

The Crowding-out Effect of Homeownership on Fertility

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Abstract Mulder (Demogr Res 15:401–412, 2006) argues that homeownership has influences on a household's fertility decision; however, literatures have concluded different findings regarding whether homeownership promotes or delays a family's reproduction behavior. In this study, we construct the regional-based panel data comprising 23 counties and cities from 1994 to 2007 in Taiwan to investigate how and to what extent homeownership will affect fertility. Our empirical results show that the private homeownership rate is negatively related to the birthrate in Taiwan. It indicates that, under limited budget resources available in each household, the homeownership and reproduction decisions seem to compete and crowd out each other; however, from the results of the lagged models, the crowding-out effect diminishes as time goes by.

Keywords Fertility · Homeownership · Panel data · Taiwan

Over the past two decades, the population structure in Taiwan has undergone significant changes. These changes can be described by the vital statistics as follows. First, the life expectancy has increased from 72.01 years in 1981 to 78.36 years in 2007. Second, the total fertility rate dropped from 2.45 persons to 1.1 persons; in addition, the general fertility rate also decreased from 89 to 32‰ during the same period. Third, the population aged

65 and above in the total population increased from 4.4 to 10.2% (Table 1). These changes in figures show that Taiwan is undergoing the so-called “demographic transition”. In other words, it is apparent that the demographic structure of Taiwan is headed toward the “high-senescence and low-birthrate” trend. In fact, this demographic change also exists in other countries. As shown by Hondroyannis (2010), the average total fertility rate decreased from 2.7 births per women in the early 1960s to only 1.4 births in 2005 from his study of 27 selected European countries. Moreover, the youth dependency ratio decreased from 58% in 1960 to 48% in 2005 while, due to the increase of life expectancy, the old-age dependency ratio increased from 15% in 1960 to 26% in 2005. Hondroyannis hence points out that the current demographic trend will significantly affect the European macro-economy in the near future.

Taking the total fertility rate solely in consideration, in 1970s, each childbearing age woman in Taiwan gave birth to 3.71 children on average. By the early 1980s, this number dropped to 2.45 children. Later, Taiwan entered the phase of birthrates lower than the replacement level of 2.1 persons. Between 1985 and 1997, the total fertility rate was maintained between 1.7 and 1.8 persons but this figure reduced to 1.4 persons in 2001. According to the report published by the U.S. Population Reference Bureau in 2009, the childbearing age women gave birth only to 1.1 children on average in Taiwan, and this birthrate is ranked as the lowest level in 2007 all over the world.

The phenomenon of low birthrates not only affects demographic structure developments, it also causes social and economic problems; therefore, different countries have proposed policies to improve the low birthrate problem. For instance, Singapore government implements the Baby Bonus Scheme to supports parents' decision to have more

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Table 1 Vital statistics in Taiwan

Year	Life expectancy (years)	Total fertility rate (persons)	General fertility rate (%)	The percentage of population aged 65+ (%)
1981	72.01	2.45	89	4.4
1982	72.10	2.32	85	4.5
1983	72.16	2.17	79	4.7
1984	72.57	2.05	75	4.9
1985	73.02	1.88	68	5.1
1986	73.30	1.68	60	5.3
1987	73.39	1.70	60	5.5
1988	73.32	1.85	64	5.7
1989	73.50	1.68	58	6.0
1990	73.80	1.81	62	6.2
1991	74.30	1.72	58	6.5
1992	74.30	1.73	57	6.8
1993	74.30	1.76	57	7.1
1994	74.50	1.75	55	7.4
1995	74.62	1.77	55	7.6
1996	74.94	1.76	54	7.9
1997	75.54	1.77	53	8.1
1998	75.75	1.46	43	8.3
1999	75.90	1.55	45	8.4
2000	76.45	1.68	48	8.6
2001	76.74	1.40	41	8.8
2002	77.18	1.34	39	9.0
2003	77.33	1.23	36	9.2
2004	77.46	1.18	34	9.5
2005	77.41	1.15	33	9.7
2006	77.89	1.15	33	10.0
2007	78.36	1.10	32	10.2

Source: Ministry of the Interior, Department of Health, Taiwan

children by helping to lighten the financial costs of raising children.¹ In France, a mother is entitled to a 16-week maternal leave, paid at 100% of usual wages, for the first and second child, 26 weeks for a child of parity 3 and over; moreover, the daily wage compensations are of the same amount for the father leave.² Japan and Spain provide tax benefits to encourage births³; similarly, the U.K. introduces the Working Families Tax Credit to raise work incentives for spouses with children. Australia extends tax rebates on

¹ Under the Baby Bonus Scheme, parents will get a cash gift of up to \$4,000 each for the 1st and 2nd child, and \$6,000 each for the 3rd and 4th child. (<https://www.babybonus.gov.sg/bbss/html/index.html>).

