Housing Prices and Marriage Delay: Evidence from China*

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Abstract

This study examines the impact of increasing housing prices on the delay of marriage in China, where property ownership is culturally expected for marriage. We first present a discrete choice model demonstrating that due to increasing housing prices, individuals would delay marriage, partly involuntarily to accumulate savings for higher down payments, and partly voluntarily to mitigate the crowding-out effect on non-housing consumption. Using China's 2010 National Population Census data, our empirical estimation shows that a 10 percent increase in housing prices delays the age of first-time marriage by 0.91 months for urban-hukou holders while rural-hukou holders are not affected due to China's land policy. Female and younger individuals tend to delay their marriage more than male and older individuals. We also find that a 10 percent increase in housing prices delays the age of first childbirth for urban females by 2.05 months, which directly results from the delay of marriage.

Keywords: Housing prices, marriage delay, childbirth delay, gender differences

JEL codes: J12, J13, R21

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1. Introduction

China has experienced significant changes in housing markets in the past three decades. In the early 1990s, China started to phase out the government-controlled welfare-based housing system and gradually transitioned into a market-oriented system. The rate of homeownership among the urban population surged from about 20% in the early 1990s to 96% in 2019, which was the highest rate of homeownership in the world, compared to 64.7% in the United States (People's Bank of China, 2020). Since the reform, housing prices in urban areas, referring to the prices of all types of residential buildings (mostly apartments), have increased persistently. **Figure 1** shows the housing prices between 2000 and 2021 across city tiers, with the most pronounced increase in the first-tier cities (including Beijing, Shanghai, Guangzhou, and Shenzhen).[1]

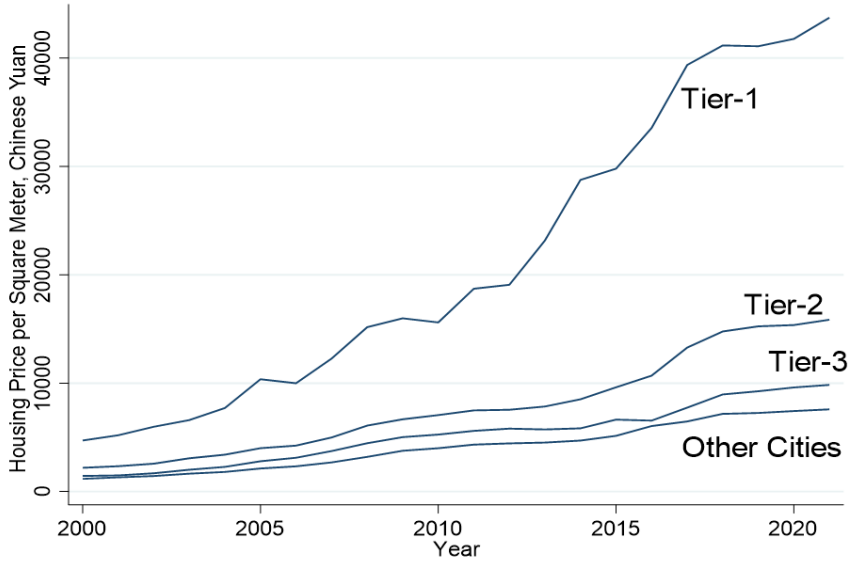


Figure 1 Housing prices in China (2000-2021)

The housing reform, among other market-oriented reforms, has profoundly changed the Chinese economy and further influenced social norms through economic power. One important norm related to housing markets is that newlyweds are expected to own a property before marriage and the groom side is expected to take the major or full responsibility. Consequently, the increase in housing prices would have an important impact on marriage decisions. Indeed, the age at first-time marriage (hereafter the marriage age) in China has continuously increased in the last several decades. The average marriage age was 23.8 for men and 22.15 for women in 1990, and rose to 29.38 for men and 27.95 for women in 2020 (China's Bureau of Statistics). **Figure 2** shows that the marriage age has increased from 2000 to 2010 across city tiers, with consistently the highest age in first-tier cities (2010 National Population Census).

[1] The National Bureau of Statistics of China classifies cities into four tiers: 4 first-tier cities (Beijing, Shanghai, Guangzhou, and Shenzhen), 31 second-tier cities, 35 third-tier cities, and the rest are other cities.

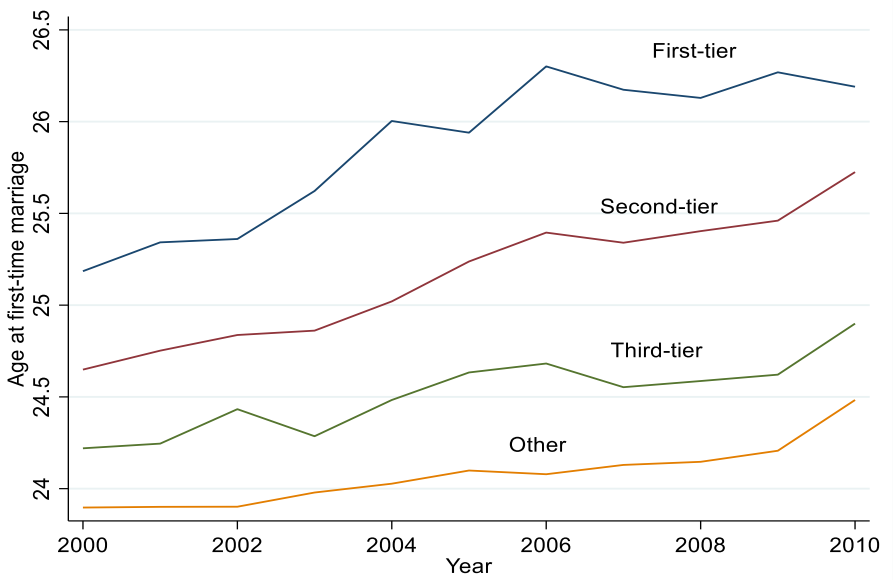


Figure 2 Marriage age in China (2000-2010)

This paper investigates the impacts of increasing housing prices on the delay of marriage. We first develop a theoretical model to illustrate the mechanisms through which housing prices influence marriage decisions, and then undertake an empirical analysis to estimate the impacts using China's 2010 National Population Census data. The census covers the period from 2006 to 2010, during which China's housing prices increased substantially. In addition to our main analysis of the delay of marriage, we also investigate the impact of housing prices on the delay of childbirth, which is a direct consequence of the delay of marriage.

There are limited studies linking housing markets to marriage markets in China's context. Wrenn et al. (2019) find that the first marriage rate declines by 0.31 percent for a 1 percent increase in housing prices using the 2005 Chinese mini-census data. Zhao et al. (2023) show that rising housing prices from China's urban land transaction policy in 2002 delayed the first marriage age by 0.228 years based on the China Labor-force Dynamic Survey data. Fang and Tian (2018) find that owning a larger property not only boosts a man's marriage prospects but also correlates with marrying a taller female based on survey data from rural China in 2011, underscoring homeownership as a signal in marriage markets.

The delay in marriage is not unique to China. Between 1970 and 2000, the proportion of single women aged over 30 increased in nearly all countries in the Asia Pacific (Jones, 2007). The rising marriage age is attributed to increasing costs associated with marriage, which include direct and indirect costs. Escalating costs of homeownership are primary direct costs. Lee et al. (2021) find that rising housing costs are an important contributor to the delay of marriage in Korea from 1990 to 2010. The study also shows that in addition to rising housing prices, educational, cultural and gender factors contribute to the delay of marriage as well. Some studies argue that improved education and career opportunities for women raise the opportunity costs of marriage (Goldstein and Kenney, 2001; Marphatia et al., 2020).

Our paper makes several contributions to the literature. First, we provide a theoretical model that links rising housing prices to the delay of marriage, while the existing studies

predominantly focus on empirical analysis. Second, our study uses a large dataset based on a national census covering the period from 2006 to 2010, during which China experienced significant increases in housing prices. By contrast, the above several studies use much smaller datasets and cover the early 2000s in which housing prices increased only modestly. Third, our estimation employs a robust identification strategy to address potential endogeneity issues, thereby establishing a plausible causal relationship between housing prices and marriage ages. Fourth, the paper provides a rich set of heterogeneity analyses, thanks to the large dataset with a wide range of variables. The heterogeneity analyses not only validate our main results, but also provide additional insights across groups. Fifth, the paper also explores the impacts of housing prices on the delay of childbirth, which has implications for the decline of fertility rates.

