



Multi-home ownership and household portfolio choice in urban China

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Abstract

This study shows that multi-home ownership determines the patterns of portfolio composition. The IV-Tobit models have been used on the 2015 China household and finance survey data, and the potential endogeneity problem has been addressed by using the variation of housing prices at the city level as instruments. The results show that multiple-housing ownership significantly crowds out the proportion of risky financial assets held by urban Chinese households, which reflects the substitution effect and people's risk awareness with regard to real estate. Moreover, this crowding out effect is particularly significant and generally stronger for wealthy households and for regions with a medium development level of financial markets.

Keywords Multi-home ownership · Portfolio compositions · Risky financial assets · Urban China

1 Introduction

Since the housing reform of the 1990s, the portfolio of household assets has greatly changed. Housing has gradually become the largest and most important asset in the portfolios of Chinese households. The 2011 China Household and Finance Survey (CHFS) showed that 89.7% of urban households own their residential properties, which is about 30% higher than the world average (Gan et al. 2012). Moreover, the proportion of households with multiple houses has increased from 15.44% in 2011 to 28.8% in 2015 (CHFS

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2011–2015). The average annual growth rate of housing prices was 17.45% during 2002–2016, which is in contrast to the average annual growth rate of capital investment in Chinese enterprises (5.94%) during the same period (NSBC). Such dramatically increased housing prices suggest investment in real estate markets as one of the most attractive investment channels, which strongly contributes to the high rate of multi-home ownership in China.¹ Accompanied by the increasing housing prices, housing has become the most important asset for Chinese households and consequently, the average proportions of housing value in the total household assets were 62.3% in 2013 and 65.3% in 2015 (CHFS 2013, 2015).

In addition to the development of the real estate market, the Chinese financial market also experienced dramatic growth. The added value in the financial market accounts for 8% of the total GDP in 2016 while the real estate market value was 6.5% of the total GDP that year (NSBC). At the household level, although financial assets gradually became the second largest tradable asset for Chinese households, the ratio of financial assets to total assets is relatively low at only 12.4%, according to CHFS 2015 survey data. In comparison, the ratio of financial assets to total assets for US household is 41.8% (SCF 2013). This paper focuses on the relationship between multi-home ownership and the household's portfolio choice for urban Chinese households. More specifically, this paper investigates how multi-home ownership affects the household allocation of risky and riskless financial assets.

Compared to single-house ownership, the illiquidity issue, housing price risk, and the wealth effect induced by mortgage constraints or down payments are all amplified in the case of multiple-housing. This negatively impacts the share of wealth allocated to risky financial assets. However, households with only one property would like to save to be able to afford the down payment for a second residence, thus preferring to hold a safer portfolio. Furthermore, 20 years of sustained increase in housing prices might weaken the risk consciousness of the housing market and the enthusiasm of urban residents for housing demand mitigates the illiquid nature of housing assets. The former indicates that the substitution effect is reduced, while the latter indicates that the buffer role of housing on the risk of financial assets is strengthened. In any case, households with multiple houses are more likely to accept risk in their portfolios.

This study contributes to the literature in the following two aspects: First, the presented analysis enriches the growing literature on how the housing status influences household portfolio compositions.² Most existing studies treat housing tenure as exogenously given (Beaubrun-Diant and Maury 2016) when examining its impact on the share of household portfolios that are held as risky financial assets. However, this ignores the potential endogeneity problem induced by unobserved factors such as risk attitudes and preferences. As indicated by Chetty et al. (2017), when conducting this analysis, the OLS strategy often yields estimates that are wrong-signed and very sensitive to the included covariates. This paper differs from previous work by allowing housing decisions and portfolio compositions to be endogenous (Cocco et al. 2005; Vestman 2012; Chetty et al. 2017). Specifically, to address the omitted variable bias, and following Chetty et al. (2017), an identification

¹ As suggested by Li and Wu (2014), the steadily decreasing loaning rate is a further important factor that contributes to the high rate of house ownership in China.

