Impact of One-child Policy on Housing Bubbles in China

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ABSTRACT

What can be potentially responsible for the ongoing unprecedented housing crisis in China? How did the decreased birth rate and increased male-biased sex ratio from the tightening of One-child Policy in China affect housing prices when the corresponding cohorts entered the housing market? To answer these questions, I employed the fixed effects difference-in-differences approach, exploiting differences between cohorts born before and after the nationwide tightening of the One-child Policy. I found in cities where people had a higher willingness to have children under the tightening of the One-child Policy, the decrease in the Housing Price Index was dampened during the housing bubble burst. Cities where people had stronger son preference in general don't differ much from cities with weaker son preference, but suggestive evidence was found showing that a more distorted local male-biased sex ratio can negatively affect the housing price.

Keywords: China, One-child Policy, Single-child Families, Son Preference, Chinese Housing Market, Fertility Policies, Sex Imbalance

1. Introduction

One-child Policy (OCP) was enacted in 1979 but was not strictly enforced until 1990. Under OCP, most couples[1] could only have one child and the failure to comply with this policy would result in monetary fines or denial of the right to social welfare such as education (Ebenstein, 2010). Starting from 1990, OCP was linked to the promotion of local officials and therefore provided them strong incentives to increase the penalty fines (Huang, Lei, & Sun, 2021). This nationwide increase in penalties will be referred to as the tightening of OCP throughout this paper.

Houses in China became tradable after the introduction of housing reform in 1991 (Guo, Wang, Yi, & Zhang, 2022). The housing prices skyrocketed in the following decades due to rapid urbanization, and more importantly, policies made to stimulate demand and investment in the housing market, as a thriving real estate industry can bring in more job opportunities and contribute to GDP growth.

Recently, there has been an ongoing crisis in the Chinese housing market: the number of transactions and unit prices are both slumping. Regarding this unprecedented housing crisis, most speculations employ the "post-COVID-19" narrative, claiming COVID-19 as the ultimate culprit. Admittedly, COVID-19 may have catalyzed the process, but it is also possible that the burst of bubbles began before COVID-19 made it discerned by people.

[1] One-and-a-half-child policy was enforced in the rural part of China, under this policy, couples were allowed to have a second child if the firstborn was a daughter. People from ethnic minority groups were not constrained by the One-Child Policy. Han people (ethnic majority in China) predominantly make up over 90% of the population in cities being used by my study, hence, this paper primarily focuses on Han Chinese in the cities.

My research aims to study how housing bubbles in China could be potentially influenced by the tightening of OCP and the male-biased sex ratio that stemmed from it, primarily focusing on the pre-COVID-19 housing market in China.

This paper will investigate these factors in a difference-in-differences framework by answering the following questions:

I. How does people's willingness to have children under 1990 tightening of OCP affect the housing bubbles when cohorts born around that period entered the housing market?
II. Given the male-biased sex ratio stemmed from son preference and stricter enforcement of OCP, how does it influence the housing price?

This topic is interesting as it centers around OCP, a policy that created the largest only-child generation in history; such an artificial social experiment is likely to lead to unexpected and unique economic outcomes.

The importance of my topic can be summarized by the following reasoning: firstly, it focuses on the housing market and population composition of China, the second largest economy with approximately a fifth of the world's population. Secondly, population composition determines demand in the housing market, and the housing sector accounts for more than 25% of Chinese GDP; these two features of the Chinese macroeconomy are closely intertwined and play a crucial role in the economic prospects of China. In an era of globalization, studying topics related to China can give us useful insights into how the global economy will be consequently influenced in the future.

The tightening happened in 1990 nationwide, and the assumption is people born after the

tightening would behave differently than previous cohorts when they entered the housing market at age 25 (average marriage age in China), and this subsequently affects the housing price.

My study is divided into two parts to study how people's willingness to have children (WTHC) and son preference under OCP tightening would separately affect housing prices 25 years later. The dependent variable that reflects the extent to which the bubbles burst in the local market is the housing price index (HPI), and the treatment variables are two sets of dummies that indicate each city's membership in corresponding WTHC or son preference groups respectively.

I found cities, where people had higher WTHC under OCP tightening, experienced a smaller decrease in HPI during the housing crisis; cities, where people had stronger son preference, generally don't differ a lot from cities with weaker son preference under OCP tightening

Plenty of papers have studied how housing prices would influence people's fertility choices, but the reverse has not been given enough attention. My study contributes to closing this gap by providing findings that align with previous studies on the unique characteristics of OCP generation, meanwhile extending it to demonstrate how these characteristics could affect the dynamics in the Chinese housing market.

In addition, findings by different scholars yield pathways through which the son preference would affect housing prices in opposite directions, this paper provides a potential answer to this debate in the field.

The remaining parts of this paper are organized as follows. Section 2 provides a detailed literature review on the legacy of OCP, the marriage market in China, and the impact of high housing prices. Section 3 summarizes the two key economic theories from previous literature and how they shape my hypothesis. Section 4 explains the research design in my study. Section 5

describes the data and empirical strategy employed. Section 6 presents the main results, alternative interpretations, and a series of robustness checks. Section 7 discusses the policy implications of my research. Section 8 concludes with a review of this paper and recommendations for future research. The tables and figures mentioned in this paper can be found after the references.

2. Literature Review

2.1 Legacy of One-Child Policy (OCP)

An issue that arose from stricter enforcement of OCP is the sex ratio imbalance in China. In "The 'Missing Girls' of China and the Unintended Consequences of the One Child Policy" (2010), Ebenstein argues the high sex ratio at birth (ratio of males to females) in China is not mainly due to biological reasons like Hepatitis, as suggested by previous papers, but parental discrimination and strict enforcement of OCP. He did a test of equality analysis and found the difference between the birth interval before a son and that before a daughter is positive and statistically significant, indicating potential human sex selection before male births.

