5-2022

The Role of Homeownership in Taiwan's Low Fertility Story

William Anderson
Wiilliam & Mary

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A thesis submitted in partial fulfillment of the requirement
for the degree of Bachelor of Arts in Economics from
William & Mary

by

William Anderson

Accepted for _____Honors_____
(Honors, High Honors, Highest Honors)

_____
Peter McHenry, Director

_____
John Lopresti

_____
Emily Wilcox

Williamsburg, VA
April 22, 2022

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ABSTRACT

With one of the lowest fertility rates on record, Taiwan is at the forefront of the global lowest-low fertility phenomenon. Policymakers in Taiwan and researchers around the world have a considerable interest in the reasons driving Taiwan's depressed fertility and possible ways to alleviate the associated economic concerns. Properties of the housing market represent one suggested factor that may be contributing to this trend. Using individual panel data from Taiwan's Panel Study of Family Dynamics, I test the correlation between homeownership and fertility outcomes. I find that other variables, such as marriage, age, generation, and socioeconomic status, can explain much of the homeownership effect and appear more significant for family planning.

[*] Special thanks for Dr. Peter McHenry for advising this thesis, as well as Dr. John Lopresti and Dr. Emily Wilcox for serving on the Examining Committee. Thanks goes to Taiwan's Academia Sinica for supplying the data for this project.

INTRODUCTION

Low and declining fertility rates in highly developed countries have been the subject of interest and concern throughout the past three decades. This demographic issue has resulted in new economic and social problems for the affected countries, and if the trend continues, threatens to greatly exacerbate those problems in the decades to come. Although low fertility rates are a question facing many parts of the globe, they have been a particularly prevalent issue for East Asia in recent years. Taiwan is leading the downward charge, consistently posting fertility rates that put it among the world's two lowest for several years now. As reversing this trend has become a growing priority for policymakers in Taiwan, a wide range of approaches are being investigated in hopes of increasing fertility or staving off the long-term consequences of gentrification. One area of interest for demographic policy has been in the housing market, which the government of Taiwan, the United Nations, and academics have discussed as a factor in Taiwan's low fertility rate. With one of the highest homeownership rates in the world, investigating the role housing in Taiwan plays in family planning is a valuable way to study the causes and potential responses to fertility decline in the unique Taiwanese context.

Demographic transition, the socioeconomic phenomenon of explosive fertility trends transforming into low-fertility environments, has given rise to record-breaking fertility rate lows since the 1990s. The potential difficulties that could be created by severely diminished fertility, economic and otherwise, has prompted a great deal of research interest for academics (Azevedo, Módenes, & López-Colás, 2019; Kohler, H. P., Billari, F. C., & Ortega, J. A., 2002; Mulder, & Billari, F. C., 2010) and policymakers alike. (European Commission, 2005; National Development Council, 2015; United Nations, 2015) While fertility rates can be categorized as low when they fall beneath replacement-level fertility (RLF), defined as 2.1 children per woman (Lee & Lin, 2016), the extreme case of lowest-of-low fertility sparks significant interest and often becomes a political issue for the affected country. Lowest-of-low fertility, typically defined as a total fertility rate (TFR) below 1.3 children per woman, has become a growing issue in developed, post-industrial nations primarily in East Asia, Southern, and Eastern Europe. Taiwan has been categorized as a lowest-low fertility country for more than a decade.

Using panel data for Taiwan, I investigate how individuals' fertility choices correlate to their homeownership status, an open question among researchers. Prior research has uncovered conflicting results when analyzing the relationship between homeownership characteristics and fertility trends, especially in low-fertility parts of the world. Investigating the effect of homeownership on fertility can provide policy-relevant insight for nations looking to shape their demographic outlook in the coming century. Several East Asian nations today face economic hardship associated with soaring real estate prices and housing scarcity. For Taiwan in particular, socioeconomic factors like the housing market and wage stagnation have been theorized to contribute to its record-low fertility rates. A better understanding of homeownership's influence on family planning choices can improve our academic comprehension of the factors that support childbearing and sharpen the effectiveness of pro-natal policy.

BACKGROUND

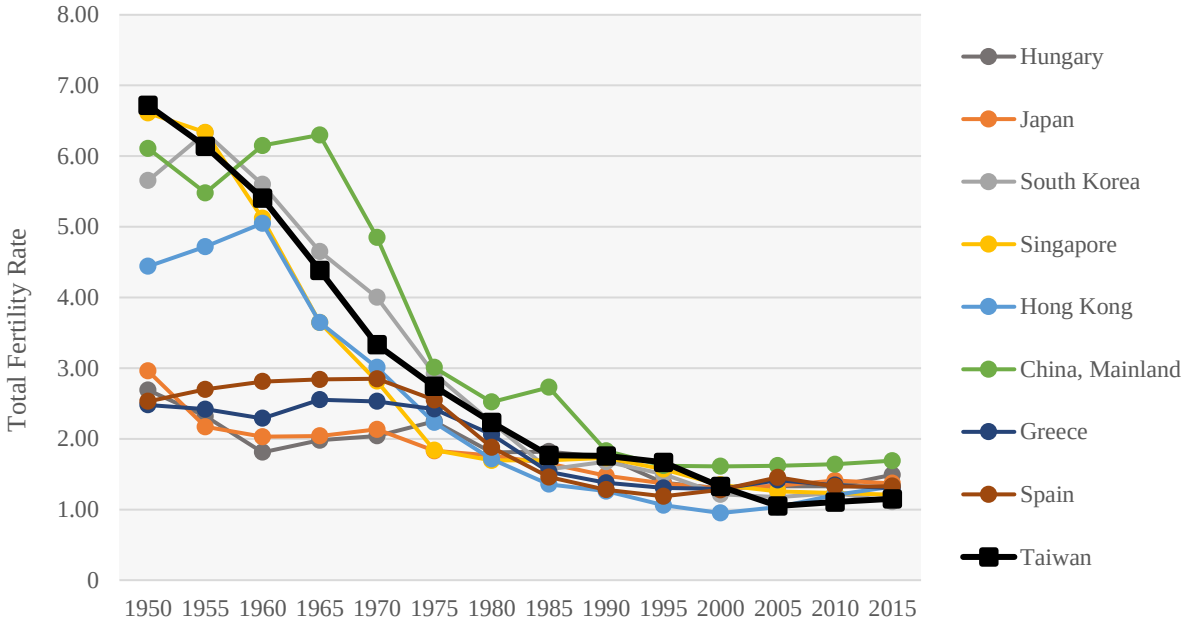
The Lowest-Low Fertility Story: A Global View

The Total Fertility Rate (TFR) is defined by demographers as the expected number of live births per woman over the course of her lifetime. This measure is developed for a given year by first tabulating the fertility rates at each age within the population of interest (i.e. the probability that a woman of a certain age will have a child). These single-age fertility rates are then all summed to determine the TFR in a given year. The resulting statistic measures the number of children a woman would be expected to have on average if she lived through her entire reproductive lifecycle and faced the current year's age-specific birth rates at each age. This is distinct from the birth rate metric, which demographers define as the annualized number of live births per 1000 women within a certain population. Birth rates are a component in calculating TFR, but TRF is often considered a superior metric for analytical studies because it measures an entire reproductive lifecycle while remaining fixed at once point in time and it provides for intuitive applications.

The term lowest-low fertility was first defined in the modern academic lexicon by Kohler, Billari, and Ortega in their work dealing with falling fertility rates across Europe in the early 2000s. (Kohler, Billari, & Ortega, 2001; KBO, 2002) Their 2002 paper ascribes the term lowest-low fertility to fertility regimes where the TFR is below 1.3 live births per woman. Interest in record-low fertility rates arose when Italy and Spain crossed the 1.3 TFR threshold in the 1990s. By 2001, fourteen European nations had been identified as having lowest-low fertility rates. (KBO, 2001) The European Union had recognized falling fertility as a major demographic issue by 2005, with the population of Europe as a whole set to decline absent immigration. (European Commission, 2005) A chief concern outlined by the European Commission's 2005 green paper was a shrinking labor force, leaving fewer workers to support more retirees. Further, the paper noted that "never in history has there been economic growth without population growth." This demographic problem had already arrived for several European nations and was clearly on the horizon for most others, threatening economic consequences for the entire continent.