² Yao and Zhang (2005) noted that the interaction of housing choice with other financial assets is largely avoided in both financial industry and academic literature. The former focuses primarily on liquid financial assets and the latter lacks sufficient exploration of the issue due to difficulties in dealing with various frictions in housing markets.

strategy was designed that instruments for the endogenous variable of housing decision, using city-level house prices. This instrument variables (IV) strategy was implemented on the 2015 CHFS data, which contains detailed information on housing and portfolio compositions of 7685 urban households. An IV-Tobit model was applied to estimate the impact of multi-home ownership on the share of both risky and riskless financial assets.

Secondly, the majority of previous studies examined how the share of risky financial assets in portfolios differs between those who own and those who do not own a house.³ Utilizing China's specific situation where about 90% of all households own their residences and about 30% possess more than one property, the obtained results complement the existing literature by providing evidence on how the ownership of multiple houses affects the decision of portfolio allocation toward risky financial assets.

All specifications indicate that multi-home ownership plays an important role in shaping the pattern of household portfolio compositions. Specifically, housing ownership significantly decreases the share of risky financial assets held by Chinese urban households. Compared to households with only one residence, the risky financial asset share of non-house assets decreased by 4.74 percentage points for households with multiple houses. Such a crowding-out effect is robust for all econometric specifications. In particular, a more significant and larger effect is observed for wealthy households. The results of the present study also indicate that investment in housing by younger and less wealthy investors reduces the investment in risky financial assets, which is consistent with previously reported findings (Cocco et al. 2005; Flavin and Yamashita 2002).

The remainder of the paper is organized as follows: Sect. 2 presents a brief literature review, introduces the background of China's real estate markets, presents the sharp increase of housing prices, and briefly describes the importance of housing assets in portfolio compositions of Chinese households. Section 3 describes the data and method. Section 4 empirically examines how multiple-housing ownership affects the demand for risky financial assets as well as how its impact varies across financial markets at different development levels and net wealth distribution. Section 5 provides a conclusion of the study.

2 Literature review and institutional background

2.1 Literature review

2.1.1 Definition of multi-home ownership

In the literature, a second home is typically defined as a property owned or rented on a long lease that is used as the occasional residence of a household that lives elsewhere. The main purpose is leisure by household members and/or family and friends on a non-commercial basis (Coppock 1977; Dartington Amenity Research Trust 1977). It is worth mentioning

³ Zhou et al. (2017) examined the relationship between housing and investment of risky financial assets by distinguishing between housing for consumption and for investment, as well as by considering the role of housing price expectation when exploring households' participation in stock markets. Chen and Ji (2017) studied the effect of the house price on stock market participation. Zou and Deng (2019) extended the literature on household finance by examining the effects of both financial literacy and housing value on household financial market participation.

that investment concern is not the main driving force for the purchase of a second home, although it is typically considered during the investment decision.

In China, a second home is usually defined as any home (with mortgage) purchased after the first home (with or without mortgage), and it is subject to a higher fraction of down payment and a higher interest rate for the mortgage. In general, the definition of a second home is relevant to neither investment nor occupancy frequency.

Since this study focuses on how the number of residences affects the household portfolio choice, this paper refers to “multiple houses” instead of “second house”. Moreover, due to a lack of housing price data in rural areas, the analysis was restricted to urban households. Thus, the key indicator variable, *multiple houses*, is equal for those who live in an urban area and own at least two residences.