This novel finding motivated him to further explore the relationship between sex ratio at birth and OCP. By exploiting the variations in sex ratio at birth and OCP fines on excessive births across different regions, he found that sex ratio at birth is positively correlated with fertility fines at 10% and smaller significance level after the implementation of OCP, and in an individual-level test, the results show that higher fines after the tightening of OCP decrease the probability of having another child but increase the probability of this child being a son, which is

consistent with the trends we observed after the tightening of OCP in 1990: decreasing birth rate and rising sex ratio at birth.

Regarding the legacy of OCP, besides the decreasing birth rate and increasing sex ratio at birth since the 1990s, some scholars suggest it lingers longer than expected. For example, the severity of China's aging and decreasing population growth rate will not be effectively alleviated given the universal two-child policy started in 2016 (Jia and Li, 2019).

This can be likely due to the unique characteristics of people who grew up under stricter enforcement of OCP, as discussed in "Fertility Restrictions and Life Cycle Outcomes: Evidence from the One-Child Policy in China". This paper centers around the pre-fertility behaviors of those who grew up under the influence of OCP (Huang, Lei, & Sun, 2021), the authors found these individuals tend to have higher high school completion rates, white-collar employment rates, and income; they also tend to delay marriage and have lower fertility rates.

2.2 Chinese Marriage Market

According to Bian and Gete (2015), housing preferences (e.g. marriage house) and population shocks play an important role in explaining the changes in housing investment and prices in China. Therefore, the legacy of OCP tightening could potentially affect the housing dynamics in China.

Rising male-biased sex ratio under OCP tightening leads to excessive men in the marriage market, which can consequently lead to stronger demand in the housing market. "Homeownership as status competition: Some theory and evidence" (Wei, Zhang, & Liu, 2017) argues that in China, a family's relative housing wealth determines their son's relative

attractiveness in the marriage market, therefore competition for marriage partners might motivate people to pursue bigger and more expensive houses. The authors regressed the purchased price and size of a house on the local sex ratio of the buyer's corresponding cohort for only-son families and only-daughter families respectively, and they found the coefficient on local sex ratio is positive and significant for only-son families but not significant for only-daughter families. A male-biased local sex ratio is usually a result of a higher sex ratio at birth decades ago, in this sense, this article implies in places where the sex ratio at birth is higher, people would have a stronger demand for houses.

On the other hand, the financial burden of buying a house to get married can be a stressor for men and have a negative impact on their mental health. "Sex Ratios and Mental Health: Evidence from China" (Zhang, He, and Ma, 2021) found a higher depression score is correlated with a higher local sex ratio at birth of the marriage age cohort, which would potentially decrease the demand in the local housing market.

These two articles bring forth a potential debate on how the sex ratio at birth could affect housing prices: "Homeownership as status competition: Some theory and evidence" (Wei, Zhang, & Liu, 2017) suggests that a higher sex ratio at birth could lead to higher demand in the housing market while results in "Sex Ratios and Mental Health: Evidence from China" (Zhang, He, and Ma, 2021) imply the opposite. To reconcile these findings, my article will proceed to investigate how the local housing price is affected by the sex ratio at birth 25 years ago.

2.3 Impact of High Housing Prices

In terms of the relationship between housing prices and individual decisions, most studies in the field focus on the impact of housing prices on individual decision-making instead of the other way around: high housing prices delay the age of the first marriage (Zhao, Chen, and Li, 2023) and decrease the fertility rate (Clark, Huang and Yi, 2019).

"Rising housing prices and marriage delays in China: Evidence from the urban land transaction policy" (Zhao, Chen& Li, 2023) uses a difference-in-differences approach and the policy shock in their study is the Urban Land Transaction Policy (ULTP), which started in 2002 and increased housing prices. The treatment group consists of people who hadn't gotten married in 2002 but had married in 2012 (the survey year), and the control group consists of people who had married in or before 2002. The outcome variables include first-marriage age and fertility rate, the time dummy is replaced by a dummy indicating whether the individual has an urban hukou[2] or not since ULTP only took place in urban China. They found that rising housing prices stemmed from ULTP delay the first marriage age and decrease fertility rate.

Another paper specifically demonstrates how high housing prices could potentially alleviate the sex-ratio imbalance in China by using difference-in-differences: Guo, Wang, Yi, and Zhang (2022) used housing reform in the early 1990s as an exogenous shock to explore whether Chinese parents' son preference was affected by the subsequent increase in housing price. Their outcome variable is a dummy indicating whether a second-born from a family i of region r in year t is a son or not and the time dummy takes the value of 1 if t is after housing reform, 0 otherwise. Their treatment variable is pre-reform housing price in region r, the authors argued this can be used as a reference to the expected cost of raising a son after the housing reform.

[2] Hukou: Chinese household registration system that determines an individual's official residency status and access to various social services and benefits.

They found the probability of having a second-born son decreases when the pre-reform housing price increases.

Although this article considers the legacy of OCP in their research, one might wonder how the newborn babies in their study would behave after entering adulthood. My research will build on their paper and use the difference-in-differences framework to study the reverse causality in a more recent context: how people's willingness to have children and son preference under the tightening of OCP would affect the housing prices when cohorts born in and after 1990 entered the housing market.

3. Underlying Economic Theories and Hypothesis

3.1 Life-Cycle Theory

In the 1950s, Modigliani and Brumberg proposed the Life-cycle Hypothesis suggesting individuals make decisions about consumption, savings, and fertility over the course of their lives. One of these decisions is investment in human capital (Becker, 1964), meaning individuals allocate their time and resources to education and training in the hope of enhancing their productivity and earning potential in the future. This is particularly true for the generation that grew up under the tightening of OCP, in "Fertility Restrictions and Life Cycle Outcomes: Evidence from the One-Child Policy in China" mentioned earlier, they are found to be more likely to delay marriage and pursue higher education, so it is conceivable that they prefer more affordable and flexible housing options (e.g. renting instead of owning property) in a period of uncertainty and individual development.

