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High Rents, Low Births: Exploring Fertility Responses to Housing Prices Via Ardl

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Abstract

China experienced rapid population growth throughout the 1990s, but this trend began to stabilize by 2015. By 2017, the number of births had fallen below the number of deaths, marking the onset of negative population growth. This demographic shift presents significant macroeconomic challenges, including labor shortages and an increasing burden of elderly care. While fertility rates have declined, household consumption levels have continued to rise, with housing expenditures surpassing food to become the largest component of per capita spending. This study investigates whether rising housing prices have contributed to declining fertility rates in China. Using panel data from 31 provinces between 2003 and 2021, the analysis employs the Autoregressive Distributed Lag (ARDL) model to examine the relationship between housing prices and fertility. The findings indicate that both increasing housing prices and the growth of the tertiary sector's GDP exert a significant negative impact on fertility rates. Based on these results, the study recommends that policymakers consider measures to regulate housing prices and manage consumption growth as part of broader efforts to address the challenges associated with negative population growth.

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1. Introduction

In order to investigate the basic information of the population and residents, the contents include name, ID card number, gender, age, nationality, education level, industry, occupation, migration, marriage, birth, death, housing, etc. The Chinese government conducted its seventh national population census on November 1, 2020; the results were announced on May 11, 2021. The total population of 31 provinces, autonomous regions, municipalities directly under the central government, and active military personnel registered in the census was 1411778724, an increase of 72.06 million or 5.38% compared to 1339.72 million in 2010; The annual average growth rate is 0.53%, a decrease of 0.04 percentage points from the annual average growth rate of 0.57% from 2000 to 2010. This data indicates that China's population has maintained a low growth rate for the past 10 years. In the Chinese context, the population distribution in China is unevenly distributed (Arellano & Bond,1991). The seventh population census also revealed the population distribution, with the eastern region accounting for 39.93%, the central region accounting for 25.83%, the western region accounting for 27.12%, and the northeast region accounting for 6.98%. Compared to 2010, the proportion of the population in the eastern region increased by 2.15 percentage points, decreased by 0.79 percentage points in the central region, increased by 0.22 percentage points in the western region, and decreased by 1.20 percentage points in the northeast region. The population is further gathering in economically developed regions and urban agglomerations. Regarding policy, China had already encouraged the rural population to migrate to cities as early as 1949. With the development of the times, the urbanisation population in 2019 had reached 60.60%. The advantage is that urbanisation often accompanies the development of industry and commerce, promoting economic growth (Arestis et al.,2017) Cities are more likely to form industrial clusters and innovation centres, which can help improve production efficiency and create job opportunities. However, economically, cities' increasing population density has increased land and housing prices. At the same time, more people are occupying resources, increasing the cost of living. (Han, 2016).

Despite the increase in the total population of China, (Luo et al., 2021) also pointed out that some regions also have significant population loss. According to the growth map, the number of people in the northern region has shown a downward trend compared to a decade ago, with the population flowing to the eastern coastal areas. Although the total population of China is increasing, the fertility rate is declining. The National Bureau of Statistics released a fact in its 2022 yearbook, stating that in 2022, there were 9.56 million births and 10.41 million deaths, with

a negative growth of 850000 people. There are many factors for the reduction of fertility (Baltagi et al.,2000). Ge and Zhang (2019, cited in Xie et al., 2025) pointed out that housing prices negatively correlate with the birth rate. For every 1000 yuan increase in housing prices, the probability of having one child will decrease by 1.8% to 2.9%, and the probability of having a second child will decrease by 2.4% to 8.8%. For women of childbearing age aged 25 to 29, for every 10% increase in housing prices, the birth rate will decrease by 1.5%. Ge and Zhang (2019, cited in Xie et al., 2025) explained the harm of negative population growth. First, there is a reduction in the labour force, especially in the supply of young adult labour force, and a severe shortage of social security payers (Baltagi et al.,2000). Secondly, the demand for purchasing houses has decreased, and the future real estate industry will be fragile. However, these social problems have a long incubation period and may only occur in the next ten years (Baum et al., 2000).

Nevertheless, the study of fertility has become very necessary. This paper compares the birth rate of the following six representative provinces from 2003 to 2021. The provinces are Xizang, the province with the most significant population growth from 2010 to 2020; Heilongjiang, the province with the most significant population loss (Chen et al., 2020); Shanghai, the province with the highest average housing price, the province with the most significant population density; Shanghai, the province with the largest resident population, Guangzhou, and Beijing, the wealthiest province in recent years. We found that the birth rate in any province showed a significant downward trend after 2017 (Luo et al., 2021).