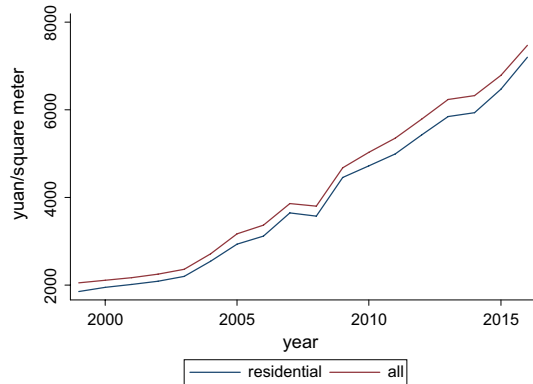
2.1.2 Multi-home ownership and household portfolios

Despite the central position of housing assets in Chinese household portfolios, few studies have examined how multi-home ownership affects economic activities at the household level in China. Exceptions include several studies on housing and its relationship to entrepreneurship (Chen and Hu 2019; Djankov et al. 2006; Li and Wu 2014; Wang 2012), to consumption (Chen et al. 2019b) and to subjective wellbeing (Wu et al. 2019). Housing ownership often discourages households to integrate risky financial assets in their portfolios. Grossman and Laroque (1990) showed that due to the transaction cost associated with the adjustment of housing consumption, individuals with housing would decrease the proportion of their wealth that is allocated to risky financial assets. Cocco et al. (2005) simulated how the housing decision affects portfolio choices and found that the stock holding is significantly lower for households that own a house. Beyond the explanation of the illiquid nature of housing, the reported results suggest that housing price risk also plays a role in shaping the pattern of these allocations. Consequently, individuals with (risky) housing are inclined to decrease their holdings of other types of risky assets. A further explanation for the discouraging effect of housing on risky assets addresses the participation cost: stock holdings for younger and less wealthy investors with housing will decrease because the investment in housing implies that less liquid wealth will be available, which thus reduces their willingness to pay for the fixed costs associated with equity market participation. Similar results can also be found in Brueckner (1997), Chetty and Szeidl (2007), Flavin and Yamashita (2002), Fratantoni (1998, 2001), and Kullmann and Siegel (2005).

In contrast, Beaubrun-Diant and Maury (2016) reported that the well-known crowding-out effect no longer applies when accounting for the interdependence of housing ownership and stock holdings. In fact, under their settings, a homeowner in 1999 had a 10% higher chance to become stockholder in 2007 than a renter with similar socioeconomic background.

Several recent studies provide an explanation for this unclear effect of housing on household portfolio allocation. Yao and Zhang (2005) reported that different conclusions can be obtained when examining the share of stocks in the total net worth and liquid portfolios. Specifically, in case of indifference between owning and renting, households that own a house hold a lower equity proportion in their total net worth, i.e., home equity substitutes for risky stocks, which reflects a substitution effect. However, a higher equity proportion in their liquid portfolio is observed, which can be explained by arguing that homeowners can use home equity to buffer financial and labor income risks, which reflects a diversification effect. Chetty et al. (2017) pointed out that to identify the effect of housing on

Fig. 1 National average housing prices in urban China. *Source:* NBSC



portfolios, it is important to separate the effect of property value from the effect of home equity. Specifically, they showed that holding home equity fixed, increases in the property value substantially reduces stockholdings by increasing the illiquidity and the exposure to risk. However, holding the property value fixed, increases in home equity raise stockholdings via the wealth effect.

2.2 Institutional background

In the 1980s, state-owned houses were allocated to urban residents based on working units and rents were charged. Due to problems of housing shortage, poor management, and corruption in the distribution process, a reform of the housing system was gradually initiated (Wang and Murie 1999). The privatization of housing took place in 1994, when public houses were allowed to be sold to state employees. With the deepening of the reform, the purchase of housing from state work units ended in 1998 and during the same year, commercial banks were allowed to offer loans for housing purchasers, which initiated a further commercialization of housing in China.