Applying this to my study, the prediction is tightening of OCP negatively affects the housing price through its impact on individual human capital investment decisions of the only-child generation. Cities where people had a higher willingness to have children under OCP tightening should see a smaller decrease in price during the housing crisis, since in these cities, young people are less likely to be the only child in the family and, hence less likely to delay marriage and buying house.

3.2 Status Good

The concept of status good was proposed by economists to demonstrate that owners can derive utility from comparing their good's value with the values of similar goods owned by members in the comparison group (Frank, 1985). In the context of the Chinese marriage market, houses can also fall under this category since it is a very visible form of wealth and can improve men's perceived attractiveness in the marriage market competition caused by sex-ratio imbalance (Wei, Zhang, & Liu, 2017).

An imbalanced sex ratio at birth can be seen as a signal of son preference, and in places where this ratio is higher, competition in the marriage market can potentially lead to a higher demand for houses. But in the meantime, the increasingly high pressure from work and out-of-reach housing prices could lead to depression (Zhang, He, and Ma, 2021) and convert a good number of men into "herbivore men", those who prioritize personal interests over pursuing career goals and marriage. Therefore, cities with stronger son preference could see prices change in 2 ways: on one hand, the "status good" nature of houses in China would create a stronger demand for houses in these cities where more men are competing for marriage partners; on the

other hand, because of the depression associated with imbalanced sex ratio, the demand could be negatively influenced, which would result in a bigger decrease in price during the housing crisis (Zhang, He, and Ma, 2021). As a result, the impact of a distorted sex ratio on housing prices remains ambiguous and it is worthwhile to be explored in my research.

4. Research Design

Interested in the impact of the One-child Policy (OCP) on the Chinese housing market, I am using the fixed effects difference-in-differences model to study how the tightening of OCP in 1990 could affect the housing bubbles when cohorts born around that period entered the housing market.

In my study, the cohorts of interest are the people who were born in or after 1990, the year when the tightening of OCP happened nationwide. The time window being considered for all birth cohorts is from 1986 to 1994. As for the dependent variable, the housing price index (HPI) comes from 2011 to 2019 to cover the years when cohorts both born before and after OCP tightening turned 25, the average age of first marriage in China.

Cities were divided into four willingness-to-have-children (WTHC) groups (denoted as 1 to 4) based on their birth rate data in 1990, the year when OCP tightening took place: first, the tightening officially came into force in 1990 but was announced beforehand, so data in 1988 and 1989 is inflated due to people's expectation of a stricter fertility policy in the future; second, people's preference of the number of children they want should not change drastically in the short-run in each city, so data in 1990 is representative when estimating such preference under the tightening of OCP, at least up to 1994. The cut-offs for each group are decided based on the

quartile statistics of the birth rate data in 1990. The lower the birth rate, the lower WTHC, if other things held constant. Groups 1 to 4, from lowest birth rate to highest birth rate, logically they also rank from lowest WTHC to highest WTHC.

A similar group division was done for the sex ratio at birth as well. Groups 1 to 4 represent the sex ratio at birth from lowest to highest, and thus son preference from weakest to strongest, if all other things being equal.

In my study, the treatment is thus being in a specific WTHC or son preference group under tightening of OCP. To better showcase the characteristics of these groups, detailed descriptive statistics are provided for these two types of groups in Tables 1 and 2.

5. Data Description and Empirical Strategy

5.1 Data

The One-child Policy (OCP) in China tightened up in 1990 nationwide. My cohorts of interest are the people who were born in or after 1990. I have birth rate and sex ratio at birth data available from 1986 to 1994, not just the year 1990 that I used to construct groups, so we can observe the trends of birth rate and sex ratio at birth for different groups over the years. The time window for the dependent variable HPI will be from 2011 to 2019, to cover both the years when cohorts born before OCP tightening turned 25 (2011 to 2014) and several years after 2015 to include subsequent cohorts of interest.

Data on the Housing Price Index (HPI) is gathered from the China Real Estate Information website, where the housing data are updated at the end of each year. There were 281

cities in total, however, after aligning with cities in the birth rate and sex ratio at birth datasets respectively, some cities in the HPI dataset were dropped due to the unavailability of their birth rate or sex ratio at birth data. In Tables 3 and 4, means of HPI will be presented by years for willingness to have children (WTHC) and son preference groups respectively.

The panel data of HPI has cities as the units of observation from 2011 to 2019. In the original dataset, every entry represents the average price per square meter in the local housing market during the corresponding year. To obtain housing indices that reflect the growth rate of housing prices, I chose 2010 as my base year then normalized the 2010 housing price to 100 through dividing the average price per square meter from subsequent years by that of 2010 and then multiplying it by 100 for each city. The decrease in the growth rate of local housing prices, which is represented by HPI, is going to be treated as the burst of bubbles mentioned throughout this article.

The data on birth rate come from China Statistical Yearbooks that were published in each corresponding year by the National Bureau of Statistics. I referred to the Gotohui website when encountering missing values. After aligning with the cities in the HPI dataset, the finalized version contains birth rate data for 192 cities, over the period of 9 years. Cities are the units of observation; the time frame is from year 1986 to 1994. Each birth rate represents the number of births among one thousand people in that city during a specific year.

Sex ratio at birth data are acquired from the National Population and Family Planning Commission database. Due to the limited availability of data, there are 67 cities over the period of 9 years in this dataset after aligning with the cities in the HPI dataset.

The cities are units of observation, and the time frame is from year 1986 to 1994. Each sex ratio at birth represents the number of male births for every female birth. In the summary statistics tables (Tables 2 and 6), I multiplied the means and standard deviations by 100, turning the interpretation into "number of male births per 100 female births", so the subtle differences among son preference groups can be discerned from the tables.

