Lucy Zhu

ECON 495 Research Proposal

Impact of One-child Policy on Housing Bubbles in China

Introduction

My research aims to study how housing bubbles in China could be potentially influenced by the 36-year-long One-child policy (OCP) and the male-biased sex ratio that stemmed from it.

OCP was enacted in 1979 but was not strictly enforced until it was linked to the promotion of local officials in 1990, which provided local officials the incentives to increase the penalty fines.

In the early 1990s, the marketization of houses in China happened during the housing reform. The housing prices skyrocketed in the following decades due to the rapid urbanization and policies made to stimulate 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 "COVID-19" narrative, claiming COVID-19 as the ultimate culprit. Admittedly, it may have catalyzed the process, but it is also possible that the burst of bubbles began

before COVID-19 made it discerned by people.

My research aims to study how housing prices 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 the 1990 tightening of OCP affect the housing prices 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?

Motivation

This topic is interesting as it centers around OCP, a policy that created the biggest only-child generation in history, this artificial social experiment is likely to lead to unexpected and unique 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.

Regarding the legacy of OCP, 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), which is likely due to a smaller population and more importantly, a lower willingness to have children of those who grew up under the influence of OCP: Huang, Lei, and Sun (2020) found that individuals with exposure to stricter OCP restrictions when young are more likely to receive higher education, work a white-collar job, delay their marriage, and have a lower fertility rate.

Another issue that arose from OCP is the sex ratio imbalance in China. After the implementation of OCP, the deep-rooted son preference in China caused the "missing girl" phenomenon (Ebenstein, 2010), and the imbalanced sex ratio was also found to be correlated with higher local demand for houses (Wei, Zhang, & Liu, 2017) since excessive men in the marriage market need houses as a "status good" to attract potential partners; on the other hand, the imbalanced sex ratio is also related to an increase in the probability of depression among Chinese men (Zhang, He and Ma, 2021).

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 could potentially affect the housing dynamics in China.

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

Among the plentitude of such articles, one paper specifically demonstrates how high housing prices could potentially alleviate the sex-ratio imbalance in China: Guo, Wang, Yi, and Zhang (2022) employed a difference-in-differences estimator to identify the impact of housing prices on the sex of second-born child after the implementation of housing reform and OCP in the early 1990s. They found the probability of having a second-born con decreases as 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 the difference-in-differences framework in their paper 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 after OCP

tightening entered the housing market decades later.

Underlying Economic Theories

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, therefore less likely to

delay marriage and buying house.

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 decades later. 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.

Empirical Strategy

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

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 the age of 25 (average marriage age in China), and this subsequently affects the housing price.

My study will be 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.

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 my 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 will be divided into four willingness-to-have-children (WTHC) groups (denoted as 1 to 4) based on their birth rate data in 1990, the first year when OCP tightening took place: firstly, 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; secondly, 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 will be 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 are 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, they are placed with other tables and figures at the

end of the proposal.

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 have done a test by only including data before 2015, then I regressed HPI on time, the interaction term of "post" (time dummy indicating whether it is in or after 2015) and "treatment" (indicator variable of group levels), and all the control variables. From Table 5, 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.

To assess the impact of people's willingness to have children and son preference under OCP tightening on housing prices decades later, I propose the following specifications:

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

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

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 use $Year$ (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 ϵ_{rt} 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).

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 will cluster 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 will include the local birth rate 25 years ago as one of the control variables for specification [2].

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

Data Sources

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. Because of the nature of the difference-in-differences framework, 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. Similarly,

data on birth rate and sex ratio at birth will be from 1986 to 1994, so both cohorts born before and after tightening will be included. Here, I include other years as well, not only the year 1990 that I will use to construct groups, so we will also be able to observe the trends of birth rate and sex ratio at birth for different group levels over the years. HPI, birth rate, and sex ratio at birth all have cities as the unit of observation.