Understanding demographic trends is crucial for assessing a country’s long-term socio-economic stability. In China, population data collection plays a fundamental role in this analysis. The seventh national population census, conducted on November 1, 2020, and released on May 11, 2021, provided comprehensive information on residents, including name, ID card number, gender, age, nationality, education level, industry, occupation, migration status, marital status, birth and death rates, housing, and more (Fang Huifen et al., 2021). According to the census, the total population—including 31 provinces, autonomous regions, municipalities directly under the central government, and active military personnel—stood at 1,411,778,724. This figure marked an increase of 72.06 million people, or 5.38%, from 2010. However, the average annual growth rate declined to 0.53%, compared to 0.57% during the previous decade, indicating that China has entered a period of sustained low population growth (Frank,2005).

Population distribution remains uneven across the country. In 2020, the eastern region accounted for 39.93% of the population, the central region 25.83%, the western region 27.12%, and the northeastern region just 6.98%. Compared to the 2010 census, the eastern region's share increased by 2.15 percentage points, while the central and northeastern regions experienced a

decline. This reflects a continued concentration of population in economically developed areas and urban agglomerations (Freeman,2000).

Historically, China has encouraged rural-to-urban migration since 1949. By 2019, the urbanization rate reached 60.60%. Urbanization has brought economic benefits, including industrial clustering, improved production efficiency, and job creation. However, it has also led to increased population density, which in turn has driven up housing and land prices, significantly raising the overall cost of living (Han, 2016).

Despite an overall increase in population, regional disparities have emerged. Chen et al. (2020) observed significant population loss in some northern provinces, while eastern coastal regions continue to attract internal migration. More importantly, fertility rates have been on a consistent decline. The National Bureau of Statistics reported that in 2022, China recorded 9.56 million births and 10.41 million deaths, resulting in a negative population growth of 850,000. Numerous factors contribute to this trend, but housing affordability has been identified as a key determinant (Liu et at., 2023）.

Research from Renmin University of China (2021) found a strong negative correlation between housing prices and fertility rates. Specifically, for every 1,000 yuan increase in housing prices, the likelihood of having a first child falls by 1.8% to 2.9%, and the probability of having a second child decreases by 2.4% to 8.8%. Among women aged 25–29, a 10% increase in housing prices leads to a 1.5% decline in the birth rate. The consequences of negative population growth are profound, including labor shortages, pressure on social security systems, and a weakening real estate market—though many of these effects may only become fully apparent in the coming decade (Han Tianming,2016).

Given these developments, examining the impact of housing prices on fertility has become increasingly necessary. This study focuses on a comparative analysis of fertility trends in six representative provinces from 2003 to 2021:

Xizang (Tibet): the province with the highest population growth from 2010 to 2020

Heilongjiang: the province with the most significant population decline

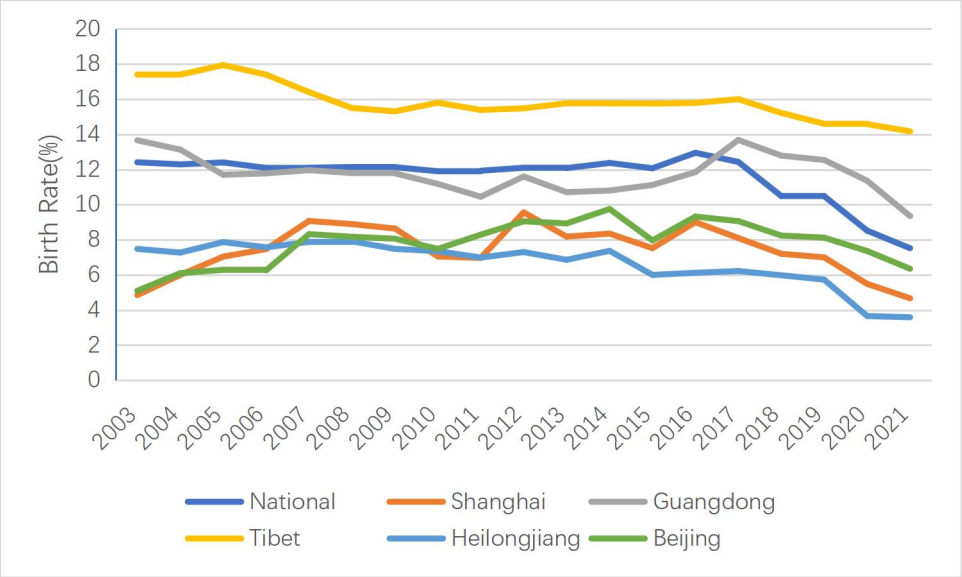
Shanghai: the province with the highest housing prices and population density

Guangdong: the province with the largest resident population

Beijing: one of the wealthiest provinces in recent years

Our findings reveal that fertility rates in all six provinces have shown a marked decline since 2017. This paper further investigates this relationship using the Autoregressive Distributed Lag

(ARDL) model, analyzing panel data from 31 provinces between 2003 and 2021. The study aims to clarify the extent to which housing prices and other economic factors are influencing China's fertility decline and to provide policy recommendations to mitigate the long-term effects of negative population growth (Hsieh & Moretti 2018).

