



Family Planning Policy and Housing Price in China

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Abstract

Different intergenerational fertility levels affected by the family planning policy under such altruistic behavior will inevitably affect real estate prices. This paper studies the effect of different intergenerational fertility levels on real estate prices under the parental altruistic behavior model with Chinese characteristics by constructing an Overlapping Generation Model (OLG) with intergenerational wealth transfer. The empirical results show that the lower the intergenerational fertility level of the middle-aged generation, the higher the average wealth level transferred to the youth generation, and the higher the real estate price. This result shows that, unlike the high fertility rate of popular cognition, the low fertility rate of the middle-aged generation under the influence of the family planning policy and the altruistic behavior of the Chinese parents are the important reasons for the current high housing prices. This paper reveals the relationship between China's population policy and real estate price, and can guide the judgment of China's real estate market in the future.

Keywords: Family Planning Policy; house price; fertility rate; generational wealth transfer; overlapping generational model

1.Introduction

After the implementation of the 1998 market-oriented reform of housing in China, the sales price and volume of real estate has both rose sharply. At the same time, China has entered the release period of the demographic dividend and large number of laborers flow into cities. The generation born in the 1980s has also gradually entered

the marriage and childbearing period, bringing numerous inelastic demanded housing consumption. All these demographic factors have great impact on real estate prices from the perspective of demand and supply. However, it seems that it is not fully explained the continuous rise in housing prices for that supply is also increased with the demand all these years in China. The research on whether the higher birth rate will surely bring real estate demand and higher house prices requires further investigation. From the time that family planning policy was designated as a basic national policy in 1982 and written into the Constitution to the time that the implementation of the second-child policy in 2015, China's family planning policy has been adjusted according to national conditions. Then very different intergenerational fertility levels were formed. Under the traditional culture of China, people attach great importance to the concept of 'home'. Home always means having own house in China. Many Chinese youths purchase houses early with the support of their parents. Parents' funding or even grandparents' sponsorship of young generation's housing purchases has caused large amounts of wealth from different generations flowing into the real estate market.

The rapid rise of China's housing prices in recent years has been the research focus of many scholars. From Figure 1, we can see that China's housing prices have rose for years continually. In 2018, the average price of houses nationwide was 8,544 yuan / m² while this figure was 2063 yuan / m² in 1998. Many domestic and foreign scholars have interpreted the influencing factors of rising real estate prices from various angles. Some scholars have studied from the perspective of monetary policy and believe that the increase in money supply will lead to the rise of housing prices (Li Jian DengWei,2011; Hongyi Chen, Kenneth Chow, Peter Tillmann, 2017;ChiWei Su,XiaoQing Wang,RanTao,Hsu-Ling Chang,2019). Some scholars have found through empirical research that land prices have a significant positive impact on housing prices (Liu Lin and Liu Hongyu, 2003; Zhou Bin and Du, 2010; Wei Wang, Yuzhe Wu, Mellini Sloan,2018). The influence of urbanization and migrant population on urban housing prices has also been proved by many scholars (Lu Ming, Ou Haijun and Chen Binkai, 2014). These are all studies on fundamental factors, but studies on the trend of housing prices in combination with the birth policy of Chinese characteristics are rare.

The Chinese population experienced a recovery in the 1960s, so the fertility rate reached a peak from 1962 to 1963, which is considered as the baby boom period. These people entered the marriage and childbearing period in the 1980s and formed the second birth peak in the 1980s. While the family planning policy, which was gradually introduced in the late 1970s, caused a low birth rate from 1977 to 1979, and this group of people entered the marriage and childbirth period, forming a birth trough from 1993 to 2000. In the late 1970s, China introduced a family planning policy to slow the population growth rate. Chinese government include indicators of controlling population growth into the national economic developing plan in July,

1971. In September 1982, the 12th National Congress of the Communist Party of China defined family planning as a basic national policy which was enacted in the Constitution in December of the same year. After more than 30 years, China's population development has undergone a major turning point: the growth of the total population has been significantly weakened, the degree of aging has continued to deepen, and the demographic dividend has gradually disappeared. In November 2011, China began to implement the policy that couples both from one child family can have two children. And this policy extend to couples can have two children if either of them come from a one child family. Moreover, the Fifth Plenary Session of the 18th CPC Central Committee in 2015 decided to fully implement the policy that every couple can have two children, which intends to respond proactively to the aging of population and improve the balanced development of population. Figure 2 is a trend graph of the fertility rate from 1959 to 2017 and the population born in each year. From this figure, it can be found that the fertility rate is consistent with the trend of the birth population.

In Chinese traditional ideas, having a house before married can increase a man's popularity in the marriage market. Nowadays, many young women also prefer buying houses before marriage, so they will feel more secure and less pressure after marriage. However, most young people do not have enough money to buy a house by themselves, so their parents would pay part of the funds for them to pay for a house. The amount of funding depends on the level of altruism of the parents. The effect of parental altruism will be passed on to the real estate market, which will result in a certain increase in house prices. But the wealth that parents can transfer is limited. Having more children means less wealth that parents will transfer to each child while fewer children means more wealth that parents will transfer to each child. Therefore, the fertility rate will affect the price. All these means that to research the effects of Family Planning Policy on house prices, we should conduct an OLG model with intergenerational wealth transfer.