The concept of lowest-low fertility was limited to a European phenomenon in the 1990s. However, the early 2000s saw the same trend spreading across East Asian countries as well: Japan, South Korea, Taiwan, Singapore, and the administrative regions of Hong Kong and Macao had all joined the lowest-low fertility club by 2002. (Billari, 2008) These nations followed a very different trend from the phenomenon of fertility decline in Europe. While most lowest-low fertility European nations saw a shallow descent from TFRs of around 2 in the 1950s to around 1 in the 1990s, the East Asian nations that today make up the handful of lowest-fertility nations in the world had very high fertility rates in the 1950s, with some TFRs nearing seven children per women. Figure 1 shows the history of total fertility rates in a selection of nations categorized as lowest-of-low. Taiwan, which jostles back and forth with South Korea for the distinction of having the lowest fertility rate in the world, started the period since 1950 with one of the highest TFRs in the world and the peak among nations recorded in the figure.

Figure 1: Global Lowest-Low Fertility Rates



Data: United Nations Population Division, World Population Prospects 2019

Over the course of the past decade, research into low fertility has focused on several potential contributors to the trend. When Europe first took on low fertility as an economic concern, the European Commission identified difficulty in achieving the economic conditions necessary for family formation as the major cause of fertility decline. (EC, 2005) Among the economic factors the green paper lists as contributing to this trend are labor force difficulties for young people (slower entry, rate of promotion, etc.), housing inaccessibility, and little economic incentivization to reproduce. These factors that interested policymakers were similar to the factors being considered in academic studies of Europe's fertility rate crisis at the time.

In their research that coined the lowest-low fertility classification, Kohler, Billari, and Ortega (2001) took a survey of macroeconomic indicators they hypothesized to affect fertility for a number of countries. They found these economic barometers varied greatly among lowest-low fertility nations—namely GDP per capita and inflation. Noting the variety of economic experiences faced by the nations in question, from high unemployment in Mediterranean nations to post-Soviet states' market transition, they instead developed the hypothesis that economic uncertainty produces an incentive to delay reproduction. For example, higher youth unemployment rates reduce the opportunity cost of higher education for young people and may exacerbate the labor market payoff for getting a degree. Following this logic, the student population grows and the average age of a first-time parent is delayed. Other potential culprits include delayed and reduced marriage trends. (Lee, 2009) Institutional problems in the housing market have been a common suspect in lowest-low fertility literature. (EC, 2005; KBO, 2002; Lo, 2012; Mulder & Billari, 2010) Nonetheless, it is difficult to settle on a single clear story for why lowest-low fertility arises and persists in certain places.

Nations experiencing lowest-of-low fertility rates have pursued a number of responses to the issue. East Asian countries have taken a particularly aggressive response. In Japan, pro-natal government initiatives began in the 1990s and have gotten more aggressive since (Abe, Chitose, Katsumata, & Oishi, 2004) Japan has one of the lowest fertility rates in the entire world and faces a declining population. (UN, 2019) More than any other nation, Japan has aggressively pursued pro-natal policies to combat what the Japanese government views as a demographic crisis. Since 2007 there has even been a ministry position in the government's cabinet dedicated to implementing pro-natal measures. (Takao, 2014) South Korea's Ministry of Gender Equality serves a similar purpose for demographic issues. South Korea has spent several years of the past decade with the world's lowest birth rate, prompting the government to also implement pro-natal policies. For the South Korean Ministry of Gender Equality, most policies focus on promoting family-friendly labor conditions, such as financial support for new mothers. (Lee & Zaidi, 2020) Though the pro-natal policies of Japan and South Korea have yet to produce convincing results, the level of government interest in these policies has been more pronounced than in lowest-low fertility parts of the Chinese-speaking world.

The People's Republic of China has perhaps most famous and heavy-handed case of demographic policy in the world. Its one-child policy, implemented under Deng Xiaoping in the 1980s, was a way to respond to a projected population that Communist Party officials feared would be economically unsustainable. Though the one-child policy began in the 1980s, its advent followed a decade of anti-natal policies rolled out under the Communist Party. Although the PRC was successful in its aim of shrinking the Mainland TFR from more 5.73 in 1970 to an equilibrium around 1.6 by the late 1990s, (OECD, 2022) the long run consequences of anti-natal policies were not as their Deng-era crafters had anticipated. The policy failed to account for its own success, resulting in a myriad of demographic-based social issues faced by the government today. Each family having one child radically altered economic participation, the culture around aging, and the social framework around raising children. (Lou & Si, 2014; Zhang & Goza, 2006) In China, where there is no social safety net for seniors, children are expected to support their parents in their old age. The one child policy resulted in the "little emperor" generation, with parents heaping resources into their single child's education as well as stressful expectations for their future. (Wang & Fong, 2009) In light of these problems and their potential to cause socioeconomic hardship in Chinese society, the PRC revoked its one-child policy in 2015—and the government quickly upped the bar to a three-child policy just a few years later. However, the policy change alone has left much to be desired in terms of demographic outcomes for the PRC, as a rebound in the annual birth rate has yet to materialize.

The Taiwan Story

Taiwan, officially the Republic of China, has one of the world's lowest fertility rates. With a population hovering around 24 million, the island off the coast of China's Mainland (referred to as a country for the purposes of this paper) presents one of the most interesting cases in the world today for studying family planning. Taiwan sits at the intersection of traditional Chinese culture and Confucian family structures, rapidly liberalizing social values, hereditary wealth, and global capitalism. Today, it faces one of the world's most pressing demographic predicaments that looks poised to redefine the island's intergenerational economy in the twenty-first century.

For Taiwan, many of the cultural and demographic characteristics that drove the demographic difficulties for Mainland China under a low fertility regime hold true, even if the policy has been very different. Around the same time the PRC was formulating its One Child Policy, which debuted in 1980, Taiwan was facing a similar explosion of new births (averaging a TFR of 7 births per woman and a 3.6% annual increase in the total population) that spurred overpopulation concerns and brought about government policy aimed at reducing the birth rate. (Lee, 2009; Lee & Lin, 2016; United Nations, 2019) The result was two decades of anti-natalist policy, designed to bring Taiwan's annual population growth rate down from 3.6% to below 2%. However, as early as the 1990s, an inverse of the demographic issue became apparent when the percentage of elderly persons first exceeded 7%, representing a rapidly ageing population. (UN, 2015) Alongside a cohort of similar developed East Asian nations enduring demographic transition, the ROC's policy and academic outlook quickly shifted from concern about overpopulation to concern about declining fertility, and anti-natal policy was swapped out for pro-natal policy soon after. (Lee & Lin, 2016) As the problem has accelerated and Taiwan faces one of the world's only shrinking population forecasts, Taiwanese political interest in these prenatal policies have grown.

The projected outcomes of Taiwan's declining fertility represent some of the most extreme facing any country today, even among lowest-low fertility nations. A dependency ratio represents the number of dependents (children and elderly dependents) per one hundred working-age people. Due to falling birth rates yielding fewer child dependents, Taiwan's dependency ratio has declined in recent history, from 57 in 1980 to 40 in 2020. (National Development Council, 2020) Looking to the future, however, paints a stark picture. The dependency ratio is project to skyrocket beyond 100 in the next fifty years, resulting in an unprecedented demographic structure with more dependents than working-age people. The same model, provided by Taiwan's National Development Council, (2020) also projects a falling birth rate and child dependency ratio through the year 2070, meaning the record-breaking dependency ratio is due to a ballooning elderly dependent population. The council projects this figure may more than quadruple per working-age person between 2020 and 2070. While it is true that we now have several decades of experience across multiple parts of the world with demographic trends towards low fertility and growing elderly populations, the extremity of this projection for Taiwan represents a severe gentrification even when compared to present-day demographic structures.

To further illustrate the macroeconomic considerations a demographic change like this could bring about, consider the proportion of elderly dependents to workers. The support ratio, or number of working-age people per elderly dependents, has the potential to fall from 5 working-age persons to just 1.2 in the same time frame, caused by a combination of longer life expectancy, Taiwan's largest generation reaching old age, and low fertility leaving a smaller generation to replace them. (NDC, 2020) The implication is that the necessary contribution from a worker to maintain support programs for the elderly could as much as quintuple over the same period. This represents uncharted water for demographic study and policymaking. Only since the turn of the century have OECD nations begun nearing support rations of two. (OECD, 2017) If the projections for Taiwan and similar lowest-low fertility regimes hold true, these nations will be tasked with facing novel demographic impacts on their economies and societies.

Based on what has already been witnessed from cases around the world, high dependency ratios, specifically with a large elderly dependency component, have been linked to a number of

economic consequences. It has been suggested that a greater burden of support for elderly dependents—and thus higher pension and welfare costs—will result in a drain on national savings, causing greater scarcity of investment and higher interest rates. (Santacreu, 2016) In terms of individual consumption and investment, it has also been theorized that demographic shifts of this nature may lead to greater consumption in high-demand services like healthcare, while potentially reducing investment in real estate as a declining birth rate results in fewer and fewer working-age adults in the market for housing. (Santacreu, 2016) Policymakers in Taiwan are taking note of these possibilities.