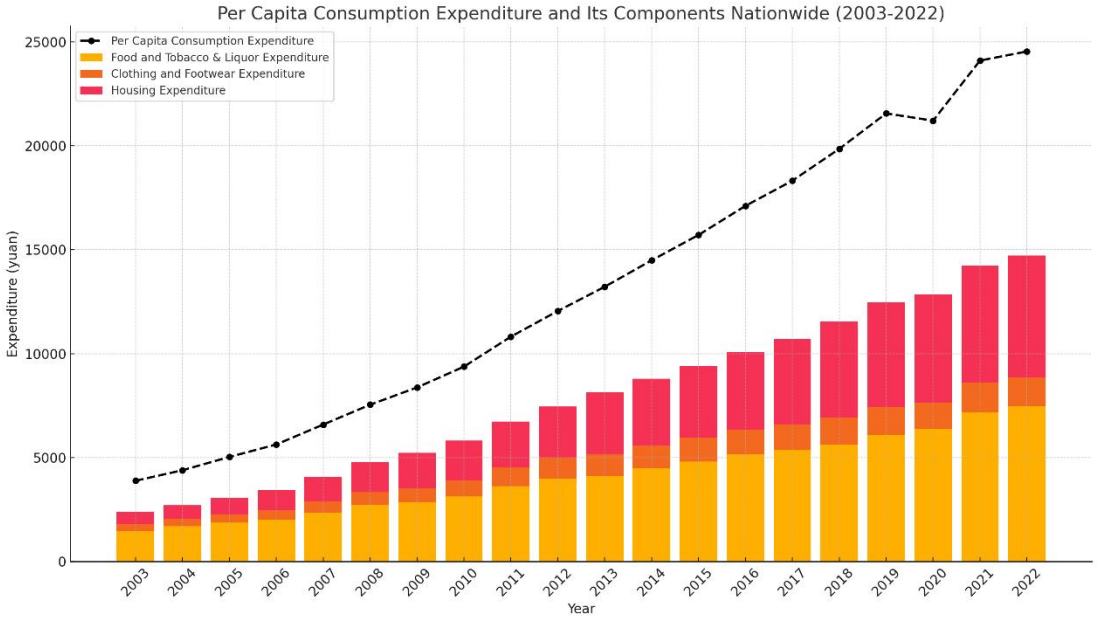


Source: National Bureau of Statistics

Figure 1: Selected five provinces and overall national birth rate from 2003 to 2021

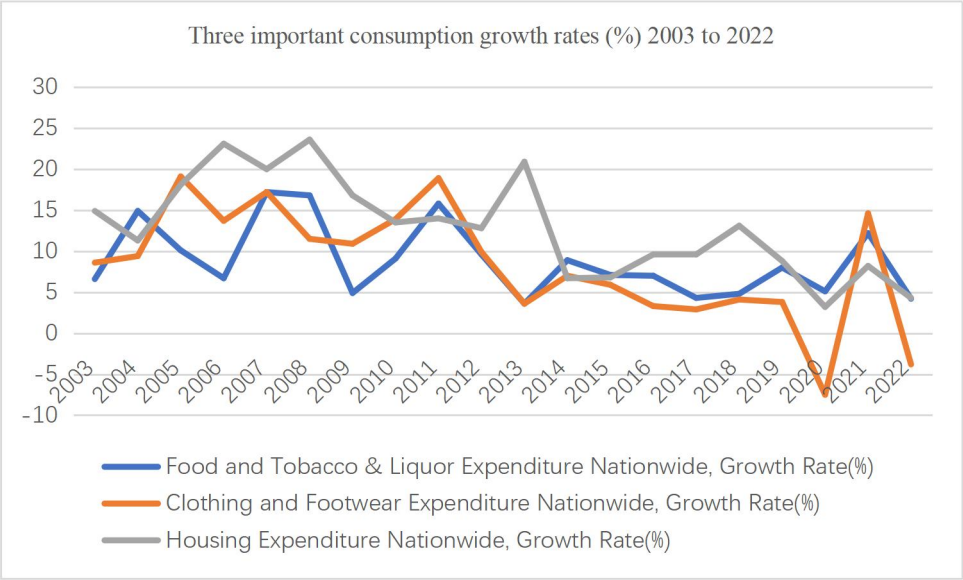
As early as 1960, American economist Gary Becker pioneered the application of economic analysis to study fertility rates. His research identified a positive correlation between fertility rates and household income, suggesting that higher household income supports higher fertility (Im et al., 2003). Conversely, he observed a negative correlation between fertility rates and household consumption levels, indicating that increased consumer demand is associated with lower fertility rates.