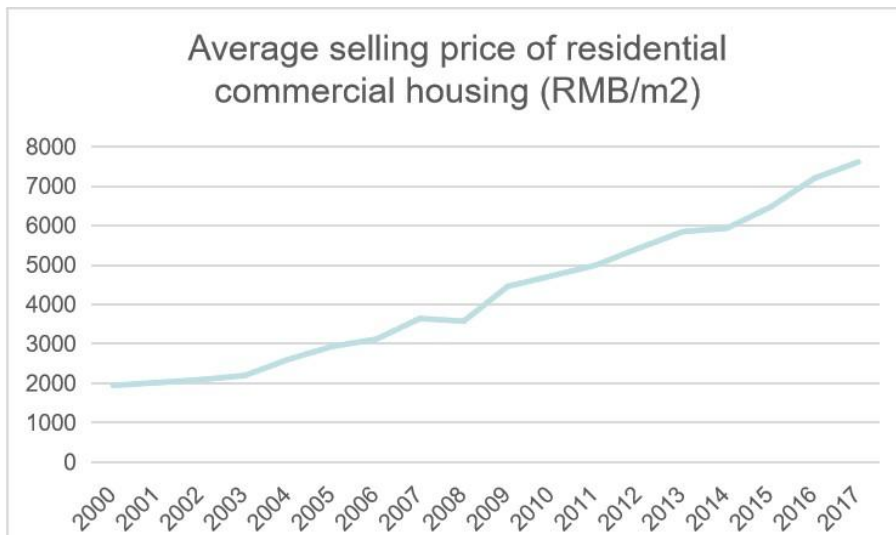


Fig.1. Average selling price of residential commercial housing

Data Source: China Statistical Yearbook

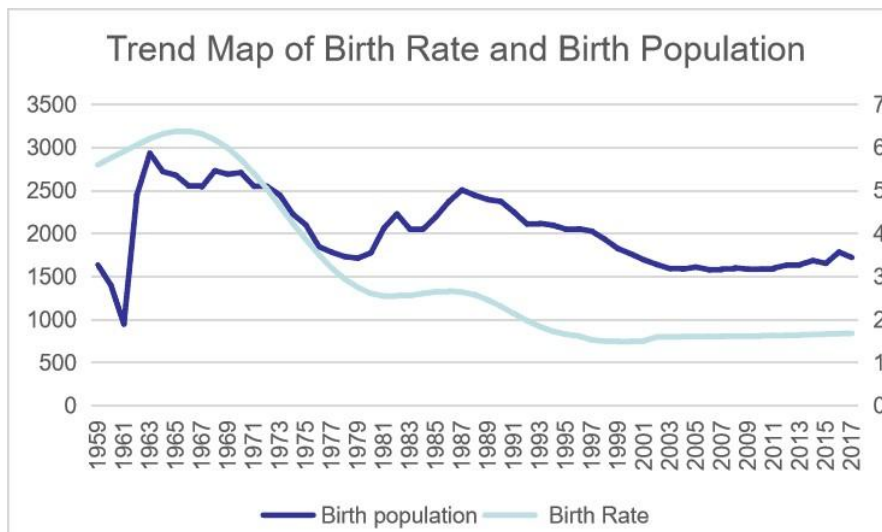


Fig.2. Trend Map of Birth Rate and Birth Population

Data Source: China Statistical Yearbook

Literature review

Research on the impact of demographic factors on housing prices has been emerging in the academic field. Mankiw and Weil (1989) studied the effects of birth peaks and birth troughs on housing prices. However, the paper's discussion and predictions

about 'the actual US house price may fall by 47% in the next 20 years' has caused widespread controversy. The paper drew a series of subsequent studies on population shocks and the housing market (Swan, 1995; Ohtake & Shintani, 1996). The research of Joe Peek and Wilcox, J. (1992) implies that the longer-run positive trends in real incomes and population size and the advance of the baby boom into ages of greater effective demand for houses are forecast to raise real house prices 10%. Ley and Tutchener (2001) studied the impact of population shocks from foreign immigrants on the US and Canadian home housing markets respectively. Fischer (2012) believed immigrants inflow from a common language country has no statistically significant impact on house prices while the noncommon language immigrants significantly push up house prices. Jager, P. and Schmidt, T. (2017) argue that the overall effect of the demographic transition on house prices has been negative. Most of these researches has focused on the impact of baby boomers and immigration on housing prices. But the impact of fertility rate caused by the family planning policy still need further studies.

There are many research literatures on the selection of research models for housing price influencing factors. Cocco (2005), Piazzesi (2007) established a relatively complete economic life cycle consumption and portfolio selection model with housing consumption. Cui Xinming (2003) constructed a two-phase intertemporal residential consumption selection model to analyze the impact of mortgage ratio, mortgage period, mortgage interest rate and income growth rate on real estate prices by introducing mortgage mechanism into resident budget constraints. Chambers, Garriga and Schlagenhauf (2009) classify consumers and discuss the impact of heterogeneous consumers and liquidity constraints on real estate demand within the general equilibrium framework. Kong Xing, Liu Zhiguo, and Yu Bo (2010) introduced real estate holding costs based on the durability characteristics of real estate, constructed an intertemporal consumption selection model including general commodities and real estate and analyzed the effect of mortgage loans on the effective demand of real estate market by solving the maximization of household utility. This paper would apply the OLG model to study the impact of fertility on housing prices in China's intergenerational wealth transfer mechanism. The research of Samuelson (1958) and Diamond (1965) provides a basic theoretical framework for the Overlapping Generational Model (referred to as OLG). OLG model has a wide range of applications in macroeconomic research. Abel (2001) constructed a two-generation OLG model with the personal heritage motive considered and found that asset prices would fall after the "baby boomer" generation retired; Ortalo-Magne and Rady (2006) used the framework of the OLG model to analyze the housing consumption upgrade behavior of representative households in different life cycles and the corresponding housing market dynamics. But their research assumes that the population size is constant, so the issue of fertility is not taken into accounts. Among the many studies on the housing market in China, Shi Qingqing (2010) also constructed an OLG model

that includes the housing market to study the impact of fertility rate on housing prices in China's intergenerational wealth transfer mechanism, which was rarely mentioned in previous studies. In this paper, we construct an overlapping generational model (OLG model) containing intergenerational wealth transfer, which is divided into three periods. And we also added the bequest to the end of the third period to analyze the impact of intergenerational wealth transfer on housing prices in China.

Research Methodology

The purpose of this paper is to study the impact of the fertility rate formed by different family planning policies on housing prices under the intergenerational wealth transfer mechanism in China. We solve the practical problem of the impact of intergenerational wealth transfer and altruistic behavior on housing prices by establishing a specific theoretical model. Liu Xueliang (2011) developed an OLG model with three generations and altruistic behavior which means parents will provide some funding when their children buy a home. They assume that the old people has no income, but in fact most people in urban China have retirement and pensions after retirement. They also assume that when a person dies, instead of transferring to the next generation, his property becomes nothing. This is contrary to the actual situation. In China, the old generation's houses are usually left as a legacy to the next generation. Because China's old generation has a high level of altruism, they hope that they can alleviate the burden of the younger generation, so they will leave as much wealth as possible for their children. In this context we build a new OLG model for analysis. Our research is mainly on Chinese urban housing prices, because most young generation in rural areas build their own homes on their own land, and old generation would transfer all their property to the next generation after the death. In that case it is rare for them to fund young home purchases. We divide the life of a person into three periods: childhood (0), adult (1), and old (2). Everyone would die at the end of the old (2) period. In order to supplement the research gaps of Liu Xueliang and others, it is assumed that in this model, the old (2) generation does not need the support expenses from the adult (1) generation, their pension is enough for covering their spending. And the old(2) generation will leave the house as a legacy to the next generation after the death. The size of the house (H) will not change, but the price will change over time. Let P_1 and P_2 be the purchasing house price of the first period and the sales price of the second period, respectively. Because many people can't pay the full amount at one time, it is assumed that each family pays the down payment in early adulthood. And usually all the home loans would be paid off by the end of adulthood. Due to the altruistic behavior of parents, we assume that when the younger generation pursuing house, they will be given an initial purchase fund, which refers to the first wealth transfer between generations. The house purchased in the (1) period will be left as a legacy to the next generation, which is the second transfer of wealth between the two generations. In addition to housing costs, there is other consumptions through a person's life. Assuming that personal consumption in