² See Thévenon (2009) for more details.

³ In Japan, parents with a dependent child less than the age of 16 are eligible to exempt 380,000 yen from income tax (Suzuki 2006). In Spain, a working mother with a child under the age of three is subsidized a tax credit of 1,200 euros per child (Sleeboos 2003).

the basis of the presence of children, with higher rebates for one-income than for two-income families. In Taiwan, Hsinchu City government encourages birth giving by implementing the maternity allowance to encourage women to have babies.⁴

The above fertility policies implemented in different countries mostly focus on childbirth subsidies or parental leave provisions yet few include discussions on the environment for the baby care and child upbringing. Narrowly speaking, the baby care and child upbringing environment refers to the environment conditions suitable for nursery, but in a broader sense, it can refer to the long-term living environment conditions. In the literatures, the effects of living conditions on reproduction decisions are discussed from social and economic aspects. The public generally believes that a stable space to live and grow up is beneficial for character building of children. Therefore, many sociological studies show that homeownership has certain effects on family formation and reproduction decision. For example, Ineichen (1981) points out that some couples in the U.K. postpone the timing of marriage or parenthood because they are not able to buy a home. Mulder (2006) argues that homeownership may have two possible but opposite impacts on fertility. First, homeownership ensures a stable family environment; it therefore will encourage parents to have children. Second, under family budget constraints and limited resources, once a large budget is spent to purchase a house, the child raising which is also high costly may either be crowded out or be postponed.

Figure 1 shows the trends of the private homeownership rate and the general fertility rate in Taiwan. The homeownership rate was about 82% in 1994, and it stably increased to 88% in 2007. On the contrary, the general fertility rate dropped from 55‰ in 1994 to 32‰ in 2007. Table 2 further provides the homeownership rates and total fertility rates of selected nations in 2006. The homeownership rate was 87.8% in Taiwan, and this ratio was second highest to Singapore where it actively promotes cheaper public housing to people. Although Korea and Taiwan were both listed as the countries with lowest birthrates (1.1 persons) in 2006, the homeownership rate in Korea was only 54%, much lower than the ratio in Taiwan. On the other hand, while Canada and Australia had similar homeownership rates (68%) in 2006, the total fertility rate of Canada was only 1.5 persons and that of Australia was 1.9 persons. Thus, according to our discussions above, it seems that each country has its own possible relationship between homeownership and fertility. In addition, although Mulder (2006) argues that homeownership has influences on a

⁴ The childbirth subsidies in Hsinchu City are: first born (NT\$15,000); second born (NT\$20,000); third born (NT\$25,000); twins (NT\$50,000); triplet and more (NT\$100,000).

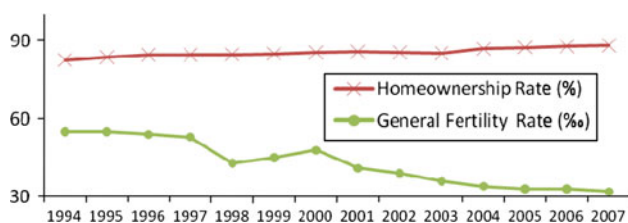


Fig. 1 Trends of general fertility rate and homeownership rate in Taiwan. *Source:* Directorate General of Budget Accounting and Statistics, Ministry of the Interior, Taiwan

household's fertility decision, the existing literatures have concluded different findings regarding whether homeownership promotes or delays a family's reproduction behavior. We therefore try to utilize a panel data in this study to investigate the direction and the influence of homeownership on fertility in Taiwan, where it has the lowest fertility rate and the second highest homeownership rate in the world. The rest of this paper is organized as follows. "Literature Review" section discusses the issues in the literatures. "Data Description and Empirical Model" section describes our estimation models, data and defines the variables. Empirical results are presented in Sect. Empirical Results. "Conclusions" finally concludes this study.