The theoretical model of our paper, assuming that a property is a necessity for marriage, demonstrates that rising housing prices delay marriage through two channels. First, higher housing prices extend the time needed for individuals to accumulate a compulsory down payment (proportional to housing prices), thereby postponing marriage. Second, individuals make a trade-off between purchasing a property for marriage and sustaining non-housing consumption, and hence voluntarily delay marriage in response to rising housing prices.

The empirical part of our paper, including a wide range of heterogeneity analyses, provides rich conclusions. First, a 10 percent increase in housing prices is associated with a 0.91-month delay in marriage for urban-hukou holders, however this relationship is not statistically significant for rural-hukou holders. This difference is related to China's land policy that urban residents do not own land and must buy properties from housing markets after the housing reform, whereas rural residents can build properties on collectively owned land. Second, a 10 percent increase in housing prices results in a 1.13-month delay in marriage for urban homeowners while the increase does not affect urban home renters. This difference likely arises because renters may not consider homeownership as a prerequisite for marriage, and hence their marriage remains unaffected by urban housing prices. Third, an increase in housing prices has a more substantial impact on the marriage age for urban females compared to urban males. Females typically receive lower incomes and less family financial support, and thus are more adversely affected by rising housing prices. Fourth, the impact of housing prices is less pronounced for individuals who married in regions with a more imbalanced sex ratio (more males than females). Fifth, the impact of housing prices is significant for individuals who married at a relatively young age (below 30), but insignificant for those who married later (above 30), indicating a non-linear impact on marriage ages. Sixth, migrants (who have relocated from rural to urban areas for more than two years) delay their marriage when housing prices increase, while non-migrants (temporary residents in urban areas) are not responsive to housing prices.

In addition to marriage ages, we also find that a 10 percent increase in housing prices delays the age at first childbirth for urban females by 2.05-months, which is a natural consequence of the delay in marriage. This finding cross-validates other studies such as Liu et al. (2020) and Clark et al. (2020), which indicate that an increase in housing prices reduces the likelihood of raising children.

The remainder of the paper is divided as follows. Section 2 builds a theoretical model linking housing prices to marriage ages. Section 3 presents the empirical method, with data described in Section 4. Section 5 discusses the results, including mechanisms and a wide range of heterogeneous analyses. Section 6 concludes the paper.

2. Theoretical model

The economic theory of marriage dates to Becker (1974) who proposes a theory based on the division of labour in the principle of comparative advantage. If men are better at earning money in the labour market and women are better at taking care of homes and children, it is desirable to combine forces within marriage so that they can specialize in what they each do best. However, the comparative advantage between men and women diminishes with the expansion of labour market opportunities for women. Carbone and Cahn (2014) argue that economic inequality within and across genders changes marriage markets through supply and demand, and marriage markets become segmented by class. More specifically, increasing economic inequality produces a larger group of high-income men than women, writes off low-income men at the bottom, and leaves a larger group of women than men in the middle.

In addition to purely economic factors, social norms also play important roles in marriage markets especially when they interact with economic factors. In the Chinese context, newlyweds are expected to buy a property for marriage and the groom side is expected to take the major or full responsibility. This norm has important implications for marriage markets when housing prices increase. In the following, we first set up a simple discrete choice model to illustrate the marriage decision of men, and then discuss the case of women.

Suppose a man decides whether to marry or remain single, at every age a ($a \geq 18$) if he has not married yet. Marriage requires owning a property, so the marriage decision involves another decision on whether to buy or rent a property. The person has four possible choices at every age: (1) buy a property and get married; (2) buy a property and delay marriage; (3) rent a property and delay marriage; and (4) rent a property and get married. The last choice is not common, and the second choice is presumably inferior to the third one. Therefore, we confine our attention to the first and third choices.

The person's decision on marriage depends on housing services, non-housing consumption, and the benefit of marriage. The utility at age a is

$$u_a(c, h, m) = v(c) + w(h) + \gamma(a)\mathbf{1}(m) \dots (1)$$

where c is the consumption of non-housing goods and services, and h represents the housing services. The housing services can be obtained from a purchased or rented property. Suppose owning and renting an identical property provides identical housing services. Assume $v(c)$ and $w(h)$ are both increasing and concave. $\mathbf{1}(m)$ is an indicator function of marriage, taking 1 if marriage and 0 otherwise. $\gamma(a)$ represents the utility of marriage at age a, which is assumed to negatively depend on the age.

The person has adaptive expectations where he forms the expectation of the future based on his current situation. Thus, one expects the housing price to remain unchanged in the future

and adjusts the expectation when the current price changes, which eliminates the motive of financial investment in properties. Whenever the person buys a property, they choose to pay exactly the down payment (as a fraction d of the housing price) and repay the mortgage equally over a fixed period T (typically 20 or 30 years). The annual repayment is a fraction δ of the housing price net the down payment. Thus, if the person delays marriage from age a to $a+1$, the utility at age a would change, the utility during each period between $a+1$ to $a+T-1$ remains the same, and the utility in period $a+T$ is different given the same time duration of the mortgage. We assume the difference in utility at age $a+T$ is negligibly small after being discounted over a long period T, so we can focus on the utility change at age a.

Denote by p the housing price or the total price of an average property whose area is normalized to one. The person pays a fraction θ of the total price of a property, with the rest shared by their partner, where θ is large for males and small for females. l is the annual rent cost. $s(a)$ is savings at age a, and $i(a)$ is the income, which are both assumed to increase in age. The person decides to marry at age a only if he saves enough for the down payment, and he is better off to get married at age a than at $a+1$. Mathematically,

$$v(s(a)-\theta dp+i-\delta\theta(1-d)p)+\gamma(a)>v\big((1+r)s(a)-\theta dp+i-l\big)\ldots(5)$$

where the person must meet the down payment requirement, i.e., $s(a)>\theta dp$. Equivalently,

$$\gamma(a)>v(s(a)-\theta dp+i+rs(a)-l)-v(s(a)-\theta dp+i-\delta\theta(1-d)p)\ldots(6)$$

Consider a specific case $v(c)=\ln(c)$, indicating that the marginal utility of non-housing consumption can be extremely large when the level of non-housing consumption is low especially below the subsistence level. Also, we assume $\gamma(a)$ is bounded at a certain level even when a is small (above 18 years old) such that people value subsistence much more than marriage. The above inequation can be rewritten as

$$\gamma(a)>ln\left(1+\frac{rs(a)+\delta\theta(1-d)p-l}{s(a)-\theta dp+i-\delta\theta(1-d)p}\right)\ldots(7)$$

The left side represents the utility gain of marriage, and the right side represents the utility loss from reduced non-housing consumption crowded out by purchasing a property for marriage. The person decides to get married when the utility gain of marriage is larger than the utility loss of crowding out non-housing consumption.

When a is small, the non-housing consumption is small if the person decides to buy a property, so the utility loss from non-housing consumption reduction on the RHS can be very large, which dominates the utility gain from marriage on the LHS. When a increases, the utility loss from non-housing consumption reduction becomes smaller because the marginal utility of consumption diminishes. Suppose the marginal utility of consumption decreases rapidly when consumption is above the subsistence level. Thus, when a is sufficiently high, the utility loss from non-housing consumption reduction becomes smaller than the utility gain from marriage. **Figure 3** illustrates the trade-off between marriage and non-housing consumption. The orange line represents the utility gain of marriage, which decreases with

age. The blue line U_{c1} represents the utility loss from non-housing consumption reduction when the housing price is low, while U_{c2} represents the utility loss when the housing price is high. When the housing price increases such that the utility loss from non-housing consumption moves from U_{c1} to U_{c2}, the person would delay his marriage from age a_1^* to a_2^*. Furthermore, due to the diminishing marginal utility of non-housing consumption, an increase in housing prices would cause a more pronounced delay in marriage for younger individuals with lower income and savings, compared to their older counterparts.