different periods is shown in Table 1: For the childhood (0) generation, they have no income and no housing consumption. They need to rely on their adult parents to maintain all other consumption (C_0). Adults have income (y_1) and the money they received from their parents when they purchase a house. They will get the inheritance from their parents. Adults' consumption includes raising children (C_0) and meeting their own needs for non-housing (C_1), they also need to repay the housing loan (C_2) and subsidize their children to buy houses. For the elderly, they can use their savings and pensions (y_2) to maintain their daily consumption (C_3). They don't have to pay for the house, the house will be left as a legacy to their children and it is equal to the value of the house (P_2H).

Table 1 Basic assumptions of three generations

<i>Period</i>	<i>Income</i>	<i>Consumption</i>	<i>Housing expenditure</i>	<i>Altruistic behavior</i>
<i>0</i>	<i>None</i>	<i>Relying on parents</i> C_0	<i>None</i>	<i>None</i>
<i>1</i>	<i>Income</i> (y_1)	<i>Other consumption</i> C_1	<i>Down payment</i>	<i>Raising children</i>
		<i>Other consumption</i> C_2	<i>Mortgage</i>	<i>Housing subsidy</i>
<i>2</i>	<i>Income</i> (y_2)	<i>Other consumption</i> C_3	<i>None</i>	<i>Legacy</i> P_2H

3.1 Maximization of utility

We assume that individuals have direct wealth transfers with their parents and children. Assuming a generation is recorded as i , then $i-1$ and $i+1$ can represent the previous generation and the next generation. N_i , N_{i-1} , and N_{i+1} are the total population of the i generation, the $i-1$ generation, and the $i+1$ generation, respectively. n_{i-1} and n_i are the fertility rates of the $i-1$ generation and the i generation. Thus, we have:

$$N_i = (1 + n_{i-1})N_{i-1}, \quad N_{i+1} = (1 + n_i)N_i \quad (3.1.1)$$

For the i generation, the utility of each period consists of housing consumption and other (non-housing) consumption, then the utility function at t should be:

$$U_t = \ln C_t^\alpha H_t^{1-\alpha}, \quad t=0, 1, 2 \quad (3.1.2)$$

Among them, t represents the period, the life cycle of each generation includes the 0,1,2 period, α indicates the preference between housing and non-housing consumption, C_t indicates non-housing consumption, and H_t indicates the houses. Then the maximum expected utility of the first phase of i can be expressed as:

$$\max EU_{i,1} = \sum_{t=0}^2 \beta^{t-1} U_{i,t} + \gamma_1(1+n_i)U_{i+1,t} + \gamma_2(1+n_i)\beta \ln \frac{T_{i,1}}{P_1} \quad (3.1.3)$$

$EU_{i,1}$ represents the expectation operator of i in the first period. β is the discount factor, $U_{i,t}$ is the utility of i in t period. $U_{i+1,t}$ is the utility of $i+1$ in t period. $\sum_{t=0}^2 \beta^{t-1} U_{i,t}$ stands for the total utility of i in housing consumption and non-housing consumption from period 0 to period 2. γ_1 and γ_2 represents the altruistic level of parents raising their children. P_1 indicates the price of the first period. $T_{i,1}$ indicates the price that i paid for them when they purchased the house in the first period of $i+1$. $\frac{T_{i,1}}{P_1}$ stands for the houses $T_{i,1}$ could get. If the utility of $i+1$ acquired in t period is $U_{i+1,t}$, then the utility obtained by i is $\gamma_1(1+n_i)U_{i+1,t}$. The wealth transfer of i when buying house in $i+1$ will make i get the utility $\gamma_2(1+n_i)\beta \ln \frac{T_{i,1}}{P_1}$, these are determined by the altruistic level of the parents. The budget of i is constrained, that is, the final income and expenditure of i are in equilibrium. (3.1.3) does not include bequest. Suppose i gives all the property to $i+1$ at the end of the second period, then the accumulated wealth of i at the end of the second period is 0. Suppose $W_{i,1}$ is the accumulated wealth of i in the first period. And $W_{i,2}$ is the accumulated wealth of i in the second period, then we have:

$$W_{i,1} = (1+r)(y_{i,1} - C_{i,1} - DP_1 H_{i,1} + T_{i-1} - (1+n_i)C_{i+1,1} + B_{i-1,2}) \quad (3.1.4)$$

$$W_{i,2} = (1+r)(W_{i,1} + y_{i,2} - C_{i,2} - (1-D)P_1 H_{i,1}(1+R) - (H_{i,2} - H_{i,1})P_2 k_2 - (1+n_i)T_{i,2}) - B_{i,2} = 0 \quad (3.1.5)$$

Where r represents the interest rate, $y_{i,1}$ and $y_{i,2}$ respectively represent the total income of i in the first period and the total income of i in the second period. $C_{i,1}$ and