Literature Review

The literatures have indicated that homeownership will affect a family's reproduction decision in several aspects. One explanation originates from the effects of homeownership on the formation of a family. For instance, Mulder (2006) points out that since it is rather difficult for younger European generation to buy houses, they will leave parents' homes and live independently at a later age. This in turn will delay the formation of families and therefore reduces the birthrate indirectly. In addition, some research argues

Table 2 Homeownership rate and total fertility rate—selective countries in 2006

	Homeownership rate (%)	Total fertility rate (person)
Taiwan	87.8	1.1
Korea	54.0	1.1
Singapore	90.9	1.2
United States	68.9	2.0
United Kingdom	70.5	1.8
France	57.2	1.9
Canada	68.4	1.5
Australia	69.8	1.9
New Zealand	54.5	2.0

Source: From this study

that parents usually hope to provide their children with more stable and higher quality living and growing environments, so it is often observed that a family's fertility behavior usually occurs after having a house. Feijten and Mulder (2002) discover that birth giving to the first child frequently takes place after a family has found a permanent place to stay in Netherlands. Mulder and Wagner (2001) investigate the interaction between first-time childbirth and first-time homeownership, and they find that there is an elevated fertility propensity after becoming a homeowner. Krishnan and Krotki (1993) show that during the period in which women give birth, women are more likely to become home owners than in other periods. However, for women without kids, there is no significant difference between the ratios of home owners and renters in any periods. Kulu and Vikat (2007) also demonstrate that there is a relatively higher probability of having a third birth for couples if they have moved to spacious single-family houses for several years. Therefore, they argue that living in bigger housing and better environment will lead to a higher fertility level.

Some studies however believe that home-owning and birth-giving are both long-term and high-cost behaviors for households; hence, subject to the family budget constraints, the crowding-out effect between these two family events is possible. Courgeau and Lelièvre (1992) demonstrate that having a house may lead to a delayed reproduction decision. Murphy and Sullivan (1985) conclude that homeownership is negatively related to the birth giving in the U.K., and they also show that the birthrate and the number of children are lower in the families owning homes, as compared to the families that rent homes. Castiglioni and Zuzanna (1994) believe that couples usually find a suitable place to live before having children because a self-owned home is the fundamentals to raise children; thus, house purchasing will postpone the fertility behavior. According to the discussions above, we find that no consensus has been reached in the literatures regarding whether homeownership increases the birthrate or produces a negative effect on reproduction decisions.

In recent research, some papers argue that the order of events may count. For example, Kulu and Vikat (2007) examine the family fertility variations across housing types following the changes of housing status, based on the first birth, second birth, and third birth of households. They demonstrate that the fertility patterns are diverse among the different birth orders. Lauster and Fransson (2006) and Annika and Mulder (2008) also point out that younger people tend to have a notion of homeownership as an investment rather than a commitment, and this changing attitude towards homeownership therefore will affect fertility as well. Thus, as suggested by Abrams and Goldscheider (2002), current research should take into account the culture changes or consider a broader perspective

nowadays in family studies. For example, the percentage of traditional nuclear families becomes smaller, and they might not be as representative as before. In addition, the government policies and political system also play an important role in analysis. Mokhtari and Asgary (2009) theoretically and empirically prove that, due to the rationing system in Soviet society, shortage of consumer goods and fertility are positively related; therefore, the lower fertility pattern in Post-Soviet economy can be attributed to the elimination of shortage of consumer goods.

The literatures that focus on the fertility behavior in Taiwan often probe to the overall trend of birthrates, and usually discuss the factors that affect fertility decisions yet very few studies especially emphasize how homeownership influences fertility. Yen and Yen (1992) demonstrate that women's education not only represents a proxy for women's wage but also exerts an attitudinal effect in fertility decisions. Cheng (1999) argues that the increase in education level cannot fully explain the drop of birthrate in Taiwan. Huang (2002) concludes the tax exemptions in the Income Tax Act have a positive effect on the birthrate but the effect is limited. Huang et al. (2006) indicate that the high college and university tuitions in Taiwan result to a decrease in birthrate; additionally, male unemployment plays a more important role than female unemployment does. Cheng (2011) shows that mass media and social networks in Taiwan play important roles in disseminating contraceptive knowledge, which further significantly reduces the fertility rates. It is worth noting that the Chinese traditionally believe that the timing of one's birth according to the signs of the Chinese zodiac determines the fate of that individual. As stated by Saw (1975), children born in the lunar dragon year are believed to lead better lives, accomplish great things in life and make their ancestors and families proud. On the other hand, the lunar tiger year is regarded as an ominous year. Children born in the lunar tiger year are believed to either suffer hardships in life or are bad-tempered. Thus, Taiwanese are more willing to give birth in the lunar dragon year but are not as willing to do so in the lunar tiger year. Referring to Fig. 1, we can notice that the general fertility rate is on a smooth downward trend; however, the two exceptions to this trend are the slight valley in 1998, the lunar year of Tiger, and the slight hill in 2000, the lunar year of Dragon.

