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House price and fertility behavior among different families – Empirical study from CFPS data

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Abstract. This paper uses panel data from the China Family Panel Studies (CFPS) to examine the relationship between housing prices and fertility behavior in China, this paper analyzes sample data from 2014, 2016 and 2018 and uses Probit model and the logit model to study how house price affects fertility behavior among different families, furthermore, after the removal of One Child Policy, how the fertility behavior would react to house price. The study found that rising housing prices have a significant negative impact on fertility behavior, and that this negative impact persists even when using instrumental variables to control for endogeneity. The study also found that the impact of housing prices on fertility varies across different subgroups of the population, depending on factors such as the gender of the first child, whether the family is urban or rural, and the region of the country in which the family resides. Additionally, the study found that the impact of housing prices on fertility was significantly negative both before and after the removal of the One-Child Policy (OCP), but that this negative impact was even greater after the OCP was removed. Overall, these results suggest that high housing prices may be an important factor contributing to China's low fertility rates.

Keywords: House Price, Fertility Rate, Gender Effect, Birth Plan Policy, One Child Policy
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1. Introduction

Since China fully implemented the “one-child” policy in the early 1980s, the excessive population growth trend has been effectively controlled, and at the same time, the population pressure of China's development has changed from the pressure of population growth in the past to the pressure of population structure. According to the seventh census data (2021)^①, China's total fertility rate has dropped to 1.296, which is far lower than the natural replacement fertility rate (2.1) of the population. The fertility rate continues to slump, population growth has entered the "three lows" modern mode of low fertility, low mortality, and low growth rate, and population development has entered a critical turning point.

In October 2015, China fully implemented the “two-child” policy, however, the effect of the “two-child” policy reform was not obvious. The population data released by the National Bureau of Statistics of China (Figure 1) showed that China's population growth rate continued to decline from 2016 to 2021, and the population growth remained at a low level. The two-child policy did not have a significant impact on China's fertility rate. The fertility rate rose briefly after the policy was implemented but then began to decline again. The three-child policy, which was implemented in 2021, also has not had a significant impact on the fertility rate.

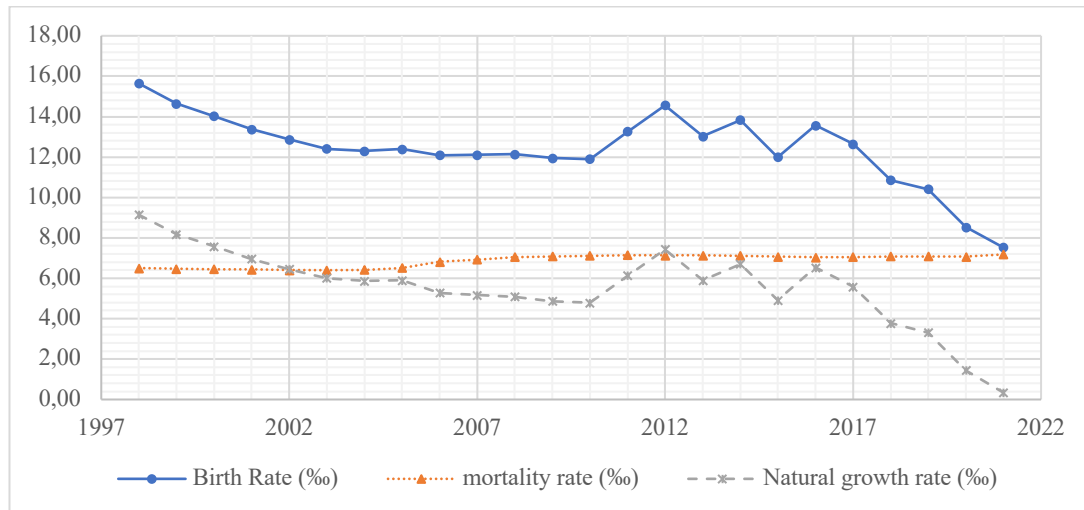


Figure 1 birth rate, mortality rate and natural growth rate in China from 1998 to 2021
Data source: National Bureau of Statistics of China

The reform of China's housing system in 1998 changed from the original welfare housing allocation system independent of the market to a housing transaction system dependent on the market. As a result,

^① National Bureau of Statistics of China. (2021). Bulletin of the Seventh National Census.
http://www.gov.cn/guoqing/2021-05/13/content_5606149.htm

the real estate market has developed rapidly, which is manifested in the continuous expansion of the housing market and the rapid rise of housing prices. Since 2003, housing prices in most urban areas have risen sharply. As shown in Figure 2, the price of residential commercial housing in China was 1,854 yuan/square meter in 1998 and 10,139 yuan/square meter in 2021, an increase of 546.87%. The development of the real estate market has regional differences, and the housing price level in developed areas is much higher than that in underdeveloped developed areas. According to He Haiyun (2021), rising housing prices have brought about an increase in the housing burden, and the current housing situation has had a certain impact on residents' reproductive choices. The high cost of housing can lead to increased financial burden for families, particularly for those who are seeking to buy a home or who are already homeowners. This can lead some families to delay having children or to have fewer children than they might otherwise have had, as they may need to prioritize housing expenses over other expenses, including the costs of raising children.



Figure 2 housing prices in China from 1998 to 2021
Data source: National Bureau of Statistics of China

Empirical studies on house price and fertility rate in China consistently document a negative relationship between the cost of housing and fertility. Ge and Zhang (2019), Song et al., (2017) reveal that high Chinese housing costs in recent years have reduced the willingness of married couples to bear children and have also delayed the age of marriage and childbearing (Chen and Peng, 2016). Closely related to this study, Clark, Yi and Zhang (2020) use the China Household Finance Survey (CHFS) from 2013 to 2017 and explore the heterogeneous effects among different groups, including women's age-group, number of children and Hukou status, and they found negative effect between house price

and fertility rate in 35 big cities. In another related study, Liu, Gao, Tisdell, and Wang (2020) found that having housing property rights has a significantly positive influence on fertility in China.

Housing costs play an important role in family decisions and become a burden for some households. Culturally, decisions are also influenced by the long-term outcomes of the “One Child Policy (OCP)”. For example, parents with a son with the resources will buy a larger and nicer house for their son to increase his competitiveness in the marriage market (Wei and Zhang 2011) which can by extension have fertility implications. Clark, et.al (2020) also found negative effect of housing price on the gender of newborn child, but only significant if the child is a boy.

However, there are few studies about effect of house price among different family’s child structures. This study not only examines differential impacts of house prices on rural vs. urban residents, homeowners vs. non-homeowners, and but also explore heterogeneous effects of families of different children’s numbers, gender, and sex ratio.

Specifically, this study uses China Family Panel Studies (CFPS) data, which contains detailed information on past fertility histories of Chinese couples, including gender composition and sequencing of all births. Since the data includes couples who have completed their childbearing before and after the implementation of One-Child Policy, it can be evaluated the role of the OCP in altering the decision to have another child, especially as affected by whether the couple previously gave birth to boys or girls. This paper attempts to study family fertility behavior from the perspective of house pricing, understand the relationship between housing prices and family fertility behavior, and provide a theoretical basis for formulating scientific and reasonable population policies and real estate regulation policies.

2. Literature review

The empirical research on the fertility decisions of households has had to deal with two competing assumptions about the likelihood of having a child or additional children. Becker's (1960) considered children as normal goods, on the one hand, assuming that children are normal goods, and knowing that housing is a major cost, it follows that an increase in the price of housing will have a negative substitution effect on the demand for children, all else equal. This is true for both potential first-time homeowners and current homeowners who might buy a larger house with the addition of a child. On the other hand, for a homeowner, an increase in city-level housing prices increases home equity. This could lead to an increase in birth rates among homeowners because of a traditional wealth effect. When house prices increase, homeowners might use some of their new housing equity to fund their childbearing goals. The relative importance of these two effects in determining fertility decisions is an important question that has been studied in many countries, including China. In China, the increase in housing prices has been particularly steep in recent years, leading to a large increase in housing wealth for many homeowners. However, the cost of housing in Chinese cities is also very high, which could potentially have a negative effect on fertility.

Many studies have investigated the relationship between urban house prices and fertility levels and changes in fertility but come to quite different conclusions. Some studies found a positive relationship between fertility and housing prices, Lovenheim and Mumford (2013) used US data and found that the rapid rise of housing prices has a significant impact on the willingness to have children of families with property rights but has no obvious impact on the willingness to have children of families without houses. The wealth effect and mortgage effect brought about by changes in house prices have significantly promoted the reproductive choices of households with housing. Some studies found a negative relationship between fertility and housing prices. Jing Linbo's (2020) research found that the rise in the housing price-to-income ratio has brought continuous economic pressure to the middle class, and factors such as economic pressure, child-rearing costs, and values will all affect families' willingness to have children. Deng and Zhou (2019) found that the inhibitory effect of house price fluctuations on childbearing behavior is different in families with different economic income levels, and the income effect of house price fluctuations on different births is also different. The impact of housing price fluctuations on the birth of a second child is more obvious.

The questions about fertility behavior have taken on even greater theoretical and empirical interest with the move to a two-child policy in China. There are real concerns about the trajectory of fertility and the forces that affect those trajectories and just how the move to a second-child policy will or will not change the overall decline in fertility (Attane 2016; Wang and Hesketh 2018; Qi 2017). A related

literature has explored a wide range of issues around fertility including studies of migrant fertility and the evidence that the floating population has lower fertility (Yang 2018; Zhou and Guo 2020).

China's house prices increased dramatically in the past two decades, which sparked tremendous research interest in its possible socioeconomic impacts. Fu, Liao, and Zhang (2016) and Li, Li, Lu, and Xie (2020) note that an increase in house prices significantly reduced the labor force participation of female homeowners, mainly through the wealth effect of the capital gains of houses. Li and Wu (2014) argue that houses are more like investment goods when house prices keep rising, therefore might encourage households to invest more on houses and crowd out entrepreneurship. Researchers also examined the impact of house prices on a variety of other aspects including consumption/saving, human capital investment, marriage, and subjective wellbeing (Chen & Qiu, 2011; Cheng, King, Smyth, & Wang, 2016; He & Yang, 2019; Wrenn, Yi, & Zhang, 2019; Zhao, Liang, & Li, 2013).

There is a growing body of research and literature on how housing factors affect fertility. The decline in fertility rate caused by high housing prices is one of the researchers' research perspectives. Many researchers found that after considering income and expenditure, people's willingness to have children and the number of children they raise is affected by budget constraints. After controlling for education, race, labor market participation, and other factors that may affect fertility, Clark W.A. (2012) found that an expensive housing market will delay the birth of a child by 4 to 5 years. This delay in childbearing mainly occurs when the income of young couples is out of sync with the growth of housing prices. The excessive growth of housing prices makes young couples need to spend more time at work, thereby increasing their economic income to buy houses, thus delaying childbirth. Dettling and Kearney (2014) found that housing is closely related to raising children, and housing prices are currently a relevant factor for young couples to consider whether to have children. With housing costs seen as the largest component of childcare costs, higher house prices could lead to lower fertility rates.

The limited supply of residential land, high land prices and consequent high housing prices have led to a negative impact on urban fertility. Hu and Wang (2020) found that housing prices can have a significant impact on the timing of a family's first childbirth. They found that for every 1% increase in housing prices, the time of the first childbirth is delayed by about 1.05 years. Additionally, their research found that the impact of housing prices on fertility is more significant for middle-income families than for low-income or high-income families. Another study by Liu, Zhang, and Hu (2016) found that high housing prices can lead to a decline in birth rate. They also found that factors such as economic growth, social security services, and women's education level can have an impact on reproductive choices.