Chinese residents consume more for housing, clothing, and food; the total sum of these three types of consumption accounts for over 50% of the per capita total consumption; housing consumption is just one of the many expenses residents must bear. Extracting housing, clothing, and food consumption from the annual consumption list of average residents for comparison, the proportion of housing consumption to clothing consumption was almost the same before 2006.



Source: National Bureau of Statistics

Figure 2: Per Capita Consumption Expenditure Nationwide (yuan) from 2003 to 2022



Source: National Bureau of Statistics

Figure 3: Three important consumption growth rates (%) from 2003 to 2022

It is evident that since 2003, the average consumption level of residents has risen very rapidly, with an annual average consumption growth of 450% in 20 years. In the annual average consumption of residents, housing, food, and clothing account for a large proportion, almost

exceeding 50% of the total consumption yearly (Martinez-Zarzoso & Bengochea-Morancho, 2016). Listing these three types of consumption separately, it is found that before 2012, the proportion of housing consumption was almost equivalent to clothing consumption, and residents mainly consumed food. After 2012, housing consumption far exceeded clothing consumption and even approached food consumption. The growth rates of these three types of consumption can also support this phenomenon, as the growth rate of housing consumption is much higher than the other two types of consumption (Moomaw & Al-Wosabi, 2007).

Here is a social phenomenon that needs to be explained: why Chinese people are so persistent in buying houses? There is a description of houses in Chinese literature over a thousand years ago. "home" refers to a house where a couple and children live. If the children reach adulthood and get married, they must form a new family (Pesaran & Smith,1995). They must own their own house and become independent, becoming a new "home." Therefore, one of the conditions for becoming a "home" is the house. This custom has become a traditional family culture in China, and owning a property may now be considered a qualification for marriage. Most families, especially those with boys, need to purchase a second home before their children get married, which increases the demand for housing in China. Apart from cultural and customary reasons, historically, China has had limited investment options for its citizens. The stock market has been volatile, and other investment opportunities may have been less appealing or accessible. Real estate, therefore, became a popular choice for investment, fostering a culture of property (Pesaran et al., 1995).

Han (2016) stated that the current housing market in China is highly competitive, making it increasingly difficult for many to purchase a home. Prices have steadily risen, resulting in a situation where even those with a stable income can no longer afford to buy a property. That has caused much financial stress for those in need of housing and frustration due to the limited availability of affordable housing options. It is worth mentioning that real name registration is required for housing purchases in China (Phillips & Moon, 2000). An individual can purchase multiple properties, but the down payment for the first property will vary depending on the quantity. The down payment for the first house is 30% of the total price, and the down payment for the second house is 40%. The remaining money must be borrowed from the bank and mortgaged to the bank with the house. At this point, the bank's interest rate is crucial as it determines how much the homebuyer will repay to the bank. From this perspective, the rise in housing prices will increase the pressure on homebuyers to make down payments and on banks to repay loans in the future. Homebuyers are required to prioritize monthly loan repayments to the bank, with the residual income available for discretionary expenditures, including costs associated with childbearing (Han,2016).

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China is currently facing significant demographic and socioeconomic challenges associated with its declining fertility rate and the implications of negative population growth. Despite the slight increase in total population as indicated by the seventh national census, the fertility rate has shown a consistent downward trend, with births falling below deaths by 2022, resulting in negative growth. This demographic shift poses long-term risks, including labour shortages, reduced economic productivity, and increased pressure on social security systems (Yu & Cai,2021).

One critical factor influencing this decline is the rising cost of living, particularly housing expenses. Housing consumption has become a significant financial burden for Chinese residents, accounting for a substantial proportion of household expenditures (He et al.,2020). This trend is partly fueled by cultural traditions emphasising homeownership as a prerequisite for marriage and family formation, alongside limited investment options that make real estate a popular choice. However, the sharp rise in housing prices has exacerbated financial stress, limiting discretionary spending on childbearing and family-related expenses. Research has shown that housing price increases negatively correlate with fertility rates, further reinforcing this trend.

Furthermore, urbanisation and economic growth have intensified population concentration in economically developed regions, driving up land and housing prices in cities. This has created barriers to homeownership and increased living costs, particularly for younger generations, leading to a postponement or reduction in childbearing. The economic pressures stemming from high housing prices and the implications of negative population growth underscore the urgent need to address the interplay between housing affordability and fertility rates.

This paper seeks to explore the relationship between rising housing prices and declining fertility rates across various Chinese provinces; it aims to provide insights into mitigating the adverse effects of housing market trends on demographic sustainability and economic stability(Clark et al.,2020).

