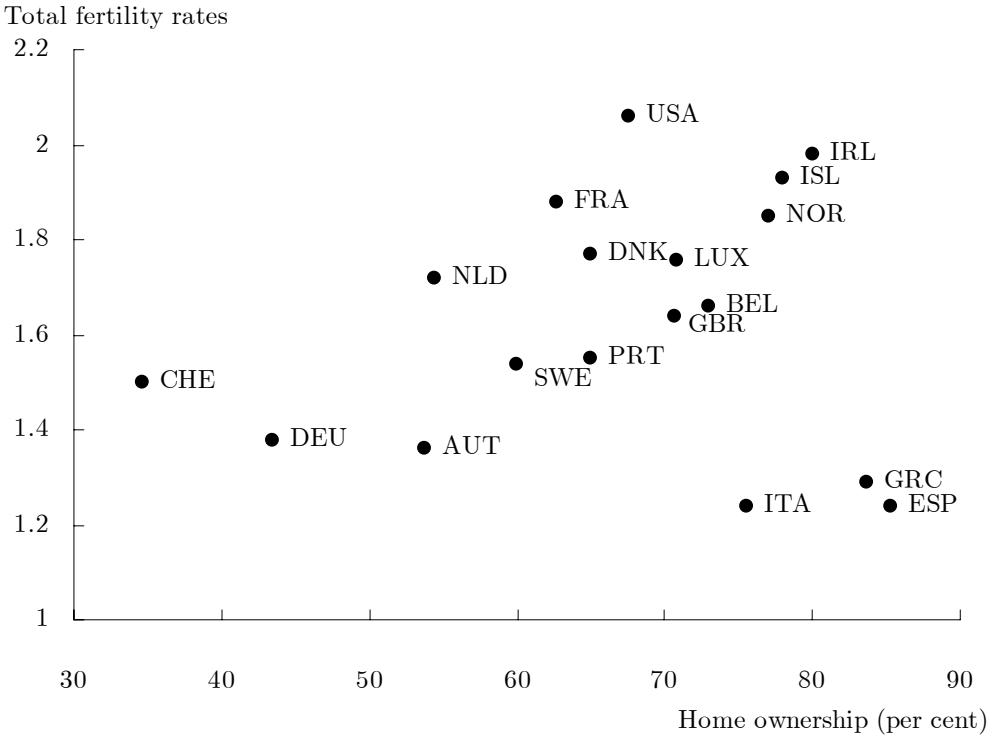
Table 3. Estimation results by the age-group

Variable	20–24	30–34	44–44
User cost	–0.729**	–0.257*	–0.060**
	(0.154)	(0.135)	(0.021)
2003	–3.755**	–2.065**	0.385**
	(0.410)	(0.303)	(0.059)
2004	–5.923**	–1.905**	0.657**
	(0.533)	(0.340)	(0.057)
2005	–3.519**	–1.351**	0.923**
	(0.420)	(0.391)	(0.071)
2006	–3.641**	0.857*	1.358**
	(0.475)	(0.453)	(0.062)
2007	–4.654**	1.801**	1.930**
	(0.531)	(0.429)	(0.063)
2008	–5.984**	3.560**	2.378**
	(0.637)	(0.512)	(0.070)
2009	–9.148**	6.354**	2.867**
	(0.842)	(0.631)	(0.086)
F-statistic	114.39	74.94	74.65
(p-value)	(0.000)	(0.000)	(0.000)

Notes: Sample sizes are 423. Robust standard errors in parentheses.
** indicates significant at 1%. * indicates significant at 10%.