Summary statistics of HPI, birth rate, and sex ratio at birth are aggregated over all available years and presented by different group types, as shown in Table 6.

Time-varying control variables are added to minimize the potential selection bias in my study. Control variables of each city include local GDP (billion yuan), GDP growth rate (%), area (1000 square kilometers), population density (number of people/ square kilometer), and average annual income per worker (yuan). They were obtained from the Wind Financial Terminal and EPS database.

Cities are the units of observation with a period from the year 2011 to 2019, after aligning these cities with those in WTHC and son preference groups respectively, I present two sets of summary statistics on control variables in Table 5, the first set has 192 cities (WTHC groups) in it and the second set contains 67 cities (son preference groups).

5.2 Specifications

$$HPI_{c,t} = \beta_0 + \beta_1 BR_c + \beta_2 Post_t + \beta_3 BR_c * Post_t + \beta_4 X_{c,t} + \beta_5 Year + \gamma_c + \epsilon_{c,t} \quad [1]$$

$$HPI_{c,t} = \beta_0 + \beta_1 SR_c + \beta_2 Post_t + \beta_3 SR_c * Post_t + \beta_4 X_{c,t} + \beta_5 Year + \gamma_c + \epsilon_{c,t} \quad [2]$$

In specification [1], BR_c is a set of indicator variables that is equal to 1 if city c belongs to a specific birth rate (WTHC) group. SR_c in the specification [2] is a set of indicator variables that is equal to 1 if city c belongs to a specific sex ratio at birth (son preference) group. In my study, the birth rate is used as a proxy for the willingness to have children in a city, and the sex ratio at birth is used as a proxy of son preference in that city.

In both specifications, $Post_t$ is 1 if t is in or after 2015 (when cohorts of interest turned 25 and entered the housing market), and 0 if before 2015. γ_c is the city fixed effect; instead of including a time fixed-effect, I used $Year$ (year numbers recentered as 1,2,3 etc.) to control for the time trend; $X_{c,t}$ represents a set of covariates in city c during year t, and $\epsilon_{c,t}$is the error term.

My parameters of interest are β_3 in both specifications since this coefficient of interaction term represents the treatment effect of a city being in a specific WTHC or son preference group on HPI in the "post" period, compared to being in the reference group (in both cases the reference group is set to group 1).

Previous literature found that people from a one-child family are more likely to delay marriage and pursue higher education (Huang, Lei, and Sun, 2020), so it is conceivable that they prefer more affordable and flexible housing options (e.g. renting instead of owning property) in a period of uncertainty and individual development. In specification [1], since the reference group (group 1) has the lowest WTHC, their children are the most likely to grow up in a one-child family and delay marriage, which decreases housing demand and HPI by the most 25 years later. So, the sign of β_3, the treatment effect of being in one of the other WTHC groups compared to

being in group 1, should be positive and the magnitude should increase as we move towards higher WTHC group levels.

The sign of β_3 for specification [2] is not as easy to predict since a male-biased sex ratio at birth could increase the housing price because of the "status good" nature of houses in the Chinese marriage market (Wei, Zhang, & Liu, 2017). But imbalanced sex ratio was also found to be correlated with an increase in the probability of depression among Chinese men (Zhang, He, and Ma, 2021), so it might delay their marriage age and cause HPI to decrease.

One potential problem is that the observations within the same city may be correlated over time due to unobserved factors specific to that city, resulting in inaccurate standard errors. To address this, I clustered by cities when running the proposed specifications to obtain more robust standard errors.

Another issue is previous papers found higher sex ratio at birth is likely a result of higher OCP penalty fines (Ebenstein, 2010), which can lead to a lower birth rate that could decrease the housing price 25 years later. To account for this potential confounder, I included the local birth rate 25 years ago as one of the control variables for specification [2].

I also included area, local GDP, average income per worker, GDP growth rate, and population density as my covariates, as they are time-variant and might also affect HPI.

5.3 Common Trends and Test of Trends

The difference-in-differences estimation method requires the dependent variable (HPI) to follow a common pre-trend across group levels before my first cohort of interest turned 25 in

2015. To validate the common trend assumption, the means of HPI for 4 group levels in WTHC and son preference groups are respectively reported in Tables 3 and 4, and corresponding trends are plotted in Figures 1 and 2 (start year is set to 2011).

From the WTHC groups' figure (Figure 1), we can see before 2015, the year that the 1990-born cohort turned 25, the trends generally satisfy the common trend assumption. From 2015 and onwards, the trends in HPI start to diverge.

The figure of mean HPI trends by son preference groups (Figure 2) shows a proof of common trend as well. Before 2015, HPI trends of groups 1,3 and 4 overlap but diverge after 2015. The trend of group 2 starts as the highest while it generally parallels with the other three before 2015.

To further test for parallel trends, I did a test by only including data before 2015, then I regressed HPI on time, the interaction term of "post" and "treatment" (indicator variable of group levels), and all the control variables. From Table 7, we can see that coefficients on the interaction terms are statistically insignificant across all group levels for both WTHC and son preference groups. This suggests we cannot reject the hypothesis that HPIs from different group levels follow a common trend before 2015.

6. Estimation Results

6.1 Main Results

When assessing the treatment effects of a city being in a specific WTHC or son preference group on HPI, I incrementally added controls throughout the columns in Tables 8-11.

The coefficients of the "treatment" variables (β_1) are not reported in these tables because the "treatment" variable is absorbed by the city fixed effects.

For WTHC groups, the coefficient β_3 is positive and increases when moving to a higher WTHC group level, which aligns with my hypothesis. From Table 8, the treatment effects (β_3) are at least statistically significant at the $p<0.1$ level in every column, and it is the most significant when all controls are included in column (3). For example, in column (3), β_3 for group 2 is 8.93, which means holding everything else constant, compared to being in the lowest WTHC group level (group 1) under the tightening of OCP, being in group 2 increases the HPI of the city by 8.93 in the "after" period (2015 and onwards). My finding is novel because, unlike existing literature on how people's choices are affected by housing market dynamics, it demonstrates how the housing market can be influenced by the OCP tightening generation's choices: I controlled for population density in column (3), so what I found is more of a result of this generation's unique characteristics, as discussed in previous studies, rather than simply due to a decrease in population from OCP tightening.