This research will relate to the literature review in section 2, stating the study's theoretical basis. Section 3, "Research Methodology," describes the methods and data used in this research. Section 4, "Empirical Results and Findings," gradually lists the computational process of this research and analyses the data. This research will be summarised at the end of the paper, and suggestions will be provided to society based on the results.

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2. Data and methods

Theoretical：

Various theories have been offered regarding the impact of housing prices on fertility. The cost of living and talent attraction theory are the major theories in this regard. As per this theory, when the housing prices increase, this could lead to a potential brain drain from the region as entrepreneurs or normal may not be able to live in such regions because of high housing and rent (Arestries, 2017). Thus, the increased housing costs could negatively affect fertility. On the other hand, regions where housing prices witness a decrease could lead to a potential increase in the talent pool as the region becomes more populated due to low housing and rent costs (Arrestries, 2017). However, contrary to this theory, the concentration of innovation in high-cost areas theory has contrasting findings. As per the concentration of innovation in high-cost area theory, regions and areas with increasing housing prices attract more Silicon Valley firms and other companies making critical investments in innovation (Hsieh & Moretti, 2018). Due to high potential opportunities in such regions, this could lead to an increased concentration of individuals with innovative capabilities and entrepreneurial talent. The clustering effect is witnessed in such regions, which leads to a high concentration of innovators (Yu & Cai, 2021). Thus, compared to the cost of living theory, the concentration of innovation in high-cost areas stressed positive relations between increasing housing prices and a more significant influx of innovators.

Another critical theory is the housing market constraint theory, which stresses that the supply side of the housing market is significantly affected by the fertility rate. When housing prices rise, the general tendency could be toward fewer children, as such individuals could engage in

delayed marriages or forgo having children until they can afford adequate housing facilities (Clark et al.,2020). The authors have analysed data from China, and through empirical analysis, they found that fertility significantly affects housing prices in the country.

The last theory that could be used in this section regarding the factors affecting housing prices is the wealth effect theory (Liu et al., 2023).

The theory stressed that fertility significantly affects housing prices, as higher wealth accumulation could lead to a high fertility rate, which could drive housing prices further in the market. A significant number of children and family members, along with the rising income, encourage individuals and families to build or rent bigger houses, increasing the demand for housing and housing prices in a region (Clark et al.,2020).

Empirical:

Fang et al. (2021) also aimed to study the relationship between birth rate and housing prices in China's Yangtze River Delta region. This paper used the LSDVC model and concluded that for cities with high and medium to high housing prices, the housing income ratio has a relatively small inhibitory effect on fertility rates; For cities with medium and low housing prices, the housing income ratio has a more significant inhibitory effect on fertility rates. This result indicates that for cities with different housing prices, fluctuations in purchasing power have different impacts on residents' willingness to have children. In cities with medium and low housing prices, fluctuations in purchasing power have a more significant impact on residents' willingness to have children. A decrease in purchasing power can significantly decrease residents' willingness to have children, leading to decreased fertility rates. This is mainly because cities with high housing prices often correspond to economically developed cities, where residents' purchasing power is prone to significant changes. However, residents living in small cities, due to the relatively stable housing market and income, have less change in purchasing power compared to large cities, making it more difficult for them to cope with fluctuations in purchasing power. Compared to the 31 provinces in China, the four provinces in the Yangtze River Delta region, Shanghai, Jiangsu, Zhejiang, and Anhui, already have the best economies. Li (2017) also reached the same conclusion. Using the ARDL model, she used GDP, children's education costs, health costs, and the House price index as control variables to study the impact of housing prices on the birth rate in Malaysia. She reached the same conclusion as Fang (2021): housing costs significantly negatively affect fertility.

Deng et al. (2019) found the opposite result through a regression model: a decrease in the birth rate will promote an increase in housing demand. This viewpoint is controversial, as the new population determines future housing sales, and this conclusion can only be consistent with the current period.

Interestingly, Yang and Ding (2022) concluded through Panel data analysis that the wealth effect is dominant in the central and western regions; rising house prices will significantly increase the population's birth rate. This conclusion differs from previous literature but is logically consistent with the research background mentioned in this study: China's housing prices have significant regional differences.

3. Results

According to Chinese law, it is monogamous. Since 1982, China has been implementing a family planning policy, which was abolished in 2016. In addition to policies, many other factors could affect fertility as well. In order to explore the impact of housing prices on fertility, this study employs the housing prices in each province as independent variables. The housing price data can be found in China's national data, and the provincial GDP, income level, and marriage rate in the economic factors as control variables; the unemployment rate can be queried through national data, and the marriage rate can be found in the civil affairs bureaus of each province. Li (2017) selected education and health costs as control variables in his study on Malaysia's fertility rate. However, many other hidden consumptions exist for a child's healthy growth, such as clothing, interest cultivation, etc. These consumptions vary according to family income. Coincidentally, they all belong to the Tertiary sector of the economy's GDP, so they chose it as control variables. Secondly, Education level is a test of the education level in a province. Cities with higher education levels are wealthier, and Li (2017) also mentioned that education significantly impacts women's willingness to have children.