Data Description and Empirical Model

A panel data is a long-term survey on the several same observations. It not only possesses the feature of time series data but also retains the characters of the cross sectional data; therefore, it is able to increase the sample size, to be

better suited to examine the dynamics of changes, and to provide more information of interests (Hondroyiannis 2010). Because there is no household-based panel data including housing and birth giving information in Taiwan; therefore, we follow Huang (2002) and Huang et al. (2006) to construct the regional-based panel data to investigate the relationship between homeownership and fertility.

The Department of Statistics in Taiwan provides some socio-economic variables not only for the entire nation but also for each district so that we are able to construct a regional-based panel data which covers 23 areas in this study, including sixteen counties, five cities and two municipalities.⁵ The fertility rates come from the Statistical Yearbook of the Ministry of Interior. The homeownership rates and household income are from the Survey of Family Income and Expenditure in Taiwan, conducted by the Directorate General of Budget Accounting and Statistics (DGBAS). The regional-based homeownership rates are only available after 1994. The income values are adjusted to a dollar value with the base year of 2007, using the consumption price index. All unemployment variables are from the Yearbook of Manpower Survey Statistics, issued by DGBAS. The infant rates are taken from the Statistical Yearbook of the Department of Health. The information of women education is reported annually by the Bureau of Statistics in each district.

The panel data is advantageous because it allows for the consideration of more availability of econometric models; for example, the fixed effect model with an intercept variable. The fixed effect model is a simple way to consider the heterogeneity across regions and/or through time, and the varying intercept can take account of some effects of the omitted independent variables. In this study, we assume some omitted variables are time-invariant, like the constant spatial characteristics or regional attributes. By using the fixed effect model, we then can eliminate these omitted but time-invariant regional-specific effects.⁶ Thus, the fixed effect model can be written as follow:

$$Y_{it} = \beta_i + \beta_1 X_{1it} + \beta_2 X_{2it} + \cdots + \beta_k X_{kit} + \varepsilon_{it} \quad (1)$$

In Eq. 1, Y is the dependent variable; X are independent variables. i indicates different regions ($i = 1, 2, \dots, N$); t represents the year ($t = 1, 2, \dots, T$). β_k describes the regional-specific effects that are time invariant but vary in

⁵ The sixteen counties are Taipei, Ilan, Taoyuan, Hsinchu, Miaoli, Taichung, Changhua, Nantou, Yunlin, Chiayi, Tainan, Kaohsiung, Pingtung, Taitung, Hualien, and Penghu. The five cities comprise Keelung, Hsinchu, Taichung, Chiayi, Tainan; Taipei city and Kaohsiung city both are two municipalities.

⁶ We also consider the random effect model in our panel data estimation. However, the Hausman test shows that the fixed effect model is more appropriate than the random effect model. Thus, we only illustrate the fixed effect model and provide its results in this study.

different counties and cities; ε_{it} is an independently identically distributed random error term. In this study, we collect the data of 23 counties and cities in Taiwan from 1994 to 2007 (14 years). Thus, in Eq. 1, $i = 23$, $t = 14$, and the total number of observations is 322.

As discussed by Mulder and Wagner (2001), although we acknowledge that there might be a possible mutual causation between homeownership and fertility, it is difficult to identify either direction of causality by any modeling settings; additionally, time ordering does not truly reflect the causal priority. People may become parents in anticipation of becoming homeowners and vice versa. Therefore, they argue that it is more preferable to use the simple regression analyses to investigate how these two family events affect each other, rather than to demonstrate their causality.

Dependent Variable

The most common indicators used to measure birth giving rate are the crude birthrate rate, the total fertility rate, and the general fertility rate. The crude birthrate is defined as the average live births per 1,000 people in a given year. The total fertility rate is the average number of children that would be born alive to a woman during her lifetime if she were to pass through all her childbearing years.⁷ The general fertility rate is the number of live births per 1,000 females of childbearing ages in a given year. As argued by Huang (2002) and Whittington et al. (1990), the crude fertility rate is sensitive to sex and age structure of population; thus, it is not a suitable indicator for birthrates. The total fertility rate is a measure of the fertility of an imaginary woman who passes through her reproductive life. Because the total fertility rate is predictive, it is unable to precisely reflect the present birth giving conditions of childbearing age women. Due to the problem of these two indicators, the general fertility rate (GFR) is used as the dependent variable in this study.

Independent Variables

Private Homeownership Rate (PHR)

As mentioned above, Mulder (2006) proposes that the relationship between homeownership and birth giving can be discussed from two ways. First, it is commonly believed that homeownership symbolizes the stability of a family, so it will encourage families that own residential houses to make birth giving plans. Therefore, homeownership and birth giving are expected to be positively related. On the

other hand, some argue that if couples have plans to have babies, most of them will first make sure they can have high quality residential houses before they raise children. As a result, if most household budgets are spent on home purchasing, there may be potential crowding-out effects between home-owning and child-raising under limited household resources. Thus, homeownership and birth giving are expected to be negatively related. In view of these two possibilities, the effects of homeownership on the reproduction decision are not ascertained. In this study, the homeownership rate in a region is defined by the percentage of owner-occupied dwelling units to total occupied dwelling units in an area.