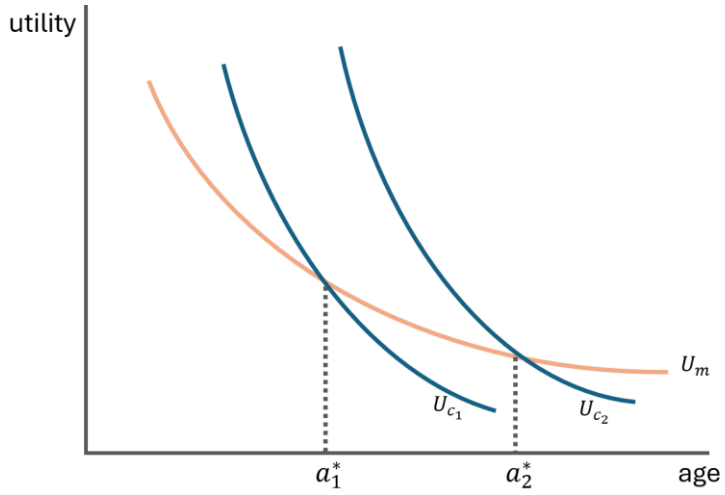


Figure 3 Marriage age and utility

The down payment requirement suggests that the age at which a person accumulates sufficient savings above the down payment threshold increases in housing prices. Therefore, in response to housing price increases, people would delay their marriage partly involuntarily because they need a longer time to accumulate more savings due to increasing down payments, and partly voluntarily because they would mitigate the crowding-out effect on non-housing consumption.

The above analysis is applicable to women. Women are expected to share less responsibility for buying properties, but they tend to have lower incomes, so an increase in housing prices can have similar impacts for men and women. There is another big difference between men and women in marriage markets, where men tend to marry down (hypogamy) and women tend to marry up (hypergamy). Saint-Paul (2015) argues that hypergamy emerges when there is widening inequality in human capital between men and women. Additionally, due to the long period of pregnancy, women incur an opportunity cost when participating in marriage markets. As a result, women need to be compensated by matching with men who have higher human capital. The equilibrium outcome of hypergamy is that a significant number of men at the lower end of the social class distribution will remain unmarried, as will a corresponding number of women at the upper end. Thus, economic inequality within and across genders plays an important role (Carbone and Cahn 2014). When housing prices increase, more men previously in the middle class may fall into the bottom of the distribution and never get married, so it is harder for women to marry up which further delays women's marriage.

3. Empirical method

To estimate the impact of housing prices on marriage delay, our empirical model is specified as follows:

$$a_{i,c,t} = \beta_0 + \beta_1 \ln(hp_{c,t}) + \beta_2 \boldsymbol{X_{i,c,t}} + \beta_3 \boldsymbol{Z_{c,t}} + \beta_4 \boldsymbol{P_c} Y_t + \gamma_c + \mu_t + \epsilon_{i,c,t} \ldots (8)$$

where *i*, *c*, and *t* represent individual, city, and year, respectively. The year denotes the time an individual had their first marriage, which can be 2006, 2007, 2008, 2009, or 2010 in our data. $A_{i,c,t}$ indicates the marriage age of individual *i* in city *c* in year *t*. $\ln(hp_{c,t})$ is the log of housing prices in city *c* in year *t*. $\boldsymbol{X_{i,c,t}}$ is a set of individual characteristics, $\boldsymbol{Z_{c,t}}$ is a set of time-varying city characteristics and $\boldsymbol{P_c}$ is a set of time-invariant city characteristics. We incorporate the time-invariant variables in the form of interacting with year trends, denoted by Y_t. The interaction controls for the influence of continuous changes in these time-invariant city characteristics over time. γ_c and μ_t are city and year fixed effects, and $\epsilon_{i,c,t}$ is an error term.

β_1 is the coefficient of our main interest, which shows the impact of housing prices on marriage ages. The estimation of β_1 in an OLS estimator can be biased if housing prices are correlated with unobserved determinants of marriage decisions. For example, cities with more employment opportunities may experience higher housing prices due to increased demand. Individuals in these cities may choose to delay marriage because there are better opportunities for career development. Also, social expectations about marriage ages can significantly differ across cities within China. These factors from the demand side are difficult to be included as covariates. Additionally, there might be reverse causality between marriage ages and housing prices as marriage rates can affect housing demand and hence housing prices. If people delay marriage, they might also delay purchasing properties, reducing housing demand with downward pressure on housing prices.

To address the potential endogeneity, we introduce instrumental variables from supply-side factors of housing markets, which typically do not directly influence individual decisions of marriage. Therefore, they are less likely to be correlated with unobserved demand-side factors that affect both housing prices and marriage ages. Several studies discuss instrumental variables to housing prices. Saiz (2010) argues that geographic factors have important impacts on house planning and thus affect housing prices from the supply side in the context of the United States. In China's context, Liu et al. (2023) use the percentage of land covered by internal water bodies (wetlands, rivers, lakes, etc) and the average slope of urban land to instrument local housing prices. In China, urban land is primarily owned by the government, and is sold to housing developers through bidding. Housing developers then build residential units (mostly apartments) and sell properties to households. Households are rarely aware of land information in this process. However, land prices play an important role in determining housing prices in China. Deng et al. (2012) indicate that housing prices appear to be driven by land prices rather than construction material costs or workers' wages based on data from 35 major Chinese cities between 2003 and 2011. Hence, it's reasonable to assume that households would not consider land prices when making marriage decisions.

However, land prices can correlate with individuals' marriage decisions through local governments' public spending. China's local governments heavily rely on revenues from selling land. Land conveyancing income accounted for 53.5% of local government revenues between 2000 and 2017 (Xu, 2019). Each local government is the sole supplier of land and has incentives to influence land prices based on its monopolistic power over land supply. Hence, land prices correlate with the local government's fiscal capacity to provide public infrastructures and services, which can affect people's marriage decisions. To address the potential concern about the correlation between the instrumental variable and the error term, we include the local government's fiscal capacity as a control variable, which is represented by the ratio of fiscal expenditure to revenues at the city level.

We use water density in each prefectural city as a measure of local geographic land constraints, denoted by $water_c$. Water density depends on local geographic conditions and is not affected by local economic variables, thus meeting the exogeneity of instrumental variables. Additionally, we use the one-year lag of residential land prices as a measure of production costs of housing prices, denoted by $lp_{c,t-1}$. Both $water_c$ and $lp_{c,t-1}$ are positively correlated with local housing prices. With appropriate control of covariates, it is reasonable to believe that our instrumental variables are independent of the error term. We use the interaction between the geographical housing constraint (water density) and the one-year lag of local residential land prices, denoted by $water_c * \ln(lp_{c,t-1})$ as the final instrumental variable because the interaction strengthens the instrument's relevance compared to each of the two variables separately. Additionally, we also include both $lp_{c,t-1}$and $water_c$ (absorbed by city fixed effects) to control for any potential direct impacts from these two variables. Thus, the first stage estimation of two-stage least squares (2SLS) can be written as

$$\ln(hp_{c,t}) = \alpha_0 + \alpha_1 water_c \ln(lp_{c,t-1}) + \alpha_2 \ln(lp_{c,t-1}) + \alpha_3 X_{i,c,t} + \alpha_4 Z_{c,t} + \alpha_5 P_c Y_t + \theta_c + \rho_t + \tau_{i,c,t} \ldots (9)$$

In addition to our main analysis of the impact of housing prices on the delay of marriage, we also investigate the impact of housing prices on the delay of childbirth which is a direct consequence of the delay of marriage. The estimation strategy for the delay of childbirth is the same as that for the delay of marriage.

4. Data

The primary data is sourced from the 2010 Chinese National Population Census, covering individuals across 31 provinces and municipalities. The dataset includes a range of variables, such as birth year and month, educational level, ethnicity, place of residence, hukou registration details, marital status, and marriage year and month. We calculated the age at first marriage for individuals who entered their first marriage within the five years preceding the census (2006–2010). We excluded individuals who were: (1) not Han ethnically (accounting for 5.4 percent of the sample) given minority ethnic groups can have different norms about marriage; (2) not married (accounting for 36.83 percent of the sample); (3) from cities with very small sample sizes (accounting for 0.14 percent of the sample); and (4) younger than 18 or older than 40 (about 400 observations) assuming that individuals who married too early or

too late were outliers who married for unusual reasons unrelated to housing factors. The refined sample comprises 260,644 individuals across 252 cities.