Research has found that fertility policies alone have had little effect on increasing fertility rates and may even have a marginal downward trend. Jing (2020) found that rising housing prices have brought

continuous economic pressure to the middle class, which can affect families' willingness to have children. Another study by Li, Li, and Gao (2012) found a significant negative correlation between rising housing prices and the fertility rate. They concluded that housing prices have the greatest impact on reproductive choices and that the rapid rise of housing prices accelerates the decline in fertility rate. Deng and Zhou (2019) found that the impact of housing price fluctuations on childbearing behavior can vary for families with different economic incomes and that the impact on the birth of a second child is more significant.

Overall, the net effect of housing prices on fertility in China is still an area of ongoing research and debate. Researchers use various methods such as observational study, survey, to understand the causal relationship between housing prices and fertility, and there are mixed findings so far, depending on the level of analysis, data availability, and empirical methods used. In addition, other factors such as government policies on childbearing, social norms, and education levels can also play a role in fertility decisions and interact with the effects of housing prices. This makes it even more difficult to make a definitive conclusion on the relationship between housing prices and fertility in China or any other country.

3. Housing market development and price trends

The advancement of housing reform in China has led to significant improvements in living conditions for residents. According to the National Bureau of Statistics, the per capita housing area in China was only 14.98 square meters in 1998, and it has increased to 41.76 square meters by 2021. Residents' requirements for living conditions have created a huge real estate market demand, driving the real estate industry to spring up like mushrooms. At the same time, with the strong support of housing finance, the real estate market has entered a stage of steady and rapid development, and the real estate industry has gradually become one of the pillar industries of the national economy. But at the same time, the rapid development of the real estate industry has also brought about the continuous rise of housing prices and the overheating of the real estate market.

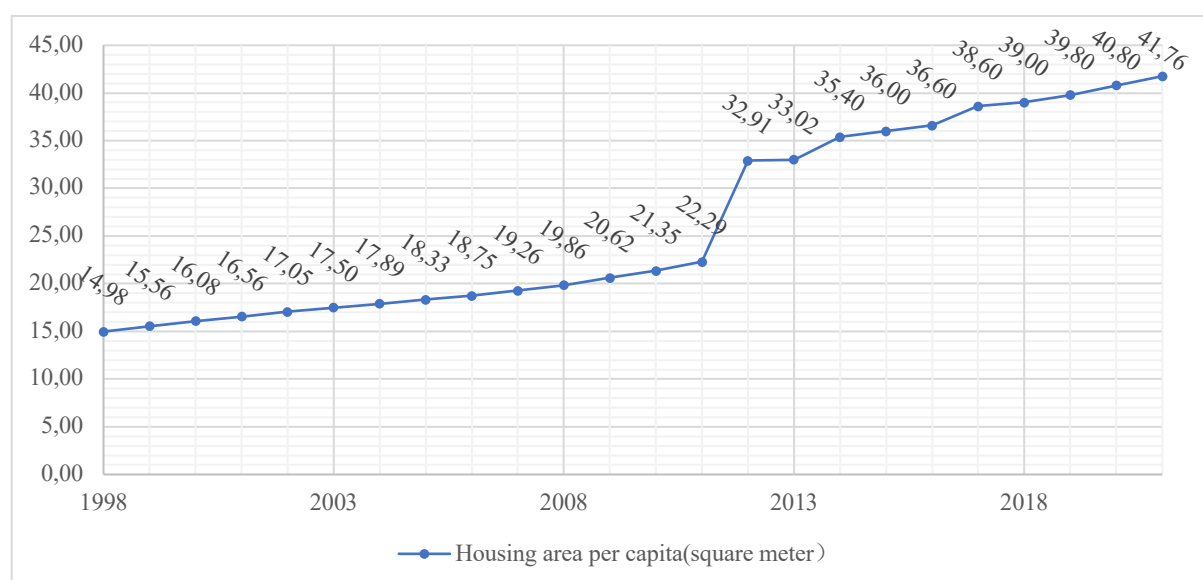


Figure 3 Changes in per capita housing area in China from 1998 to 2021
Data source: National Bureau of Statistics of China

3.1 Rapid increase in investment in real estate development

The reform of the housing system and the acceleration of urbanization in China have led to a rapid development of the real estate industry, which has become a major contributor to the national economy. The proportion of the added value of the real estate industry in GDP has increased from 2.2% in 1978 to 6.8% in 2017, and the industry has played a significant role in stimulating economic development. Investment in the real estate industry has also rapidly increased, with development investment rising from 498.405 billion yuan in 2000 to 12,026.4 billion yuan in 2021, a 24-fold increase. Residential development investment specifically has increased 33.57 times, from 331.198 billion yuan in 2000 to 11,117.3 billion yuan in 2021. This has led to a significant increase in housing supply in the real estate

market, with the area of houses under construction and completed by Chinese real estate development companies increasing by 19.12 and 5.76 times respectively from 1998 to 2021. The market demand for housing remains strong, with the sales area of commercial housing increasing 14.70 times from 122 million square meters in 1998 to 1.794 billion square meters in 2021.

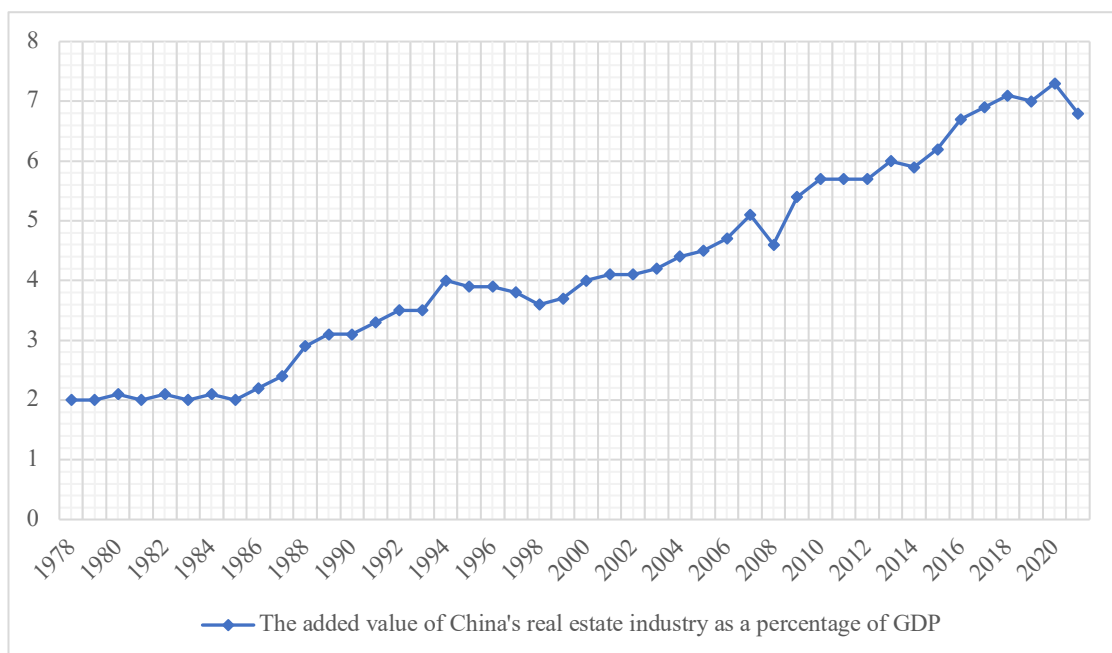


Figure 4 The trend of the proportion of added value of China's real estate industry in GDP from 1978 to 2021

Data source: National Bureau of Statistics of China

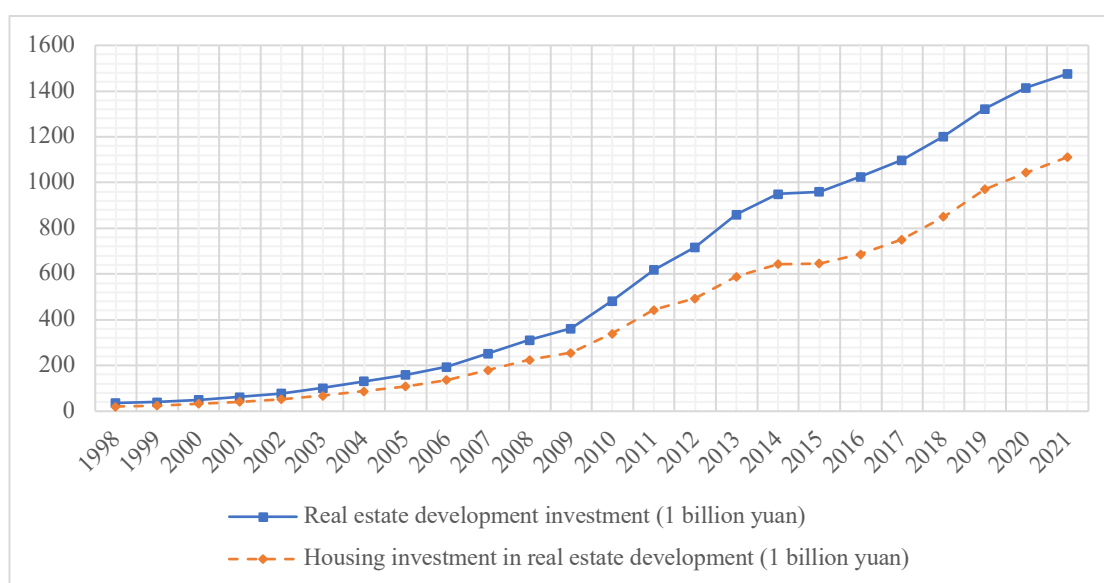


Figure 5 The trend of real estate development investment in China from 1998 to 2021

Data source: National Bureau of Statistics of China

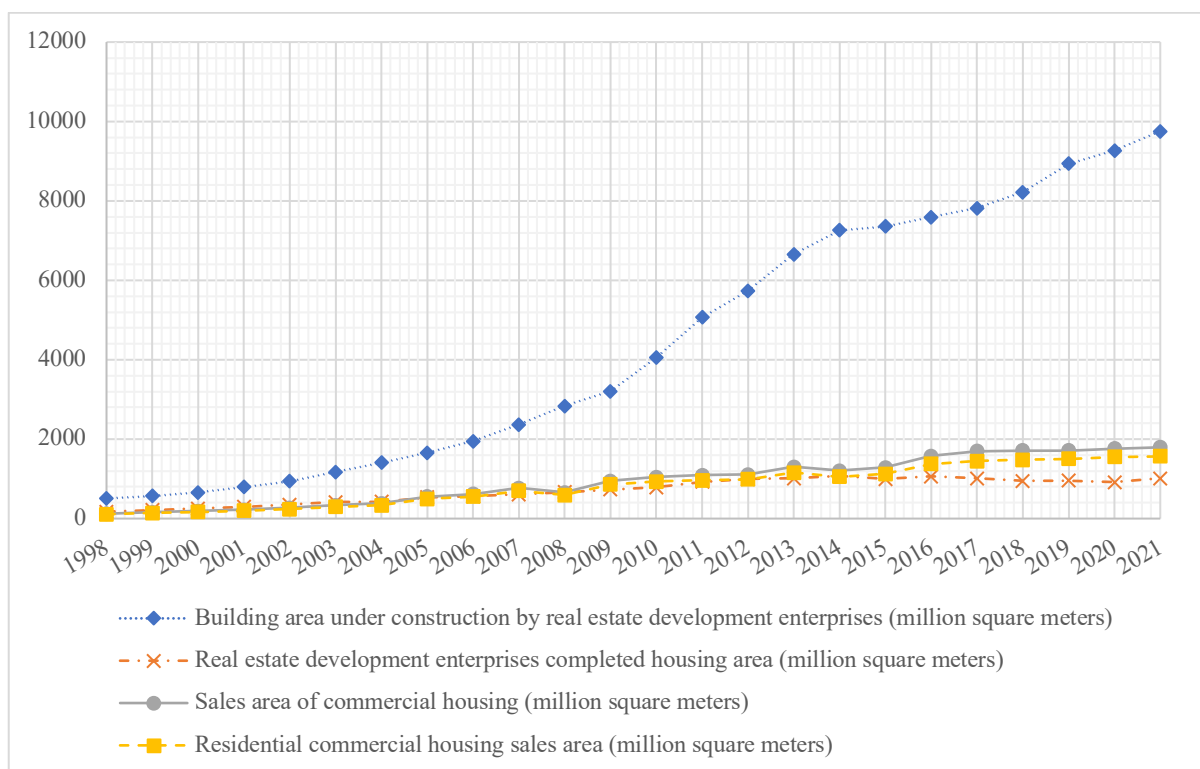


Figure 6 China's housing supply area and sales from 1998 to 2021
Data source: National Bureau of Statistics of China

The reform of housing marketization in China has led to a rapid development of the real estate industry. The number of real estate development companies has increased from 24,378 in 1998 to 112,500 in 2021, a 4.6-fold increase. The average number of employees in real estate development enterprises increased from 825,900 to 2,801,600, 3.4 times that of 1998. As market players, the rapid expansion of real estate companies and practitioners has made the supply of housing products more diversified and the market environment more competitive, effectively improving the supply capacity of the market and greatly stimulating the vitality of the market.