Responding to these concerns about potential demographic-caused social issues, the National Development Council has encouraged Taiwan's policymakers to support pro-natal measures. The Executive Yuan, the executive branch of Taiwan's government, has approved a set of measures for programs running from 2018 to 2022 that aim to meet a target fertility rate of 1.4 by 2030. (NDC, 2020) For Taiwan's policymakers, a chief economic concern of falling fertility rates has been the impact on labor supply. Taiwan has one of the world's lowest labor force participation rates and the government expects it to continue to fall. (NDC, 2015) Broadly speaking, the policy menu prescribed by the Executive Yuan to respond to Taiwan's demographic transition has two fronts: increasing labor supply and increasing birth rates. In pursuit of the former, the Executive Yuan has focused on attracting foreign skilled labor, improving the work environment (especially for women), and speeding up the transition from education to employment for young adults. (NDC, 2015)

For Taiwan, a key component of its demographic issues has been declining marriage rates, strongly linked to the declining fertility rates. Marital rates have been plummeting in Taiwan since the 1970s. Between 1970 and 2007, the percent of women under 30 who were married plunged from 83% to just 31%, meaning nearly one in two women on average have gone from marrying in their twenties to remaining single. (Lee, 2009) Interestingly, though not surprisingly, while marital rates fell across both genders, survey results investigating the reasons why young Taiwanese are remaining single turned up very different results. After not yet finding the right person (a plurality for both genders), the next top reason was economic for men, while women cited being content unmarried and fear of an unhappy marriage as their next two top reasons. Economic concerns hardly factored into the women's break down, while fear of an unhappy marriage only registered with 1% of men. (Lee, 2009) Chinese culture undoubtedly has a hand in these results—for example, tradition says the groom is expected to pay for the wedding in China, and often the house as well. (CGTN, 2018; Fincher, 2016) On the other hand, the distinction of a Taiwanese cultural identity may also contribute. For example, while the social phenomenon of "leftover women," unmarried women past the age of 27 who are labeled undesirable by deep-rooted tradition, has been propagandized by mainland state media (Fincher, 2016), ROC President Tsai-Ing Wen is herself an unmarried woman. Taiwan seems to have mirrored its developed East Asian contemporaries, South Korea and Japan, with women waiting later to get married, rather than perpetuating the "leftover women" stereotype. (Brandt, Turner, & Zou, 2018; Lee, 2009)

While lowest-low fertility countries are often lumped together in studies of demographic transition, this question may motivate national differentiation when analyzing the drivers of lowest-low fertility. Consider that much of western and northern Europe now see between 40% and 60% of children born outside of marriage. (Haub, 2010; Lee, 2009) In Taiwan, that number has yet to exceed just 5%. (Suzuki, 2009; Wu & Chiang, 2015) Likewise, even among lowest-

low fertility nations in Europe, homeownership regimes vary greatly with different buying traditions, habits, and outcomes. (Mulder, 2010) Taiwan's unusually high homeownership rate, consistently nearing 90%, is far higher than most lowest-low fertility nations. It is important to consider that while factors like marriage and housing undoubtedly play an important role in family planning, the family formation regimes that create lowest-low fertility conditions in each concerned nation have a different structure. This not only means that studying each lowest-low fertility country individually is valuable, but also that effective policy prescriptions for each may vary significantly as well, despite facing the same problem.

Marriage aside, a second (and interrelated) key component identified as a possible contributor to low fertility rates for Taiwan are economic institutions. Housing has been cited by academics and policymakers alike as a barrier in the lowest-low fertility discussion, both broadly and for Taiwan specifically. (Azevedo, Módenes, & López-Colás, 2019; Lee, 2009; Mulder, 2006; UN, 2015) In recent years, Taiwan has experienced soaring urban housing costs and a large share of young adults continuing to reside with their parents, which might contribute to delayed fertility. (UN, 2015) Perhaps the most pressing component in the intergenerational socioeconomic conundrum is the rising cost of living in Taiwan compared to stagnating wages. Since the turn of the century, average wages have only increased in about one in every two years. Contrasted with Taiwan's rising housing costs, wage stagnation makes the ability for young adults to become financially independent, let alone start a family, increasingly difficult. (UN, 2015) Co-residence between young adults and parents is a common phenomenon in Taiwan and Mainland China, but continued co-residence has been linked to lacking the financial means to move out for Taiwanese young adults in particular. (Chu, Xie, & Yu, 2011) Like all countries, Taiwan's marriage culture, housing market, labor market, and traditional background are a unique combination with their own challenges in the family formation context.

In addition to having one of the world's lowest fertility rates, Taiwan also has one of the world's highest homeownership rates. Now over 80%, Taiwan's homeownership rate is not only high but has also been on a steady incline over the past thirty years. Only a handful of countries in the world have higher rates of homeownership, and most developed countries trail Taiwan by at least fifteen percent. (Bourassa & Peng, 2011) This has been the result of decades of public policy devised under the belief that every family should own their own home. The strong belief in the importance of homeownership, pushed by the government, has led most Taiwanese families to buy a home even during a skyrocketing real estate market in the 1990s that saw home prices jump around 500%. (Bourassa & Peng, 2011) This produces a housing market in Taiwan with few parallels globally. The perceived importance of homeownership in Taiwan might give stronger motivation to concerns about housing in the family planning context.

Falling birth rates have been a major political concern in Taiwan since former ROC President Ma Ying Jeou declared record low 2010 births as a national crisis and named a Minister without Portfolio to address the issue. Prior to that, a 1992 revision to Taiwan's national Guideline for Population Policy, which documents the government's goals for fertility, marked an official transition to pro-natalist policy. In 2006 a follow-up revision stressed the importance of providing childbearing assistance but was otherwise lukewarm about population growth and mainly emphasized improving quality of life. (Lee, 2009) Some of these quality of life measures did serve to support fertility though, such as an expansion of Taiwan's childcare system, maternity leave, and financial support for raising children. Ma's Guomindang Party, now the opposition party, has suggested creating a government ministry for supporting births. (Hsiao,

2021) Since 2021, Taiwan's government has stepped up its aggressive policy response aimed at achieving birth rate goals. Just in the past year, parental leave subsidies have been increased by one-third, paid leave for prenatal healthcare has been expanded, and direct-payment stipends for new parents have been increased. This year, the government plans to reduce preschool fees as well. (Su, 2022)

Still, many within Taiwan have criticized the government for not doing enough. The transition from the anti-natal policies of the 1960s and 1970s to the pro-natal turnaround in the 1990s was slow and did not bring about the necessary change in attitude to be effectual in a culture that had embraced the idea of limited fertility being good for the family. In addition to this, sociologist Lee Meilin (2009) has also written in detail about how feminist and environmentalist political movements create incidental push-back on pro-natal policies. Government efforts in recent years have still been spotty. Taiwan's ruling party, the Democratic Progressive Party, has not been as aggressive as its predecessor. When addressing demographic issues, solutions like boosting immigration have been suggested to boost the working-age population and efforts to get women into the work force have been prioritized for the same reason. (NDC, 2020) The efforts of government policymakers have largely been focused on primarily easing the future burden on workers of a burgeoning elderly population, and secondarily boosting birth rates. Above all, championing a high quality of life has largely trumped all other policy interests throughout Taiwan's recent history of demographic politics.

PRIOR LITERATURE

Taiwan's rapid decline in birth rates and its potential causes have been the subject of a range of literature. Luoh (2007) provides a decomposition of the birth rate decrease in Taiwan into its potential contributing factors. Lee (2009) does a similar exercise. Luoh highlights declining or delayed marriage as a primary factor in the trend of declining fertility and then decomposes the decrease into a change in marital rates and a change in fertility rates among married women between 1965 and 2005. Luoh shows that the age-specific fertility rate among younger married women has actually increased over time in some cases, but a decrease in marriage rates offset this. Lee (2009) confirms a staggering decline in female marriage rates, especially for women in their twenties (from 83% to 31% between 1970 and 2007). Lee further investigates social trends among married and unmarried women in Taiwan and finds that women are declining to pursue marriage due to disinterest, a desire to pursue careers, and gender inequality within the institution of marriage. Lee suggests greater gender equity in and beyond marriage and stronger support systems for raising families would be beneficial to encouraging family formation.