We also matched the micro census data with macro variables at the city level, including GDP per capita, population, sex ratio (male to female), and the rural-hukou ratio. These macro variables were either collected from China's Statistical Yearbook for each city or aggregated from the 2010 Population Census data.

Our main variable of interest is the city-level housing price, which in this study refers specifically to newly-built residential properties We sourced housing information from Anjuke.com, a leading real estate website in China, which aggregates marketing data from various stakeholders including developers, intermediaries, brokers, and property owners. This source offers the most balanced housing price data across the sample period of our study.

The instrumental variable contains water density and local residential land prices. The data of water density were collected from the National Geomatics Center of China. Water density is calculated based on the vectors of water and the administrative area of cities. The data of land transaction information were collected from the China Land Market website. The transaction data report each project name, project location, land supply method, land use, industry classification, land area, and transaction price for each type of land in each city. We aggregated the residential land areas and the transaction prices across projects for each city in each year and calculated the average residential land price by dividing the total transaction price by the total land area.

Table 1 presents the descriptive statistics for the full sample and the sub-samples of urban-hukou and rural-hukou holders. The full sample consists of individuals who entered their first marriage within the five years prior to 2010, with an average marriage age of 24.47 years. The data also show that the average marriage age is higher among the urban sample, at 26.39 years, compared to their rural counterparts with an average age of 23.71 years.

Table 1: Descriptive statistics: Micro and Macro variables

	Full sample			Urban-hukou	Rural-hukou
	N	Mean	s.d	Mean	Mean
Micro variable					
Age at first-time marriage	260,644	24.47	3.61	26.39	23.71
Female	260,644	0.53	0.50	0.51	0.53
Education	260,644	3.52	0.89	4.36	3.18
Rural hukou	260,644	0.71	0.45	/	/
Whether work	260,644	0.81	0.39	0.81	0.82
Whether migrate	260,644	0.57	0.5	0.58	0.56
Macro variable					
Housing price per m^2	1,260	4,975.07	3,734.61		
GDP per capita	1,260	25,090.35	18,286.68		
Population	1,260	450.47	309.22		

Sex ratio	252	0.46	0.12
Fiscal ratio	252	2.23	1.44
Rural-hukou ratio	252	0.72	0.16
Variable for IV			
Lag of residential land prices	1,260	528	340.12
Water density	252	0.22	0.12

Notes: Micro variables refer to individual characteristics. Education is a category variable, they are no education, primary school, secondary school, junior high school, and college and above. Macro variables refer to city characteristics. The sex ratio and rural-hukou ratio for each city were computed using 2010 micro-census data. The sex ratio for each city indicates the proportion of females aged 18 years and above within that specific city. The rural-hukou ratio represents the proportion of individuals holding rural hukou, aged 18 years and above, within the city. Water density refers to the concentration of lakes and rivers within a particular city.

Table 2 presents the descriptive statistics across hukou types and gender. The urban-hukou male has the highest marriage age, at 27.2; while the rural-hukou female has the lowest, at 22.93. Additionally, the urban-hukou male also has the highest level of education and the rural-hukou female has the lowest. More than half of urban residents own a property, while most rural-hukou holders do not have commercial properties given we do not include self-built houses on collective land to calculate housing ownership.

Table 2: Descriptive statistics: by hukou type and gender

	Urban-hukou male			Urban-hukou female		
	N	Mean	s.d	N	Mean	s.d
Age at first-time marriage	36,370	27.20	3.41	37,963	25.61	3.22
Education	36,370	4.38	0.78	37,963	4.35	0.81
Housing ownership	36,370	0.622	0.485	37,963	0.629	0.483
Whether work	36,370	0.92	0.28	37,963	0.70	0.46
Whether migrate	36,370	0.55	0.5	37,963	0.61	0.49
	Rural-hukou male			Rural-hukou female		
	N	Mean	s.d	N	Mean	s.d
Age at first-time marriage	88,206	24.58	3.53	98,229	22.93	3.07
Education	88,206	3.22	0.66	98,229	3.14	0.66
Housing ownership	88,206	0.055	0.227	98,229	0.065	0.247
Whether work	88,206	0.95	0.21	98,229	0.7	0.46
Whether migrate	88,206	0.53	0.5	98,229	0.6	0.49

Notes: The calculation of housing ownership does not count the self-built houses on collective land.

Figure 4 depicts the correlation between city-level housing prices and marriage ages across gender. Overall, there are positive relationships between marriage ages and housing prices for both males and females, while there is a stronger positive correlation for females.

In addition to marriage ages, the 2010 National Population Census inquired about the fertility status over the past 12 months, and thus provided information on women's specific remaining time between November 2009 and November 2010. Based on this data, we calculated the

specific birth time for women. The average age for urban-hukou females to have their first baby is 26.44 years, while it is 23.64 years for rural-hukou females.

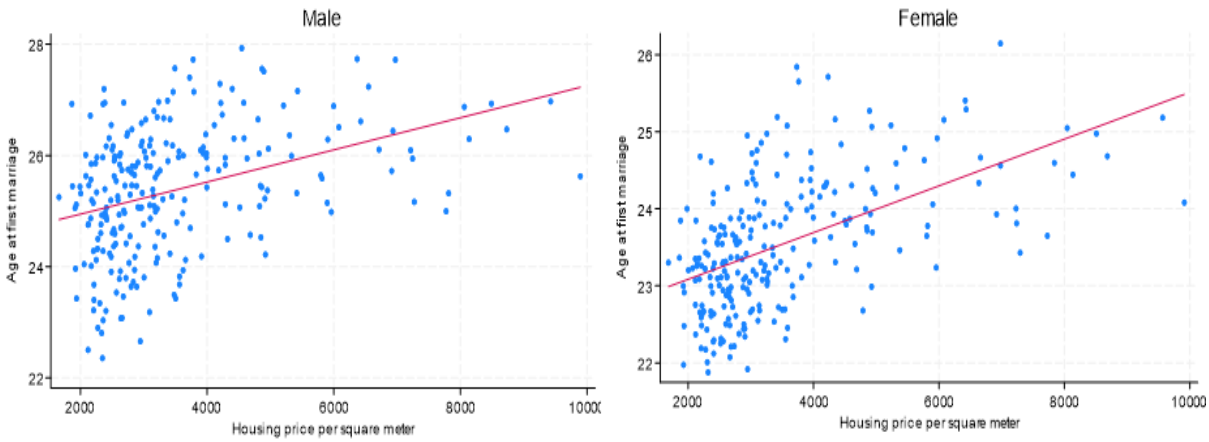


Figure 4: Housing prices and marriage ages, by gender

Figure 5 shows the housing prices and residential land prices across cities. There are strong positive relationships between housing prices and residential land prices. Additionally, the cities in coastal areas tend to have higher housing prices and residential land prices compared to their inland counterparts. The provincial capital cities also tend to have the highest housing prices and residential land prices within their respective provinces.