Household Income (INC)

In order to control the effects of income on fertility decisions, the average household income in each region is used as an explanatory variable. If a child is considered as a normal good, when the household income increases, the child is more favored. It is therefore expected that the household income has a positive effect on the birthrate.

Unemployment Rate (UR)

The unemployment rate has been demonstrated to affect the fertility behaviors in the literatures. Huang (2003) argues that the unemployment rate significantly influences many family decisions such as divorce, marriage and conception. Mocan (1990) concludes that fertility rates seem to be pro-cyclical under the bivariate VAR models, indicating the unemployment has a negative effect on fertility. It is therefore speculated in this study that the unemployment rate and the birthrate are inversely related. Shreffler et al. (2010) argue that the benefits and costs of having children are perceived differently by men and women. For example, they find that men's perceptions of their wives' work-family conflict significantly predict men's fertility intentions; however, they do not find a similar relationship for women. Huang et al. (2006) show that the male unemployment rate plays a greater role in the fertility decision than the female rate does. Hence, in order to discuss the different effects of male and female unemployment on birthrates, we also divide the unemployment rate into the male unemployment rate (MUR) and the female unemployment rate (FUR) in this study.

Infant Mortality Rate (IMR)

Whittington et al. (1990) believe that the infant mortality rate has two possible effects on the birthrate including the replacement effect and the cost effect. The replacement effect indicates that when parents have urgent needs for

⁷ The common international statistical usage of the childbearing years is ages 15–44 or 15–49. Taiwan uses the later definition.

kids, the rise in the infant mortality rate will force the fertility rate to increase. On the other hand, the cost effect signifies that the high infant mortality rate may indicate the result of inadequate medical technology. The higher medical costs and birth giving costs may inhibit fertility behaviors. Therefore, the size of the replacement effect and the cost effect determines the effects of infant mortality rates on birthrates. Hondroyiannis (2010) applies the panel data of 27 European countries to show that the infant mortality has a positive effect on fertility.

Women Education (WEDU)

Schultz (1985) argues that there will be the sample selection problem if we only focus on women in the labor force when discussing fertility behaviors; thus, he suggests using women’s education instead of women’s wage. As the level of women’s education becomes higher, the shadow price of wages increases and the opportunity cost for raising children will also increase. Cheng (2011) uses the women’s years of schooling as the proxy for the price of having children, and finds that it is negatively associated with the number of live births in Taiwan. Therefore, we expect that the education level of women has a negative effect on birthrates.

The Lunar Dragon/Tiger Year (Dummies)

Since antiquity, people in several East Asian countries, such as Taiwan, China, Japan and South Korea, have believed that a person is destined to possess specific characteristics according to the sign of the zodiac under which he or she was born. Based on this cultural belief, some parents plan the births of their children according to the Chinese zodiac in order to give the child an extra endowment of “capital”. Goodkind (1991, 1996) demonstrates that the Chinese tended to plan more for the birth of their offsprings in dragon years. Additionally, Yip et al. (2002) show that a temporary increase of fertility was identified in the dragon years of 1988 and 2000 in Hong Kong. Saw (1975) further argues that some Chinese consider the year of tiger an inauspicious time to bear a child because that animal is associated with ferocious characteristics. In order to control this cultural effect on the birthrate, the dummy variables of dragon and tiger years are also included in the regressions.⁸

Since there is a 9-month pregnancy gestation period, the lagged form is a more suitable specification. As Huang (2002) mentioned, because the correct lag structure is difficult to identify, one-year lag and two-year lag models are estimated for comparisons ($k = 1$ or 2). In addition, we

use the log–log form to estimate the elasticities. Based on the descriptions above, the fertility equations estimated in this study are as follows.