For the son preference groups in Table 9, using column (4) as an example, the treatment effect of a city being in group 4 is -3.59, which implies holding everything else constant, compared to being in group 1, being in the strongest son preference group decreases the HPI by 3.59 after 2015.

However, the coefficients in Table 9 are not very robust in any of the columns, meaning the treatment effect of being in the other three son preference groups is not significantly different from being in group 1. This can be due to the high standard errors from a sample that is not large enough, or the two opposing factors mentioned in my prediction: the status good nature of

houses can push up housing demand in places where the sex ratio at birth is more imbalanced, but depression associated with higher sex ratio at birth can weaken the demand.

6.2 Combined Effects

In addition, since we are also interested in how HPI varies for different group levels particularly during the bubble burst period, also known as the "post" period, in Tables 10 and 11 I also report the linear combinations of the coefficients for both "Post" (time trend) and "Post*Treatment" (treatment effect) to demonstrate their combined effects.

For the WTHC groups, the combined effects in Table 10 are significant in all columns and become less negative when moving from group 2 to group 4, this means that in cities where people had higher WTHC, the decrease in HPI is dampened during the housing bubble burst when cohorts of interest entered the housing market.

The combined effects for the son preference groups are also negative throughout all columns in Table 11, besides, there is an interesting pattern: the combined effects, compared to being in group 1, become more negative when moving to higher group levels across all columns. To some extent, it might suggest that if the local sex ratio at birth was too distorted under the OCP tightening, it could further negatively affect the housing price during the crisis, which is against the "status good" theory but inclined to the "depression" theory in the field.

6.3 Robustness Check

To confirm the significance found for WTHC groups in the main results section, a placebo test was conducted. I changed the pre-treatment period to 2011-2012 instead of 2011-2014, and made the post-treatment period 2013-2014, excluding the period when the real treatment took place in my study (2015-2019). Since no real treatment happened between 2013 and 2014, we should not expect to see any significant treatment effect in this placebo test.

In Table 12, none of the treatment effects in any column is significant, which aligns with my expectations. The placebo test further supports my main results: the treatment effect of a city being in a specific WTHC group is unlikely to be driven by unobservable time-varying characteristics of the cities.

In addition, I also regrouped the WTHC groups based on the 50^{th} percentile data of the birth rate in 1990. The treatment effects are still significant at least on the 10% level in Table 13. This indicates that, first, data in 1990 is representative of people's preference under the tightening of OCP, and choosing this year to group the cities is well supported. Secondly, significant treatment effects that I got for WTHC groups in my main results are unlikely due to random chance and they do not rely on how the cities are grouped if the grouping can reflect a progressive increase in people's willingness to have children.

7. Policy Implications

Given the findings in my empirical analysis, it is important to understand that fertility policies can have more profound impacts than originally envisioned by the policymakers.

In my study, stricter enforcement of OCP started in 1990 was made to curb the rapid population growth and alleviate social, economic, and environmental problems in China; some

statistics show that if there was no such policy, the Chinese population would be 2 billion instead of 1.4 billion today (Huang, Lei, & Sun, 2021).

OCP has indeed helped China with the overpopulation problem in the short run, but from a long-term point of view, this policy is no panacea. Policymakers should be extra cautious about implementing an unprecedented policy like OCP since the outcomes are usually difficult to forecast and examine. OCP has created the largest only-child generation in history and although the unique characteristics of this generation play an important role in the future of China, they were not given careful consideration at the time of OCP implementation. One of the unforeseeable implications is the downward pressure on housing prices decades after the tightening of OCP in 1990, which is responsible for the ongoing housing crisis in China today.

On the other hand, the government of China is amending fertility policies to slow down the aging of the population: OCP was replaced by the two-child policy in 2016; 5 years later, the three-child policy was introduced, and in some places, parents can even receive subsidies for having a third child. These policies are well advised given the nation's stagnant population growth and subsequent consequences of OCP as investigated in my study.

But in reality, it is a lot harder to make people have children than making them not. Jia and Li (2019) found that the severity of China's aging and decreasing population growth rate will not be effectively alleviated even with the universal two-child policy started in 2016. Besides, the three-child policy doesn't seem to help much either: two years after implementation, China experienced a negative population growth rate for the first time since the Great Chinese Famine in 1960.

In conclusion, the legacy of OCP lasts longer than what policymakers initially expected and will not be easily reversed in the short run.

8. Conclusion

Through using fixed effects difference-in-differences approach, I have novelly investigated how people's willingness to have children and son preference under the tightening of the One-child Policy would affect the housing price and cause the bubbles to burst in the Chinese housing market when the cohorts born during the tightening period entered the market 25 years later.

My initial hypothesis about the WTHC groups is well-supported by the findings: I found that in cities where people had a higher willingness to have children, the decrease in HPI was dampened during the housing bubble burst when cohorts of interest entered the housing market. Previous literature states people from a one-child family are more likely to delay marriage, have fewer kids, and pursue higher education rather than buy houses in their mid-twenties (Huang, Lei, & Sun, 2021), my findings confirm such unique characteristics of the only-child generation and elaborate on how they could influence Chinese housing market, which further contributes to closing the gap in the field where most papers focus on how housing prices can affect individual decisions, rather than the other way around.

However, cities, where people had stronger son preference, don't differ a lot from cities with weaker son preference. This could be due to two reasons: first, my limited sample size; second, the status good nature of houses in China as well as the correlation between men's depression and the high local sex ratio are influencing the housing prices in two opposite directions, neutralizing each other's effect. Nevertheless, I still managed to find some suggestive evidence

indicating that the negative impact of local son preference on housing prices through the "depression" channel exceeds the positive impact through the "status good" channel.