$C_{i,2}$ respectively represent the consumption of other commodities in the first period and the consumption of other commodities in the second period of i . D represents the down payment ratio of housing consumption. $P_1 H_{i,1} \cdot T_{i-1}$ is the financial support $i-1$ offers to i in order to help i reduce the pressure of life when they start a family. $C_{i+1,1}$ indicates the consumption of other commodities in the first period of $i+1$. $B_{i-1,2}$ and $B_{i,2}$ respectively represent the legacy left by $i-1$ at the end of the second period and the legacy left by i at the end of the second period. Here we assume that the legacy is given to the next generation in the form of house. $(1+R)$ is the loan interest rate of the housing. $H_{i,1}$ and $H_{i,2}$ respectively indicate the amount of housing in the first period and the amount of housing in the second period. k_2 is the capitalization rate of the property. P_1 and P_2 represent the house price of i in the first period and the house price in the second period. $T_{i,2}$ is the property fund that i provided for $i-1$ when $i-1$ purchasing a house. As the assumption is true, then we have:

$$B_{i,2} = P_{i,2} H_{i,2} \quad (3.16)$$

3.2 New model

After the analysis in 3.1, we found the control variables of i 's maximization of utility are $C_{i,1}$, $C_{i+1,1}$, $H_{i,1}$, $C_{i,2}$, $H_{i,2}$, $T_{i,2}$. So we can solve the maximization problem of i generation under budget constraints by establishing the bellman equation:

$$V_1(W_{i,1}) = \max\{[\alpha \ln C_{i,1} + (1-\alpha) \ln H_i] + \beta V_0(W_{i,2})\} \quad (3.2.1)$$

$$\text{s.t. } W_{i,2} = (1+r)(W_{i,1} + y_{i,2} - C_{i,2}) - P_{i,2} H_{i,2} = 0 \quad (3.2.2)$$

Where $y_{i,2}$ is the pension of the older generation, form $V_0(W_{i,2}) = 0$, the optimal solution of H_i and $C_{i,2}$ can be calculated by first-order conditions:

$$H_i^* = (1-\alpha)(1+r)W_{i,1} / P_{i,2} \quad (3.2.3)$$

$$C_{i,2}^* = \alpha W_{i,1} \quad (3.2.4)$$

The corresponding value function is :

$$V_1(W_{i,1}) = \alpha \ln C_{i,1}^* + (1-\alpha) \ln H_i^* \quad (3.2.5)$$

Through iteration, we can get the bellman equation of i in the first period:

$$V_2(W_{i,1}) = \max\{[\alpha \ln C_{i,1} + (1-\alpha) \ln H_i + \eta_1(1+n_i)\alpha \ln C_{i+1,1}] + \beta V_2(W_{i,2})\} \quad (3.2.6)$$

$$\text{s.t. } W_{i,2} = (1+r)(y_{i,2} - C_{i,1} - DP_1 H_{i,1} + T_{i-1} - (1+n_i)C_{i+1,1} + B_{i-1,2}) \quad (3.2.7)$$

$$\begin{aligned} W_{i,2} &= (1+r)(W_{i,1} + y_{i,2} - C_{i,1} - (1-D)P_1 H_{i,1}(1+R) - \\ &(H_{i,2} - H_{i,1})P_2 k_2 - (1+n_i)T_{i,1}) - B_{i,2} = 0 \end{aligned} \quad (3.2.8)$$

From $\frac{\partial V_2}{\partial C_{i,1}} = 0$, $\frac{\partial V_2}{\partial C_{i+1,1}} = 0$, then we have :

$$C_{i,1}^* = \frac{\alpha W_{i,1}}{(1+r)^2} \{(1-\alpha) + \beta[1 + \eta_2(1+n_i)] + \beta^2\} \quad (3.2.9)$$

$$C_{i+1,1}^* = \frac{\alpha \eta_1 W_{i,2}}{(1+r)^2} \{(1-\alpha) + \beta[1 + \eta_2(1+n_i)] + \beta^2\} \quad (3.2.10)$$

According to the results of $C_{i,1}^*$, $C_{i+1,1}^*$, $C_{i,2}^*$, H_i^* , we can get the optimal H_i^* :

$$H_i^* = \frac{(1+n_{i-1})^{-1} p_{i-1,2} H_{i-1} + (1+r)y_{i,2} + (1+r)^2 y_{i,1}}{\{D(1+r)^2[1-\eta_2(1+n_{i-1})^{-1}] + (1-D)(1+r_m)(1+r)\}P_{i,1} + P_{i,2}Z(n_i)} \quad (3.2.11)$$

Where $Z(n_i)$ is the i generation fertility function:

$$Z(n_i) = \left[\frac{1+\beta+\eta_2(1+n_i)}{1-\alpha+\beta} + \frac{\alpha[1+\eta_1(1+n_i)]}{1-\alpha+\beta[1+\beta+\eta_2(1+n_i)]} \right] / [(1-\alpha)(1+r)] \quad (3.2.12)$$

From

$$\frac{\partial Z(n_i)}{\partial n_i} = \frac{\eta_2}{(1-\alpha+\beta)(1-\alpha)(1+r)} + \frac{\alpha \eta_1 \{1-\alpha+\beta[1+\beta+\eta_2(1+n_i)]\} + \alpha \beta \eta_2 [1+\eta_1(1+n_i)]}{\{1-\alpha+\beta[1+\beta+\eta_2(1+n_i)]\}^2 [(1-\alpha)(1+r)]^2} > 0 \quad (3.2.13)$$

So theoretically the i generation fertility function is a strictly increasing function.

H_i^* is the optimal housing consumption of the i generation. From (3.2.11), once the loan interest rate increases, housing consumption will decrease. When wages increase, housing consumption will increase. But when house prices rise, housing consumption will decrease. From this formula, it can be known that the housing is related to the down payment ratio, the fertility rate, and the loan ratio in addition to interest rates, wages, and housing prices. The theoretical model is in line with our actual situation.

3.3 Equilibrium house prices with wealth transfer

Housing prices are solved in the situation that the final income expenditure reaches equilibrium and intergenerational wealth transferred. According to (3.2.11), the relationship between housing demand and housing prices in different periods was established. $P_{i,1}$, $P_{i-1,2}$, $P_{i,2}$ represent the i generation purchase price in the (1) period, the i generation in the (2) period, and the i generation in the (2) period. Supposed $P_{i,1}$ is the house price at time t . $P_{i-1,2}$ and $P_{i,2}$ represent the house price at time $t+1$ and time $t+2$, then we have, $P_{i,1} = P_t$, $P_{i-1,2} = P_{t+1}$ and $P_{i,2} = P_{t+2}$. From this formula, we can draw this conclusion: Instead of a specific generation, the house price is related to the time of housing transition. Thus we can assume $P_{t+1} = \lambda_1 P_t$, $P_{t+2} = \lambda_2 P_{t+1}$. When $\lambda_1 > 1$ and $\lambda_2 > 1$, house prices rise over time ; When $\lambda_1 < 1$ and $\lambda_2 < 1$, house prices fall over time ; When $\lambda_1 = \lambda_2 = 1$, house prices remain unchanged without regarding to inflation.