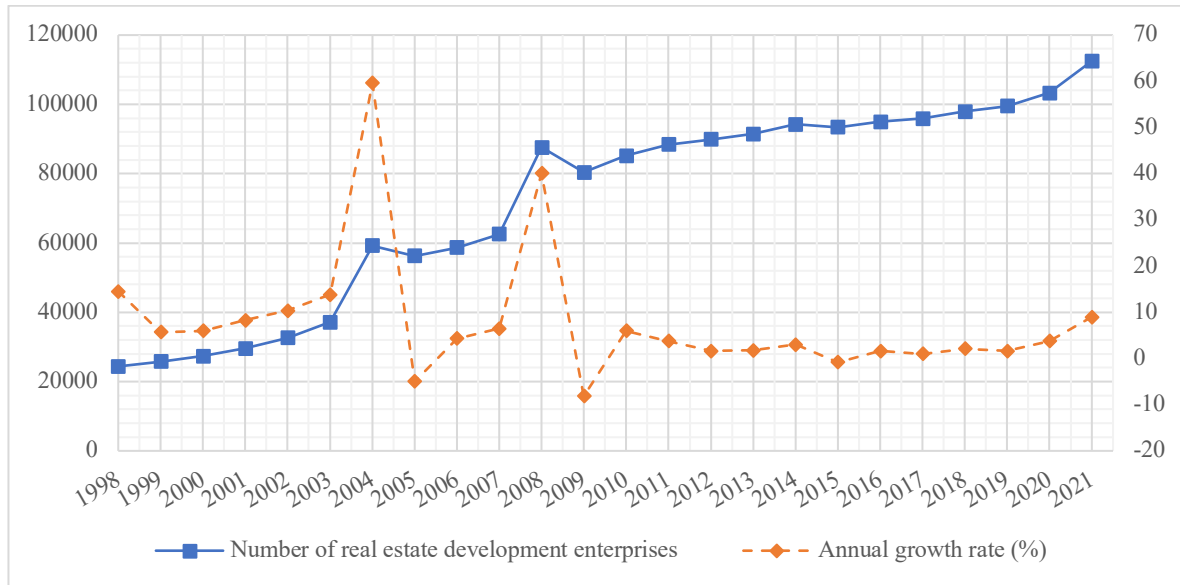


Figure 7 Quantity trend of real estate development enterprises in China from 1998 to 2021
Data source: National Bureau of Statistics of China

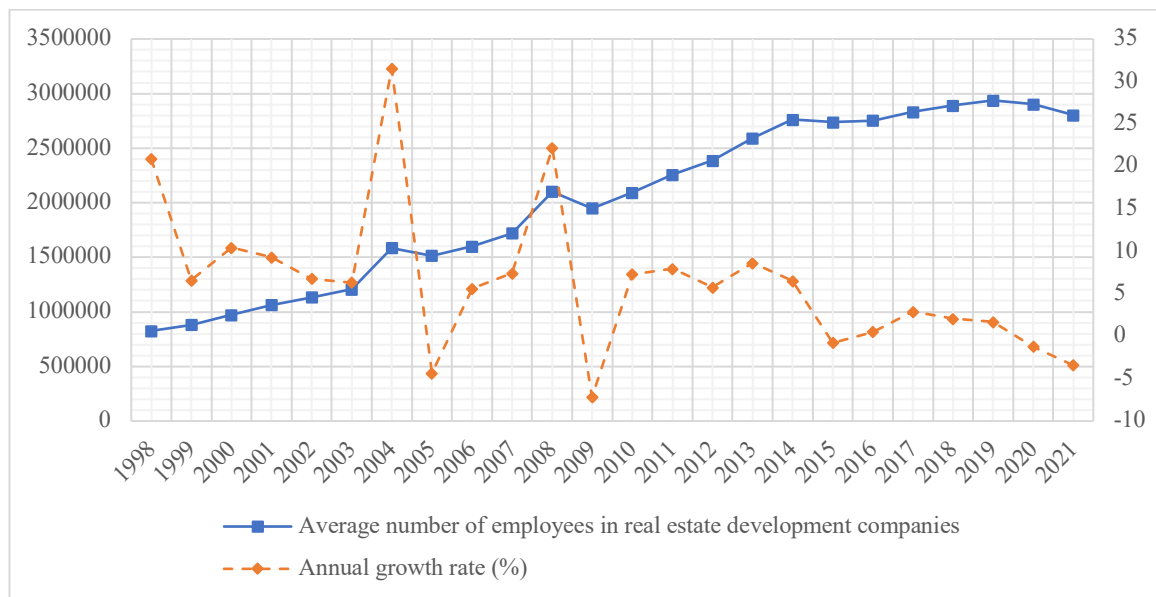


Figure 8 The trend of the average number of employees in Chinese real estate development companies from 1998 to 2021
Data source: National Bureau of Statistics of China

3.2 Housing prices continue to rise

In 1998, China fully implemented the monetization of housing distribution, marking the beginning of housing marketization. As a result, housing prices in China have been on an upward trend. According to data from Figure 10, the average sales price of commercial housing has risen from 2,063 yuan/square meter in 1998 to 10,139 yuan/square meter in 2021. Additionally, the average sales price of commercial

housing increased from 1,854 yuan/square meter in 1998 to 10,396 yuan/square meter in 2017, representing an increase of 391.47% and 460.73% respectively.

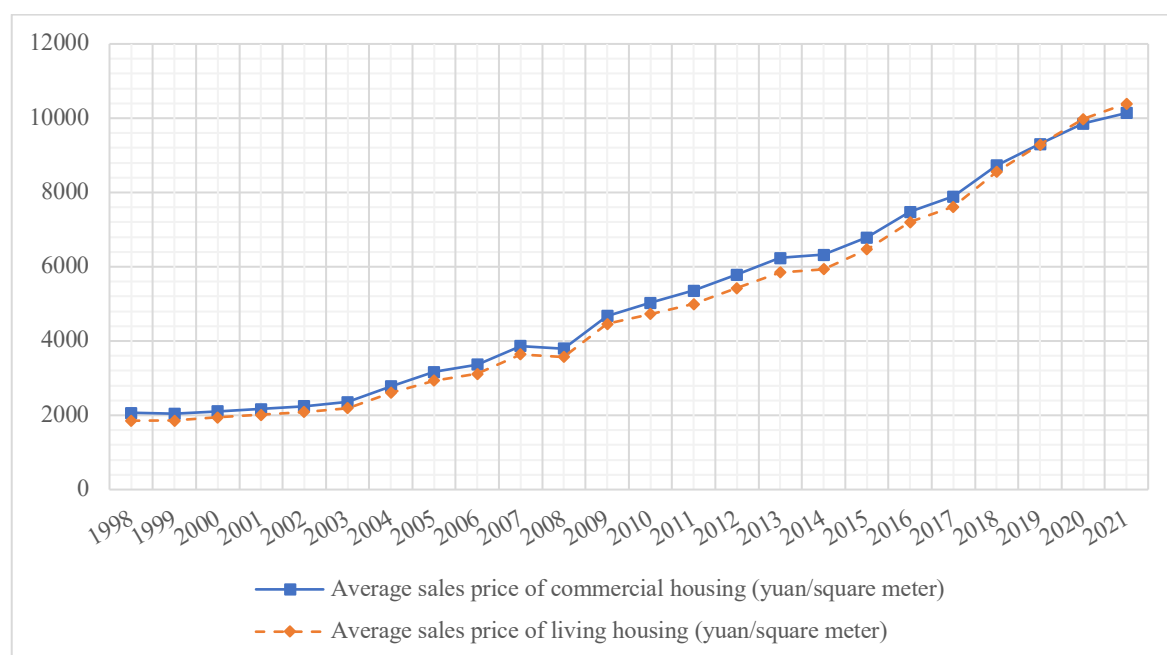


Figure 9 The trend of housing prices in China from 1998 to 2021
Data source: National Bureau of Statistics of China

While housing prices have generally been increasing, there are significant differences in the rate of increase among different regions, indicating a high degree of heterogeneity among cities. According to data, the city with the highest increase in housing prices between 1998 and 2021 is Zhejiang, with an increase of 11.0 times, while the city with the lowest increase is Xinjiang, with an increase of only 2.9 times. This suggests a large disparity in housing price growth among different cities.

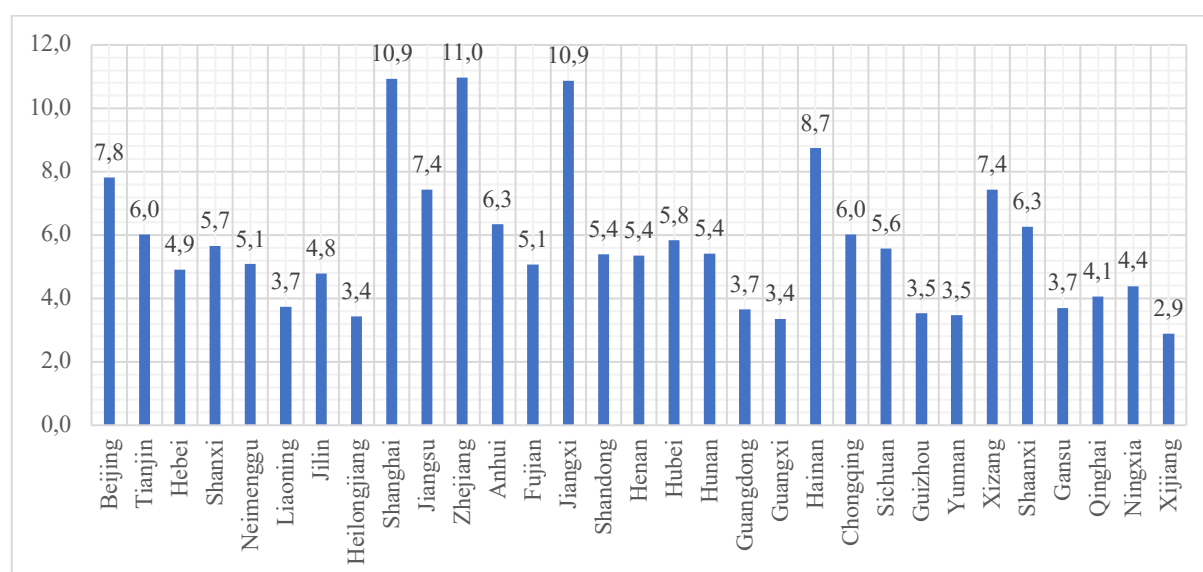


Figure 10 Distribution of housing price growth in China's provinces and cities from 1998 to 2021
Data source: National Bureau of Statistics of China

4. Birth Plan Policy in China

As early as the 1950s, shortly after the founding of the People's Republic of China, the government advocated birth control; the late 1950s saw a great debate on population issues and the implementation of family planning policies in cities to varying degrees; the 1966 "Cultural After the "Great Revolution" began, the family planning work was impacted and came to a standstill or semi-suspended state; it was not until the national population exceeded 800 million in the 1970s that the family planning work made a big improvement; in 1978, the Third Plenary Session of the Eleventh Central Committee re-established the principle of seeking truth from facts. In the 1980s, the family planning policy became a basic national policy in China; in the 1990s, the current family planning policy was formed and gradually moved towards legalization^①. Entering the 21st century, China is facing a new population situation. At the Third Plenary Session of the 18th Central Committee, the Party Central Committee and the State Council decided to adjust China's birth policy and launched the "separate two-child" policy. The implementation of China's childbearing policy has experienced two periods of stagnation. The following will combine the evolution of China's childbearing policy with the historical stages of China's economic and social development and divide the evolution of China's childbearing policy into four stages.