For future studies, if the data on sex ratio at birth permit, researchers can build on my paper to further look for concrete evidence on how son preference can influence the local housing price. In addition, since my study focuses on the pre-COVID-19 housing market in China, research using more recent data can be conducted to test whether the findings still hold in the post-COVID-19 era.

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Tables and Figures

Table 1. Means of Birth Rates by WTHC Groups

Year	(1)	(2)	(3)	(4)
1986	15.05	14.87	15.23	15.84
	(2.45)	(2.51)	(2.31)	(3.32)
1987	16.09	15.99	16.44	17.08
	(1.83)	(2.28)	(2.73)	(3.70)
1988	14.64	15.73	16.38	17.71
	(1.71)	(1.73)	(2.9)	(3.20)
1989	13.97	16.01	16.94	19.44
	(1.29)	(1.85)	(2.83)	(5.24)
1990	13.26	16.03	19.28	21.24
	(1.09)	(0.85)	(1.00)	(3.88)
1991	11.16	13.14	13.84	17.35
	(1.71)	(2.33)	(3.72)	(2.95)
1992	11.24	12.49	13.14	14.75
	(1.70)	(2.73)	(3.05)	(3.09)
1993	11	12.37	12.59	14.28
	(1.84)	(2.74)	(3.26)	(3.08)
1994	10.83	12.49	12.77	13.76
	(1.93)	(2.59)	(2.93)	(3.00)
Cities	48	49	47	48

Source: Data come from Gotohui and the National Bureau of Statistics website. Birth rate: number of births per thousand people. Standard deviations in parentheses.

Table 2. Means of Sex Ratio at Birth by Son Preference Groups				
Year	(1)	(2)	(3)	(4)
1986	101.73	104.21	105.66	108.26
	(1.49)	(0.35)	(0.54)	(1.20)
1987	102.37	104.95	106.39	109.1
	(1.53)	(0.41)	(0.58)	(1.32)
1988	102.76	105.23	106.69	109.35
	(1.53)	(0.37)	(0.50)	(1.21)
1989	103.77	106.29	107.77	110.42
	(1.52)	(0.35)	(0.56)	(1.22)
1990	104.79	107.32	108.84	111.49
	(1.53)	(0.36)	(0.59)	(1.23)
1991	105.81	108.35	109.88	112.56
	(1.55)	(0.37)	(0.59)	(1.25)
1992	105.81	108.36	109.89	112.56
	(1.55)	(0.36)	(0.58)	(1.25)
1993	106.83	109.41	110.92	113.65
	(1.55)	(0.36)	(0.54)	(1.24)
1994	107.84	110.43	111.98	114.65
	(1.57)	(0.38)	(0.56)	(1.10)
Cities	16	18	16	17

Source: Data comes from National Population and Family Planning Commission database. Sex Ratio at Birth: number of male births per 100 female births. Standard deviations in parentheses.

Table 3. Means of Housing Price Index (HPI) by WTHC Groups				
Year	(1)	(2)	(3)	(4)
2011	144.95	118.66	118.94	119.76
	(13.39)	(24.07)	(18.84)	(11.01)
2012	123.64	120.61	126.68	128.99
	(19.22)	(21.71)	(20.43)	(14.01)
2013	130.74	131.39	137.14	138.88
	(19.70)	(25.35)	(22.12)	(17.55)
2014	136.1	136.13	141.81	144.08
	(23.83)	(29.66)	(23.52)	(18.67)
2015	136.41	138.88	145.75	147.78
	(24.83)	(32.33)	(34.56)	(21.17)
2016	140.8	147.56	151.24	152.79
	(31.50)	(34.07)	(35.75)	(23.17)
2017	153.16	163.53	165.62	169.14
	(26.90)	(38.38)	(38.09)	(29.77)
2018	177.07	182.29	181.85	193.14
	(38.22)	(41.99)	(40.77)	(31.83)
2019	188.21	195.68	195.64	207.8
	(44.14)	(43.51)	(47.05)	(35.01)
Cities	48	49	47	48

Source: China Real Estate Information website. HPI: 2010 =100. Standard deviations in parentheses.

Table 4. Means of Housing Price Index (HPI) by Son Preference Groups

Year	(1)	(2)	(3)	(4)
2011	109.04	117.54	114.71	112.3
	(13.15)	(8.91)	(10.66)	(15.98)
2012	113.76	128.94	124.03	114.05
	(19.44)	(12.86)	(13.66)	(19.67)
2013	120.55	139.01	131.87	122.82
	(15.63)	(14.87)	(15.75)	(20.03)
2014	127.64	145.48	132.8	124.1738
	(15.19)	(18.69)	(15.84)	(21.79)
2015	132.53	146.08	135.33	132.2
	(21.67)	(19.51)	(14.66)	(32.62)
2016	133.82	154.02	145.18	145.78
	(19.81)	(27.05)	(17.33)	(38.78)
2017	151.19	168.04	168.26	166.86
	(23.08)	(27.89)	(21.31)	(44.61)
2018	177.72	193.40	187.3	185.01
	(37.93)	(22.82)	(24.34)	(46.76)
2019	190.44	205.06	204.05	194.28
	(43.39)	(25.38)	(24.04)	(47.76)
Cities	16	18	16	17

Source: China Real Estate Information website. HPI: 2010 =100. Standard deviations in parentheses.

Table 5. Means of Control Variables by Different Group Types

Control Variables	(1) **WTHC**	(2) **Son preference**
Area (1000 square km)	15.91	14.94
	(18.70)	(12.31)
Population Density (people/square km)	450.65	567.3
	(353.74)	(381.48)
Local GDP (billion yuan)	3.07	5.67
	(4.10)	(5.66)
GDP Growth Rate (%)	8.45	8.96
	(4.60)	(3.29)
Average Annual Income per Worker (yuan)	56611.98	62797.48
	(18225.43)	(21058.44)
Cities	192	67

Source: Wind Financial Terminal and EPS database. Data reported in real 2010 Chinese yuan. Standard deviations in parentheses.