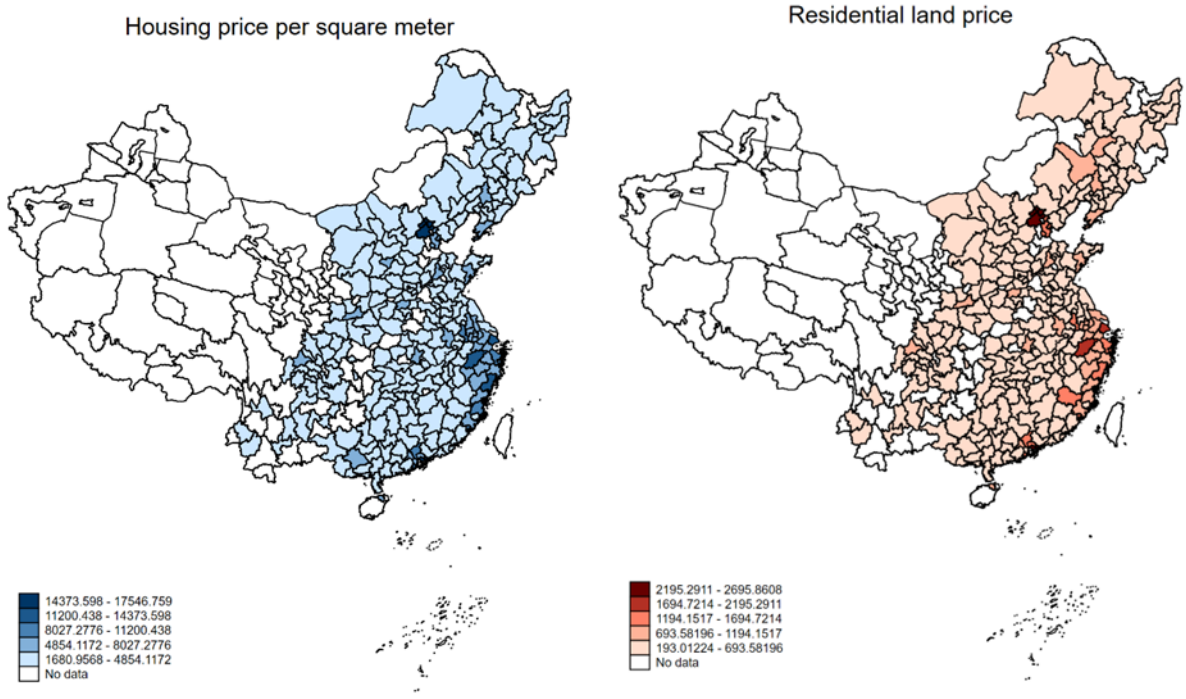


Figure 5: Housing prices and residential land prices

5. Empirical results

This section consists of two main parts: the first part presents the results of marriage delay, including the main results and some heterogeneous effects, while the second part presents the results of fertility delay.

Main results

Table 3 presents the OLS results, with columns (1)-(3) for the full sample, urban-hukou holders, and rural-hukou holders, respectively. All estimations include individual-level controls such as gender, educational level, employment status, and previous migration history. Additionally, we control for city characteristics including GDP per capita, population, sex ratio, and proportion of rural population. Both city and year fixed effects are incorporated in all columns. Standard errors are clustered at the city level to account for variations in housing prices.

Table 3: Main results, OLS

	(1) Full sample	(2) Urban-hukou	(3) Rural-hukou
ln(hp)	0.550***	0.683***	0.461**
	(0.144)	(0.164)	(0.273)
Whether female	-1.618***	-1.526***	-1.660***
	(0.052)	(0.041)	(0.060)
Education level			
Primary school	-0.655***	-0.102	-0.679***
	(0.238)	(0.818)	(0.243)
Secondary school	-1.430***	-0.690	-1.486***
	(0.224)	(0.811)	(0.231)
High school	-0.903***	-0.040	-1.067***
	(0.227)	(0.804)	(0.234)
College and above	-0.151	0.502	-0.031
	(0.232)	(0.803)	(0.243)
Whether rural hukou	-1.841***		
	(0.043)		
Whether work	0.050**	0.182***	-0.001
	(0.023)	(0.042)	(0.027)
Whether migrate	0.103***	-0.110***	0.192***
	(0.030)	(0.039)	(0.033)
ln(gdppc)	0.024	-0.000	0.048
	(0.088)	(0.110)	(0.095)
ln(pop)	-0.110	-0.035	-0.163**
	(0.071)	(0.083)	(0.077)
ln(rp_{t-1})	-0.077	-0.075	-0.124
	(0.074)	(0.092)	(0.076)
Sex ratio	3.111	5.122	3.501
	(3.883)	(4.084)	(4.225)
Fiscal ratio	-1.901***	-1.906***	-1.834***
	(0.435)	(0.560)	(0.435)
Rural proportion	-1.901***	-1.906***	-1.834***

	(0.435)	(0.560)	(0.435)
Observations	260,644	74,281	186,363
Adjusted R-squared	0.214	0.116	0.120
City FE	YES	YES	YES
Year FE	YES	YES	YES

Notes: All estimates are from OLS. Robust standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1. Columns (1)-(3) contain the full sample, urban-hukou holders, and rural-hukou holders respectively. All estimates are controlled by city fixed effects and year fixed effects. There are five categories of education level, and the referencing group is no education.

Column (1) indicates that a 10 percent increase in housing prices is associated with a 0.055-year (0.66-month) delay in marriage at the 5 percent significance level. For convenience, we will use months instead of years hereafter to describe the impacts of housing prices on marriage delay. Columns 2 and 3 reveal that urban-hukou holders delay marriage more than rural-hukou holders. A 10 percent increase in housing prices is associated with a 0.82-month delay for urban-hukou holders and a 0.55-month delay for rural-hukou holders. These results underscore a positive relationship between housing prices and marriage ages, with urban-hukou holders more sensitive to housing prices, potentially because rural-hukou holders can build properties on collective rural land, while urban-hukou holders do not have land and must purchase properties.

Table 4 shows the IV estimates. In Panel A, the instruments are positively and significantly correlated with the endogenous variable across all columns, which is a reasonable outcome given that both water density and the lag of residential land prices are positively correlated with housing prices. The F-statistics are well above the Staiger and Stock (1994) threshold of 10, suggesting that the instruments are strong. Lee et al. (2022) propose a more conservative threshold of 104.7 for the strength of instruments. Although our F-statistics are below the threshold, our corrections for critical values and calculations of tF 0.05 standard errors (adjusted t-ratio based on F statistics), as proposed by Lee et al. (2022), confirm the robustness of our instruments[2].

Table 4: Main results, IV estimation

	(1) Full sample	(2) Urban-hukou	(3) Rural-hukou
Panel A. *First stage*			
	Dependent variable: housing price per square meter		
water*lag(lp)	0.330***	0.302***	0.339***
	(0.038)	(0.041)	(0.036)
F statistics	75.18	54.99	83.56
Panel B. *Second stage*			
	Dependent variable: age at first-time marriage		
ln(hp)	0.292	0.755***	0.178
	(0.191)	(0.248)	(0.196)

[2] The bound estimates on the confidence interval for urban-hukou, based on Lee et al. (2022), range from 0.32 to 1.2, excluding zero, confirming statistical significance at the 5% level.

Observations	260,644	74,281	186,363
Individual characteristics	YES	YES	YES
City characteristics	YES	YES	YES
City FE	YES	YES	YES
Year FE	YES	YES	YES

Notes: All estimates are from IV estimation. water*lag(lp) indicates the interaction between water density and the lag of residential land prices. Robust standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1. Columns (1)-(3) contain the full sample, urban-hukou holders, and rural-hukou holders, respectively. All estimates are controlled by individual characteristics, city characteristics, city fixed effects, and year fixed effects.

Panel B presents the results from the second-stage estimation. Column (1) shows an insignificant impact of housing prices on marriage ages. The insignificance reflects the composition of the sample, dominated by rural-hukou holders, as demonstrated by the results in column (3) of Panel B, where housing prices have no statistically significant effect for rural-hukou holders. This finding aligns with China's land policy, where rural residents can build houses on collectively owned land, thus mitigating the impact of urban housing prices. The results in column (2) of Panel B reveal that a 10 percent increase in housing prices results in a 0.91-month delay in marriage for urban-hukou holders at the 1 percent significance level. Compared to the OLS estimations, the results for the full sample and rural-hukou holders become insignificant in the IV estimates. As a caveat, our analysis may underestimate the full effect of housing prices on marriage delays, as we exclude individuals who remained single. The estimates do not capture those who postponed or forwent marriage due to high housing costs.

Robustness checks

Saturated 2SLS and IV strength

Blandhol et al. (2022) point out that 2SLS estimates do not necessarily produce local average treatment effects under heterogeneity when specifications include covariates unless these are included in saturated form (Blandhol et al., 2022). Specifically, the 2SLS estimator reflects treatment effects for both compliers and always/never-takers, and some treatment effects for always/never-takers are negatively weighted. Blandhol et al. (2022) show that a saturated 2SLS estimator, including interactions between covariates into specifications, could address the potential estimation bias due to negative weighting. **Table 5** shows the estimated results from saturated IV estimation for urban-hukou and rural-hukou holders respectively, which are consistent with our main estimation in **Table 4**.