4.1 Proposal and suspension of birth control policy

At the beginning of the founding of New China, China had a population of about 400-500 million. At this time, the national economy was recovering, and China had no clear birth policy. Under the influence of various factors, there was a peak of population growth. First, in terms of economy, the founding of New China liberated social productive forces, industrial and agricultural production developed rapidly, a large number of unemployed people were employed one after another, and social order became increasingly stable. After the people's life has improved significantly, the fertility rate has naturally rebounded; secondly, in terms of ideology, the concept of "many children, many blessings" inherited from the Chinese nation, coupled with the idea of "more people are more powerful", has prompted people to actively bear children; in addition, in terms of political factors, because the Chinese government was consistent with the Soviet Union at that time, in terms of population policy, it also believed in the idea that encouraging population growth was conducive to national development and strength. Thus, between 1949 and 1953, China's population increased by more than 34 million.

From 1953 to 1957, China formulated the first five-year plan for the national economy. At the same time, due to the rapid population growth, various social problems were prominent, including children's

^① Tian Xueyuan. (2009). "60 years of China's population policy". Social Science Literature Publishing House, 3.

education, urban housing and other problems, and the contradictions between population and nature and the environment were sharp. There are constant voices in the society to advocate contraception and birth control. People from all walks of life called for birth control, and there was a heated debate on population policy. At this time, party and state leaders began to advocate birth control. From 1957 to 1958, China's "Great Leap Forward" was in full swing. In such a special historical period, the birth control policy also stagnated. From 1959 to 1961, China fell into a period of three years of economic difficulties. At this time, excessive population growth led to more serious social problems. Therefore, the issue of population control was raised again.

4.2 The formation and stagnation of population control policies

In December 1962, the central government issued the document "Instructions on Conscientiously Promoting Family Planning", which raised birth control and population growth control to the level of national policy for the first time. In October 1963, the State Council held a meeting to discuss the corresponding details of family planning work and established the Central Family Planning Commission in 1964 to lead the national family planning work. Subsequently, various provinces and cities successively organized family planning work, and began to comprehensively control population growth and carry out family planning work. In 1966, China entered the ten-year "Cultural Revolution" period. At this time, all kinds of work were in a state of chaos, and the family planning work was paralyzed again, so the population increased significantly, forming a baby boom. At the end of the 1960s, China's total population had exceeded 800 million, an increase of about 300 million compared with the early days of the founding of the People's Republic of China. The average annual birth rate of the population was above 34‰, and the annual population increase was about 20 million^①.

4.3 The initial formation and adjustment of the family planning system

In the 1970s, the Chinese government put forward again the need to control population, pay attention to population issues, and carry out family planning work nationwide. China has entered the formation stage of the family planning system and has experienced the transition from the relatively loose "late, rare, and few"^② to the strict "one-child policy", as well as the policy adjustment of "opening small mouths, blocking big mouths, and stopping crooked mouths"^③ process.

^① Tian Xueyuan. (2009). "60 years of China's population policy". Social Science Literature Publishing House, 3.

^② "Late, rare, and few" means to encourage young men and women to marry and have children later, to encourage couples to lengthen the interval between two children, and to encourage a couple to have fewer children. The specific content is that women who marry late are 23 years old, and men are 25 years old. It is best to have one child, at most two, and the birth interval must be more than 3 years.

^③ "Opening a small opening" refers to continuing to open the opening slightly larger in a controlled manner in rural areas. According to the prescribed conditions, after approval, a second child can be born; Second child and multiple births; "Stop crooked mouth" refers to the strict prohibition of favoritism and malpractice, and resolutely punish cadres who engage in

After a relatively loose birth policy in the early 1970s, China began to implement a strict family planning policy from 1978 to 1984, which is also the development stage of the family planning policy. In order to adapt to the goal of economic development and achieve a moderately prosperous material and cultural life for the people of the country, on September 25, 1980, the Central Committee of the Communist Party of China issued the "Open Letter to All Communist Party Members and Communist Youth League Members on Controlling China's Population Growth", clearly stating that, The state encourages a couple to have only one child to ensure that China's total population will be kept within 1.2 billion by the end of the 20th century. The publication of the "Open Letter" marks the start of China's one-child policy. Due to the strictness of the "one-child policy" and the violation of the people's desire to have children, the implementation process has become more difficult and led to a slight rise in the birth rate. In 1981, the National Family Planning Commission was established, and at the Twelfth National Congress of the Communist Party of China in 1982, family planning was determined as China's basic national policy, and "family planning" was incorporated into the Constitution and the Marriage Law, making it more authoritative and broader legal support. After the adjustment of the birth policy, China's natural population growth rate and total fertility rate have dropped significantly.

The effectiveness of family planning in China in the 1970s and early 1980s shows that in places where the economy is still underdeveloped, the culture is still relatively backward, and the population is growing rapidly, the excessive growth rate can be slowed down through family planning work, and economic and social development can be promoted. The foundation of family planning in China in the early 1980s laid the foundation for further controlling the growth rate of the population in the future and created important conditions for the reform and opening up since the 1980s, as well as economic and social development.

4.4 The Formation and Perfection of Family Planning Policy

4.4.1 The Maturity of the One-Child Policy

After experiencing changes in China's population fertility situation in the 1980s, China's current family planning policy was basically formed in the mid-1980s, and the Family Planning Law of the People's Republic of China was promulgated in 2001 to establish its legal status. The current birth policy advocates late marriage and late childbearing, fewer and better births, and advocates that a couple have only one child. For special circumstances and those who really have difficulties, they are allowed to have a second child after a few years of approval. No matter what the situation is, they cannot have a

unhealthy practices on childbearing issues.

second child. For the third child, special care will be given to the ethnic minorities according to the actual situation. During the implementation of the current family planning policy, special policies have been set up for rural populations and ethnic minority populations in different regions, such as the "one and a half child" policy for some rural one-woman households. Minorities with a population of less than 10 million are allowed to have a second child. Encourage childbearing, etc. After years of practical experience, China's birth control policy is becoming more and more mature.

4.4.2 Relaxation of the One-Child Policy

In recent years, China's population has presented new characteristics and new problems, such as aging population, shrinking family size, increasing number of families who lost their only child, decreasing labor force, and unbalanced sex ratio between men and women. Policies should be adjusted and optimized to achieve simultaneous and coordinated development of population and economic and social development. On November 15, 2013, at the Third Plenary Session of the Eighteenth Central Committee, it was proposed to "adhere to the basic national policy of family planning and initiate the implementation of the policy that couples with only one child can have two children". This is also the first time that China has relaxed restrictions on childbearing conditions after implementing the family planning policy for more than 30 years.

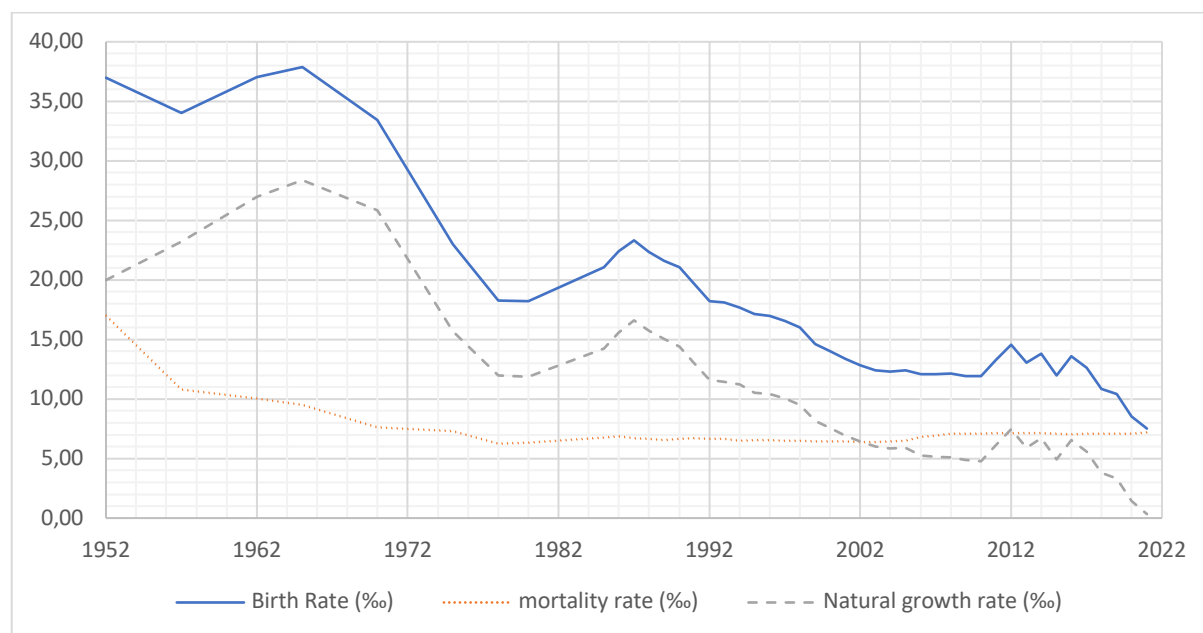


Figure 11 birth rate, mortality rate and natural growth rate in China from 1952 to 2021
Data source: National Bureau of Statistics of China

From Figure 11, the changes in China's population under the influence of different birth policies. From 1949 to 1954, since new China had just been established, various economic and social undertakings

were in the stage of restoration and reconstruction, and the population policy mainly adopted the attitude of encouraging birth and increasing population. rate has declined. The period from 1959 to 1961 was a three-year difficult period for China's national economy. The population fluctuated greatly, the birth rate dropped, the death rate rose sharply, and even negative population growth occurred. In the next few years, with the recovery of the national economy, the population rebounded sharply. After entering the 1970s, due to the implementation of the loose family planning policy, the birth rate declined slowly, while the death rate was basically in a stable state. In the mid-1980s, a tightening birth control policy was adopted, but various difficulties were encountered in its implementation. During this period, the birth rate fluctuated slightly and rose slightly. Since the 1990s, due to vigorous economic development and gradual stabilization of the birth control policy, the natural population growth rate has steadily declined. After 2000, China's birth policy has been continuously adjusted and improved, coupled with changes in people's concept of birth, economic and social development and other factors, the birth rate and natural growth rate have shown a trend of steady decline.