One milestone in the development history of housing markets happened in 2003, when the “Notifications of the State Council” on promoting the sustained and healthy development of real estate markets was approved. For the first time, this emphasized that the real estate industry is the backbone of China’s booming economy. In the same year, the open auction in the transfer of state-owned land use rights was implemented, which significantly increased the price of land for commercial, service, and residential usage (Deng et al. 2012). Since then, housing prices in China have steadily increased.⁴

On average, the national housing prices increased from 2092 yuan/m² in 2002 to 7203 yuan/m² in 2016 (Fig. 1). Xiamen, Shenzhen, Shanghai, and Nanjing have experienced the fastest increase. Using Shanghai as example, the residential housing price has increased 5.47-fold from 4007 yuan/m² in 2002 to 25,910 yuan/m² in 2016. As shown in

⁴ Other causes for high housing prices include monetary and fiscal stimuli (Deng et al. 2011), the acceleration of urbanization (Chen et al. 2011), the increase of income (Zheng et al. 2009), and economic openness (Wang 2012).

Fig. 2 Residential housing prices by regions in urban China.
Source: NBSC

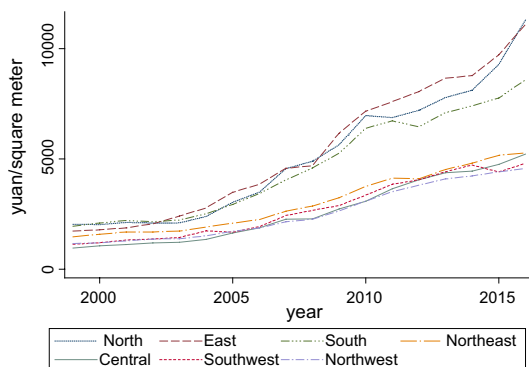


Fig. 2, housing prices in the southeast coastal region of China are relatively higher and increase at the highest speed.⁵

3 Data, hypotheses, and methodology

3.1 Data

The utilized data originated from the 2015 wave of China Household Finance Survey (CHFS).⁶ Conducted by the Southwestern University of Finance and Economics (SWUFE) in China, the CHFS provided a high-quality nationally representative dataset, including detailed information on Chinese household demographic characteristics, both financial and nonfinancial assets and liabilities, income and expenditure, social security, insurance, and other micro-level financial information.

Since its launch in 2011, the CHFS continually surveys a representative sample of the Chinese population every 2 years. The first wave (2011) of the survey included 8438 households, spanning 320 communities in 80 counties of 25 provinces. Starting from the second wave, four relatively remote provinces were added and the sample size of provinces with a small sample size was further expanded. The third wave (2015) realized a total sample of 37,289 households, comprising 1439 communities in 363 counties of 29 provinces. The 2015 CHFS is representative at the national, provincial, and sub-provincial city level.

The data contain detailed information on household financial and nonfinancial assets. In this study, household assets were broadly categorized into four components: risky financial assets, riskless financial assets, housing assets, and other assets. Risky financial assets were defined as the sum of stock, bond, funds, derivatives, bank financing products, foreign currency, and gold. Riskless assets include cash, deposit, lending, and public insurance (social security). Other assets consist of durable goods and vehicles. Following Yao and Zhang

⁵ Shi et al. (2016) showed that the balance of several overriding policy objectives has determined the direction of the affordable housing policy in urban China. The achievements and problems of affordable housing programs in post-reform China are also introduced. Finally, the authors discussed the lessons that can be drawn from the Chinese affordable housing policy developments.

⁶ Official website for the CHFS data: <http://www.chfsdata.org/>.

(2005), the measure for the portfolio compositions of a household is risky (or risk-free) financial assets as a fraction of household non-housing assets.⁷

The following data attrition process was applied: First, the rural sample was dismissed and the main focus addressed the impact of multiple-housing ownership on the portfolio share of risky financial assets in urban China. This is due to two reasons: First, China's financial markets and financial products are still under-developed, which is further aggravated in rural areas (Allen et al. 2005). Second, the awareness of investing in risky financial products among Chinese rural households is still weak and incomplete. Both result in an even lower rate of risky asset holding in rural China. The other reason is that the difficulty to collect information on housing prices in rural areas leads to a severe problem of missing instruments for multiple-housing ownership.