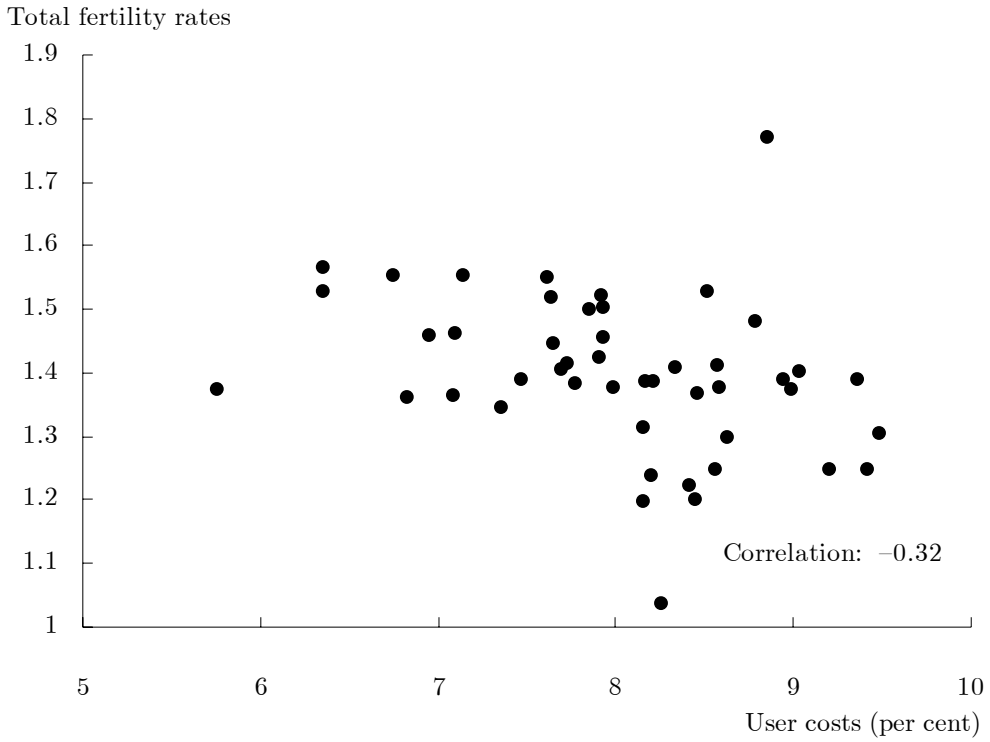


(A) Total fertility rates and mortgage loans per capita (in thousands of euros), 18 countries.

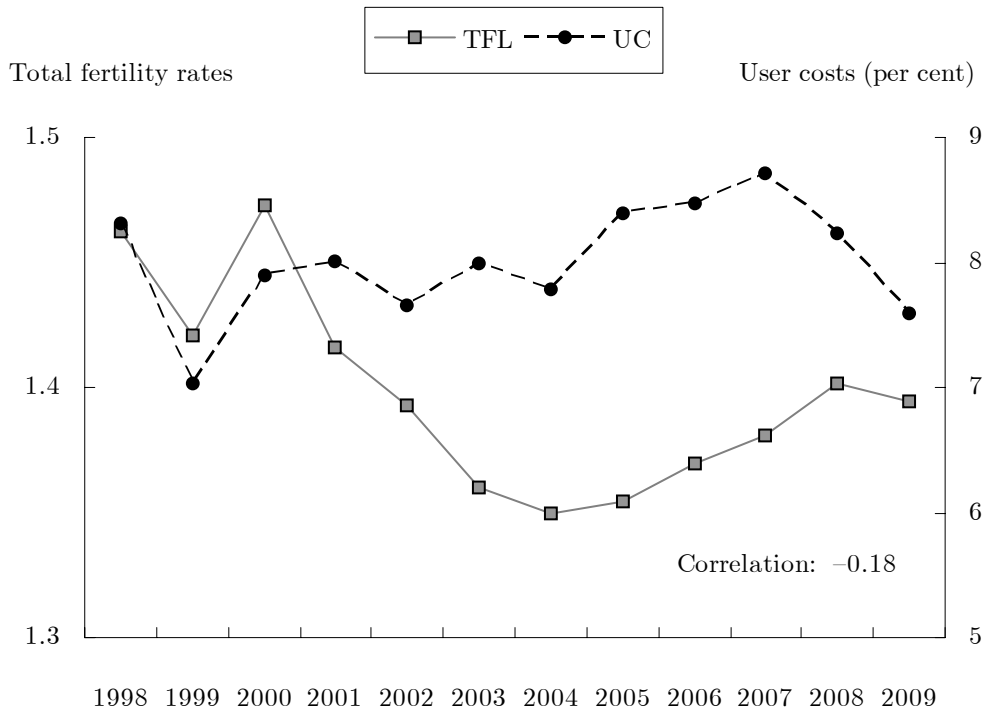


(B) Total fertility rates and home ownership rates, 18 countries.

Figure 1



(A) Total fertility rates and user costs, on average; 47 prefectures.



(B) Total fertility rates and user costs, on average; 12 years.

Figure 2