4.4.3 The Two-Child Policy

The "one-child" policy has been strictly enforced for nearly 35 years. It has effectively controlled the total population, but it has damaged the population structure to a certain extent. One is the disappearance of the demographic dividend. Low labor costs were once an important condition for China to attract foreign investment; however, with the increase in the size of the economy, the supply of labor has become seriously insufficient, and the labor force has quickly turned from "surplus" to "shortage", which directly led to a slowdown in economic growth. Second, the aging population is serious. The "one-child" policy has brought about the aging of China's population nearly 20 years earlier, and the burden of social pensions has increased sharply, seriously affecting China's status in the international community. Third, gender imbalance will affect social stability. Due to the influence of the feudal ideology of "passing on the family line", many families have "selective births", which has led to an imbalance in the sex ratio of the Chinese population and triggered a series of negative social problems. Since the 1990s, China's total fertility rate has been lower than the generation replacement level of 2.1, maintained at around 1.2 from 2010 to 2014, and dropped to 1.05 in 2015, which is already lower than the internationally recognized. The "low fertility trap" has a fertility rate of 1.3. On November 15, 2013, the Third Plenary Session of the 18th Central Committee of the Communist Party of China proposed to implement the "separate two-child" policy, that is, couples with one child can have two children. Experts predict that the long-term backlog of childbearing desires of couples of childbearing age will inevitably explode, and there will be a childbearing climax. Within five years, about 2 million separate second children will be born every year. In fact, the number of births in 2014 was 16.87 million, 470,000 more than in 2013; the number of births in 2015 was 16.55 million, 320,000 fewer than in 2014, far below the expected Effect. Therefore, some scholars believe that the "separate two-child" policy is

indeed in the cold. The development of China's population situation is facing a severe test. The aging rate is accelerating, and the working-age population has been decreasing for many years. In October 2015, the Communiqué of the Fifth Plenary Session of the Eighteenth Central Committee of the Communist Party of China pointed out: to promote the balanced development of the population, adhere to the basic national policy of family planning, improve the population development strategy, fully implement the policy that a couple can have two children, and actively carry out actions to address population aging. On January 1, 2016, the "universal two-child" policy was officially launched, marking the beginning of China's second fertility revolution.

4.4.4 Recent Birth Policy of China

The results of the seventh national census show that China's current total population is 1,411.78 million, an increase of 72.06 million compared with the sixth national population census in 2010, with a growth rate of 5.38% and an average annual growth rate of 0.53%, China's population has continued to grow at a low speed for 10 years. Among the total population, there are 723.34 million males, accounting for 51.24%; 688.44 million females, accounting for 48.76%. The sex ratio of the total population is 105.07, slightly lower than that in 2010. The sex ratio at birth was 111.3, a drop of 6.8 from 2010, indicating that the gender structure of China's population is continuously improving. However, the results of the "Seven People's Census" also show that in 2020, the total number of elderly people aged 60 and above in mainland China will be 264 million, accounting for 18.7% of the total population. An increase of 5.4%, mainly because the population cohorts formed by the first birth peak in the 1950s have successively entered old age. During the "14th Five-Year Plan" period, the larger population cohort formed by the second birth peak in the 1960s will also enter the old age one after another, which will turn China's population aging level into the "fast lane" of growth. On May 31, 2021, the Politburo of the Communist Party of China Central Committee held a meeting, marking the beginning of China's third fertility revolution. The meeting pointed out that the childbearing policy should be further optimized, and the policy that a couple can have three children and supporting measures should be implemented. The obvious difference between the "freedom of three children" and the "comprehensive two-child" policy is that it not only encourages a couple to have three children, but also clearly puts "supporting and supporting measures" on the agenda. The implementation of the policy that a couple can have three children will help alleviate the decline in fertility levels in the long run, deal with the problem of population aging, and promote the long-term balanced development of the population.

5. Data sources and Variable selection

5.1 Data sources

The data used in this study comes from the China Family Panel Studies (CFPS), a nationally representative longitudinal survey of Chinese communities, families, and individuals conducted by Peking University. The CFPS started in 2010 with 14,960 participating households in 162 counties of 25 provinces, representing 95% of the Chinese population. Respondents were interviewed every two years and asked about their family dynamics, economic activities, income, assets, health, and demographic characteristics. Since the survey content in 2010, 2012 is not comprehensive enough, this study does not include the data in 2010 and 2012; and the data in 2020 has not yet been released. Therefore, this study selects the survey panel data of 2014, 2016, and 2018 for research.

CFPS asks for information about all household members across the full age distribution, defined as family members who live together and who are directly related due to genetics, marriage, adoption or fostering, or non-family members living together for more than 3 months who share economic resources as a unit. The family questionnaire collects demographic and socioeconomic information on families, including their fertility histories, while the adult questionnaires collect demographic, social relationship, economic, educational and health information on individuals in the households. Fertility information (birth order and gender of every child born) is from the household survey.

The survey center has preprocessed the collected data, including removing invalid samples and interpolating missing values. On this basis, this study further removes samples with missing core variables data, and obtains 9,398 samples each year, and finally forms balanced panel data with 28,194 valid samples.

5.2 Variables

The purpose of this paper is to investigate the relationship between house prices and fertility rates, and to control for other individual, family, and social characteristics that may also influence fertility behaviour. Therefore, this paper combines the relevant questions of the questionnaire, sets reasonable indicators, introduces these background factors as control variables, and participates in regression. The selection basis and measurement method of the variables in this paper are described below:

Dependent variable:

Fertility rate: Whether there are children younger than 2 years old in the family, if it is 1, otherwise it is 0.

Independent variables:

House Price (HP): Calculated according to the price per square meter, the current total market price of the house / the current housing area (square meters).

Control variables:

The control variables in this paper include individual family characteristics (age, gender, education level and household registration, sex ratio, first child gender), family economic characteristics (average annual household income, family housing property rights), and regional characteristics (east, central, and western regions of China, urban/rural families).

5.3 Descriptive statistics

This study uses 3 waves of survey from the year 2014, 2016 and 2018, and selects households within a child under age 2.

According to the analysis of 5.2, the descriptive statistics of the indicators in 2014, 2016, 2018, and total are obtained, as shown in Table 1.

Table 1 Descriptive statistics (Mean±SD)

VARIABLES	2014	2016	2018	Total
Fertility rate	0.115±0.319	0.108±0.310	0.104±0.305	0.109±0.311
House Price (HP)	0.252±0.523	0.326±1.682	0.447±1.734	0.342±1.429
Total children number	1.981±1.137	1.892±1.142	1.825±1.113	1.899±1.132
sex ratio	0.770±0.736	0.764±0.731	0.758±0.720	0.764±0.729
first-born gender	0.494±0.591	0.445±0.633	0.485±0.645	0.474±0.624
income	12269±16443	14967±19025	20914±28891	16050±22406
Property right	0.859±0.348	0.839±0.368	0.818±0.386	0.839±0.368
age	51.153±12.970	51.040±14.144	51.951±14.630	51.381±13.937
gender	0.606±0.489	0.511±0.500	0.520±0.500	0.546±0.498
edu	2.807±1.753	2.571±1.315	2.707±1.366	2.695±1.494
hukou	0.719±0.450	0.723±0.448	0.713±0.452	0.718±0.450
urban	0.455±0.498	0.479±0.500	0.500±0.500	0.478±0.500
region	1.814±0.815	1.807±0.815	1.803±0.817	1.808±0.816
N	9,398	9,398	9,398	28,194

The data in table 1 shows that the mean value of fertility rate gradually decreases with time, while the house price (HP) gradually increases with time, indicating a negative relationship between the two. The average value of the total children number is also gradually decreasing, indicating that the number of families with children has gradually decreased over time. Although China liberalized the "one-child policy" in 2016, the average value of the number of children in families is still decreasing, indicating that Chinese residents are still fettered by the "one-child policy", the desire to have children is low. From the point of view of the sex ratio of males and females, the average value is less than 1, and the average value is decreasing year by year, indicating that the number of girls in Chinese families is more than that of boys, and more and more families are more inclined to have girls. Judging from the gender of the first child in the family, the mean value is less than 0.5, indicating that there will be slightly more girls than boys. The average income of Chinese households has increased year by year, thanks to the development of China's economy and the diligence of Chinese family workers, which has led to an increase in income year by year. Most families own the property where they live. The average age of the respondents is 51 years old. Most of the respondents are male with a higher education level. Most of them have agricultural hukou, and most of them live in rural areas and the central and western regions.

It would be interesting to see the results of the analysis of the relationship between house price and fertility rate in different households. It would be useful to know how the house price varies for

households with different fertility rates, and whether there is a strong relationship between the two variables. The results are shown in Table 2 and Figure 13 provide insights into the factors that may influence fertility behavior and the decision to have children.

Table 2 Analysis of house price in different fertility rate families

year	Fertility rate	N	Mean±SD	t	P
2014	no child younger than 2 years old	8,321	0.258±0.532	3.325	0.001
	with child younger than 2 years old	1,077	0.202±0.444		
2016	no child younger than 2 years old	8,385	0.342±1.772	2.566	0.010
	with child younger than 2 years old	1,013	0.198±0.472		
2018	no child younger than 2 years old	8,424	0.462±1.811	2.518	0.012
	with child younger than 2 years old	974	0.315±0.799		
Total	no child younger than 2 years old	25,130	0.354±1.499	4.315	0.000
	with child younger than 2 years old	3,064	0.236±0.590		

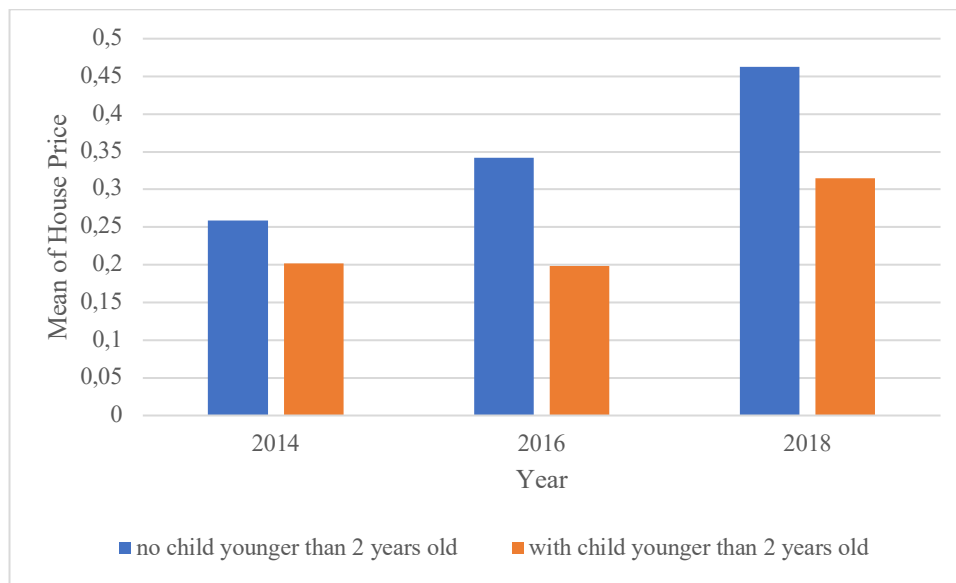


Figure 12 The mean of house price in different Fertility rate families

The data from the table 2 and figure 12 suggest that the average house price of the family with no child younger than 2 years old is significantly higher than that of the family with child younger than 2 years old. The house price in both types of households is statistically significant, indicating that children's number will be affected by the value of the family's house. Families with children need to use their savings to raise children, while the savings of families without children can be directly used for expenses, for the purchase of real estate, etc., the value of the family property will be significantly lower than that of a family without children.

To further analyze the impact of the number of children on the family house price, this paper analyzes the descriptive statistics of the house price of 2014, 2016, 2018 and the total number of children of 0, 1, 2, 3 and above families. The results are shown in Table 3 and figure 2.