Data on the Housing Price Index (HPI) will be gathered from the China Real Estate Information website, where the housing data are updated at the end of each year. 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 will come from China Statistical Yearbooks that were published in each corresponding year by the National Bureau of Statistics. I will also refer to the Gotohui website when encountering missing values. Each birth rate represents the number of births among one thousand people in that city during a specific year.

Sex ratio at birth data will be acquired from the National Population and

Family Planning Commission database. Each sex ratio at birth represents the number of male births for every 100 female births.

Time-varying control variables from 2011 to 2019 with cities as their unit of observation 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 will be obtained from the Wind Financial Terminal and EPS database.

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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. 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 time and city fixed effects.

Standard errors clustered by city. *p<0.1; **p<0.05; ***p<0.01. HPI: year 2010=100.

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

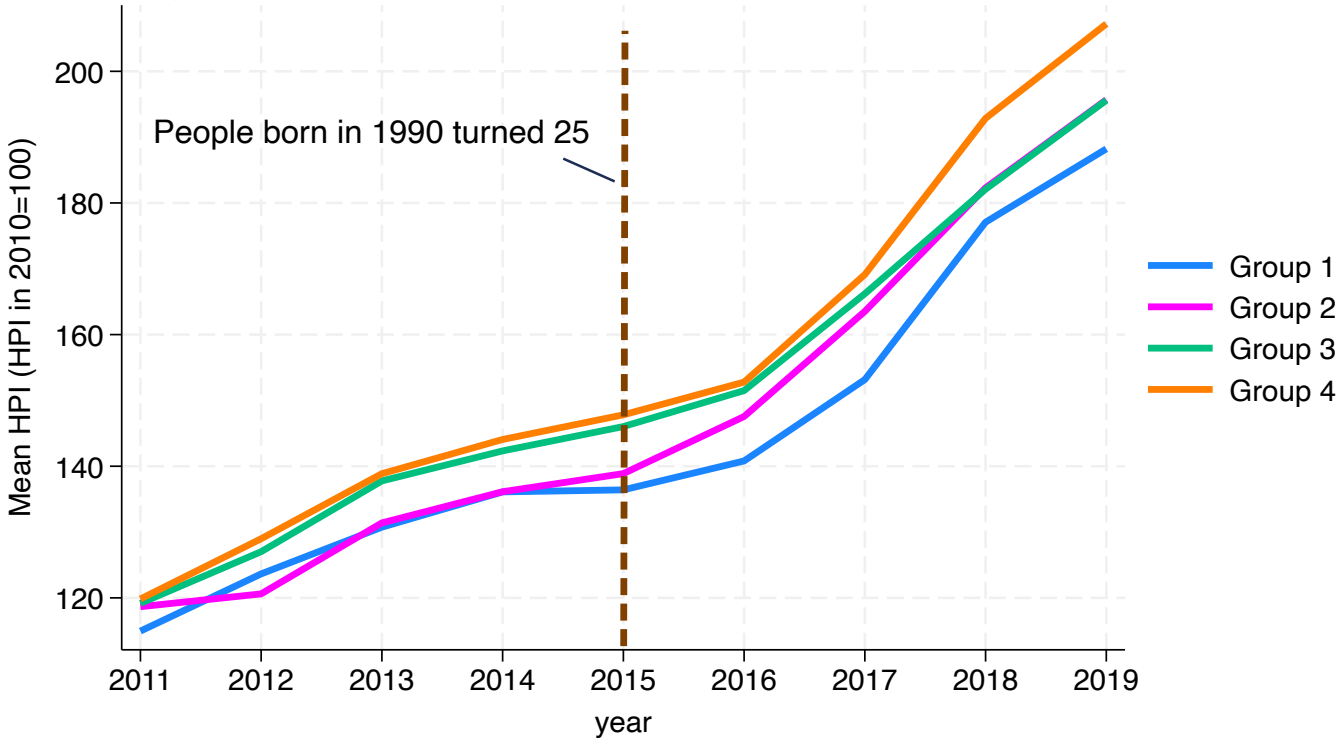

Figure 2. Trends in HPI by Son Preference (Sex Ratio at Birth) Groups