Furthermore, respondents were excluded who did not report the number or value of owned houses. Next, among respondents with information on housing, respondents who did not own any house in 2015 were further excluded, which resulted in a sample of 7685 respondents.

3.2 Econometric methodology

The econometric modeling of the share of risky financial assets in household portfolios needs to overcome two main challenges. First, multiple-housing ownership and the holding of risky financial assets are potentially endogenous due to unobserved factors. Failure to account for these effects might bias the estimation of variables of interest. To overcome this issue, Chetty et al. (2017) applied the instrument variable model, where the key interested variable, an indicator for whether a household owns multiple houses, is indicated by the city-level housing prices in 2014. Furthermore, a regional fixed effect is introduced to adjust the time-invariant economic conditions that might affect both the local housing prices and the decisions for holding risky financial assets. Second, the share of risky financial assets in portfolios as dependent variable is truncated to non-negative values, and its distribution includes about 75% zeros. Since the majority of households does not own any risky financial assets, a Tobit model with an instrument variable (IV) extension was used to consider the potential endogeneity issue.

Specifically, the IV-Tobit regression model was used:

$$SRFA_i^* = \alpha + MH_i\beta + X_i\theta + \mu_i \quad (1)$$

$$SRFA_i = \max(0; SRFA_i^*) \quad (2)$$

where $SRFA_i^*$ represents a continuous latent share of risky financial assets held by household i ; and $SRFA_i$ represents the observed share that censors the latent share at 0. MH_i is a variable that indicates whether the household owns multiple houses; X_i denotes control variables.

The endogeneity problem can be solved by simultaneously modeling endogenous variable via instruments. The resulting IV-Tobit model can be estimated via the two-stage residual inclusion method (Terza et al. 2008). For the regional house price to work as a valid IV, two requirements have to be fulfilled: First, the city-level house price must be correlated with the endogenous explanatory variable (multi-home ownership dummy) conditional on

⁷ The household's total asset including housing assets and non-housing assets.

the other covariates, and can be checked at the first stage estimation. The second requirement is an exclusion restriction, which means conditional on the other covariates, the regional house price should not correlate with the error term.

As pointed out by Chetty et al. (2017), two potential concerns violate exclusion restriction; one is that the difference in risk preference may lead to selection bias due to the endogenous timing of housing purchases; the other is that the house price may correlate with factors that impact portfolio choice decisions. To address the first concerns, measure of household risk attitudes⁸ was included, which measures household knowledge such as whether the respondent has any knowledge in economics and the level of access to economic-related information, both of which may impact the decision of portfolio choice and whether multiple houses will be owned.

With regard to the second concern, a further instrument was introduced: the housing price at the time the house was purchased. This was done to create over-identification and examine the exogeneity of instruments. Furthermore, the development degree of local financial markets was included, which is proxied by the provincial scale of social financing. The scale of social financing data for each province was obtained from the Chinese Statistical Yearbooks of 2014. Regional fixed effects include a dummy variable, taking the value of one if the household in Central China, East China, South China, North China, northwest China, southwest China, or northeast China, included in all estimations. This enables control of the time-invariant regional conditions that might affect both the price of housing and the decision of the portfolio choice. Individual characteristics (age, age square, gender, marriage status, years of education, and years of education square) and household demographics (housing value, total household asset, wealth, annual income, and whether housing accumulation fund is applied) are also controlled. Finally, decisions on housing ownership that were made prior to 2014 that of the share of risky financial assets held by the household. Thus, the potential reverse effect of risky financial assets on housing ownership was not a problem.