Model 1:

$$\ln(GFR_{i,t+k}) = \beta_i + \beta_1 \ln(PHR_{i,t}) + \beta_2 \ln(INC_{i,t}) + \beta_3 \ln(UR_{i,t}) + \beta_4 \ln(IMR_{i,t}) + \beta_5 \ln(WEDU_{i,t}) + \varepsilon_{i,t} \tag{2}$$

Model 2:

$$\ln(GFR_{i,t+k}) = \beta_i + \beta_1 \ln(PHR_{i,t}) + \beta_2 \ln(INC_{i,t}) + \beta_3 \ln(MUR_{i,t}) + \beta_4 \ln(FUR_{i,t}) + \beta_5 \ln(IMR_{i,t}) + \beta_6 \ln(WEDU_{i,t}) + \varepsilon_{i,t} \tag{3}$$

Model 3:

$$\ln(GFR_{i,t+k}) = \beta_i + \beta_1 \ln(PHR_{i,t}) + \beta_2 \ln(INC_{i,t}) + \beta_3 \ln(UR_{i,t}) + \beta_4 \ln(IMR_{i,t}) + \beta_5 \ln(WEDU_{i,t}) + \beta_6 D_{t+k} + \beta_7 T_{t+k} + \varepsilon_{i,t} \tag{4}$$

Model 4:

$$\ln(GFR_{i,t+k}) = \beta_i + \beta_1 \ln(PHR_{i,t}) + \beta_2 \ln(INC_{i,t}) + \beta_3 \ln(MUR_{i,t}) + \beta_4 \ln(FUR_{i,t}) + \beta_5 \ln(IMR_{i,t}) + \beta_6 \ln(WEDU_{i,t}) + \beta_7 D_{i+k} + \beta_8 T_{i+k} + \varepsilon_{i,t} \tag{5}$$

The explanatory variables in Model 1 include the private homeownership rate (*PHR*), the household income (*INC*), the unemployment rate (*UR*), the infant mortality rate (*IMR*) and the women education (*WEDU*). Model 2 is similar to Model 1 except that the unemployment rate is subdivided into the male unemployment rate (*MUR*) and the female unemployment rate (*FUR*). Models 3 and 4 are similar to Models 1 and 2 but both include the dummy variables of the effects of lunar dragon year (*D*) and the lunar tiger year (*T*). The subscript $k = 1, 2$ signifies the number of lagged years. The definitions and the descriptive statistics of all variables are listed in Table 3.

Empirical Results

Tables 4 and 5 represent the empirical results. The *F*-test values in all regressions suggest that there are significant regional effects, implying that the fixed-effect model is better than the classical OLS model. In addition, because Models 3 and 4 control for the specific lunar-year effects by including dummy variables, they have better regression explanations. Thus, we will mainly discuss our results based on Models 3 and 4.

⁸ In this study, 1998 is the lunar tiger year, and 2000 is the lunar dragon year.

Table 3 Definitions and descriptive statistics of the variables

Variables	Descriptions	Mean	SD	Minimum	Maximum	Expected Sign
<i>GFR</i>	General fertility rate (%): regional live births per 1,000 women aged 15–49.	45.60	11.35	26	77	
<i>PHR</i>	Private homeownership rate (%): regional ratio of owner-occupied houses to total residential houses.	86.92	5.15	71.7	95.94	?
<i>INC</i>	Household income (NTD): regional average household income, deflated to the year of 2007 by CPI.	842,298	155,256	529,824	1,288,803	+
<i>UR</i>	Unemployment rate (%): regional annual unemployment rate.	3.45	1.21	0.9	5.51	–
<i>MUR</i>	Male unemployment rate (%): regional male unemployment rate.	3.73	1.41	0.5	6.8	–
<i>FUR</i>	Female unemployment rate (%): regional female unemployment rate.	3.05	1.02	0.9	5.2	–
<i>IMR</i>	Infant mortality rate (‰): regional ratio of infant deaths aged below 1 year old to live births.	5.94	1.57	2.32	12.97	?
<i>WEDU</i>	Women education level (%): regional ratio of women graduated from college or higher to total female population.	5.26	4.2	0.73	27.05	–
<i>D</i>	$D = 1$, if year = 2000; $D = 0$, others.	0.07	0.26	0	1	+
<i>T</i>	$T = 1$, if year = 1998; $T = 0$, others.	0.07	0.26	0	1	–

In the one-year lag form (Table 4), after including the lunar-year dummies, the coefficients of *PHR* in Models 3 and 4 are -0.2789 and -0.2967 , respectively. This result indicates that the private homeownership rate and the birthrate are negatively related in Taiwan. Namely, when the homeownership rate is increased by 1%, there will be a 0.28–0.3% decrease in the birthrate. Moreover, in the two-year lag form (Table 5), a 1% increase in the homeownership rate will result to a drop only of 0.19–0.24% in the fertility rate. Thus, our findings conclude that an increase in the rate of homeownership will result to a decrease in the birthrate; however, as time goes by, the negative effect seems to become smaller. Therefore, our results support Courgeau and Lelièvre (1992) and Murphy and Sullivan (1985), under the limited household budget constraints, the homeownership produces a resource crowding-out effect or a delay effect on a family's fertility decision, and we further show that this negative effect will become smaller as time passes. This diminishing influence of homeownership on fertility can be explained by Mulder and Wagner (2001). They believe that even postponement or crowding-out effect is possible, but parenthood cannot be postponed for more than just a few years because female biological age will restrict to fecundity work against the long-term postponement.