The effect of homeownership on fertility has been studied at the macro level. A number of studies have investigated the link between national or regional homeownership regimes and fertility. (Azevedo, Módenes, & López-Colás, 2019; Lo, 2012; Mulder & Billari, 2010) Approaches like these look at a set of national factors or trends among a group of nations and attempt to draw insight into the drivers of fertility based on national housing patterns. For example, Kohler, Billari, and Ortega (2001; 2002) compare national economic statistics among lowest-low fertility European Union nations and those with higher fertility rates. They discuss the relationship between economic conditions and fertility and theorize several socioeconomic structures that might incentivize fertility rate declines. Mulder & Billari (2010) categorize EU

nations into groups based on their housing statistics and mortgage practices and discuss correlated trends with lowest-low fertility nations. However, less attention has been paid at the microeconomic level to the interaction of housing and fertility for individuals. This is a critical differentiation: Mulder (2006) suggests that this may resolve certain contradictions in the theory. This paper contributes to a discussion of how housing and fertility are linked at the individual level.

The question of how homeownership impacts fertility decisions at the family level is subject to academic debate. On one hand, some scholars suggest that homeownership provides an important sense of stability for starting a family and demonstrate empirically a positive relationship between homeownership and fertility metrics. (Azevedo, Módenes, & López-Colás, 2019; Becker, 1981; Dettling & Kearney, 2014) On the other hand, some scholars suggest that fertility and homeownership, both being high-cost investments in developed countries, may "crowd out" one another and fertility may be delayed or reduced among families that buy a house early. Mulder (2006) attempts to bridge the competing theories about homeownership and fertility by dividing the effect into a micro and macro effect. Mulder hypothesizes that there is a positive relationship between homeownership and fertility at the family level, whereas higher levels of homeownership nationwide (coupled with difficult access to housing financing) induce lower fertility rates due to low turnover in the housing market.

A few studies have looked at homeownership and fertility in Taiwan specifically. K.T. Lo (2012) studies the interaction between homeownership and fertility in Taiwan at the regional level. The findings of this study support the hypothesis of Mulder (2006) that the costs of homeownership and reproduction crowd out one another. Lo implements a fixed effects model for regional panel data. Chen (2013) studies the relationship between housing prices and fertility in Taiwan. Similarly, Yin & Su (2021) use panel data to study the effect of a rise in real estate prices on China's fertility rate and find a negative effect. Aside from homeownership, other researchers studying fertility in Taiwan have focused on its interaction with crime (Huang, Chiang, & Pan, 2015), economic uncertainty (Pan & Yang, 2020), and preferences for a child of a certain sex (Hu & Chiang, 2021). This paper aims to contribute to the literature by studying homeownership's effect on fertility using individual panel data. As exemplified by Chen (2013), individual panel data is more frequently used to study the relationship between housing prices and fertility. The data used in this paper have previously been used to study parent-child co-residence trends in Taiwan and parts of China. (Chu, Xie, & Yu, 2011) I will use it to expand on other studies looking at Taiwan, such as Lo (2012), by addressing the similar question of homeownership and fertility with more individual specificity.

DATA

The Panel Study of Family Dynamics is a project founded in 1998 to collect panel data on a range of domestic topics for Taiwan and limited part of Mainland China. This project was initiated by researchers at Academia Sinica, the national academy of the Republic of China, which also funds the project. The PSFD surveys groups of main respondents with birth years between 1935 and 1991. All main respondents were between 25 and 64 years of age at the time of their first interview. The first sample of data was collected in 1999 and the project conducts follow-up interviews with the same sample of main respondents in subsequent panel sets. Since 1999, four new cohorts of respondents have been added to the project. In addition to main

respondents between 25 and 64, the project also surveys children of main respondents between 16 and 25. Once a main respondent's child reaches the age of 25, they are included in a third category of surveyed individuals, adult children, who are treated as an additional, separate sample of main respondents. Surveys are conducted regularly, once every one or two years. There are over 6,000 unique respondents in Taiwan as of 2020.

Respondents are randomly sampled geographically based on locality. Only one respondent is sampled per household for the initial survey; follow-up surveys add additional waves of adult children as respondents, but these are filtered out for the purposes of this paper. For the five cohorts of main respondents, a probability proportional to size (PPS) model was used to get an initial sample. According to the PSFD,

> The townships and districts of Taiwan are first stratified by their degree of urbanization. In the first stage of sampling, townships and districts are randomly drawn from each stratum. In the second stage, villages are randomly drawn from each selected township or district. In the third stage, individuals who fit the birth year criterion are randomly drawn from each selected village.

Sampling of the cohorts has varied over time; the first three waves of new respondents and the second two waves used different studies to stratify townships and districts. Additionally, how the project deals with non-response has varied across samples. When a non-response to a follow-up survey is deemed temporary by the PSFD (e.g. not a death), the non-respondent will still be contacted in subsequent years despite dropping out of the sample for a year. Each individual respondent is assigned a number with digits that link them to their initial geographic region and family. That number is consistent across all iterations of the survey. Until 2016, almost all interviews were conducted face-to-face; since then, online methods have been used as well. For the main survey, respondents answer questions on topics such as health, employment, spousal information, family, housing, and other domestic topics. These questions are repeated in each follow-up with minimal changes to the questionnaire over time. For child respondents (before age 25), the survey focuses primarily on educational topics along with a more simplistic overview of family topics.

Table 1 contains summary statistics broken down by cohort, which refers to the first year a participant was surveyed. First year surveys were initiated five times for the main sample: 1999, 2000, 2003, 2009, and 2016. One puzzling aspect of the data is the range of ages contained within and between each cohort. Table 1 shows the average birth year and age at first survey for each cohort. While the last three cohorts seem fairly consistent with average birth years around 30, the first two cohorts, sampled only one year apart, have an average birth year that varies by more than a decade and have average ages at first survey in their forties or fifties, meaning many respondents are well beyond their childbearing years. Furthermore, the youngest respondent in the 1999 cohort was 36 at the time of first response and the youngest in the 2000 cohort was already 46 years old. The PSFD's documentation does not clarify why the age ranges vary so greatly or why the age statistics for the first two cohorts do not include young adults.

Cohorts 1999 and 2000 have other peculiarities. Table 1 shows key variables to the question of fertility and demonstrates both cohorts have extremely high levels of marriage. An interesting trend that persists for all cohorts is the consistent rise in college education over time (albeit with a decrease in the 2000 cohort). The college education level jumps by around 20% for each new cohort from 2003 to 2016, and the 2003 cohort has a college education rate that is

around 10% higher or more than its predecessors. This shows an incredible rise in educational investments in Taiwan over generation and time. The final statistic included in table 1 is the percentage of respondents who were still answering the survey at its end, in 2018.

In some econometric studies, age and year of birth can be used fairly interchangeably, especially if the economic environment within which the study takes place does not change over time and the birth year effect predominantly just captures variation in the age of individuals. However, a theme I develop over the course of the empirical analysis is that the year of a respondent's birth contains more relevant information than just how old they are in the case of this data. One example of the importance of considering birth year (or cohort) in addition to age as a relevant variable to Taiwanese family planning is contained in table 2. Here, the data are sorted into two broad cohort groups according to the age ranges and birth years. The "Older Cohorts" group includes those cohorts first surveyed in 1999 and 2000. I group these two cohorts together because their average age at first survey is over forty. The "Younger Cohorts" group, on the other hand, includes the remaining three cohorts (2003, 2009, and 2016), which each have an average age at first survey within four years of one another, right around thirty years old. Though the cohort method of sorting is not the cleanest way of comparing generations of respondents born in the past fifty years and those born in the earlier decades of the twentieth century, the cohort tool provides for easy and straightforward sorting. Table 3 shows select variables broken down by both age range and group so that statistics for the same age group can be compared across time.

Table 1: Summary Statistics

Variables	**Cohort**				
	1999	**2000**	**2003**	**2009**	**2016**
Number of Participants	999	1960	1152	2182	1972
Percent Female	49.2%	49.9%	46.0%	49.8%	48.9%
Average Birth Year	1958	1946	1970	1980	1987
Age at First Survey (Mean)	41	54	33	29	29
Min	36	46	27	26	25
Max	55	66	41	62	32
Percent Married (Start)[1]	92.0%	97.4%	66.1%	36.7%	27.4%
Percent Married (End)[1]	94.7%	98.0%	80.5%	63.1%	34.8%
Education Level[1]					
College Education	11.0%	7.4%	20.3%	39.1%	62.0%
Female College Edu.[2]	8.6%	5.0%	16.0%	38.4%	63.9%
Complete Response	46.6%	41.3%	46.3%	63.4%	78.5%

Perhaps most striking is the statistical difference for the variables presented in table 3 between the respondents in their thirties in the older cohorts and the same age range in younger

cohorts. Marital rates for Taiwanese young adults in their thirties are nearly thirty percent lower among the younger group. And the marital rate is not a standalone—homeownership rates are a mere half what they were for that same age group in the older cohorts. The average number of children had likewise more than halved as well. The staggering gaps between individuals of the same age group across time suggests a changing environment in Taiwan's society for establishing some of these building blocks of a family. In approaching a model, these summary statistics press the importance of not simply controlling for either birth year or age, but rather doing both.