4 Results

4.1 Summary of statistics

Among these four types of household assets, housing supplied more than 80% of a household's total assets on average, and has become the largest asset of Chinese households. Riskless financial assets follow next, accounting for 10.82% of a household's total assets. In contrast, approximately 25% of Chinese households hold specific risky financial assets, which account for less than 2.3% of household assets. Even those who own risky financial assets, these account for less than 4% of household total assets.⁹

Table 1 provides a summary of individual and household characteristics sorted by the ownership of multiple houses. Households with multiple houses are generally more

⁸ The CHFS asks the head of each household to choose from one of these 5 investment projects: High risk-High return project; Relatively high risk-Relatively high return project; Average risk-Average return project; Relatively low risk-Relatively low return project; and Very low risk-Very low return project.

⁹ In the USA, two-thirds of households own their primary residence, with a value accounting for 55% of a homeowner's total assets, on average. Approximately 50% of households own stocks and/or stock mutual funds, which accounts for less than 12% of household assets (Yao and Zhang 2005).

Table 1 Descriptive Statistics for key variables. *Source:* Urban households that owned at least one house in CHFS 2015

Variable	All sample			One house owner			Multiple house owner		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Household characteristics									
No. of houses owned	7685	1.366	(0.695)						
Multiple houses	7685	0.296	(0.456)						
With housing provident fund = 1, otherwise = 0	7685	0.439	(0.496)	5411	0.379	(0.485)	2274	0.581	(0.494)
Household size	7685	3.093	(1.325)	5411	2.955	(1.292)	2274	3.422	(1.345)
Total assets, million	7685	1.626	(11.800)	5411	1.262	(13.700)	2274	2.494	(4.556)
Income, million	7685	0.118	(0.261)	5411	0.091	(0.192)	2274	0.182	(0.371)
Netwealth, million	7685	1.614	(11.800)	5411	1.256	(13.700)	2274	2.466	(4.522)
Age of household head ^a	7685	0.657	(0.475)	5411	0.643	(0.479)	2274	0.689	(0.463)
Gender of household head, male = 1, female = 0	7685	0.701	(0.458)	5411	0.665	(0.472)	2274	0.787	(0.410)
Married = 1, otherwise = 0	7685	43.952	(15.430)	5411	45.162	(16.150)	2274	41.074	(13.124)
Year of education of household head	7685	11.509	(3.348)	5411	11.143	(3.409)	2274	12.379	(3.024)
Respondent characteristics									
Risk aversion, discrete 1–5	7685	3.890	(1.218)	5411	3.997	(1.190)	2274	3.634	(1.245)
Knowledge in economics, yes = 1, no = 0	7685	3.593	(1.130)	5411	3.708	(1.104)	2274	3.320	(1.142)
Less economics-related info, discrete 1–5	7685	0.140	(0.347)	5411	0.110	(0.313)	2274	0.211	(0.408)
Geographical distribution									
Provincial scale of social financing, 100 million	7685	6970.4	(3829.3)	5411	6884.6	(3847.3)	2274	7174.5	(3779.1)
Housing price in bought year, yuan/m ² , province-level	5513	3924.0	(3030.4)	3627	3360.1	(2638.6)	1886	5008.5	(3416.4)
Housing price in 2014, yuan/m ² , city-level	7685	9302.9	(5499.6)	5411	9259.5	(5453.3)	2274	9406.1	(5608.2)

The household head is defined as the family member who is in charge of the family's financial decisions. 70.6% of the respondents of urban household who own a house are household heads

Table 2 Household portfolio choice

	All sample		Netwealth < q(1/3)		q(1/3) < Netwealth < q(2/3)		Netwealth > q(2/3)	
	One house owner (%)	Multiple house owner (%)	One house owner (%)	Multiple house owner (%)	One house owner (%)	Multiple house owner (%)	One house owner (%)	Multiple house owner (%)
% of household with risky financial asset	22	39	7	13.9	22.7	28.7	45.5	52.1
	31.7	31.8	26	35.2	29.5	29.7	34.7	32.2
shares of risky financial asset in total non-housing asset								

educated and risk tolerant than those with only one house. They also tend to have a larger household size, have certain knowledge of economics, have more access to economics-related information, and live in regions with more developed financial markets. These households are also wealthier, earn a higher income, and own more total assets.