Assuming $H_i^* = H_i^d$, We can solve the housing price of the i generation in the first period according to the equation (3.2.11):

$$P_{i,1}^* = \frac{(1+r)y_{i,2} + (1+r)^2 y_{i,1}}{\{D(1+r)^2 [1 - \eta_2 (1 + n_{i-1})^{-1}] + (1-D)(1+r_m)(1+r)\} H_i^d + \lambda_1 \lambda_2 Z(\eta_1) H_i^d - (1 + n_{i-1})^{-1} \lambda_1 H_{i-1}} \quad (3.3.1)$$

According to (3.3.1), we can get the function of housing price. And we can also derive the wealth transferred to i generation from $i-1$ generation, including the initial amount of subsidy and inheritance when i form a own family:

$$M_{i-1} = D(1+r)^2 \eta_2 (1 + n_{i-1})^{-1} H_i^d + (1 + n_{i-1})^{-1} \lambda_1 H_{i-1} \quad (3.3.2)$$

M_{i-1} represents the total amount of wealth transferred by the $i-1$ generation. $D(1+r)^2 \eta_2 (1 + n_{i-1})^{-1} H_i^d$ is used to measure the wealth and other financial support from $i-1$ generation when i purchasing a house. If we assume that the impact of D and H_i^d on the transfer of wealth can be offset by the altruism level of the $i-1$ generation, then the total amount of wealth transfer directly related to house prices can be explained by the fertility rate of the $i-1$ generation and the housing consumption of the $i-1$ generation. Then the reduction in the total amount of wealth transfer will definitely be related to the increase of n_{i-1} . And the increase in H_{i-1} will increase the total amount of wealth transfer. Although the future changes in housing prices are related to many factors, we mainly study housing prices through wealth transfer.

So we substitute (3.3.2) into (3.3.1), then:

$$P_{i,1}^* = \frac{(1+r)y_{i,2} + (1+r)^2 y_{i,1}}{\{D(1+r)^2 + (1-D)(1+r_m)(1+r) + \lambda_1 \lambda_2 Z(n_i)\} H_i^d - M_{i-1}} \quad (3.3.3)$$

From (3.3.3), we can know that the greater the total amount of wealth transfer, the higher the house price would be. Then we study the housing price from the demand and supply of housing. Assuming the balance between supply and demand is existing, there is:

$$H_i^d = H_i^s \quad (3.3.4)$$

H_i^d represents the housing demand of the i generation, H_i^s represents the effective housing supply of the i generation, including the new housing supply H_i^N of the i generation. And the existing housing supply of the $i-2$ generation is H_{i-2} . From $N_i = (1+n_{i-1})N_{i-1}$, $N_{i-1} = (1+n_{i-2})N_{i-2}$ we have :

$$H_i^s = H_i^N + (1-n_{i-2})^{-1}(1+n_{i-1})^{-1}H_{i-2} \quad (3.3.5)$$

Substituting (3.3.5) into (3.3.3), we can get the price under the balance of supply and demand:

$$P_{i,1}^* = \frac{(1+r)y_{i,2} + (1+r)^2 y_{i,1}}{\{D(1+r)^2 + (1-D)(1+r_m)(1+r) + \lambda_1 \lambda_2 Z(n_i)\} \{H_i^N + (1-n_{i-2})^{-1}(1+n_{i-1})^{-1}H_{i-2}\} - M_{i-1}} \quad (3.3.6)$$

Assumed $Y = (1+r)y_{i,2} + (1+r)^2 y_{i,1}$, $Q = D(1+r)^2 + (1-D)(1+r_m)(1+r)$ and $\omega = \lambda_1 \lambda_2$, We have a simplified formula for equilibrium house prices:

$$P_{i,1}^* = \frac{Y}{[Q + \omega Z(n_i)]H_i^s - M_{i-1}} \quad (3.3.7)$$

where

$$H_i^s = f(H_i^N, H_{i-2}, n_{i-1}, n_{i-2}) \quad (3.3.8)$$

$$M_{i-1} = g(n_{i-1}, H_{i-1}) \quad (3.3.9)$$

The simplified equilibrium house price formula (3.3.7) can be used to determine the factors affecting the price of i generation housing, including lifetime income Y , down payment and mortgage portfolio Q , fertility rate of i generation, effective housing supply H_i^s , and the total amount of wealth transfer M_{i-1} of $i-1$ generation. Among them, the influencing factors of H_i^s include the new housing supply H_i^N of the i

generation at the (1) period, the existing housing supply H_{i-2} of the i-2 generation, the i-1 generation fertility rate n_{i-1} and the i-2 generation fertility rate n_{i-2} .

Therefore, we can calculate the impact of fertility rate of i, i-1, i-2 generation on i generation housing prices. Through practical experience, we can know that when the fertility rate of i generation increases, house prices will decrease. The reason is that if the fertility rate of the i generation rises, the i generation will spend more money on raising children, so the cost on the housing will be reduced. The increase in the fertility rate of the i-2 generation will reduce the supply of effective housing and stimulate the growth of housing prices. The rising fertility rate of the i-1 generation will reduce intergenerational wealth transfer and effective housing supply, so the impact of the i-1 generation fertility rate on housing prices cannot be determined

based on empirical knowledge. Taking the derivative of n_{i-2} , we have :

$$\frac{\partial P_{i,1}^*}{\partial n_{i-1}} = \frac{Y\{[Q + \omega Z(n_i)](1 + n_{i-2})^{-1}H_{i-2} - \lambda_1 H_{i-1} - D(1+r)^2 \eta_2 [H_i^N + 2(1 + n_{i-2})^{-1}(1 + n_{i-1})^{-1}H_{i-2}]\}}{\{[Q + \omega Z(n_i)]H_i^S - M_{i-1}\}^2(1 + n_{i-1})^2} \quad (3.3.10)$$

Assuming

$$A = [Q + \omega Z(n_i)](1 + n_{i-2})^{-1}H_{i-2}$$

$$B = \lambda_1 H_{i-1} - D(1+r)^2 \eta_2 [H_i^N + 2(1 + n_{i-2})^{-1}(1 + n_{i-1})^{-1}H_{i-2}]$$

Then (3.3.10) can be simplified to:

$$\frac{\partial P_{i,1}^*}{\partial n_{i-1}} = \frac{Y(A - B)}{\{[Q + \omega Z(n_i)]H_i^S - M_{i-1}\}^2(1 + n_{i-1})^2} \quad (3.3.11)$$

Assuming $H_{i-2} < H_i^N$ and $H_{i-2} < H_{i-1}$, thus $A < B$ and $\frac{\partial P_{i,1}^*}{\partial n_{i-1}} < 0$, that is, the i-1 generation

fertility rate will increase, but the house price will decrease. That is, the effect of n_{i-1} on M_{i-1} is greater than the impact on H_i^S , which is contrary to the saying that the general baby boom will cause house prices to rise. So next we will apply the data for specific analysis.