Variable	Code	Description	Source
Fertility rate	FR	Birth rate by province	National Bureau of Statistics
House Price	hp	Average selling price of residential commodity housing price	National Bureau of Statistics
Income	Income	average annual income per person	National Bureau of Statistics
Education level	EL	Average Education Level by Province	National Bureau of Statistics
Marriage Rate	MR	Assuming monogamy and getting married before having children	National Bureau of Statistics
GDP of Tertiary sector of the economy	TGDP	Birth costs, education costs and health costs are basically included in the GDP of the	National Bureau of Statistics

	Tertiary sector of the economy.
	(RMB)

The first chapter of this study introduced the idea that as early as 1960, American economist Gary Becker introduced economic analysis methods into the study of fertility rate and found a direct relationship between fertility rate and household income. However, in the first chapter's introduction, housing consumption in China's CPI dominates. The higher the housing price, the lower the consumption ability in other aspects. According to Gary Becker's (1960) theory, children also belong to household consumption, including birth, education, and health costs, which are all included in the GDP of the tertiary industry. Of course, the problem of low fertility cannot be entirely blamed on housing prices. In terms of policy, China's monogamous system prohibits unmarried men and women from having children legally. With the development of society, women's education level is increasing, and they are gradually becoming independent, leading to a decreasing demand for marriage. Therefore, to explore the relationship between housing prices and the dependent variable fertility (FR), this study chose the ratio of annual housing prices to annual per capita income (RPI) as the independent variable. This ratio demonstrates the pressure that residents bear on housing consumption. Simultaneously controlling variables such as education level (EL) and marriage rate (MR) resulted in differences in fertility rates among different provinces. Finally, the GDP of the tertiary industry is set as the control variable because the GDP varies in different provinces, and the cost of children's growth also varies. As couples, whether the remaining savings after paying the mortgage are enough to cover the cost of children's growth determines their attitude towards childbirth.

4. Discussion

4.1. Panel independence inspection

Due to the characteristics of panel data, it is often possible for some common reason to affect all individuals, such as a financial crisis, which may lead to cross-sectional dependence. When there is a cross-sectional correlation, traditional panel unit root tests such as the Lein Lin Chu test and the Augmented Dicky Fuller test may be ineffective, leading to the phenomenon of pseudo regression. Therefore, before conducting unit root tests on variables, a CD Test panel independence test was conducted, and the results are shown in Table 1.

Table1：The result of independence inspection

Variable	CD-test	p-value	corr	abs(corr)
br	55.80	0.000	0.594	0.609
lnhp	91.95	0.000	0.978	0.978
el	87.44	0.000	0.93	0.93
mr	60.06	0.000	0.639	0.682

ttgdp	91.12	0.000	0.969	0.969
income	93.66	0.000	0.996	0.996

Table 1 shows that variables show significance below the 1% level through the CD test, thus rejecting the hypothesis of panel independence. Therefore, the panel data used in this article does not have panel independence. When conducting unit root tests on variables, it is necessary to distinguish them from traditional methods, which will be explained in the following section.

4.2. Panel unit root test

Generally speaking, econometric models need to undergo stationarity tests before estimating variables to prevent the occurrence of "pseudo regression" phenomena. By testing the independence of panels, it was found that the test results rejected the null hypothesis at the 1% level, indicating the existence of panel independence, which means the existence of panel correlation. Therefore, when conducting stationarity tests on variables, traditional tests such as LLC, ADF, and KPSS cannot meet the requirements, so Pesaran-CD tests can only be used. The test results are shown in Table 2, where I (1) represents the first-order difference and I (2) represents the second-order difference. According to the results, it can be seen that most variables remain stable at the 1% level after the first order difference. The variable tertiary industry GDP (ttGDP) also stabilized after the second-order difference.

Table2: Panel unit root test result

Variable	I(0)	I(1)	I(2)
br	-2.555 *	-4.254***	-
lnhp	-2.432	-3.918***	-
el	-3.170***	-4.560***	-
mr	-3.305***	-4.455***	-
ttgdp	-1.620	-2.054	-3.744***
income	-1.563	-3.308***	-

4.3. Cointegration test

Pedroni and Kao proposed a method for conducting panel cointegration testing. The original hypothesis is that there is no cointegration relationship. This article first tests the possible cointegration relationship between variables using these two methods, and the results are shown in Table 3. The Pedroni Test and Kao Test both show significant results below 1%. Therefore, it is reasonable to reject the null hypothesis that there is a significant cointegration relationship between variables that do not exist.