Table 3 Analysis of house price of families with different numbers of children

	2014	2016	2018	Total
0 child	0.441±0.620	0.522±2.187	0.923±2.119	0.664±1.922
1 child	0.356±0.662	0.439±0.999	0.660±2.581	0.487±1.664
2 children	0.200±0.474	0.242±1.579	0.286±0.906	0.243±1.083
3 children	0.170±0.334	0.237±1.735	0.247±0.882	0.216±1.138
4 children and more	0.166±0.251	0.278±3.024	0.195±0.450	0.212±1.771

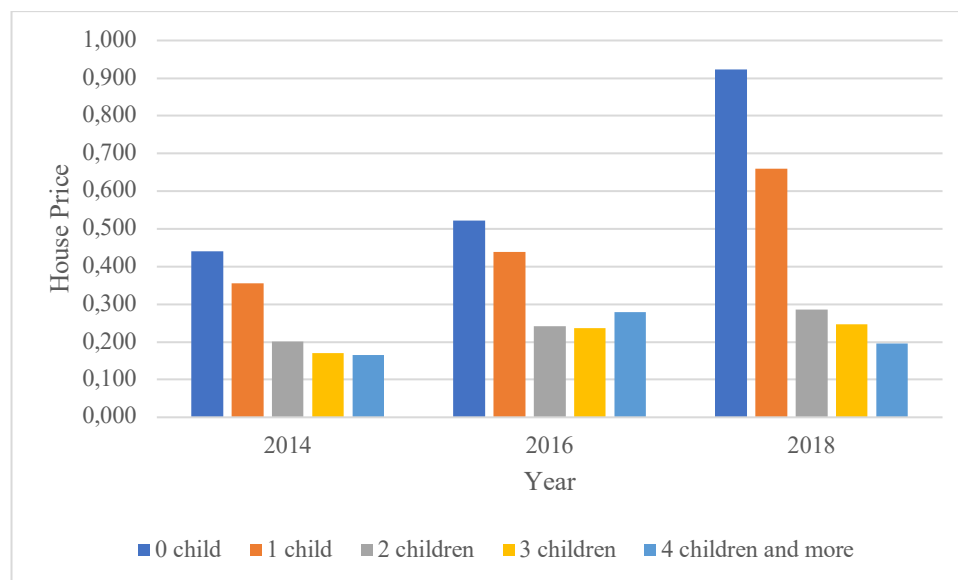


Figure 13 The mean of house price of families with different numbers of children

Data from Table 3 and Figure 13 shows that the more children, the lower the house price of the family, which also shows that children will negatively affect the house price of the family. From the time dimension, the house price of families with different numbers of children is rising, which also indicates the house's ability to preserve its value.

6. Empirical Methods

In this paper, the initial empirical analysis consists of a linear probability model, following Clark, Yi and Zhang (2020), the basic model is constructed as:

For each household i ,

$$y_{ijt} = \alpha + \beta \text{HousePrice}_{ijt} + \gamma X_{ijt} + \omega_j + \tau_t + \varepsilon_{ijt}$$

Where i is individuals, j represents region, and t as survey year, which is 2014, 2016, and 2018 respectively. author uses a three-year pooled cross-sectional regression model to deal with the data. Dependent variable y_{ijt} is a latent variable, and $y_{ijt} = 1$ if there is a child under age 2 in the family, otherwise $y_{ijt} = 0$. House Price is self-reported market value of house price by each household divided by living area, which in this study, contains both house price data from rural and urban region. For household catachrestic X_{ijt} , this study adds two separate control variables: sex ratio and gender of first-born child, apart from age, education, Hukou status, propriety right, income. Finally, ω_j , τ_t , and ε_{ijt} represent region, survey year and error term respectively.

7. Results

7.1 Basic Result

To explore the impact of house price on fertility rate, this paper uses the Probit model to conduct benchmark regression analysis, and then adds control variables for analysis, and then controls for regional effects and time effects. The results are shown in Table 4.

Table 4 Basic Regression Results

Variables	(1) Basic	(2) Control	(3) FE
lnHP	-0.2978*** (0.037)	-0.1765*** (0.042)	-0.1711*** (0.042)
sex ratio		0.1098*** (0.015)	0.1098*** (0.015)
first-born gender		0.3055*** (0.018)	0.3051*** (0.018)
lnincome		-0.0177*** (0.005)	-0.0169*** (0.005)
property right		0.1623*** (0.031)	0.1610*** (0.031)
age		-0.0270*** (0.001)	-0.0270*** (0.001)
gender		0.0279 (0.021)	0.0271 (0.021)
education level		0.0425*** (0.008)	0.0420*** (0.008)
hukou		0.1160*** (0.029)	0.1183*** (0.029)
urban		-0.0311 (0.024)	-0.0313 (0.024)
region		0.0285** (0.013)	0.0278** (0.013)
Constant	-1.1774*** (0.012)	-0.3417*** (0.082)	-0.3376*** (0.083)
Observations	28,194	28,194	28,194
Region FE	NO	NO	YES
Year FE	NO	NO	YES

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The results from table 4 suggest that the logarithm of house price has a significant negative impact on fertility rate at the 1% confidence level, regardless of whether the control variable is added, or the region and time effects are controlled. According to equation (3), for every 1% increase in the logarithm of housing prices, the fertility rate will decrease by 0.1711%, which also verifies the results in the previous descriptive analysis: housing prices have a negative effect on fertility rate. The analysis also shows that certain individual and family characteristics, such as the sex ratio of children, the gender of the first-born child, property right, education level, and type of hukou, have a positive impact on fertility rates.

On the other hand, factors such as income and age have a negative impact on fertility rates. Gender, urban and rural areas do not appear to have a significant impact on fertility rate.

The above analysis suggests that rising house prices may lead families in China to prioritize financial considerations, such as the cost of purchasing real estate, over having children. As a result, they may delay or choose not to have children in order to afford the high cost of housing. This suggests that house prices may inhibit fertility behaviour in China. It would be interesting to further explore the specific factors that may contribute to this relationship and how it varies across different regions and demographic groups within China.

7.2 Robustness Check

To further analyze the relationship between house price and family fertility behavior, the paper uses the logit model to replace the Probit model to check the robustness of model. By adding control variables and fixed effects for region and time, the paper can ensure that the results are not being influenced by these factors and are more generalizable to other populations. The results shown in Table 5 will provide further insights into the relationship between house price and fertility behavior in China.

Table 5 Robustness Check

Variables	(1) Basic	(2) Control	(2) FE
lnHP	-0.6158*** (0.078)	-0.3634*** (0.085)	-0.3516*** (0.086)
sex ratio		0.2170*** (0.029)	0.2169*** (0.029)
first-born gender		0.5816*** (0.035)	0.5806*** (0.035)
lnincome		-0.0322*** (0.009)	-0.0312*** (0.009)
property right		0.2884*** (0.060)	0.2862*** (0.060)
age		-0.0530*** (0.002)	-0.0531*** (0.002)
gender		0.0540 (0.040)	0.0540 (0.040)
education level		0.0852*** (0.014)	0.0844*** (0.014)
hukou		0.2169*** (0.056)	0.2218*** (0.056)
urban		-0.0617 (0.045)	-0.0633 (0.045)
region		0.0457* (0.025)	0.0437* (0.025)
Constant	-1.9906*** (0.023)	-0.3543** (0.154)	-0.3494** (0.156)

Observations	28,194	28,194	28,194
Region FE	NO	NO	YES
Year FE	NO	NO	YES

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The results from Table 5 support the conclusion that the logarithm of house price has a negative impact on fertility behaviour in China. This finding is consistent with the results obtained from the probit model, suggesting that the relationship between these variables is robust and holds up under different statistical methods. Additionally, the results show that several individual and family characteristics, such as the sex ratio of children, the gender of the first-born child, property right, education level, and type of hukou, have a positive impact on fertility behaviour. On the other hand, factors such as income and age have a negative impact on fertility behaviour. Gender and urban residence do not appear to have a significant impact on fertility behaviour. Overall, these results suggest that house prices may inhibit fertility behaviour in China, as families may prioritize financial considerations, such as the cost of purchasing real estate, over having children.

7.3 Pooled IV Regression

The regression results of the benchmark model show that house price has a significant inhibitory effect on fertility behavior. However, there might be missing variables and two-way causality that may affect the results. The missing variables, such as family background or subjective attitude, can affect the fertility rate but can be hardly controlled, and thus can lead to biased results. On the one hand, there are many factors that affect family fertility behavior, and variables such as family background and family subjective attitude cannot be directly controlled. On the other hand, fertility behavior is also related to the current situation and future of the family, which will also make the family make plans for future work, income and life when considering fertility behavior, to better balance work and life.

To solve the error caused by the endogeneity of the model, this study selects appropriate instrumental variables to estimate the IV-probit model. Effective instrumental variable selection should satisfy two basic principles: instrumental variables are highly correlated with endogenous explanatory variables, and instrumental variables are not correlated with random disturbance terms. This paper uses the average price of village houses as an instrumental variable. First, house price is highly correlated with the average house price of village houses. Second, a family's fertility behavior has nothing to do with other families' house prices. On this basis, this paper uses a two-stage method for analysis, and the results obtained are shown in Table 6.

Table 6 The results of instrumental variable analysis of house price on family fertility behavior

Variables	First stage	Second stage
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lnHP		-0.1403** (0.061)
sex ratio	-0.0059*** (0.002)	0.1066*** (0.015)
first-born gender	-0.0144*** (0.002)	0.3041*** (0.017)
lnincome	-0.0006 (0.001)	-0.0169*** (0.005)
property right	-0.0518*** (0.005)	0.1615*** (0.031)
age	0.0001 (0.000)	-0.0270*** (0.001)
gender	0.0051* (0.003)	0.0265 (0.021)
education level	0.0035*** (0.001)	0.0426*** (0.007)
hukou	-0.0251*** (0.004)	0.1344*** (0.029)
urban	0.0055* (0.003)	-0.0350 (0.024)
region	-0.0035*** (0.001)	0.0229* (0.013)
lnHP_cid	0.7868*** (0.015)	
Constant	0.0728*** (0.012)	-0.3461*** (0.085)
F	1211.56	
Wald test	422.41	
P	0.000	
Observations	28,194	28,194
Region FE	YES	YES
Year FE	YES	YES

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

According to the results of the F value and T value of the Wald test, the average price of the house in the same village is not a weak instrumental variable and can solve the endogeneity problem. After using instrumental variables, the effect of house price on family fertility behaviour is reduced, but still has a significant inhibitory effect at the 5% confidence level, which is consistent with the results in the benchmark regression model. This also shows that the existence of endogeneity problems will increase the impact of house price on family fertility behaviour.

7.4 Heterogeneity Test

Due to the unbalanced development of China's regions, the factors that affect fertility behavior may vary across different regions and conditions. Therefore, it is important to conduct empirical analysis on different samples of families to gain a more comprehensive understanding of the relationship between house price and fertility rate.

Analyzing the effects of house prices on fertility behavior from different perspectives, such as first-born gender, urban vs rural, and different regions, can provide insights into how these factors may influence the relationship. For example, analyzing the effects of house prices on fertility behavior among urban and rural families can provide insights into how access to housing may differ between these two groups and how this may influence fertility decisions. Similarly, analyzing the effects of house prices on fertility behavior in different regions can provide insights into how regional differences in economic development, culture, and access to resources may influence fertility decisions.

Also, analyzing the effects of house prices on fertility behavior among different subgroups, such as families with and without house ownership, or families with different numbers of children, can provide insights into how these factors may influence the relationship. This can help to identify specific areas where policies and interventions may be needed to support families in making decisions about fertility.

7.4.1 First-born gender

It is true that the preference for boys over girls in China can have a significant impact on fertility behavior in Chinese families. Research has shown that if a Chinese family's first child is a boy, they may be less likely to have more children, while families with a girl as their first-born may be more likely to have additional children. Therefore, analyzing the effect of house price on fertility behavior in families with different genders of the first child can provide valuable insights into how this cultural preference may influence fertility decisions. The results are shown in Table 7.