Table 6

Summary Statistics **(aggregated data from all available years)**

	WTHC Groups					Son Preference Groups			
Variable	(1)	(2)	(3)	(4)	Variable	(1)	(2)	(3)	(4)
Birth Rate	13.03	14.35	15.18	17.49	**Sex Ratio at Birth**	104.63	107.17	108.67	111.34
	(2.59)	(2.74)	(3.54)	(5.85)		(2.50)	(2.06)	(2.13)	(2.40)
HPI	144.57	148.3	151.63	155.819	**HPI**	139.63	155.29	149.28	144.16
	(36.23)	(41.56)	(40.17)	(36.20)		(36.25)	(33.96)	(33.75)	(44.29)
Cities	48	49	47	48	**Cities**	16	18	16	17

Notes: Means calculated for birth rate and sex ratio at birth from 1986 to 1995; means of HPI from 2011 to 2019. Standard deviations in parentheses. Birth rate: number of births per thousand people, data from Gotohui and National Bureau of Statistic. Sex Ratio at Birth: number of male births per 100 female births, data from National Population and Family Planning Commission database. HPI: 2010 =100, data from China Real Estate Information website.

Table 7. Test of Parallel Trends		
	WTHC Groups	**Son Preference Groups**
Time	10.01***	5.20***
	(1.49)	(1.74)
Time*Group 2	-1.03	2.61
	(1.30)	(2.04)
Time*Group 3	-0.07	-0.24
	(1.36)	(1.87)
Time*Group4	-0.29	-1.64
	(1.35)	(1.94)
Number of Cities	192	67

Notes: Used data before 2015. Included all five controls.

Both columns include city fixed effects.

Standard errors clustered by city. *p<0.1; **p<0.05;

***p<0.01. HPI: year 2010=100.

Table 8:
Treatment Effects on HPI of Being in a Specific WTHC Group

	(1)	(2)	(3)
Post	-23.28***	-23.27***	-23.85***
	(2.74)	(2.75)	(2.75)
Post *Treatment			
Group 2	7.54*	7.54*	8.93**
	(4.47)	(4.47)	(4.26)
Group 3	7.85*	7.87*	9.68**
	(4.49)	(4.48)	(4.44)
Group 4	11.15**	11.14**	14.19***
	(4.26)	(4.26)	(4.34)
Other Controls			
Area	Yes	Yes	Yes
Local GDP	Yes	Yes	Yes
GDP Growth Rate		Yes	Yes
Average Income Per Worker			Yes
Population Density			Yes

Notes: Groups in the order from lowest to highest birth rate in 1990. All columns include city fixed effects. Standard errors (in parentheses) are clustered by city. *p<0.1; **p<0.05; ***p<0.01. HPI: year 2010=100. Reference group =1. 192 cities in all columns.

Table 9:
Treatment Effects on HPI of Being in a Specific Son Preference Group

	(1)	(2)	(3)	(4)
Post	-17.73***	-17.94***	-17.12***	-14.5***
	(4.17)	(4.17)	(4.16)	(3.54)
Post *Treatment				
Group 2	2.17	2.5	1.72	2.05
	(6.32)	(6.64)	(6.77)	(6.62)
Group 3	1.41	1.32	0.49	0.39
	(5.51)	(5.66)	(5.85)	(5.12)
Group 4	0.27	0.14	-0.91	-3.59
	(9.3)	(9.33)	(9.12)	(7.98)
Other Controls				
Area	Yes	Yes	Yes	Yes
Local GDP	Yes	Yes	Yes	Yes
Birth Rate 25 years ago		Yes	Yes	Yes
GDP Growth Rate			Yes	Yes
Average Income Per Worker				Yes
Population Density				Yes

Notes: Groups in the order from lowest to highest sex ratio at birth in 1990. All columns include city fixed effects. Standard errors (in parentheses) are clustered by city. *p<0.1; **p<0.05; ***p<0.01. HPI: year 2010=100. Reference group =1. 67 cities in all columns.

Table 10:
Combined Effects on HPI of Being in a Specific WTHC Group

	(1)	(2)	(3)
Post	-23.28***	-23.27***	-23.85***
	(2.74)	(2.75)	(2.75)
Post + Post *Treatment			
Group 2	-15.75***	-15.73***	-14.92***
	(3.15)	(3.15)	(2.99)
Group 3	-15.43***	-15.40***	-14.18***
	(3.39)	(3.36)	(3.33)
Group 4	-12.14***	-12.13***	-9.66***
	(2.94)	(2.94)	(3.03)
Other Controls			
Area	Yes	Yes	Yes
Local GDP	Yes	Yes	Yes
GDP Growth Rate		Yes	Yes
Average Income Per Worker			Yes
Population Density			Yes

Notes: Groups in the order from lowest to highest birth rate in 1990.
All columns include city fixed effects. Standard errors
(in parentheses) are clustered by city. *p<0.1; **p<0.05; ***p<0.01.
HPI: year 2010=100. Reference group =1. 192 cities in all columns.