A final note on the data relates to the civil rights of LGBTQ+ individuals in Taiwan. While Taiwan is well known for providing the greatest protection of LGBTQ+ rights in East Asia, many of the reforms that established these rights have come since the most recent data release from the PSFD. Gay marriage was legalized in 2019 and the provision for homosexual couples to adopt is still undergoing legal and legislative approval as of 2022, so even for the most recent survey conducted in 2018, it can still be assumed that all marriages are heterosexual and any adoptions take place within heterosexual marriages.

Table 2: Group Statistics

Variables	**Age Ranges**				
	20-29	30-39	40-49	50-59	60+
Marriage Status					
Older Cohorts	-	90.8%	94.8%	96.6%	98.1%
Younger Cohorts	24.6%	61.5%	86.4%	90.4%	-
Homeownership					
Older Cohorts	-	59.1%	71.4%	78.3%	84.4%
Younger Cohorts	8.6%	27.0%	51.9%	64.5%	-
Children					
Older Cohorts	-	2.03	2.34	2.72	3.33
Younger Cohorts	0.28	0.90	1.67	1.87	-

EMPIRICAL ANALYSIS AND RESULTS

General Regression: Number of Children

To evaluate the relationship between fertility and homeownership, I regress homeownership status against the total number of children a respondent has using an OLS model. The following model represents such a regression.

$$[A]\ \Omega_i = \beta_0 + \beta_1 x_{1i} + \sum_{k=1}^{K} \beta_k x_{ki} + \varepsilon_i$$

Here, omega (Ω_i) represents the total number of children for individual i, β_0 is an intercept value, β_1 represents the increase in the number of children someone is expected to have had if they own

their home, x_{1i} is a dummy variable for homeownership status where a value of 0 means individual *i* does not own their home and a values of 1 means they do, β_k is the coefficient for each of *k* control variables, x_{ki} is the individual's value for control variable *k*, and ε_i is an idiosyncratic error term for individual *i*.

Table 3 contains the estimation of model (A) for the full dataset with different selections of control variables. The first variation, regression (1.1), is an initial estimation with no control variables. It just looks at the correlation between whether an individual is a homeowner and the number of children the individual has. Regression (1.2) adds control variables for whether an individual has ever been married, their age, and their birth year. Regression (1.3) also includes controls for the combined household wages of the respondent and whether they graduated from a post-secondary school.

Age is an obvious variable to control for in this and subsequent regressions. Since human fertility is naturally dependent on age perhaps more so than any other variable, controlling for age is necessary. Furthermore, older individuals are more likely to own homes and have older children, so controlling for age is an important step in clarifying the effect of homeownership. Age is likely to interact with family planning decisions in different ways at different points in life, so a simple age control may not be sufficient to accurately capture age effects. For example, the impact of age on expectations for total number of children would presumably be quite significant when looking at respondents between ages 25 and 45. However, expectations for total number of children would probably not vary much by age for respondents between the ages of 65 and 85. Because the anticipated impact of another year of life on fertility outcomes is not uniform throughout one's life, including an age-squared variable in addition to the age variable allows for more nuance when modeling age's effect.

In addition to age, a variable for birth year is included. This variable is important and distinct from the age variable because it represents a generational effect, while the age variable represents a point in the respondent's lifecycle. The generational effect turns out to be quite significant, with a strong negative effect on the expectation for number of children. After its inclusion alongside other controls, homeownership loses its significance. When searching for reasons why different regressions for different generations may affect homeownership's significance, one explanation could be motivated by the age differentiation. Since respondents in the older cohorts, for the most part, are not actively having more children and other aspects of their life are likely to be less dynamic, the survey could be seen more of as a reflection of their past. The interpretation of this coefficient would be that those who own a home are expected to have had more children. But it may be that young people start having children and purchasing real estate irrespective of one another, so while later in life having done both is a strong correlation, the relationship at a young age is less defined. However, there are other possibilities. There may be a generational difference; the story in Taiwan may not be consistent across time. Perhaps homeownership was a major factor in fertility decisions for older generations, but younger generations are acting differently. Given the evolution of fertility trends in Taiwan in the past eighty years, this seems plausible.

Regardless, I include birth year as a control variable in regressions (1.2) and (1.3) for its usefulness in differentiating between generations and I believe this is preferable to dividing the sample by groups or cohorts. Although their averages are very different, the cohorts themselves do contain a range of ages and birth years. While manually dividing the sample by generation might solve this issue, it is difficult to know where exactly to draw lines between generations. As for the two groups of cohorts I've previously outlined, the groups are a simplification rather than a clarification of the data, meaning they lump together cohorts which have average birth years that vary by as much as twenty years. The two groups better capture differences in average ages, but since new samples are added decades apart, this doesn't necessarily translate best to generational differences. As a result, I find the birth year approach to be more convincing.

Table 3: Regressions, Number of Children (Model A) (Full Dataset)

Children	(1.1)	(1.2)	(1.3)
n	55172	54647	49972
Homeowner	1.338***	-.010	.006
	.012	*.010*	*.010*
Ever Married[1]		1.497***	1.482***
		.013	*.013*
Age		-.018***	-.021***
		.003	*.003*
Age-Squared		.000***	.000***
		.000	*.000*
Birth Year[2]		-.044***	-.041***
		.001	*.001*
Household Wages[3]			-.001***
			.000
College[4]			-0.303***
			.012
β_0	1.272***	2.239***	2.376***
	.009	*.099*	*.101*
R-Squared	.1890	.6087	.6251
f-statistic	12859	16993	11902

* Statistically significant at 90%
** Significant at 95%
*** Significant at 99%
[1] Ever married, including cohabitation, those separated or divorced, and those with deceased spouses
[2] Starting at 1934 (this variable is birth year minus 1934)
[3] New Taiwan Dollar, tens of thousands, combined wages of respondent and spouse
[4] College has a value of 1 if respondent has ever graduated from a tertiary education program and zero if not

In demographic studies, women's education has long been the hallmark barometer and most powerful influence on a nation's fertility rate. (Kasarda, 1979; Martin, 1995; Martin & Juarez, 1995) The theoretical explanation has several components: first, women with more

education are more likely to be able to be informed about and exercise reproductive health care. Women's education is a factor within the umbrella of women's rights, and the promotion of women's rights empowers women to assume greater autonomy over their reproductive decision-making. In addition, it is widely held that women's education goes hand-in-hand with economic development, which in turn is linked to declining fertility rates at the macroeconomic level. (King & Hill, 1997)

While a variable for women's education would have been preferable to an all-gendered education variable from a theoretical standpoint, the only implementation to do so without losing the half of the sample that are men would be to use the spousal education variable for men as a reflection of their wife's education. This could work well, except that it would effectively restrict the sample to women and only married men (unmarried men would be dropped). Because unmarried men can have children too, and because for the purposes of this model I want to include marriage as a control variable rather than limiting the sample to just married couples, I opt for simply using the respondent's education background (specifically, whether they graduated from a tertiary education program) in place of women's education. While a female education variable may be more interesting, an all-gendered education variable is still quite theoretically useful as it at least partially reflects the education background of the household.

Finally, the sum of household wages is included as an independent variable. The impact of income on fertility is contested in the literature (Bar, Hazan, Leukhina, Weiss, & Zoabi, 2018; Borg, 1989) and presents an interesting, but motivating, inclusion in the model. Theoretical understandings of fertility debate whether household income provides greater means for parents to raise a larger family or whether those with a higher income are more likely to make high-cost investments in their children (such as education) that result in having fewer children. While this paper doesn't attempt to address this question, a family's income is undoubtedly a major consideration in their family planning, so it warrants inclusion regardless of which theory is correct. Unfortunately, the PSFD did not collect household data consistently for all income sources (e.g. investments, transfers, etc.) so I choose to go with the consistent data for a summation of respondent and spousal wages. While this data will not perfectly reflect total income (for instance, a wealthy investor may not earn wages), it at least incorporates some representation of the household's socioeconomic status.

In table 4, regression (1.1) shows a strong positive correlation between whether an individual is a homeowner and the number of children they have. When the controls for marriage, age, and birth year are added in with regression (1.2), however, homeownership loses its statistical significance, and the magnitude of the coefficient falls from more than one to negative one one-hundredth. The explanation seems straightforward: all else equal, older individuals are more likely to be homeowners than younger individuals, so homeownership may be acting as a proxy for age in the initial regression. Homeownership may also be acting as a proxy for marriage if individuals in established families are more likely to be homeowners than single people, which seems logical. The most statistically significant and largest magnitude variable is marriage: a married individual is expected to have one to two more children on average than an unmarried individual. Age is also statistically significant. Its linear value has a

negative coefficient and its squared value has a positive coefficient. Taken together, age alone—that is to say, not in conjunction with another factor, such as getting married—does not start having a clear positive effect on the number of children an individual is expected to have until around forty years old.