Table 7 First-born gender subgroup result

Variables	Girl		Boy	
	Control	FE	Control	FE
lnHP	-0.2609** (0.127)	-0.2863** (0.128)	-0.3015*** (0.116)	-0.2750** (0.117)
sex ratio	0.1788*** (0.062)	0.1818*** (0.062)	0.2303*** (0.035)	0.2283*** (0.035)
lnincome	-0.0319** (0.014)	-0.0340** (0.014)	-0.0168 (0.012)	-0.0150 (0.012)
property right	0.1223 (0.092)	0.1272 (0.092)	0.1689** (0.080)	0.1649** (0.080)
age	-0.0755*** (0.003)	-0.0754*** (0.003)	-0.0484*** (0.002)	-0.0486*** (0.002)
gender	0.1613** (0.064)	0.1659** (0.065)	0.0495 (0.053)	0.0519 (0.053)
education level	0.1453*** (0.024)	0.1474*** (0.024)	0.0819*** (0.018)	0.0799*** (0.018)
hukou	0.3780*** (0.090)	0.3676*** (0.090)	0.1909*** (0.074)	0.2017*** (0.074)
urban	-0.0244 (0.072)	-0.0231 (0.072)	-0.0911 (0.060)	-0.0972 (0.060)

region	0.0158 (0.039)	0.0199 (0.039)	0.0701** (0.032)	0.0651** (0.033)
Constant	0.7702*** (0.245)	0.7386*** (0.248)	-0.1378 (0.208)	-0.1406 (0.211)
Observations	10,875	10,875	15,348	15,348
Region FE	NO	YES	NO	YES
Year FE	NO	YES	NO	YES

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

From the information provided in Table 7, it appears that the logarithm of house prices has a significant negative impact on family fertility behaviour, regardless of whether the first-born child is a boy or a girl. However, the impact on families with a first-born boy is stronger than that on families with a first-born girl. This suggests that the cultural preference for boys in China may interact with other factors such as access to housing to influence fertility decisions.

The region- and time-fixed-effects models show that the effects of control variables on fertility behaviour are different for families with a first-born boy and for families with a first-born girl. For example, in the sample of families with a first-born girl, sex ratio, gender, education level, and hukou have a significant positive effect on fertility behaviour, while logarithm of income and age have a significant negative effect on fertility behaviour. On the other hand, in the sample of families with a first-born boy, sex ratio, property right, education level, hukou, and region have a significant positive effect on fertility behaviour, while age has a significant negative effect on fertility behaviour.

In conclusion, the data from Table 7 suggests that house price has a significant inhibitory effect on fertility behaviour in Chinese families, with the effect being stronger for families with a first-born boy. Additionally, the results suggest that the cultural preference for boys in China may interact with other factors such as access to housing, income, education level and hukou to influence fertility decisions.

7.4.2 Urban, rural

Due to the dual structure of urban and rural in China for a long time, the impact of house price on the fertility behavior of urban and rural family is different. This section divides the data into two samples, urban and rural, to explore the impact of house price on fertility behavior. The results are shown in Table 8.

Table 8 results for Urban, Rural

Variables	Rural		Urban	
	Control	FE	Control	FE
lnHP	-0.9812*** (0.205)	-0.9771*** (0.206)	-0.2122** (0.095)	-0.2207** (0.096)

sex ratio	0.1647*** (0.036)	0.1649*** (0.036)	0.2946*** (0.049)	0.2890*** (0.049)
first-born gender	0.5113*** (0.048)	0.5117*** (0.048)	0.6669*** (0.050)	0.6651*** (0.050)
lnincome	-0.0353*** (0.012)	-0.0311** (0.012)	-0.0279** (0.012)	-0.0305** (0.012)
property right	0.2027** (0.096)	0.1846* (0.096)	0.3458*** (0.078)	0.3463*** (0.078)
age	-0.0474*** (0.002)	-0.0475*** (0.002)	-0.0596*** (0.003)	-0.0596*** (0.003)
gender	0.0197 (0.054)	0.0124 (0.055)	0.0773 (0.060)	0.0801 (0.060)
education level	0.0820*** (0.018)	0.0781*** (0.018)	0.0882*** (0.023)	0.0864*** (0.023)
hukou	-0.0530 (0.100)	-0.0480 (0.100)	0.2985*** (0.069)	0.2965*** (0.069)
region	0.0794** (0.032)	0.0819** (0.032)	0.0016 (0.040)	-0.0037 (0.041)
Constant	-0.1622 (0.215)	-0.1244 (0.219)	-0.3175 (0.220)	-0.3200 (0.223)
Observations	14,714	14,714	13,480	13,480
Region FE	NO	YES	NO	YES
Year FE	NO	YES	NO	YES

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The results from table 8 show that the impact of house prices on fertility behavior is negative for both urban and rural families. The coefficient of the logarithm of house price is larger in the urban sample, but both coefficients are significantly negative, indicating that rising housing prices will inhibit fertility behavior in both areas. In the rural sample, the study finds that sex ratio, first-born gender, property right, education level, and region have a significant positive impact on fertility behavior, while logarithm of income and age have a significant negative impact. Gender and hukou are found to have no significant effect on fertility behavior. In the urban sample, sex ratio, first-born gender, property right, education level, and hukou have significant positive effects on fertility behavior, while logarithm of income and age have a significant negative effect. Gender and region are found to have no significant effect on fertility behavior.

7.4.3 East, Middle, West region

Due to the unbalanced economic development in various regions of my country, this paper divides the sample into three regions: East^①, Middle^② and West^③, and establishes empirical models respectively. The specific results are shown in table 9.

^① East includes Shanghai, Beijing, Jilin, Liaoning, Heilongjiang, Tianjin, Shandong, Guangdong, Jiangsu, Hebei, Zhejiang, Hainan, and Fujian.

^② Middle includes Anhui, Shanxi, Jiangxi, Henan, Hubei, and Hunan.

^③ West includes Yunnan, Neimenggu, Sichuan, Ningxia, Guangxi, Gansu, Guizhou, Shaanxi, Chongqing, and Qinghai.

Table 9 results for East, Middle, West

Variables	East		Middel		West	
	Control	FE	Control	FE	Control	FE
lnHP	-0.2548** (0.099)	-0.2531** (0.100)	-0.7755*** (0.246)	-0.7649*** (0.247)	-0.6229** (0.261)	-0.6245** (0.261)
sex ratio	0.2612*** (0.048)	0.2631*** (0.048)	0.1895*** (0.052)	0.1943*** (0.052)	0.1680*** (0.052)	0.1668*** (0.052)
first-born gender	0.6101*** (0.053)	0.6088*** (0.053)	0.6293*** (0.065)	0.6319*** (0.065)	0.4817*** (0.064)	0.4833*** (0.064)
lnincome	-0.0414*** (0.012)	-0.0401*** (0.013)	-0.0244 (0.017)	-0.0183 (0.017)	-0.0325* (0.017)	-0.0337* (0.017)
property right	0.2122** (0.084)	0.2120** (0.084)	0.4442*** (0.120)	0.4321*** (0.120)	0.2695** (0.130)	0.2699** (0.130)
age	-0.0592*** (0.003)	-0.0593*** (0.003)	-0.0561*** (0.003)	-0.0560*** (0.003)	-0.0397*** (0.003)	-0.0396*** (0.003)
gender	-0.0079 (0.063)	-0.0144 (0.064)	0.1518** (0.072)	0.1436** (0.072)	0.0288 (0.076)	0.0317 (0.076)
education level	0.0871*** (0.026)	0.0865*** (0.026)	0.0890*** (0.027)	0.0906*** (0.027)	0.0800*** (0.021)	0.0824*** (0.022)
hukou	0.3126*** (0.086)	0.3148*** (0.086)	0.3001*** (0.100)	0.3055*** (0.100)	-0.0512 (0.112)	-0.0498 (0.112)
urban	0.0133 (0.071)	0.0153 (0.071)	-0.0771 (0.082)	-0.0765 (0.082)	-0.2049** (0.087)	-0.2063** (0.087)
Constant	-0.0428 (0.227)	-0.0116 (0.230)	-0.3649 (0.278)	-0.3490 (0.280)	-0.4138 (0.270)	-0.4436 (0.275)
Observations	12,659	12,659	8,404	8,404	7,200	7,200
Year FE	NO	YES	NO	YES	NO	YES

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The study finds that the coefficients of the logarithm of house price in the fixed effect model are smaller than those in the non-fixed effect model, indicating that the results are more realistic after adding fixed effects. The study also finds that the coefficient of the logarithm of house price has a significant negative impact on fertility behavior in all three regions at least at a 5% confidence level. The greatest impact of the logarithm of house price on fertility behavior is found in the middle region, followed by the western region, and finally the eastern region. The study suggests that this may be due to the fact that middle and western China are underdeveloped areas and the house price in family's assets is relatively large, so when the price of houses increases, it will inevitably lead to families investing more funds in buying houses, leaving less money to raise children, and may choose to be infertile. The eastern region is relatively developed and the impact of house price on family fertility behavior will be smaller.

7.4.4 With or without house ownership

In China, housing property rights are very important to a person. Houses are related to personal medical care and children's education. Usually, when a family is established, a house is purchased and property rights are obtained at the same time. For families with or without housing property rights, the impact of

house price on fertility behavior is not the same. This section conducts an empirical analysis on this, and the results are shown in Table 10.

Table 10 results for with and without house ownership

Variables	without housing property rights		with housing property rights	
	Control	FE	Control	FE
lnHP	-0.4900*** (0.164)	-0.5099*** (0.165)	-0.3131*** (0.101)	-0.2888*** (0.102)
sex ratio	0.1874** (0.080)	0.1897** (0.081)	0.2271*** (0.032)	0.2252*** (0.032)
first-born gender	1.1857*** (0.084)	1.1841*** (0.084)	0.4577*** (0.038)	0.4567*** (0.038)
lnincome	-0.0253 (0.018)	-0.0252 (0.019)	-0.0305*** (0.010)	-0.0299*** (0.010)
age	-0.0843*** (0.005)	-0.0839*** (0.005)	-0.0486*** (0.002)	-0.0487*** (0.002)
gender	0.0776 (0.110)	0.0621 (0.111)	0.0517 (0.043)	0.0540 (0.044)
education level	0.1489*** (0.040)	0.1465*** (0.040)	0.0798*** (0.015)	0.0790*** (0.015)
hukou	-0.0157 (0.130)	-0.0292 (0.131)	0.2623*** (0.062)	0.2703*** (0.063)
urban	-0.2015* (0.121)	-0.1923 (0.122)	-0.0392 (0.049)	-0.0436 (0.049)
region	-0.0931 (0.070)	-0.0684 (0.072)	0.0692*** (0.027)	0.0667** (0.027)
Constant	0.8418** (0.365)	0.8845** (0.371)	-0.2987* (0.164)	-0.3111* (0.167)
Observations	4,547	4,547	23,647	23,647
Region FE	NO	YES	NO	YES
Year FE	NO	YES	NO	YES

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

From Table 10, it can be seen that regardless of whether there is a house property rights, the logarithm of house price has a significantly negative impact on fertility behavior at the 1% confidence level. The study also finds that the impact of house price is much greater in the sample without housing property rights compared to the sample with housing property rights. This is because the fertility behavior of families without housing property rights is more easily affected by the house price as they need to save money to buy a house, whereas for families with housing property rights, the house price has an impact on their fertility behavior, but not as much. On the control variables, sex ratio, first-born gender, and education level have a significant positive effect on fertility behavior in both samples, age has a significant negative effect on fertility behavior in both samples, hukou, region only have a significant positive effect on fertility behavior. The fertility behavior of families with housing property rights has a significant positive impact, the logarithm of income has a significant negative impact on the fertility behavior of families with housing property rights, and the other indicators have no significant impact.

7.4.5 Different children number living in the households

House price also have different effects on the fertility behavior of families with different numbers of children. In this section, the samples are divided into 0-child group, 1-child group, 2-children group, 3-children group and ≥ 4 -children group according to the number of children. The empirical results obtained are shown in Table 11.