As for the household income, the results both in one-year and two-year lag models are the same as expected in the traditional birth-giving model. When children are considered as a normal good, an increase in income will bring to an increase demand for children. Therefore, income and birthrate are positively related. In addition, the

Table 4 Empirical results—one-year lag

Independent variables	Dependent variable: $\log(GFR_{t+1})$			
	Model 1	Model 2	Model 3	Model 4
$\log(PHR_t)$	-0.3737^* (0.1473)	-0.3805^{**} (0.1475)	-0.2789^* (0.1196)	-0.2967^{**} (0.1162)
$\log(INC_t)$	0.3563^{***} (0.0743)	0.3778^{***} (0.0750)	0.3443^{***} (0.0601)	0.3830^{***} (0.0590)
$\log(UR_t)$	-0.1697^{***} (0.0201)		-0.1368^{***} (0.0171)	
$\log(MUR_t)$		-0.1369^{***} (0.0213)		-0.1425^{***} (0.0168)
$\log(FUR_t)$		-0.0122 (0.0287)		-0.0464^* (0.0231)
$\log(IMR_t)$	-0.0051 (0.0219)	-0.0038 (0.0219)	-0.0192 (0.0178)	-0.0161 (0.0173)
$\log(WEDU_t)$	-0.1895^{***} (0.0157)	-0.1958^{***} (0.0160)	-0.2238^{***} (0.0141)	-0.2384^{***} (0.0141)
D_{t+1}			0.1032^{***} (0.0131)	0.1085^{***} (0.0128)
T_{t+1}			-0.1003^{***} (0.0145)	-0.1079^{***} (0.0142)
Constant	0.9872 (1.1545)	0.7143 (1.1596)	0.7583 (0.9338)	0.2917 (0.9111)
R^2	0.8647	0.8656	0.9122	0.9178
F-statistic	316.91***	265.17***	365.25***	342.05***
FE vs OLS: F-test	18.91***	18.95***	28.89***	31.53***

The standard errors are in parentheses. $^\dagger p < 0.10$, $* p < 0.05$, $** p < 0.01$, $*** p < 0.001$

Table 5 Empirical results—two-year lag

Independent variables	Dependent variable: $\log(GFR_{t+2})$			
	Model 1	Model 2	Model 3	Model 4
$\log(PHR_t)$	(0.1661)	-0.1657	-0.1947 [†]	-0.2415*
	-0.1328	(0.1643)	(0.1127)	(0.1218)
$\log(INC_t)$	0.2269***	0.2586***	0.1986**	0.2447***
	(0.0808)	(0.0802)	(0.0649)	(0.0618)
$\log(UR_t)$	-0.0866***		-0.1476***	
	(0.0233)		(0.0196)	
$\log(MUR_t)$		-0.1107***		-0.1762***
		(0.0242)		(0.0194)
$\log(FUR_t)$		-0.0541 [†]		-0.0646**
		(0.0305)		(0.0234)
$\log(IMR_t)$	-0.0234	-0.0191	-0.0201	-0.0127
	(0.0244)	(0.0240)	(0.0197)	(0.0186)
$\log(WEDU_t)$	-0.2427***	-0.2478***	-0.1978***	-0.2017***
	(0.0196)	(0.0194)	(0.0161)	(0.0153)
D_{t+2}			0.1220***	0.1252***
			(0.0139)	(0.0132)
T_{t+2}			-0.0864***	-0.0967***
			(0.0148)	(0.0141)
Constant	1.6335	1.3279	2.3006*	1.8541 [†]
	(1.2747)	(1.2586)	(1.0223)	(0.9673)
R^2	0.8268	0.8330	0.8906	0.9032
F -statistic	214.82***	186.18***	259.4***	258.78***
FE vs OLS: F -test	16.21***	17.11***	24.44***	28.65***

The standard errors are in parentheses. [†] $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

unemployment rate is significantly negative to the birth-rate. This coincides with the results of Mocan (1990) that the fertility behavior is pro-cyclical. In other words, as the unemployment rate drops, there are prosperous economic developments, and people become more hopeful in their ability to have children and raise them; the birthrate will therefore increase. If we further look at the male and female unemployment rates, our finding supports the results of Huang et al. (2006) where they find out that the male unemployment rate has a greater impact on fertility than the female unemployment rate does.