In regression (1.3), the coefficients for the variables defined in (1.2) are roughly the same. Household wages and college education are both shown to have a significant negative effect on fertility. While the negative effect of college on fertility is well-established theoretically, the negative effect of wages is an interesting, if not unpredictable, result. A few notes on the wage effect: this variable represents the combined wages of the individual and their spouse, if they have one. It seems reasonable to expect households with two working parents may have higher combined wages than those with one, and households with two working parents should also be expected to have fewer children. Women's employment has been tied in the literature to lower fertility rates. (Berhardt, 1993) Much of the theoretical component of this paper deals with the hypothesis that homeownership and childbearing may be decisions that crowd each other out due to their high costs on a couple. At first glance, it seems like higher wages would alleviate that concern and enable more childbearing, but given more careful consideration, including the factors discussed previously that complicate the income effect, the negative relationship becomes more understandable.

As an initial analysis of homeownership's impact on Taiwanese family planning, this model suggests that homeownership only predicts fertility insofar as it reflects someone's marital status and age. It is important to note that this regression is very limited in how it can be interpreted. Because the regression is not taking into account a timeline for when these events happen, and because respondents for a range of ages are mixed together, important and more complex interpretations are not yet possible. For example, two sixty-year-olds may both have children and own their home, but they might have very different stories relating to this statistic. We can imagine one may have had their first child when they were twenty-five and bought their first home when they were forty-five while the other bought their first home at thirty and had their first child at thirty-two. Despite their significant differences in homeownership and fertility history, our imagined pair of respondents are represented identically as observations in this regression. As a result, this regression can only be interpreted as a simple correlation between whether a person owns a home and whether they have children. There are a few ways to address some of these concerns. The next regression, a female-specific regression, restricts the sample to a limited and perhaps more insightful subsample.

Female-Specific Regression

Model (A) can be expanded on for sample subsets. One population that is definitely of particular interest when studying fertility topics is women of childbearing age, and there are a few benefits for a regression using this subset that were not achievable with the main sample. First, there are female-specific variables that family planning and fertility literature pay particular interest to and which I would be remiss not to build a model using. Second, a version

of model (A) with just females of childbearing age is a straightforward way to ensure that the results of regressions (1.1) through (1.3) still hold when just focusing on the most important demographic to reproductive trends. Not only does a female-specific regression allow for the inclusion of other relevant variables, but it also provides a more specific window to study the same question.

Table 4 contains four regressions that follow the general structure of model (A) but incorporate new controls and limit the sample to women in their 20s and 30s. The minimum age in the data is 25, so this allows for a fifteen-year age range in the subsample, from 25 to 39. The control variables used in this model are the same controls for whether a respondent has ever been married, their age and birth year, college education, and a new control for whether they are employed.

Table 4: Regressions, Children (Model A) (Female, 20-39)

Child	(2.1)	(2.2)	(2.3)	(2.4)
n	9079	9077	9077	8690
Homeowner	.658***	-.003	-.050***	-.028
	.024	*.019*	*.019*	*.019*
Ever Married		1.431***	1.409***	1.306***
		.018	*.018*	*.018*
Age		-.301***	-.290***	-.254***
		.037	*.036*	*.036*
Age-Squared		.005***	.005***	.004***
		.001	*.001*	*.001*
Birth Year			-.025***	-.023***
			.002	*.002*
Employed				-.193***
				.019
College				-.274***
				.017
β_0	.806***	4.148***	5.559***	5.241***
	.013	*.599*	*.598*	*.598*
R-Squared	.0751	.5237	.5359	.5521
f-statistic	737	2494	2095	1529

* Statistically significant at 90%
** Significant at 95%
*** Significant at 99%
[1] Ever married, including cohabitation, those separated or divorced, and those with deceased spouses
[2] New Taiwan Dollar, tens of thousands, combined wages of respondent and spouse
[3] College has a value of 1 if respondent has ever graduated from a tertiary education program

Women's education is widely regarded as the critical indicator for birth rate declines: education gives an individual the knowledge base for informed family planning, financial independence, and broader career opportunities. (Martin & Juarez, 1995) Women's education is also often strongly correlated with national development indicators like higher wages, capital

development, and low infant mortality rates, which create an environment where having many children becomes less important. (Martin, 1995) Women's education is also closely linked to women's rights. (King & Hill, 1997) For these reasons, women's education is often identified by demographers as a crucial step towards demographic transition. I include the same college variable in regression (2.4) as that in (1.3); while women's college education and non-gendered college education are surely closely interrelated, having a women's education control is quite useful theoretically.

Female employment is a commonly studied factor in fertility trends. There is strong theoretical reasoning for this, especially studying the effect of motherhood on employment, since giving birth to and raising a child will obviously be a large time commitment competing with a mother's time allocation to possible employment. (The literature also notes that this impact declines the older a mother's children get, again for fairly obvious reasons, as older children require less constant attention.) (Bernhardt, 1993) However, the empirical impact of employment on fertility is much less clear. In developed countries, previous studies suggest that a negative correlation between female employment and fertility existed prior to the 1980s, but that the trend disappeared and even flipped to a positive correlation in the more recent decades. (Oshio, 2019; Engelhardt, 2004) In particular, the closer to present, the stronger the positive correlation between a nation's female employment rate and TFR. (Oshio, 2019) However, this question has mostly been looked at using national trend data and has not had extensive research within a panel data structure.

Despite the mixed bag of results for developed countries' employment effects on fertility, theoretical explanations are easy to come by for the link between the two. Conventional wisdom had been that female employment decreases the likelihood of reproduction due to the time commitment of employment. (Becker, 1981) However, the change in pattern for developed countries spurred alternative theories. Oshio (2019) suggests that a higher socioeconomic background leads to better environmental conditions for raising children in developed countries. In particular, for higher-income parts of the world, a two-income household may yield such important economic benefits that it offsets the difficulties stemming from the added time constraint. However, the result for this variable in regression (2.4) is still negative and statistically significant, more closely aligning to the traditional view of employment and fertility.

The regressions presented in table 4 largely reflect the same trends seen in regressions (1.1) through (1.3). The female-only regressions are not totally analogous to their full-sample predecessors, though. One additional regression is included to provide additional insight to the one area where the female regressions diverge significantly from their full-sample counterparts. Aside from homeownership's coefficient in model (2.3), the rest of the regression outcomes resemble the estimations of the first set of regressions fairly well. When employment status and college education are added in to complete the set of controls, homeownership once again loses its explanatory value. Employment and college predictably have a negative effect on number of children.

Regressions (2.2) and (2.3) are very similar; regression (2.3) adds only a control for birth year. Curiously, when age alone is introduced to the model, homeownership loses its

significance, but when birth year is then also added, its coefficient gains a significant negative effect. One theoretical interpretation for this could be that homeownership captures two distinct and separate effects: a generational divide and a class divide. In both cases, older and upper-class individuals may both be expected to have larger-than-average wealth endowments—and thus are more likely to own their home. This creates two groups of likely homeowners, the older generation and the younger upper-class, who have conflicting fertility outlooks. As evidenced by regression (1.3), the earlier a person's birth year, the more children they are expected to have, but the more money a person makes, the fewer children they are expected to have. This could mean that older generation homeowners are expected to have more children while younger affluent homeowners are expected to have fewer children, jumbling the effect of homeownership after controlling for marriage and age and leaving homeownership's coefficient ambiguous in regression (2.2). However, when just one of those effects, birth year, is controlled for in regression (2.3), homeownership not only regains its significance, but flips negative. Finally, when the college variable is introduced in (2.4), both effects are accounted for in the control terms and homeownership again loses its statistical significance.

An obvious problem with this interpretation is that regression (1.2) did not have a significant negative coefficient for homeownership despite controlling for birth year. A possible explanation to resolve this point of contention could be that the class effect is only relevant to homeownership for women; the observed negative effects for socioeconomic factors are only reflected in the homeownership variable for women while men's homeownership is more consistent across class. However, these models are not enough to substantiate the possible answers I lay out to address the discrepancy. Further investigation on this topic could be promising.

Child Difference Regression

In further developing a model of the effect of homeownership on fertility, I exploit the panel structure of the data to build a regression model with a differenced dependent variable. Here, the dependent variable is the change in the number of children a respondent has between year *t* and one year prior. The homeownership status in year *t* is the independent variable. A few key points are worth noting about this model: first, these numbers represent total children, not just dependents. Second, while the number of children an individual has is not likely to increase by more than one per year, the dependent variable is not a binary variable and it is possible for the increase to be two or more.