Table 11 results for different children number living in the households

Variables	(1) 0 child	(2) 1 child	(3) 2 children	(4) 3 children	(5) ≥ 4 children
lnHP	0.4167*** (0.086)	0.0229 (0.134)	-0.4426*** (0.108)	-0.2700 (0.580)	-1.6197*** (0.549)
sex ratio	-0.2251*** (0.029)	0.1629*** (0.050)	0.2011*** (0.035)	0.5057** (0.199)	0.2397** (0.107)
first-born gender		0.3348*** (0.061)	0.6241*** (0.042)	0.6666*** (0.217)	0.6708*** (0.135)
lnincome	0.0361*** (0.009)	-0.0342** (0.016)	-0.0202* (0.011)	-0.0420 (0.044)	-0.0512* (0.030)
property right	-0.3432*** (0.059)	0.1462 (0.104)	0.3054*** (0.072)	0.0373 (0.351)	0.2326 (0.245)
age	0.0435*** (0.002)	-0.0245*** (0.003)	-0.0571*** (0.002)	-0.1104*** (0.015)	-0.0619*** (0.007)
gender	-0.0190 (0.040)	-0.1655** (0.071)	0.1188** (0.049)	0.3901 (0.283)	0.4307*** (0.159)
education level	-0.0731*** (0.014)	0.0706*** (0.025)	0.0843*** (0.017)	0.0960 (0.082)	0.0466 (0.054)
hukou	-0.2392*** (0.055)	0.3873*** (0.103)	0.1950*** (0.067)	-0.7252** (0.322)	0.2830 (0.235)
urban	0.0573 (0.045)	-0.1007 (0.081)	-0.0262 (0.055)	0.3793 (0.314)	-0.1898 (0.175)
region	-0.0499** (0.025)	0.1129*** (0.044)	-0.0027 (0.030)	0.2506 (0.167)	0.0338 (0.094)
Constant	0.4576*** (0.154)	-3.1070*** (0.284)	-0.6819*** (0.187)	-1.4991* (0.891)	-2.6783*** (0.587)
Observations	28,194	28,194	28,194	28,194	28,194
Region FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

From Table 11, it can be seen that house price has a significant positive effect on the fertility behavior of families with 0 children, and a significant positive effect on the fertility behavior of families with 2 children and ≥ 4 children. It has no significant effect on the fertility behavior of families with 1 and 3 children. Other factors such as sex ratio, property right, education level, and hukou also have an impact on family fertility behavior. Logarithm of income, age, and first-born gender also have a significant effect on fertility behavior of families with 1 child and above. The effect of these factors varies depending on the number of children in the family.

8. Before and after the removal of the OCP in 2016

On January 1, 2016, the two-child policy was fully implemented in China, marking the official cessation of the One-Child Policy (OCP) that has been in place for more than 30 years. During the implementation of the OCP, Chinese families can have only one child, and after it is stopped, they can have two children, and individual families can have 3 or more children. Also, since 2016, China has listed "housing, not speculating" as a long-term national policy, which has played a very important role in stabilizing housing prices.

Based on the previous analysis, this chapter selects cross-sectional data in 2014 and 2016 for empirical analysis and compares the impact of house price on fertility behavior before and after OCP. The results are shown in Table 12.

Table 12 house price impact on fertility in 2014 and 2018

Variables	2014		2018	
	Control	FE	Control	FE
lnHP	-0.1063 (0.087)	-0.0919 (0.087)	-0.1473** (0.061)	-0.1588*** (0.061)
sex ratio	0.1400*** (0.026)	0.1372*** (0.026)	0.0972*** (0.028)	0.0991*** (0.028)
first-born gender	0.2574*** (0.032)	0.2562*** (0.032)	0.3742*** (0.033)	0.3750*** (0.033)
lnincome	-0.0254*** (0.007)	-0.0256*** (0.007)	-0.0058 (0.011)	-0.0056 (0.011)
property right	0.1293** (0.057)	0.1272** (0.057)	0.1818*** (0.052)	0.1829*** (0.052)
age	-0.0247*** (0.002)	-0.0247*** (0.002)	-0.0293*** (0.002)	-0.0292*** (0.002)
gender	0.0899** (0.037)	0.0945** (0.037)	-0.0065 (0.038)	-0.0093 (0.038)
education level	0.0172* (0.010)	0.0177* (0.010)	0.0550*** (0.017)	0.0564*** (0.017)
hukou	0.1036** (0.049)	0.1098** (0.049)	0.1101** (0.052)	0.1058** (0.052)
urban	-0.0853** (0.041)	-0.0899** (0.041)	0.0455 (0.043)	0.0474 (0.043)
region	0.0117 (0.022)	0.0077 (0.022)	0.0368 (0.023)	0.0401* (0.023)
Constant	-0.2477* (0.129)	-0.2642** (0.129)	-0.4719*** (0.171)	-0.4667*** (0.171)
Observations	9,398	9,398	9,398	9,398
Region FE	NO	YES	NO	YES

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 12 shows that before the removal of the OCP, the logarithm of house price has no significant impact on fertility behavior, and after the removal of the OCP, the logarithm of house price on fertility

behavior is significantly negative at the 1% confidence level. This shows that before the removal of OCP, house price has no significant effect on family fertility behavior, that is, it's not the most important factor affecting family fertility behavior, but after removing OCP, house price becomes one of the most important factors affecting family fertility behavior. This may be due to the fact that when OCP was implemented, Chinese families were generally only able to have one child. Under the influence of traditional concepts such as "unfilial piety has three, no descendants are great" and "childbirth is for the purpose of inheriting the family", the fertility behavior of Chinese families is less affected by house price. However, after the removal of the OCP policy, and China's house price was already at a high level in 2016, the impact of house price on family fertility behavior was more significant.

The control variables also have an effect on fertility behavior. In the sample before the removal of the OCP, sex ratio, first-born gender, property right, gender, education level, and hukou have a significant positive effect on fertility behavior, while logarithm of income, age, and urban have a significant negative impact on fertility behavior. In the sample after the removal of the OCP, sex ratio, first-born gender, property right, education level, hukou, and region have a significant positive effect on fertility behavior, and age had a significant negative effect on fertility behavior.

9. Discussion

The paper examines the complex relationship between housing prices and fertility behavior and its effect on economic development. High housing prices can bring about economic development through the wealth effect, but it can also lead to an investment bubble in the real estate market and increase the migration cost of labor which can negatively impact the economy. Furthermore, it is noted that the decline in fertility behavior can have significant implications for the population structure, leading to a decline in the labor force population and an increase in the elderly population which can cause economic growth to slow and put a pressure on the social security system. It is pointed out that China is facing an aging population problem and the negative effects of housing prices on fertility behavior is an important issue that needs to be addressed in order to promote long-term stable economic development.

Various regions in China have implemented a number of measures to promote sustainable economic development, such as joint construction and sharing of infrastructure and public service facilities and exploring new governance models. However, as the paper suggests, regulating housing prices is also important in order to maintain long-term economic stability. The decline in fertility behavior that can be influenced by high housing prices, can cause changes to the population structure, and may lead to a decline in the labor force population and an increase in the elderly population. This can in turn cause a decline in economic growth and put significant pressure on the social security system. With the problem of population aging in China looming, it is crucial to address the issue of high housing prices and its impact on fertility behavior in order to ensure sustainable economic development.

It is important to note that understanding the reasons for the decline in fertility behavior is not enough, effective policies must be developed to regulate fertility behavior in the context of sustainable economic development. The effectiveness of policies adopted by different countries in response to declining fertility behavior varies and it is important to learn from other countries experiences. Evidence from France and the Nordic countries shows that reproductive behavior can be kept at reasonable levels through the coordinated use of public policies in a range of interrelated areas, such as economic policy, employment policy, housing policy, gender policy, nuclear family policy, etc. However, these policies tend to have short-lived effects and it is important to develop a family-friendly culture in order to improve fertility behavior in the long run. Also, experience of OECD countries shows that often there are disparities between policy intentions and actual implementation effects, and the effects of these policies also tend to differ between groups, making it difficult to truly address the decline in reproductive behavior. Timing of policy implementation is crucial, as changes in reproductive behavior will lead to changes in population structure and further affect subsequent reproductive behavior. In response to extremely severe changes in reproductive behavior, Japan has adopted various measures to

encourage childbearing, but these policies have not been able to rescue the declining trend of reproductive behavior. Part of this is due to insufficient policy implementation, and a large part of the reason is that the policy was not implemented in a timely manner, thus missing the best time to adjust the birth control policy.

China has gone through several stages in their childbearing policy since 1949, from loose to tight, and then from tight to loose. However, even after recent liberalization of childbearing, the effect on fertility behavior is not obvious, partly due to insufficient policy implementation, and partly due to the policies not being implemented at the right time. Many surveys show that willingness to have children in China is connected with the current burden of people's lives, particularly the burden of housing. Therefore, liberalizing the number of children alone is not enough to change the overall trend of declining fertility behavior. To address this issue, scholars and policymakers need to explore more effective policies and implementation methods, while also monitoring and evaluating the effectiveness of these policies over time.

10. Conclusion

To summarize, this study analyzes the impact of house prices on fertility behavior using CFPS balanced panel data from 2014, 2016, and 2018. The study uses a probit model and conducts robustness testing with a logit model. Instrumental variables are used to test for endogeneity and the average house price of the same village is used as an instrumental variable. The main findings of the study are:

- (1) Rising housing prices have a significant negative impact on fertility behavior, and for every 1% increase in the logarithm of housing prices, fertility behavior decreases by 0.1711%. Other variables such as sex ratio, first-born gender, property right, education level, hukou also have an impact on fertility behavior, with positive and negative effects.
- (2) The results obtained by the basic model are robust.
- (3) The average price of the house in the same village is not a weak instrumental variable and can solve the endogeneity problem. After using instrumental variables, the effect of house price on family fertility behavior is somewhat reduced, but still has a significant inhibitory effect at the 5% confidence level, which is consistent with the results in the benchmark regression model.
- (4) From the perspective of heterogeneity test, the study finds that housing prices have a significant negative impact on reproductive behavior regardless of the gender of the first child in the family. For families with their first child as a girl, the negative impact of housing prices on reproductive behavior is less as compared to families with their first child as a boy. Additionally, the study finds that the impact of housing prices on reproductive behavior is greater for families with no children, families with 2 children, and families with 4 or more children. The impact of housing prices on reproductive behavior is found to be greater for rural families, families in the central region, and families without property rights. The study also finds that the impact of housing prices on reproductive behavior is greater in the central region than in the western region and the smallest in the eastern region.
- (5) Before and after the removal of the OCP are analyzed separately, no matter before the removal of the OCP or after the removal of the OCP, the impact of housing prices on fertility is significantly negative, but after the removal of the OCP housing prices, the impact on reproductive behavior is even greater.

The study concludes that the cost of childbearing is a main reason for suppressing childbearing demand and reducing childbearing probability, and that comprehensive two-child and three-child policy is no longer the main way to regulate population growth and population structure. To improve fertility intentions and boost fertility behavior, it is necessary to take a two-pronged approach: First, rationally regulate housing prices by region to curb the irrational rise in housing prices, ensure the healthy development of the real estate market, and combat speculative demand. Improve the housing rental

market and legal system, implement a multi-subject supply, multi-channel guarantee, and rental-purchasing housing system, and narrow the difference in functional ownership between rental housing and housing purchase. Develop and support the self-occupancy needs of homeless families and the improvement needs of families with a set of houses and link the purchase of improved housing with the number of children born. And second, gradually promote "work-family-friendly" policies such as giving direct childbirth cost subsidies and tax incentives to families who have children, introducing a flexible working system, promoting the construction of inclusive childcare centers, and increasing financial investment in social security and parenting security systems, including more complete educational resources, medical security, and other living security.

However, the study also acknowledges some limitations in the research. The study used data from 2014 to 2018, so the sample size is not large enough to subdivide the sample for in-depth research, and the nature of the work of the respondents was not included in the variable selection. Additionally, the sample size of ethnic minorities is small, so the conclusion may not be applicable to ethnic minorities, and further research is needed.

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