Table 5: IV estimation, saturated in covariates

	(1) Urban-hukou	(2) Rural-hukou
Panel A. *First stage*		
	Dependent variable: housing price per square meter	
water*lag(lp)	0.298***	0.312***
	(0.035)	(0.029)
F statistics	57.76	81.46

Panel B. *Second stage*

	Dependent variable: age at first-time marriage	
ln(hp)	0.829***	0.379
	(0.210)	(0.315)
Observations	74,281	186,363
Saturated individual characteristics	YES	YES
Saturated city characteristics	YES	YES
City FE	YES	YES
Year FE	YES	YES

Notes: All estimates are from saturated IV estimates. water*lag(lp) indicates the interaction between water density and lag of residential land price. Robust standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1. Columns (1) and (2) contain the urban-hukou holders and rural-hukou holders respectively. All estimates are controlled by saturated individual characteristics, saturated city characteristics, city fixed effects, and year fixed effects.

One assumption of IV estimation is that instrumental variables are strong. We have applied the method of Lee et al. (2022) to test the strength of our instrumental variables based on F-statistics. However, a recent study by Keane and Neal (2023) indicates that 2SLS t-tests have little power to detect a true coefficient for treatment effects that are opposite in sign to the OLS bias, a phenomenon they refer to as "power asymmetry." This makes the F-statistics unreliable even if the instruments are strong[3]. Instead, Keane and Neal (2023) offer a sensitivity test that assumes the instrument is weak. They suggest developing confidence intervals for the second-stage estimated endogenous variable coefficient, where the measurement of these confidence intervals is independent of the first-stage F-statistic. According to **Table 6**, the results show that the estimated confidence intervals for both urban-hukou and rural-hukou holders support our main IV estimation.

Table 6: Keane and Neal (2023), weak IV test

Group	Confidence interval
(1) Urban-hukou	[0.288, 1.271]
(2) Rural-hukou	[-0.191, 0.547]

Notes: The bound estimates on the confidence interval are estimated by using the identification assumptions of Keane and Neal (2023).

Relaxation of exclusion restriction

Traditional IV estimation assumes that the instrument influences the outcome variable solely through the endogenous variable, implying that its direct effect on the outcome is precisely zero. Conley et al. (2012) develop an approach to testing the sensitivity of the results while allowing for potential violations of the exclusion restriction assumption. This approach explicitly models the potential violation of the exclusion restriction by introducing a parameter, γ, which captures the direct effect of the instrument on the outcome. If $\gamma=0$, the instrument is perfectly exogenous, but if $\gamma\neq0$, the instrument has some level of direct

[3] Keane and Neal (2023) indicate that even a first-stage F-statistic in the thousand is still required to eliminate size distortions in first-stage 2SLS t-tests.

influence on the outcome, potentially biasing the IV estimates. We apply the approach in our robustness check, but specify a plausible bound for this direct effect rather than treating γ as unknown and unrestricted. Since the key variable of interest, housing prices, is in logarithmic form, any potential violation of the exclusion restriction is unlikely to exceed 50%.

To test the sensitivity of our IV estimates to deviations from strict exogeneity, we employ the Union of Confidence Intervals (UCI) method, which constructs confidence intervals for the treatment effect under varying assumptions about γ. The results, summarized in **Table 7**, show that even when γ is allowed to take values up to 0.5, the estimated confidence bounds for the urban population do not include zero, whereas those for the rural population always do. This suggests that the estimated effect remains robust even under plausible deviations from the strict version of exclusion restriction, providing support for the validity of the instrumental variable.

Table 7: Relaxation of the exclusion restriction

Group	Confidence interval
Full sample	
(1) γ=0	[-0.083, 0.667]
(2) γ=0.5	[-0.233, 0.874]
Urban	
(1) γ=0	[0.425, 1.055]
(2) γ=0.5	[0.268, 1.242]
Rural	
(1) γ=0	[-0.205, 0.563]
(2) γ=0.5	[-0.535, 0.911]

Notes: The bound estimates on the confidence interval are estimated based on the identification assumptions of Conley et al. (2012).

Relaxation of independent assumption

Nevo and Rosen (2012) relax the traditional assumption that the instrument is independent of the error term, and suggest replacing the independence assumption with two alternative conditions: (1) the instrument is less correlated with the error term than the endogenous variable is, and (2) the correlation between the endogenous variable and the error term shares the same sign as the correlation between the instrument and the error term. After estimating the residuals from our IV estimates, we find that the correlations between the residuals and the endogenous variables are positive. Based on these findings, we assume positive correlations between the endogenous variable and the error term, as well as between the instrumental variable and the error term. **Table 8** reports the results from the bounding procedure proposed by Nevo and Rosen (2012). Recall that our instrumental variables are positively correlated with the endogenous variable; hence, the procedure yields only an upper bound. The estimated upper bounds are 1.032 for urban-hukou holders and 0.322 for rural-hukou holders, indicating a larger impact of housing prices on the marriage age for urban-hukou holders. Although the results do not rule out a null impact due to the absence of a lower bound, the upper bounds encompass the estimated coefficients from our IV estimates, validating our main estimation.

Table 8: Relaxation of the instrument independent to the error term

Dependent variable: age at first-time marriage	Lower Bound (Estimator)	Lower Bound (CI)	Upper Bound (Estimator)	Upper Bound (CI)
(1) Full sample	/	/	0.292	0.518
(2) Urban-hukou	/	/	0.419	1.032
(3) Rural-hukou	/	/	0.178	0.322

Notes: The bound estimates on the confidence interval are estimated by using the identification assumptions of Nevo and Rosen (2012).

China's 2008 economic stimulus program

In November 2008, in response to the global financial crisis, China's central government launched a 4 trillion-yuan stimulus program. This policy led to a substantial increase in housing prices, although the impact varied significantly across cities. Using a difference-in-difference methodology, Chen et al. (2020) observed that housing prices in cities specifically targeted by the stimulus experienced notable increases. As the global financial crisis and the government stimulus program both had significant impacts on the entire economy, we excluded the unusual period to avoid any potential bias in our main estimation. **Table 9** presents the results using the sample after excluding individuals who married in 2009 and 2010. The outcomes are very similar to those of our main estimations, which underlines the robustness of our main results.

Table 9: Robustness check: excluding the 2008 stimulus program

	(1) Full sample	(2) Urban-hukou	(3) Rural-hukou
Panel A. *First stage*			
	Dependent variable: housing price per square meter		
water*lag(lp)	0.345***	0.334***	0.348***
	(0.034)	(0.038)	(0.034)
F statistics	101.08	79.28	106.07
Panel B. *Second stage*			
	Dependent variable: age at first-time marriage		
ln(hp)	0.380	0.684***	0.342
	(0.207)	(0.254)	(0.216)
Observations	171,113	47,589	123,524
Individual characteristics	YES	YES	YES
City characteristics	YES	YES	YES
City FE	YES	YES	YES
Year FE	YES	YES	YES

Notes: All estimates are from IV estimates. The sample used in this estimation excludes individuals who had married in 2009 and 2010. The dependent variable in the second stage of this estimation is age at first birth. water*lag(lp) indicates the interaction between water density and lag of residential land price. Robust standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1. Columns (1) to (3) contain the full sample, urban-hukou holder, and rural-hukou holder respectively. All estimates are controlled by individual

characteristics, city characteristics, city fixed effects, and year fixed effects.

Lag of residential land price

The one-year lag of residential land prices is used as part of our instrumental variables above. As a robustness test, we use the two-year lag of residential land prices given a longer lag is more likely to be exogenous. **Table 10** demonstrates that the results are similar to those from the main IV estimation, although there is a decrease in F-statistics across all cases and a significant reduction in the number of observations.

Table 10: Robustness check, two-year lag of residential land price

	(1) Full sample	(2) Urban-hukou	(3) Rural-hukou
Panel A. *First stage*			
	Dependent variable: housing price per square meter		
water*2-lag(lp)	0.314***	0.302***	0.317***
	(0.043)	(0.040)	(0.044)
F statistics	53.99	50.38	51.74
Panel B. *Second stage*			
	Dependent variable: age at first-time marriage		
ln(hp)	0.196	0.723***	0.082
	(0.200)	(0.251)	(0.218)
Observations	199,041	57,423	14,1618
Individual characteristics	YES	YES	YES
City characteristics	YES	YES	YES
City FE	YES	YES	YES
Year FE	YES	YES	YES

Notes: All estimates are from IV estimates. water*2-lag(lp) indicates the interaction between water density and the two-year lag of residential land price. Robust standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1. Columns (1)-(3) contain the full sample, urban-hukou holders, and rural-hukou holders respectively. All estimates are controlled by individual characteristics, city characteristics, city fixed effects, and year fixed effects.