Finally, the *loss* of children is factored out because it does not indicate a family planning decision—all negative values are changed to zero. It is not clear why year-over-year changes in survey data might show the loss of a child. This could be due to the death of a child or a reporting error. Perhaps factors like estrangement or divorce might prompt a respondent to report fewer children. Nonetheless, all negative values are removed. (The loss of children could theoretically be problematic if a respondent loses a child *and* gains a child in a year, but that seems rare enough as to not affect the model outcome.) Model (B) specifies this regression.

$$[B]\ \Omega_{it} - \Omega_{it-1} = \beta_0 + \beta_1 x_{1it} + \sum_{k=1}^{K} \beta_k x_{kit} + \varepsilon_{it}$$

The dependent variable term **Ω** represents the same value as it has in preceding models, this time subtracting out the previous year's number of children to derive a change value. The intercept value β_0 represents the expected change in number of children for an individual with all $x_i = 0$; this is a hard value to interpret because age is included as a control variable. For the independent variable's coefficient interpretation, β_1 is the additional expected change in number of children associated with someone owning their own home. A binary independent variable for homeownership is x_{1it} and control variables *k* are included in a summation containing some controls that were included in previous models and some new ones. Finally, ε_{it} represents idiosyncratic error.

As in previous models, age, birth year, marital status, and household wages are controlled for. The incorporation of these variables as controls is the same, with the exception of marital status. The ever married variable is replaced with a current marital status variable, which has a value of one if the respondent is married or cohabiting and a value of zero if not. New variables included in this model are controls for dragon and tiger zodiac years. Some papers studying fertility in the Chinese diaspora control for the year of the dragon and tiger. (Lo, 2012) In Sinophone countries where the Chinese zodiac is observed, children born in the year of the dragon are ascribed particularly desirable traits, while tradition holds a superstition against births in the year of the tiger. National statistics demonstrate a spike in births during dragon years and the inverse in tiger years. Studies have demonstrated a causal effect, (Goodkind, 1993; Yip, Lee, & Chung, 2002) though the continued significance of this effect has been questioned. (Hung, 2016) Over the course of this survey's time period, one dragon year (2012) and one tiger year (2010) are represented in the data. I include a dummy variable for both in two of the regressions for this model.

Table 5 contains the results of this model estimation under three sets of controls. Regression (3.1) contains just the homeownership variable and controls for marital status and age, the variables with the strongest theoretical justification and results in previous models. Here, homeownership has a statistically significant positive effect on the expectation for change in children. However, the inclusion of variables for birth year and zodiac controls in regression (3.2) eliminates the explanatory value of homeownership. Regression (3.3) adds household wages as a regressor.

Previous models showed how the introduction of age and marriage variables consistently eliminate the significance of the homeownership effect in the aggregate and the results from the differences model also illustrate the importance of generational variation in clarifying this effect generally across models. While the dragon year and tiger year controls were also introduced in model (5.2), these variables only carry non-zero values in two out of sixteen survey years. Birth year seems the by far more likely culprit that resulted in homeownership losing its significance. Since age is already controlled for, the inclusion of birth year is not showing the effect of how old someone is, but rather the effect of when someone was born, or what generation they belong to. This variable allows us to differentiate between our fertility expectations for a thirty-year-old in 2000 and a thirty-year-old in 2015. The strong negative coefficient for birth year shows that

all else equal, we can expect those who have reached reproductive age more recently to have fewer new children at any given age level. Not only is this consistent with the previous models' results, but it is also quite predictable given what we already know about Taiwan's falling TFR.

Table 5: Regressions, New Child (Full Dataset)

New Child	(3.1)	(3.2)	(3.3)
n	54650	54650	49966
Homeowner	.040***	.003	.003
	.004	*.004*	*.004*
Currently Married[1]	.057***	.045***	.052***
	.004	*.004*	*.004*
Age	-.055***	-.094***	-.094***
	.001	*.001*	*.001*
Age-Squared	.000***	.001***	.001***
	.000	*.000*	*.000*
Birth Year[2]		-.018***	-.018***
		.000	*.000*
Household Wages[3]			-.000***
			.000
Dragon Year		.138***	.118***
		.005	*.005*
Tiger Year		-.186***	-.199***
		.006	*.006*
β_0	1.628***	3.477***	3.505***
	.021	*.035*	*.037*
R-Squared	.1459	.2350	.2361
f-statistic	2333	2398	1930

* Statistically significant at 90%
** Significant at 95%
*** Significant at 99%
[1] Currently married, including cohabitation
[2] Years since 1934, the oldest observed birth year
[3] New Taiwan Dollar, tens of thousands, combined wages of respondent and spouse, monthly

But what does the loss of statistical significance for homeownership mean in conjunction with this? The relationship between generation and homeownership seems complex: in the female-specific model, the introduction of birth year gave homeownership an entirely new direction of correlation. For the differences model, homeownership also has a significant effect even with marriage status and age included, but loses significance once birth year and wages are included. Since homeownership only loses its statistical significance once birth year is introduced, like before, the significant coefficient for homeownership in regression (3.1) may be masking an intergenerational story. One similarity across models is that including birth year as a control always results in a lack of a significant positive correlation between homeownership and fertility outcomes. This lends itself to the implication that any positive relationship between

homeownership and fertility is merely due to older generations being more likely to both own a home and have more children.

Regression (3.2) does provide a new level of clarification. Model (A)'s dependent variable was the total number of children a respondent had had over the course of their lifetime, which presented some ambiguity with the theoretical interpretation, especially for the older individuals included in the full sample who were unlikely to have new children. These regression results show a dynamic relationship. When all controls are included, homeownership not only lacks a correlation with the number of total children a respondent has, but also lacks a correlation with the expectation for whether the respondent will have a new child in the next year.

First Differences Regression

A first differences regression can be used to estimate the change in number of children as a function of the change in homeownership while eliminating the possible influence of individual attributes that do not change over time. This nicely allows for a more direct method of estimating the relationship between homeownership and fertility without concerns about a myriad of static variables. The model's dependent variable is the change in number of children for year *t*. Like the previous model that uses change in number of children as its dependent variable, this is not a binary variable, but its values will typically be zero or one. The intercept β_0 is the expected change in number of children provided no independent variables change between year *t*–1 and *t*. The independent variable $(x_{1ti} - x_{1t-1i})$ represents the change in homeownership as the difference between the same binary variable over the course of two time periods. Since a value of one is assigned to x_{1ti} when the individual owns their home and a value of zero when they don't, the independent variable for homeownership change in this model will have a value of one if the individual has become a homeowner over the past year, a value of zero if their homeownership status hasn't changed, and a value of negative one if they were previously a homeowner but now are not. The model is specified below.

$$\text{[C]}\ (\Omega_{it} - \Omega_{it-1}) = \beta_0 + \beta_1(x_{1it} - x_{1it-1}) + \sum_{k=1}^{K} \beta_k(x_{kit} - x_{kit-1}) + \varepsilon_{it}$$

The model controls for *k* control variables that do vary over time. The use of these variables follows the same approach: each variable's value in year *t* is subtracted from the previous period's value. Previously used controls like birth year are not used in the model since they do not vary over time. Although college may vary over time, most of the variation will occur prior to childbearing, so I opt not to include it in this regression. Age, on the other hand, does vary over time, but it does so in standard increments, so it is omitted as well. The variables that are included in the control summation are the respondent's current marital status, their combined household wages, and whether year *t* is a dragon or tiger year.

Because this model uses change in number of children as its dependent variable, I choose to restrict the sample to individuals between the ages of 20 and 39, when having children is most likely. This eliminates any concerns about a large volume of observations with zeroes for the dependent variable (but non-zero values for the independent and control variables) from

cluttering the model and keeps the intuition of the coefficient values straightforward. Doing so certainly eliminates individuals who may have children at a later age—particularly men, whose window for childbearing years is greater than that for women—however, this regression provides the most value for the purposes of studying how homeownership influences family formation, particularly with an interest in addressing low fertility rates and public policy.