4. Empirical analysis

In the case of China's intergenerational wealth transfer, the OLG model has been improved through altruistic behavior. The theoretical model shows that intergenerational wealth transfer has a positive impact on housing prices. The previous generation fertility rate, along with the housing consumption will also affect housing prices. From the description in the third section, we can know that the fertility rate of different generations has different effects on housing prices Income

and housing supply will also affect housing prices to some extent. Then we confirm the theoretical results through specific empirical study, the process is as follows.

4.1 Variables and data

We assume in the theoretical model that everyone will go through three periods. The specific division is as follows: under the age of 21 is the (0) childhood period; the age of 21-59 is the (1) adult period; over the age of 60 is the (2) old period. Among them, (1) adult period is our main research object. The i generation represents the group between the ages of 21 and 59, and the $i-1$ generation represents the group over 60 years old.

The source of the data is mainly the Chinese General Social Survey (CGSS) and the China Statistical Yearbook published by the Chinese Statistics Department. The Chinese General Social Survey has obtained the date of birth of the interviewee (this data is used to calculate the age) and the number of children in the family (this data is used to calculate fertility rates), and the number of household-owned properties, ie, the amount of housing available. From the China Statistical Yearbook we have obtained the price level, the current housing supply and the natural growth rate of the population. Because the latest data from the Chinese General Social Survey (CGSS) is in 2015, we used the 2015 data as the research object. In 2015, there were 10,968 respondents and 487 communities in this project. There remain 6,470 interviewees after clearing the data of rural respondents. There are 5,715 in the questionnaires are living in their own houses, and 5,704 effective responses having children. Since it is almost impossible to find housing prices of each community, we choose the data of the provinces and cities as observation points. Because Hainan, Tibet, and Xinjiang have no respondents, the observation points in our study are 28 provinces, autonomous regions, and municipalities. According to the age of each interviewee, we distinguish $i+1$ generation, i generation, $i-1$ generation. the average number of children delivered by each woman in each generation is the fertility rate, and the average number of homes owned by each family, as well as the income of each household, and then we can derive our independent variables: n_i , n_{i-1} , H_{i-1} , H_i , H^N , f , y_{i-1} , y_i , D1, D2 and dependent variable P_i

Table 2 variables

	<i>Names</i>	<i>Proxy variable</i>	<i>Expectation</i>
<i>dependent variable</i>	P_i	<i>Average house price in 2015</i>	
<i>independent variable</i>	n_i	<i>Average fertility rate of the i generation</i>	-
	n_{i-1}	<i>Average fertility rate of $i-1$ generations</i>	-

	H_{i-1}	Average home ownership of the $i-1$ generation	-
	H_i	Average home ownership for the i generation	+
	H^N	New housing supply	+
	f	Natural population growth rate	+
controlled variable	y_{i-1}	Average income of the $i-1$ generation	+
	y_i	Average income of the i generation	+
	$D1$	Whether the community is in the first-tier city (Yes=1, No=0)	+
	$D2$	Whether the community is in the second-tier city (Yes=1, No=0)	+

According to the theoretical model, we can know that n_i and y_i have direct impact on house prices. And n_{i-1} , y_{i-1} , and H_{i-1} affect the house price by affecting wealth transfer.

H_i and H^N affect the housing price by affecting housing supply. f is known through empirical knowledge that it has an impact on house prices. In addition, in the study using cross-sectional data, the level of development of the city where the community is located has a significant impact on local housing prices. To control this effect, we used two dummy variables to measure the level of urban development. Since China usually uses first-tier cities and second-tier cities to measure the degree of urban development, we regard “whether the community is in the first-tier cities” and “whether the communities are in the second-tier cities” as dummy variables.

Table 3 Variables and statistical descriptions

Variables	Minimum value	Maximum value	Mean value	standard deviation
P_i	3629	22300	6781.36	4656.583
n_i	0.75	1.64	1.23	0.21
n_{i-1}	1.65	3.67	2.54	0.45
H_i	1.07	1.53	1.22	0.11
H_{i-1}	1.00	1.46	1.16	0.11
$D1$	0	1	0.21	0.42
$D2$	0	1	0.61	0.50
y_i	20560.87	98619.19	38824.14	21621.32
y_{i-1}	4340.00	49086.04	21896.68	10470.18
H^N	31847	682532	243854.25	149749.83

f	0.26	8.57	5.02	2.37
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According to Table 3, it can be known that the mean values of n_{i-1} and n_i are 2.54 and 1.23. $n_{i-1} < n_i$ indicates that the fertility rate is decreasing with time. There is also the country's macroeconomic regulation and control, as well as the cost of raising children. The average of H_i is 1.22, The average of H_{i-1} is 1.16. This shows that the current generation has more houses than the older generation. This is in line with the actual situation. With the development of the economy, buying a house has become a kind of investment and financial management for adults who have enough funds to do this kind of investment. The average of H_i is 1.22 which means that a family has at least one house. The average f is 5.02, which indicates the national population is still showing an upward trend.

4.2. Results

We have empirically studied the data because the differences in dimensions would affect the result. To eliminate that effect, we convert the dependent and independent variables into natural logarithmic forms to establish a stable linear relationship. Using the natural logarithmic form, the coefficient of the independent variable represents the percentage change in the residential price, in response to a 1% change in the independent variable. Before the analysis, we produced a series of scatter plots to show the relationship between house price and fertility (Figure 3).