Whittington et al. (1990) argue that the infant mortality will influence fertility because of the replacement effect and the cost effect. However, our estimates in all models are insignificant. As for the women’s education level, the estimated coefficients are negative values. It indicates that the areas with higher women education level have lower birthrates. This result coincides with the theory that women with higher education will increase the opportunity cost of raising children. It thus will have a negative effect on the

Table 6 Empirical results—using total fertility rates as the dependent variable

Independent variables	One-year lag: $\log(TFR_{t+1})$		Two-year lag: $\log(TFR_{t+2})$	
	Model 3	Model 4	Model 3	Model 4
$\log(PHR_t)$	-0.2238*	-0.2341*	-0.1653	-0.2037 [†]
	(0.1047)	(0.1033)	(0.1191)	(0.1134)
$\log(INC_t)$	0.3301***	0.3561***	0.1718***	0.2110***
	(0.0526)	(0.0524)	(0.0582)	(0.0557)
$\log(UR_t)$	-0.1195***		-0.1339***	
	(0.0149)		(0.0176)	
$\log(MUR_t)$		-0.1127***		-0.1557***
		(0.0150)		(0.0175)
$\log(FUR_t)$		-0.0207		-0.0516*
		(0.0205)		(0.0211)
$\log(IMR_t)$	-0.0047	-0.0029	-0.0130	-0.0066
	(0.0156)	(0.0154)	(0.0176)	(0.0168)
$\log(WEDU_t)$	-0.2197***	-0.2295***	-0.2009***	-0.2038***
	(0.0123)	(0.0125)	(0.0145)	(0.0138)
D	0.1182***	0.1219***	0.1310***	0.1339***
	(0.0115)	(0.0113)	(0.0125)	(0.0119)
T	-0.1010***	-0.1060***	-0.0898***	-0.0986***
	(0.0127)	(0.0126)	(0.0133)	(0.0127)
Constant	4.1659***	3.8449***	6.0251***	5.6395***
	(0.8169)	(0.8096)	(0.9174)	(0.8722)
R^2	0.9174	0.9199	0.8954	0.9060
F -statistic	440.35***	398.3***	312.22***	307.52***
FE vs OLS: F -test	28.16***	29.39***	23.24***	26.98***

The standard errors are in parentheses. [†] $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

reproduction decision. The cultural lunar-year effect also coincided with expected results. Taiwanese are more likely to give births in the lunar dragon year but not in the lunar tiger year. Finally, in order to test the robustness of our estimation, we also consider the total fertility rates (TFR) as the dependent variable in all regressions. The results are shown in Table 6. We can find that the outcomes are very similar to the results in which we use the general fertility rates. The homeownership rate and the total fertility rate remains negatively related in Taiwan, and the effect still becomes smaller when time goes by.

Conclusions

Mulder (2006) argues that homeownership provides a family’s stable living space and a more favorable

environment to raise the young. Therefore, the homeownership increases a couple's willingness to have children. However, under the household's budget constraints, once a family spends a large resource to purchase a house, the crowding-out effect may take place or the fertility behavior may be postponed in the short-run. Hence, the relationship between these two events remains indecisive. In this study, the panel data comprising of 23 counties and cities in Taiwan are used together with the fixed-effect model to investigate the effects of homeownership on the fertility behavior. According to our results, the homeownership rate and the birth rate in Taiwan are negatively related. In other words, with other conditions being constant, areas with higher homeownership rates tend to have lower birthrates. This result supports the finding of Courgeau and Lelièvre (1992). Under the limited household resources, the homeownership and reproduction decision will compete and crowd out each other. However, from the lagged models, this research further finds that the crowding-out effect diminishes as time goes by.

This study also shows that when the household income increases the birthrate will increase as well, implying children are normal goods. In addition, when women's education level increases, the higher shadow price of their wages will be; therefore, the cost of raising children will also increase, and it further will inhibit the increase in fertility. In addition, the unemployment rate is negatively related to the birthrates, but the male unemployment rate has a bigger effect than the female rates. As expected, the traditional lunar-year culture does play an important role in fertility decisions in Taiwan.

To sum up, we have concluded that areas with higher private homeownership rates tend to have lower fertility rates in Taiwan, indicating that homeownership and fertility seem to be competitive needs to a family under the limited household budget constraints. Consequently, if more tax deductions of mortgage interests or more friendly housing subsidies are provided to newly-married couples, the government then can stimulate the birthrate by lowering the possibility of the crowding-out effect. Finally, as argued by Annika and Mulder (2008), we have to address that because each country or generation has its own attitude towards homeownership and parenthood, our results therefore might be specific in regards to Taiwan. However, it extends the research in this field to study the international and intergenerational comparisons in the future.

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