Table3: Cointegration test result

	Kao		Pedroni	
ADF	Statistic	p-value	Statistic	p-value
	-1.8652	0.0311	-2.5053	0.0061

This article further conducts cointegration testing using the Westerlund test. According to the Westerlund cointegration test results, the statistic is -1.4075, corresponding to a p-value of 0.0796. At a significance level of 10%, the p-value is less than 0.1, so we can reject the null hypothesis and assume a cointegration relationship exists between the sequences in the panel data.

This conclusion indicates a long-term stable equilibrium relationship between the data sequences within the selected sample range. Confirming this cointegration relationship is significant for further economic analysis and modelling, as these sequences maintain a relatively stable connection in dynamic changes.

However, we also need to note that various factors, including data quality, sample size, and model settings, may influence the results of statistical tests. Therefore, in future research, we should continue to explore the specific relationships between these sequences and attempt to improve the accuracy and reliability of the test by improving methods and expanding the sample range.

In summary, the Westerlund cointegration test confirmed the existence of cointegration relationships between panel data sequences at a significance level of 10%. This discovery provides an important statistical basis for further analysing the interdependence between these sequences.

Table4: Westerlund test result

Westerlund test		
Variance	Statistic	p-value
ratio	-1.4075	0.0796

4.4. Panel ARDL inspection results

This article uses mixed intergroup averaging (PMG) and dynamic fixed effects (DFE) to estimate the panel ARDL model, and selects the optimal lag order of the model based on the maximum lag order of 5 and the AIC information criterion. The dynamic fixed effects method (DFE) is a mixed estimation of the time series of each cross-section, which only allows for heterogeneity in the intercepts of each cross-section. The mixed intergroup averaging method (PMG) combines the mixed estimation ideas of MG and FE, allowing for heterogeneity in the intercepts,

short-term volatility coefficients, and error variances of the ARDL model of each cross-section; On the other hand, like FE, the coefficients of the long-term equilibrium equation that constrain each section are the same The MG estimator does not impose any constraints on the long-term equilibrium equation coefficients of each cross-section in the panel, while the PMG and DFE estimators both constrain the long-term equilibrium equation coefficients of each cross-section in the panel to be the same. Only when the assumption that the long-term equilibrium equation coefficients are the same is true, the PMG and DFE estimators are consistent and more effective. Therefore, the Hausman test compares the PMG and DFE estimators.

4.5. ARDL test results

Based on the results of ARDL panel regression, this study conducted an in-depth analysis of the determinants of birth rate (Br). The PMG regression results are in column (1), and the DFE regression results are in column (2).

In terms of long-term effects, we found that the housing price (hp) significantly negatively impacts the birth rate, indicating that high housing prices relative to average wage levels may be an important factor in suppressing family fertility intentions. In addition, the increase in local marriages (MR) significantly promotes the increase in birth rate, indicating a positive correlation between marital status and fertility rate. However, the impact of education level (el) on birth rate is not significant in the long term, possibly due to the complexity of the impact of education level improvement on fertility intention, which may increase or inhibit fertility intention.

In the short-term effect, the error correction term (ec) is significantly negative, indicating the existence of a dynamic mechanism for the system to adjust towards long-term equilibrium. In the short term, the housing prices (lnhp) do not significantly impact the birth rate, possibly due to the lag effect of changes in housing prices on fertility intentions. At the same time, short-term changes in education level (D.el) significantly negatively impact the birth rate, which may reflect that individuals are more inclined to pursue career development rather than family fertility in the short term after improving education level.

In the short-term analysis of the ARDL model, the error correction term (ECM) is found to be significantly negative. This indicates the presence of a stable and effective dynamic adjustment mechanism within the system, suggesting that any short-term deviations from the long-term equilibrium in fertility rates are gradually corrected over time. In other words, despite short-term shocks or fluctuations, the model tends to converge back to its long-run equilibrium, reinforcing the validity of the long-term relationships identified in this study.

Interestingly, in the short term, the coefficient for housing prices (lnhp) does not show a statistically significant effect on fertility. This result suggests that changes in housing prices may not immediately influence childbearing decisions. One possible explanation for this phenomenon

is the lag effect: individuals or couples may take time to adjust their fertility plans in response to changing housing market conditions. For example, rising housing prices might initially delay marriage or family planning discussions, but their full effect on fertility may only materialize after a few years, as financial pressures accumulate and household decisions adapt. In 2017, average housing prices in Shenzhen increased rapidly due to speculative demand and limited land supply. Despite this spike, the birth rate in the city did not immediately decline in the same year. Young couples who had already planned to have children may not have altered their decision in response to the sudden price hike. However, within the next two to three years (2018–2020), birth rates began to decline significantly in Shenzhen, as high housing costs led to delayed marriages, reduced household formation, and lower fertility intentions. This illustrates the lag effect: the economic pressure of high housing prices affects fertility decisions gradually over time.