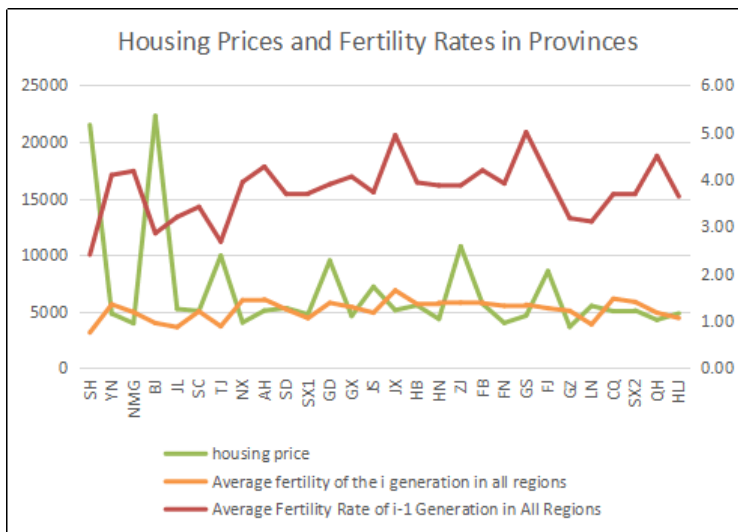


Fig.3. Housing Prices and Fertility Rates in Provinces

Data Source: China Statistical Yearbook

From Figure 3, we can see that the higher the house price, the lower the fertility rate. For example, the price of Shanghai and Beijing has exceeded 20,000, but the i generation fertility rates of these two cities are the lowest. The housing prices in Yunnan and Inner Mongolia are relatively low, but the fertility rate is relatively high. This is in line with the actual situation, that is, the less developed the economy, the higher the fertility rate would be. It can also be seen from Figure 3 that the fertility rate of the i generation is much lower than that of the $i-1$ generation, which means with the stream of time and the development of society, the fertility rate has dropped significantly.

Table 4 Parameter estimation

<i>Variables</i>	<i>Parameter estimation 1</i>	<i>Parameter estimation 2</i>	<i>Parameter estimation 3</i>	<i>Parameter estimation 4</i>
$\ln n_i$	-0.755***	-0.038**	-0.137***	-0.338***
$\ln n_{i-1}$		-0.686***	-0.536***	-0.789***
$\ln H_i$			0.321***	0.097***
$\ln H_{i-1}$		-0.379***	-0.512***	-0.219***
$D1$				0.605***
$D2$				0.336***
$\ln y_i$	0.567***	0.360***	0.340***	0.351***
$\ln y_{i-1}$		0.324***	0.345***	0.296***
$\ln H^N$			0.056**	0.045***
$\ln f$				0.146***
R^2	0.491	0.653	0.724	0.825

Table 4 is a parameter estimate for stepwise linear regression, where parameter estimate 1 and parameter estimate 2 reflect the effect of intergenerational wealth transfer on house prices. When $\ln n_i$, $\ln y_i$ are used as independent variables, R^2 is 0.491, which means $\ln n_i$ and $\ln H_i$ can account for 49.1% of $\ln P_i$. Parameter estimation 2 is to increase R^2 to 0.653 by adding $\ln n_{i-1}$, $\ln y_{i-1}$, and $\ln H_{i-1}$, which shows that the interpretability is also increasing through the increase of variables. The coefficient of $\ln n_i$ in parameter estimation 2 is -0.038, indicating that if the i generation fertility rate is increased by 1%, and the house price will reduce by 0.038%. The increase if i generation fertility rate indicates that the child's raising cost increases, which is accompanied by a decline in housing consumption. The coefficient of $\ln n_{i-1}$ is negative, indicating that the average fertility rate of the $i-1$ generation is increased by 1%, which reduces the intergenerational wealth transfer of the i generations, resulting in a 0.686% decline of house prices. The coefficient of $\ln H_{i-1}$ is also negative, and the average number of owned properties in the $i-1$ generation has increased by 1%, which

has caused the house price to drop by about 0.379%. Estimates 3 and 4 give the effect of all independent variables. Estimation 3 is performed without control variables, and estimation 4 is performed with control variables. The results of the study show that the two dummy variables have a significant positive impact on house prices. The coefficient of D_1 is greater than D_2 , indicating that communities located in cities with higher economic development will receive higher housing prices. In the process of adding variables gradually, R is also gradually increasing, which indicates that the better the model fits, the results of the actual data analysis are consistent with the results of the theoretical model, which indicates the robustness of our test.

Conclusion

Family Planning Policy is one of basic national policy in China which has been adjusted with the situation and formed very different generational fertility rates. In the context of parents helping their children to buy houses, pre-marriage purchase of the younger generation has become a common phenomenon. Therefore, the number of newly registered marriages has a strong relationship with the rise of housing prices in China. The younger generation usually can't afford high purchasing house price by their own, so their middle-aged parents are willing to provide some financial support, then intergenerational wealth transfer appears. The transferred wealth will eventually flow into the real estate market and push up house prices. The intergenerational transfer of wealth to everyone in the next generation is related to the fertility rate of different generations. This study establishes an overlapping generational model involving intergenerational wealth transfer and different generation fertility rates caused by the family planning policy from a new perspective. The theoretical model shows that intergenerational wealth transfer has a positive impact on housing prices which is affected by the previous generation's fertility rate and housing consumption. We further conduct empirical research to validate our hypothesis. The results show that the average fertility rate of the adult generation decreased by 1%, which increased the transfer of intergenerational wealth to the younger generation, resulting in a 0.338% increase in house prices. While the average number of properties owned by the old (2) generation increased by 1%, resulting in a decline in housing prices of approximately 0.219%. The results also show that the fertility rate of the old generation has a negative impact on housing prices, and every 1% increase in fertility rate of old generation will caused house prices to fall by 0.789%. Empirical studies have confirmed that the impact of income and housing supply factors on housing prices, that is, the annual income of the adult generation will increase by 0.351% for every 1% increase, the income of the old generation will increase by 1%, and the house price will increase by 0.296%. It has been pointed out that China's baby boom pushes up China's housing prices. However, the result we get from the empirical analyze based on actual data sounds the opposite. Baby boomers will have a negative impact on the generational wealth transfer. The low fertility rate of the middle-aged generation under the influence of the family planning policy and the altruistic

behavior of the Chinese parents are the important reasons for the current high housing prices.