Table 6: First Differences Regression (C) (Ages 20-39)

Child	(4)
n	38698
Δ Homeowner	.070***
	.012
Δ Current Marital Status[1]	.119***
	.007
Δ Household Wages[2]	.000
	.000
Dragon Year	-.004
	.005
Tiger Year	-.006
	.006
β_0	.035***
	.002
R-Squared	.0083
f-statistic	65

* Statistically significant at 90%
** Significant at 95%
*** Significant at 99%
[1] Currently married, including cohabitation
[2] New Taiwan Dollar, tens of thousands, combined wages of respondent and spouse

Table 6 presents the results of the first differences model. Here, a change in homeownership and marital status are both associated with a same-year increase in number of children. These results have a strong statistical significance. All other independent variables were not found to have a significant association with a change in number of children. While previous models estimated in this paper have found that homeownership loses its explanatory value with respect to childbearing when sufficient controls are introduced, this regression result suggests that becoming a homeowner does have predictive value over whether the respondent will also have a child. It is important to note here that the causality is not clear: this regression is not suggesting that becoming a homeowner leads to having one or more new children; it is merely suggesting that the two are correlated. The causation may go in the other direction, with an anticipated new birth leading to a couple choosing to buy a home.

This result can be reconciled with a lack of significance for the homeownership variable in previous models in that the first differences regression provides insight into a sort of timeline of events. While homeownership may not be associated with an increase in the overall number of children we would expect a family to have, homeownership may be associated with an increase

in the number of children we would expect the family to have in the next year (or next few years). We could extrapolate and imagine that homeownership may be linked with the timing of when families start having children, and *younger* homeownership could potentially be associated with having more children, even if homeownership alone is not. This provides a useful starting point for further research.

One helpful way to conceptualize this model compared to the child differences model is imagining a population of people divided into two groups: homeowners and non-homeowners. In the child differences approach, model (B), the expectation for whether someone has a new child in the next year is the same, all else equal. In the first differences approach, model (C), we divide the population in a new way: whether someone has bought a house in the past year and whether they haven't. In this model, the expectation for whether someone has a new child is different. Those who bought a new home are more likely to have a new child than those who did not. What we can draw from this conceptualization is that homeownership may not be a very good predictor for whether someone has a child, but the timing of becoming a homeowner is a good predictor of when someone has a child.

CONCLUSION

Taiwan is at the global forefront of lowest-low fertility research and policy formation. Its demographic story is critical to the livelihood its future generations will face on the island and will inform population researchers' understanding of low fertility for decades to come. The familial, social, and cultural structures give Taiwan unique characteristics, but the questions it faces today are shared by many countries around the world. As more nations advance through economic development, demographic change is sure to follow, and the question of what factors influence fertility and in what way will only become more relevant. This paper has studied at one variable of interest, homeownership, and explored ways it interacts with fertility at the individual level.

This paper's results call into question whether homeownership alone plays an impactful role in family planning decisions. Regressions (1.1) through (1.3) initially show that homeownership is only empirically tied to fertility in the absence of stronger variables. Though homeownership has a positive correlation with the number of children a person has, once marital status and age are accounted for, homeownership loses its explanatory value. Age and marital status are both strongly correlated with homeownership, so it is easy to see how homeownership may have only been serving as a proxy for those more impactful fertility indicators.

The female-specific OLS regressions support most of the findings of the general OLS regressions. Once again, homeownership has a sizeable effect as a lone independent variable, but once all the controls are introduced, it completely loses its statistical significance. One difference worth highlighting between the female-specific regressions and the full-sample regressions is that when just controls for age, marriage, and birth year were introduced, homeownership lost its significant effect for the general sample but saw the coefficient sign switch from positive to negative for the female sample. A possible explanation is that the homeownership variable

contains information about important education and workforce factors in the sample of women, but do not do so in the mixed sample. This topic warrants further study. However, it seems unlikely that homeownership itself was truly the root factor at play.

The child differences regression model again indicates that the correlation between homeownership and fertility is a proxy for other factors impacting family formation patterns. Though homeownership retains a positive effect on whether a respondent will have a child in the next year with only controls for marriage and age included, the addition of generational and socioeconomic controls results in the effect of homeownership disappearing. This supports the idea discussed in response to the female-specific regressions that generation and class may also have effects that homeownership is capturing in addition to marital status and age. Uniformly, whether a model uses a cumulative fertility dependent variable or a change in fertility dependent variable, once controls for marriage, age, generation, and socioeconomic background are included, homeownership alone is not correlated with fertility.

However, the first differences model suggests that a change in homeownership is correlated with family planning decisions. The first differences model shows that in a dynamic setting, someone who becomes a homeowner in a given year is more likely to also have a child in that year than the rest of the population. This is a likely but nonetheless interesting outcome: obtaining a home and having children are both logical building blocks to family formation and it is easy to see how they go hand-in-hand. However, previous literature has called into question whether these two life events would really be expected to go together or whether their costs would crowd one another out. Confirming that homeownership increases the likelihood of a young adult having a child in the next year is useful to a broader discussion about the interconnectedness of housing, marriage, and childbearing in family planning.

Throughout the empirical analysis, homeownership often took the backseat to stronger variables as a predictor of fertility. It is tempting to say that for Taiwan, the focus should be on marriage culture rather than the housing market when it comes to pro-natal interests. However, the close ties between these variables related to family formation—a close relationship that is easy to define empirically, theoretically, and anecdotally—does not allow for an easy resolution. Perhaps marital status absorbs most of the predictive power over fertility outcomes and leaves little explanatory value for homeownership. But let's take a step back: what if homeownership is, in turn, the primary predictor of whether a young couple gets married? What if buying a home is the main barrier to getting married in Taiwan? Although marriage may be the more direct factor influencing fertility, homeownership may still be just as important of a factor in the family formation story.

Untangling this knot of interrelated and highly correlated issues may be difficult to do empirically, but further research into how Taiwan's current housing market is affecting the ability of couples who would like to get married to do so would be a good first step. Further research that focuses on how the timing of life events, such as marriage, buying a first home, and having a first child affect one another would provide important insight not only into how these variables are related but also what factors are most important to enabling family formation. Additional research that could address the causality of effects on homeownership would also be

useful in clarifying what socioeconomic factors have a true effect. Formulating targeted policy is difficult to do in the absence of this information.

At a fundamental level, the question of how governments can best respond to declining fertility is complicated by the question of whether and to what extent these trends are a problem. One conceptual approach to consider is a decomposition of declining fertility. Meilin Lee (2009) has previously attempted to break down Taiwan's fertility decline into its contributing components. Most significantly, a decomposition of the decrease into the effects of socioeconomic factors and personal preference factors is very significant not only for formulating an effective policy response, but also for evaluating the scale and short-run significance of the conceived problem. If the bulk of the reason young people are not having children is due to institutional economic barriers, this presents a complex but clearly motivating direction for government action. These economic barriers to family formation would, in this case, be clearly limiting to the utility of young adults and warrant a strong economic agenda. On the other hand, if the primary reason young people are not having children is simply because of their personal preferences, the response is much more complicated. It would be controversial for a government to try to influence social preferences, the direction for policy formation is less clear, and trying to effectively encourage a desire for fertility seems a dubious task. Moreover, a government trying to encourage a change in preferences seems contrary to the utility interests of its people. Even as we consider the economic drivers of delayed family formation, the role of changing attitudes towards childbearing is important to keep in mind and warrants more study. Comparing the effects of sociological preferences and economic conditions as they relate to low fertility would be particularly useful in a joined literature.

One challenge for policymakers in Taiwan is weighing competing interests and desirable economic outcomes, even within the demographic issues discussed in this paper. For instance, one of the chief concerns of the falling fertility rate is the burden on shrinking future generations of working-class people to support a ballooning elderly population. Although Taiwan's record-low fertility rate may be the root cause, one of the chief policy pursuits of Taiwan's government goes in a different direction: getting women to enter the workforce and stay in the workforce. This, of course, is a noble goal and more women in the workforce will help alleviate the impending labor market shortage that the Taiwanese government seems particularly concerned with. However, it will also undoubtedly contribute to Taiwan's TFR decline—an established fertility effect that was supported by this paper's regression results. This is one example of how social policy can be a double-edged sword for competing interests. It is important for policymakers to define a clear vision for a long-term economic future and come up with holistic solutions rather than addressing different social concerns independent of one another.

The contributing and limiting factors to family planning form a complex relationship that take a different shape in different societies around the world. With one of the world's lowest fertility rates and highest homeownership rates, Taiwan's demographics and housing market both represent intriguing case studies. Taken together, investigating the role homeownership plays in family planning represents an important question for the island and for demographers globally. In Taiwan, marriage and socioeconomic background appear to be stronger indicators of fertility

outcomes than homeownership. Generational effects also show a strong influence over both fertility and homeownership's effect on fertility. Policymakers in Taiwan will likely need to take a broad view and consider many of these social and economic structures in tandem; addressing housing without addressing social attitudes towards marriage and children, for instance, seems unlikely to yield strong pro-natal results. This paper contributes a next step for research into housing and fertility in Taiwan, but further exploration into the relationship between the two, especially in pursuit of developing a multivariate model of family formation, would be extremely valuable to fertility research and policy.

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