Table 11:
Combined Effects on HPI of Being in a Specific Son Preference Group

	(1)	(2)	(3)	(4)
Post	-17.73***	-17.94***	-17.12***	-14.5***
	(4.17)	(4.17)	(4.16)	(3.54)
Post + Post *Treatment				
Group 2	-15.56***	-15.43***	-15.40***	-12.45**
	(4.59)	(5.05)	(5.07)	(5.48)
Group 3	-16.32***	-16.62***	-16.63***	-14.11***
	(3.34)	(3.55)	(3.60)	(3.60)
Group 4	-17.45**	-17.80**	-18.02**	-18.10***
	(7.17)	(7.13)	(7.10)	(6.42)
Other Controls				
Area	Yes	Yes	Yes	Yes
Local GDP	Yes	Yes	Yes	Yes
Birth Rate 25 years ago		Yes	Yes	Yes
GDP Growth Rate			Yes	Yes
Average Income Per Worker				Yes
Population Density				Yes

Notes: Groups in the order from lowest to highest sex ratio at birth in 1990. All columns include city fixed effects. Standard errors (in parentheses) are clustered by city. *p<0.1; **p<0.05; ***p<0.01. HPI: year 2010=100. Reference group =1. 67 cities in all columns.

Table 12. Placebo Test

Treatment Effects on HPI of Being in a Specific WTHC Group

	(1)	(2)	(3)
Post	4.47**	4.34**	4.54**
	(1.89)	(1.90)	(1.80)
Post *Treatment			
Group 2	0.49	0.43	-0.06
	(2.75)	(2.74)	(2.56)
Group 3	2.95	2.97	2.37
	(2.64)	(2.65)	(2.64)
Group 4	3.56	3.61	2.3
	(2.57)	(2.57)	(2.52)
Other Controls			
Area	Yes	Yes	Yes
Local GDP	Yes	Yes	Yes
GDP Growth Rate		Yes	Yes
Average Income Per Worker			Yes
Population Density			Yes

Notes: Post=0 if t is 2011 or 2012; post =1 if t is 2013 or 2014.

All columns include city fixed effects. Standard errors

(in parentheses) are clustered by city. *p<0.1; **p<0.05; ***p<0.01.

HPI: year 2010=100. 192 cities in all columns.

Table 13. Regroup
Treatment Effects on HPI of Being in a Specific WTHC Group

	(1)	(2)	(3)
Post	-19.47***	-19.45	-19.38
	(1.95)	(1.95)	(1.95)
Post *Treatment			
Group 2	5.69*	5.69*	7.26**
	(3.13)	(3.13)	(3.21)
Other Controls			
Area	Yes	Yes	Yes
Local GDP	Yes	Yes	Yes
GDP Growth Rate		Yes	Yes
Average Income Per Worker			Yes
Population Density			Yes

Notes: Groups are divided based on the 50th percentile of birth rate data. All columns city fixed effects. Standard errors (in parentheses) are clustered by city. *p<0.1; **p<0.05; ***p<0.01. HPI: year 2010=100. 192 cities in all columns.

Figure 1. Trends in HPI by WTHC (Birth Rate) Groups

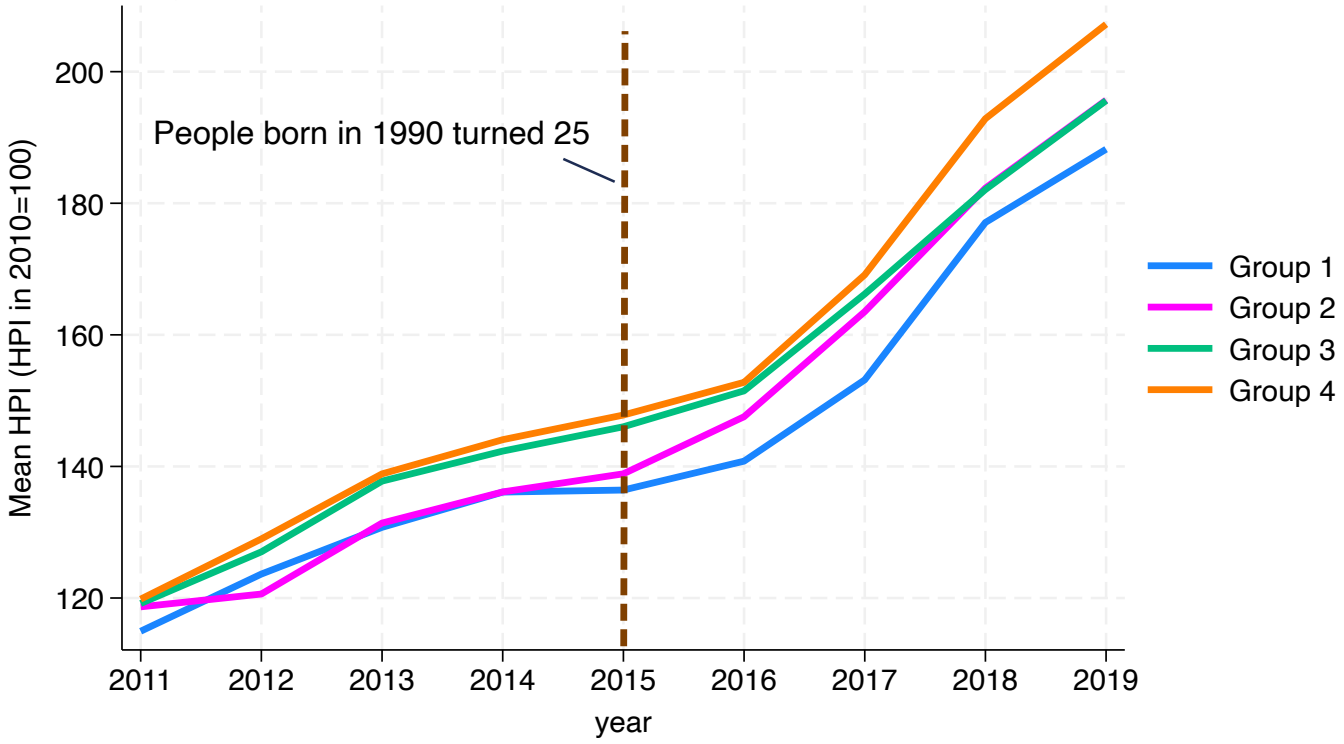

Figure 2. Trends in HPI by Son Preference (Sex Ratio at Birth) Groups