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References

- [1] Li Jian, Deng Ying, 2011. Research on the Monetary Factors Promoting the Rising of House Price—Based on the Empirical Analysis of the Accumulation Period of the United States, Japan and China .J. Financial Research, 6, 18-32. (in Chinese)
- [2] Hongyi Chen, Kenneth Chow, Peter Tillmann, 2017. The effectiveness of monetary policy in China: Evidence from a Qual VAR. J. China Economic Review, 43, 216-231. <https://doi.org/10.1016/j.chieco.2017.02.006>
- [3] Chi-Wei Su, Xiao-Qing Wang, Ran Tao, Hsu-Ling Chang, 2019. Does money supply drive housing prices in China? International Review of Economics & Finance, 60, 85-94. <https://doi.org/10.1016/j.iref.2018.12.013>
- [4] Liu Lin, Liu Hongyu, 2003. Economic Analysis of the Relationship between Land Price and House Price .J. Quantitative Economics of Economics and Technology, 7, 27-30. (in Chinese). <https://doi.org/10.3969/j.issn.1000-3894.2003.07.005>
- [5] Zhou Bin, Du Liangsheng, 2010. Land Finance and Real Estate Price Rise: Theoretical Analysis and Empirical Research. J. Finance and Trade Economics, 8, 109-116. (in Chinese). <https://doi.org/CNKI:SUN:CMJJ.0.2010-08-020>
- [6] Wei Wang, Yuzhe Wu, Mellini Sloan, 2018. A framework & dynamic model for reform of residential land supply policy in urban China. J. Habitat International, 82, 28-37. <https://doi.org/10.1016/j.habitatint.2018.10.006>
- [7] Lu Ming, Ou Haijun, Chen Binkai, 2014. Rationality or Bubble: An Empirical Study of Urbanization, Immigration and Housing Price. J. World Economy, 1, 30-54. (in Chinese) . <https://doi.org/CNKI:SUN:SJJJ.0.2014-01-003>
- [8] Mankiw, N. G. , & Weil, D. N. , 1989. The baby boom, the baby bust, and the housing market. Regional Science and Urban Economics, 2, 235-258. [https://doi.org/10.1016/0166-0462\(89\)90005-7](https://doi.org/10.1016/0166-0462(89)90005-7)
- [9] Swan, C., 1995. Demography and the demand for housing a reinterpretation of the mankiw-weil demand variable. Regional Science and Urban Economics, 25, 41-58. [https://doi.org/10.1016/0166-0462\(94\)02074-Q](https://doi.org/10.1016/0166-0462(94)02074-Q)

- [10] Ohtake F , Shintani M ., 1996, The effect of demographics on the Japanese housing market, *Regional Science & Urban Economics*, 26,189-201. [https://doi.org/ 10.1016/0166-0462\(95\)02113-2](https://doi.org/10.1016/0166-0462(95)02113-2)
- [11] Joe Peek, Wilcox, J., 1992, The Baby Boom, Pent-up Demand, and Future House Prices[J]. *Fisher Center for Real Estate and Urban Economics, Research Reports*, 4,347-367. [https://doi.org/ 10.1016/S1051-1377\(05\)80017-8](https://doi.org/10.1016/S1051-1377(05)80017-8)
- [12] Ley D , Tutchener J ., 2001, Immigration, Globalisation and House Prices in Canada\'s Gateway Cities, *Housing Studies*, 16,199-223. [https://doi.org/ 10.1080/02673030120038483](https://doi.org/10.1080/02673030120038483)
- [13] Andreas M. Fischer, 2012, Immigrant language barriers and house prices, *Regional Science and Urban Economics*, 42, 389-395. <https://doi.org/10.1016/j.regsciurbeco.2011.11.003>
- [14] Jager, P., Schmidt, T., 2017, Demographic change and house prices: Headwind or tailwind? *Economics Letters*, 160, 82-85. <https://doi.org/10.1016/j.econlet.2017.09.007>
- [15] Cocco, J. F . Portfolio, 2005, Choice in the Presence of Housing. *Review of Financial Studies*, 18, 535-567. <https://doi.org/10.1093/rfs/hhi006>
- [16] Monika Piazzesi, Martin Schneider, Selale Tuzel, 2007, Housing, consumption and asset pricing, *Journal of Financial Economics*, 83, 531-569. <https://doi.org/10.1016/j.jfineco.2006.01.006>
- [17] Cui Xinming, 2003, The Impact of the Financing Effect of Residential Mortgage on the Price of Residential Demand, *Financial Research*, 06, 85-95.(in Chinese). <https://doi.org/CNKI:SUN:JRYJ.0.2003-06-008>
- [18] Chambers M , Garriga C , Schlagenhauf D E., 2009, ACCOUNTING FOR CHANGES IN THE HOMEOWNERSHIP RATE, *International Economic Review*, 50, 677-726. [https://doi.org/ 10.1111/j.1468-2354.2009.00544.x](https://doi.org/10.1111/j.1468-2354.2009.00544.x)
- [19] Kong Xing, Liu Zhiguo, Yu Bo, 2010, User costs, housing mortgage loans and effective demand in the real estate market. *Financial Research*, 1, 186-196. <https://doi.org/10.1360/972010-1084>
- [20] Samuelson P A, 1958, An Exact Consumption-Loan Model of Interest with or without the Social Contrivance of Money. *Journal of Political Economy*, 66, 467-482. <https://doi.org/10.2307/1826989>
- [21] Diamond P A, 1965, National Debt In A Neoclassical Growth Model. *American Economic Review*,1126-1150. <https://doi.org/10.1007/BF01354256>
- [22] Abel A B, 2001, Will Bequests Attenuate the Predicted Meltdown in Stock Prices When Baby Boomers Retire?. *The Review of Economics and Statistics*, 83, 589-595. <https://doi.org/10.2307/3211754>
- [23] Ortalo-Magne F , Rady S, 2006, Housing Market Dynamics: On the Contribution of Income Shocks and Credit Constraints*. *Review of Economic Studies*, 73, 459-485. https://doi.org/10.1111/j.1467-937x.2006.383_1.x

- [24] Shi Qingqing, Fei Fangyu, Zhu Weiliang, 2010, Independence of Demographic Dividend and Real Estate Yield. *Economics (Quarterly)* , 10,1(in Chinese)
- [25] Liu, X. L., Wu, J., Deng, Y. H, 2011, Demography, marriage and the housing market. Working Paper (in Chinese).
<http://www.shangxueba.com/ebook/36208.html>.
- [26] Douglas H.Wrenn, JunjianYi, BoZhang, 2018, House prices and marriage entry in China, *Regional Science and Urban Economics*, 74,118-130.
<https://doi.org/10.1016/j.regsciurbeco.2018.12.001>