Heterogeneity analysis

We now present a wide range of heterogeneous effects across various groups, including homeowners vs. renters, males vs. females, high vs low sex ratios, young vs. old cohorts, and rural-to-urban migrants vs. non-migrants.

Homeowners vs. renters

The effect of housing prices on marriage is likely more pronounced among individuals who consider owning a property a prerequisite for marriage. In contrast, individuals who do not view homeownership as necessary for marriage are less likely to be affected by local housing prices. Specifically, for individuals who plan to purchase a home before marriage, rising housing prices directly increase the financial burden, extending the time required to save for a down payment and making it more difficult to meet the economic prerequisites for marriage. Spouses who consider homeownership a prerequisite for marriage must therefore adjust their

marriage timing in response to housing price fluctuations. In contrast, those who do not view homeownership as a requirement—who do not need to save for a down payment—are largely insulated from this financial pressure, as their ability to marry does not depend on their capacity to buy a home.

The 2010 census data, which includes questions about each household's homeownership status, enables us to distinguish between renters and homeowners. Renters, who are married without owning a home, presumably do not consider homeownership a necessary condition for marriage and, therefore, are less impacted by housing price increases. **Table 11** presents the results for the sub-samples of homeowners and renters respectively. The results from column (1) confirm our hypothesis: the impact of housing prices on the marriage age is insignificant for renters, but significant for homeowners, with a 1.13-month delay in marriage associated with a 10 percent increase in housing prices. Notably, it is uncommon to enter marriage without owning a home, where married renters account for only approximately 15% of the urban married sample, highlighting the strong social expectation of homeownership as a prerequisite for marriage in China.

Table 11: Heterogeneous results, IV estimation, Urban renter vs. homeowner

	(1) Urban Renter	(2) Urban homeowner
Panel A. *First stage*		
	Dependent variable: housing price per square meter	
water*lag(lp)	0.321***	0.278***
	(0.035)	(0.043)
F statistics	81.78	41.51
Panel B. *Second stage*		
	Dependent variable: age at first-time marriage	
ln(hp)	0.478	0.938***
	(0.383)	(0.285)
Observations	10,899	63,382
Individual characteristics	YES	YES
City characteristics	YES	YES
City FE	YES	YES
Year FE	YES	YES

Notes: All estimates are from IV estimates. water*lag(lp) indicates the interaction between water density and lag of residential land price. Robust standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1. Columns (1) and (2) contain urban renters and urban homeowners respectively. All estimates have been controlled by individual characteristics, city characteristics, city fixed effects, and year fixed effects.

Urban male vs female

We further investigate the impact of housing prices on marriage, focusing on gender differences. **Table 12** demonstrates the heterogeneous effects of housing prices on urban males and females. Column (1) shows that a 10 percent increase in housing prices delays marriage by 0.80 months for urban males, statistically significant at the 5 percent level. For

urban females in column (2), the impact is more pronounced: a 10 percent increase in housing prices delays marriage by 0.94 months at the 1 percent significance level. Empirical evidence indicates that rising housing prices have a more pronounced effect on delaying women's marriage compared to men. This difference between men and women is consistent with our theoretical hypothesis, and can be explained by the marriage market sorting mechanism (Saint-Paul 2015), where men tend to marry down while women tend to marry up. When housing prices rise, the financial burden of homeownership increases, making it more difficult for lower and middle-income men to meet the marriage expectations of homeownership. As a result, more men—especially those in the lower socioeconomic strata—are pushed out of the marriage market, reducing the pool of eligible partners for women seeking to marry up. This forces more women to delay marriage as their potential matches become scarcer.

Table 12: Heterogeneous results, IV estimation, Urban male vs. female

	(1) Urban male	(2) Urban female
Panel A. *First stage*		
	Dependent variable: housing price per square meter	
water*lag(lp)	0.300***	0.305***
	(0.041)	(0.039)
F statistics	53.63	59.74
Panel A. *Second stage*		
	Dependent variable: age at first-time marriage	
ln(hp)	0.669**	0.785***
	(0.295)	(0.246)
Observations	36,346	37,935
Individual characteristics	YES	YES
City characteristics	YES	YES
City FE	YES	YES
Year FE	YES	YES

Notes: All estimates are from IV estimates. water*lag(lp) indicates the interaction between water density and lag of residential land price. Robust standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1. Columns (1) and (2) contain male urban-hukou holders and female urban-hukou holders respectively. All estimates have been controlled by individual characteristics, city characteristics, city fixed effects, and year fixed effects.

Urban sex ratio

We also examine the heterogeneity of gender balance which significantly differs across cities in China. We ran two regressions for urban-hukou holders who reside in cities in the top 25th percentile (more balanced sex ratio) and the bottom 25th percentile (more males than females) of the sex ratio distribution. **Table 13** presents the heterogeneous effects of housing prices on marriage ages for the two sub-samples. The results indicate that a 10 percent

increase in housing prices delays marriage by 1.47 months for individuals in cities with a more balanced sex ratio, and by 0.50 months for those in cities with an imbalanced sex ratio.

This disparity can be explained through the dynamics of women marrying up and men marrying down. In more balanced-sex-ratio cities, before the rise in housing prices, there were relatively more potential matches available in the marriage market, ensuring smoother partner formation. However, as housing prices increase, more men are pushed out of the marriage market, reducing the pool of financially viable partners for women seeking to marry up. This scarcity leads to longer delays in marriage as women search for economically stable partners. By contrast, in cities with more imbalanced sex ratios, where males already outnumber females, the effects of rising housing prices on marriage delays are less pronounced. Many men in these regions were already excluded from the marriage market due to financial constraints or competition, even before housing prices rose. Furthermore, Wei and Zhang (2011) argue that in male-surplus cities, households with sons tend to accumulate higher savings to enhance their sons' marriage prospects, making pre-emptive homeownership planning more common. As a result, many men in these areas are better prepared to afford housing, mitigating the impact of rising housing prices on marriage timing.

Table 13: Heterogeneous results, IV estimation, Urban sex ratio

	(1)	(2)
	Top 25%	Bottom 25%
Panel A. *First stage*		
	Dependent variable: housing price per square meter	
water*lag(lp)	0.239***	0.308***
	(0.060)	(0.052)
F statistics	15.87	34.45
Panel A. *Second stage*		
	Dependent variable: age at first-time marriage	
ln(hp)	1.224***	0.415***
	(0.439)	(0.121)
Observations	17,064	13,633
Individual characteristics	YES	YES
City characteristics	YES	YES
City FE	YES	YES
Year FE	YES	YES

Notes: All estimates are from IV estimates. water*lag(lp) indicates the interaction between water density and the lag of residential land price. Robust standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1. Columns (1) and (2) contain the samples in cities where the sex ratio is at the top 25 percentile and bottom 25 percentile respectively. All estimates are controlled by individual characteristics, city characteristics, city fixed effects, and year fixed effects.

Urban young vs old (non-linear impacts)

We further examine whether the impact of housing prices on marriage ages is potentially non-linear, that is, whether an increase in housing prices affects younger people more than older people. To do so, we divided individuals into two groups: one group of people married before age 30 and the other married after age 30. **Table 14** shows that, for individuals who married before age 30, a 10 percent increase in housing prices delays marriage by 0.98 months at the 1 percent significance level. In contrast, there is no significant effect for individuals who married after age 30. This implies that housing prices have non-linear impacts on marriage ages. Increases in housing prices are likely to cause a more pronounced delay in marriage age for younger individuals, whose income and savings are typically lower, compared to their older counterparts.

Table 14: Heterogeneous results, IV estimation, Urban young vs old

	(1) Married before age 30	(2) Married after age 30
Panel A. *First stage*		
	Dependent variable: housing price per square meter	
water*lag(lp)	0.303***	0.303***
	(0.040)	(0.040)
F statistics	57.19	58.28
Panel A. *Second stage*		
	Dependent variable: age at first-time marriage	
ln(hp)	0.816***	-0.217
	(0.193)	(0.249)
Observations	65,170	13,881
Individual characteristics	YES	YES
City characteristics	YES	YES
City FE	YES	YES
Year FE	YES	YES

Notes: All estimates are from IV estimates. water*lag(lp) indicates the interaction between water density and the lag of residential land price. Robust standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1. Columns (1) and (2) contain the samples who married before age 30 and after age 30 respectively. All estimates are controlled by individual characteristics, city characteristics, city fixed effects, and year fixed effects.