In contrast, short-term fluctuations in the education level (D.el) show a significant and negative impact on the birth rate. This may reflect the opportunity costs associated with education and career development, particularly for women of childbearing age. As education levels rise, individuals—especially those in urban and professional environments—are more likely to prioritize personal development, career advancement, and financial independence before considering family formation. In the short term, this shift in priorities can lead to postponement of childbirth, contributing to a temporary decline in fertility rates. Moreover, the demands of academic and professional life often compete with the time and resources needed for parenting, further discouraging early childbearing.

These findings underscore the importance of considering the temporal dimension in fertility research. While some factors, such as education, may have an immediate influence on reproductive behavior, others, like housing affordability, exert their influence more gradually. This distinction is critical for policymakers, as it highlights the need for both short-term supportive measures—such as childcare subsidies or work-life balance programs—and long-term structural reforms, including housing policy and income support, to effectively address declining fertility rates.

In addition, the short-term fluctuations in the number of local marriages (D.mr) do not have a significant impact on the birth rate, while the short-term fluctuations in the GDP of the tertiary industry (D2. ttgdp) have a weak positive impact on the birth rate, which may reflect the potential positive effect of economic development on fertility intentions. The short-term change in wage level (D. income) has a significant positive impact on the birth rate in the second model, further supporting that economic conditions are one of the important factors affecting family fertility decisions.

Table5: ARDL test results

Variable		(1) d.br
LR	lnhp	-4.1408**
		(-2.0003)
	el	1.4646
		(0.9970)
	mr	0.2328***
		(3.3506)
	ttgdp	0.0000
		(0.3081)
	income	-0.0002*
		(-1.7320)
SR	__ec	-0.1457***
		(-3.8973)
	D.lnhp	0.0686
		(0.2258)
	D.el	-0.5140***
		(-2.9734)
	D.mr	-0.0301***
		(-3.4334)
	D2.ttgdp	0.0001*
		(1.8269)
	D.income	0.0003***
		(3.7604)
	_cons	3.8295*
		(1.6707)
	N	442
	Regional control	YES

Notes: The value of t in parentheses, * p<0.1, ** p<0.05, *** p<0.01

5. Conclusions

This study utilizes panel data from 31 provinces and autonomous regions in Mainland China spanning the period from 2003 to 2021. The dataset includes annual birth rates, average housing prices, educational attainment, marriage rates (logarithmic form), provincial GDP, and per capita income within the tertiary sector. To assess the dynamic relationship between these variables and fertility rates, the Autoregressive Distributed Lag (ARDL) model was employed. The reliability of the model's estimates was confirmed through Hausman and robustness tests, ensuring the

validity of the results. These findings serve as a basis for analyzing the key economic and social factors influencing fertility in China.

The results reveal that elevated housing prices, particularly when considered relative to average wage levels, significantly suppress fertility intentions. This supports the study's core hypothesis: rising housing prices contribute to declining birth rates. As housing constitutes a major household expenditure, higher prices reduce disposable income available for other essential needs such as food, clothing, healthcare, and education—many of which are captured within the GDP of the tertiary industry. Notably, the study finds that growth in the tertiary sector's GDP has a long-term and statistically significant negative effect on fertility.

In contrast, household income demonstrates a consistent positive impact on fertility in both the short and long term. Higher income levels enhance a household's capacity to support child-rearing, thereby strengthening fertility intentions. Additionally, marriage rates positively correlate with birth rates, underscoring the importance of marital stability in demographic trends. Given the significant negative impact of housing prices relative to income on fertility, it is recommended that policymakers explore measures to alleviate financial burdens on households. These may include moderating housing price inflation or raising wage levels to improve affordability. The positive influence of marriage on fertility suggests that supportive policies—such as marriage counseling, financial incentives for newlyweds, and family welfare programs—could encourage higher birth rates. However, the observed short-term negative impact of higher education on fertility signals the need to better integrate career development with family planning. Introducing flexible work arrangements and enhanced childcare support can enable individuals to better balance professional aspirations with parenthood.

Finally, while the long-term negative impact of the tertiary sector GDP on fertility warrants attention, the concurrent positive role of rising income indicates that economic growth remains a vital driver of improved fertility potential. Therefore, sustained efforts to foster economic development, boost household incomes, and enhance the overall quality of life will be critical in creating a more supportive environment for family formation and childbearing in China.

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