Migrants versus non-migrants

Rural-hukou residents may respond differently to housing price increases from urban-hukou residents. We divide rural-hukou residents into two groups: rural migrants who have relocated from their hukou registration places for more than two years, and rural non-migrants who have lived in cities for less than two years. This duration is indicative of a potential transition to permanent residency in cities. **Table 15** presents the results for rural migrants versus non-migrants. Column (1) shows an insignificant impact of housing prices for non-migrants. Since rural residents can build houses on collectively owned rural land, they are not

compelled to buy urban properties, rendering urban housing prices irrelevant to them. Column (2) indicates that for rural migrants, a 10 percent increase in housing prices delays marriage by 0.61 months at the 1 percent significance level. Columns (3) and (4) explore the heterogeneous effects of housing prices on male and female migrants, respectively. A 10 percent increase in housing prices delays marriage by 0.46 months for male migrants and 0.69 months for female migrants. The effects on rural migrants are less pronounced than on their urban counterparts. One possible explanation is that rural migrants may seek spouses from their hometowns rather than from their new locales. Additionally, they may plan to return to their hukou registration areas in the future, rather than committing to permanent migration.

Table 15: Heterogeneous results, IV estimation, Urban vs rural hukou

	(1) Rural non-migrant	(2) Rural migrant	(3) Rural migrant – Male	(4) Rural migrant – Female
Panel A. *First stage*				
		Dependent variable: housing price per square meter		
water*lag(lp)	0.308***	0.377***	0.375***	0.377***
	（0.038）	（0.044）	（0.042）	（0.044）
F statistics	65.59	74.35	78.81	74.35
Panel B. *Second stage*				
		Dependent variable: age at first-time marriage		
ln(hp)	0.529	0.506***	0.381**	0.576***
	(0.331)	(0.169)	(0.186)	(0.139)
Observations	81,404	41,409	17,972	23,437
Individual characteristics	YES	YES	YES	YES
City characteristics	YES	YES	YES	YES
City FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Notes: All estimates are from IV estimates. water*lag(lp) indicates the interaction between water density and lag of residential land price. Robust standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1. Column (1) to (5) contain rural non-migrants, rural migrants that left hometown for more than two years, male rural migrants, and female rural. All estimates are controlled by individual characteristics, city characteristics, city fixed effects and year fixed effects.

Fertility delay

The above analysis shows that higher housing prices delay marriage. It is naturally expected that the delay of marriage would postpone first childbirth. The following empirical analysis validates the hypothesis.

The data for the age at first childbirth is also obtained from the 2010 National Population Census. We calculated the age at which females first gave birth between 2009 and 2010, based on the responses to the question about whether respondents had given birth in the 12 months prior to the survey. We also determined whether each birth was a first-time birth by examining the number of children each female reported. We then applied the same instrumental variable (IV) used previously and replaced the outcome variable with the age at

first childbirth. **Table 16** presents the results, where columns (1) to (3) represent the full sample, urban-hukou holders, and rural-hukou holders, respectively. The results show that a 10 percent increase in housing prices delays the age at first birth by 2.05 months for urban females, while there is no significant impact for rural-hukou holders. This finding corroborates two studies Liu et al. (2020) and Clark et al. (2020), which indicate that an increase in housing prices reduces the likelihood of having children.

Table 16: IV estimates, age at first birth

	(1) Full sample	(2) Urban-hukou	(3) Rural-hukou
Panel A. *First stage*			
	Dependent variable: housing price per square meter		
water*lag(lp)	0.329***	0.315***	0.332***
	(0.043)	(0.043)	(0.044)
F statistics	58.59	54.18	58.05
Panel B. *Second stage*			
	Dependent variable: age at first birth		
ln(hp)	0.629**	1.709***	0.363
	(0.270)	(0.413)	(0.366)
Observations	21,336	5,114	16,222
Individual characteristics	YES	YES	YES
City characteristics	YES	YES	YES
City FE	YES	YES	YES
Year FE	YES	YES	YES

Notes: All estimates are from IV estimates. The dependent variable in the second stage of this estimation is age at first birth. water*lag(lp) indicates the interaction between water density and lag of residential land price. Robust standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1. Columns (1) to (3) contain the full sample, urban-hukou holders, and rural-hukou holders respectively. All estimates have been controlled by individual characteristics, city characteristics, city fixed effects, and year fixed effects.

6. Conclusion

This paper links the increase in housing prices to the delay of marriage in China. We set up a simple discrete choice model to illustrate that in response to housing price increases, people would delay their marriage partly involuntarily because they need a longer time to accumulate more savings due to increasing down payments, and partly voluntarily because they would mitigate the crowding-out effect on non-housing consumption.

The empirical analysis, based on China's 2010 National Population Census Data, shows that a 10 percent increase in housing prices leads to a 0.91-month delay in the marriage age for urban-hukou holders, while there is no statistically significant relationship for rural-hukou holders. The difference arises as urban residents must buy properties from markets, whereas rural residents can build homes on collectively owned land. Additionally, an increase in housing prices has a more substantial impact on the marriage age for urban females compared to urban males. The results also indicate that rural-to-urban migrants also delay marriage due

to increasing housing prices, with a slightly larger impact for female migrants than for male migrants. Our analysis further shows that a 10 percent rise in housing prices leads to a 1.13-month delay in marriage for urban homeowners, but no effect for urban renters. This disparity likely occurs because renters do not consider homeownership as a prerequisite for marriage.

The heterogeneous analysis of gender balance finds that individuals who married in regions with more males than females experience a weaker impact from rising housing prices compared to those in areas with a balanced sex ratio. Furthermore, rising housing prices significantly affect the marriage age of individuals who marry before 30 but have little impact on those marrying later. This is consistent with the theoretical model in which the utility loss from crowding out non-housing consumption is stronger for younger individuals with lower income and savings compared to older individuals, given the marginal utility of consumption is diminishing.

The paper also finds that a 10 percent increase in housing prices delays the age at first childbirth for urban females by 2.05 months, which is a direct consequence of the delay in marriage. This finding suggests that rising housing prices indirectly affect fertility through the channel of delaying marriage, providing an additional insight into the existing literature that evaluates the direct impacts of housing prices on fertility decisions (Liu et al. 2020; Clark et al. 2020).

Although based on the period of 2006-2010, this study can shed light on the relationship between housing prices and marriage ages after 2010. China's housing prices continued to increase sharply in the 2010s while marriage ages also continued to rise to 29.38 for men and 27.95 for women in 2020. It is plausible to postulate that the increase in housing prices has impacts on the delay of marriage in the 2010s although there is no household data to undertake the analysis in the 2010s. This also helps to explain that the fertility rate did not increase markedly after China abolished its long-standing one-child policy in 2015 but significantly declined since 2018.

There are several potential limitations to this study. First, the 2010 Chinese National Population Census does not provide information on financial support from parents, despite family financial support playing a crucial role in China's housing and marriage markets. Second, our dataset only covers the period prior to 2010, while China's housing prices continued to grow significantly after 2015. This analysis can be extended to cover a longer period if the 2020 Population Census data are made available in the future. Third, the sample used for estimation includes only individuals who married, while those who remained single were excluded. Consequently, our results may underestimate the negative impact of rising housing prices on marriage.

The findings of our paper have important policy implications, especially in the context of historically low fertility rates. The increase in housing prices and more broadly in living costs reduces young people's willingness to marriage and prevents those who wish to build families and raise children from affording a home. The Chinese government has deeply intervened in housing markets and heavily depended on housing markets for government revenues, leading to the complex housing crisis now. The government should gradually

reduce regulation and reliance on housing markets, which is vital to reducing housing prices. On the other hand, the government should expand welfare housing for low-income people in urban areas, which could increase their access to marriage markets and increase their fertility rates. Recently, it has been proposed that the government should buy incomplete properties and convert them to welfare housing, which could be a strategic approach to addressing the housing crisis and improving social welfare.

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