Table 2 shows how the shares of risky financial asset in the total non-housing asset are different across samples with a different number of homes. 39% of multiple-house owner holds risky financial asset while 22% of the one-house owner does. However, without conditioning on anything, among those households with risky financial asset, the shares of risky financial asset in the total non-housing asset is around 32%, regardless how many houses they owned. For those whose net-wealth are ranked at top 1/3, the multiple-house owners are less likely to hold risky financial asset than the one-house owners.

4.2 Estimation results

This section empirically examines how household portfolio compositions are affected by multiple-housing ownership and other demographic characteristics. Firstly, the first stage regression results of IV variables on multiple-housing ownership are reported. As shown in column (1) of Table 3, a higher regional housing price is a strong predictor that households are less likely to own multiple houses. The Wald F test indicates that the weak instrument problem is not an issue for this IV as the F statistic is 42.58.

The results of first stage have useful implications for the understanding of multiple-house behavior and are in accordance with existing literature, which reported that large, married, and richer families are more likely to own multiple houses. Furthermore, risk attitude, economics related information access, and knowledge in economics were found to play important roles in determining multi-house ownership. The more risk averse a family is, the less likely it owns multiple houses. Households with economics knowledge and with more economic-related information have a significantly higher likelihood to own multiple houses.

Columns (3)–(4) of Table 3 show the results of the same IV-Tobit model as was used in columns (1)–(2), which includes one more instrument in the regression: the housing price at the time of purchase. The advantage of including two instruments for the ownership of multiple houses can be found in the fact that this enables testing the exogeneity of instruments. As shown in column (3), the *p* value of the over-identification test is 0.64, which alleviates the concern that the utilized instruments would also affect the dependent variable. Moreover, the household portfolios held as risky assets are significantly decreased for those with multiple houses. In columns (6)–(7), the key variable of interest changes to the number of houses and a similar conclusion is obtained.

A significant crowding-out effect of the multiple-housing ownership was found for on the household portfolios that held risky assets. The marginal effect calculated based on coefficients matrix in column (4) shows that households with multiple houses are associated with 4.74 percentage-point reduction in the fraction of risky financial assets to total assets as shown in column (8) of Table 3. Column (5) and (9) of Table 3 report coefficient estimates and marginal effect, respectively, obtained by regressing the proportion of riskless financial assets on the key variable of interest and the same set of controls as in column (4). No significant crowding-out effect was found for the owning of multiple houses on the share of riskless financial assets.

These results also indicate that the household's portfolio compositions have other important determinants. Both risky asset proportion measures show a hump shape in age.

Table 3 Estimation results

	Coefficients				
	(1)	(2)	(3)	(4)	(5)
	First-stage: multi-home ownership	Risky share	First-stage: multi-home ownership	Risky share	Riskfree share
Multiple houses		−0.395*** (0.123)		−0.175*** (0.0634)	−0.0536 (0.0478)
N of house					
House price in 2014	−0.145*** (0.0175)		−0.264*** (0.0357)		
House price at purchase year			0.342*** (0.0564)		
Housing provident fund	0.0376** (0.0154)	0.0349** (0.0168)	0.0419** (0.0167)	0.0240 (0.0185)	0.0752*** (0.00951)
Risk aversion	−0.00834 (0.00540)	−0.0549*** (0.00574)	−0.00871 (0.00623)	−0.0554*** (0.00577)	0.0183*** (0.00473)
Less economics-related info	−0.0102** (0.00466)	−0.0757*** (0.00597)	−0.00670 (0.00551)	−0.0698*** (0.00591)	0.0108*** (0.00389)
Knowledge in economics	0.0686*** (0.0116)	0.00265 (0.0186)	0.0758*** (0.0141)	0.00786 (0.0172)	−0.0262** (0.0116)
Household size	0.0360*** (0.00577)	0.0160** (0.00703)	0.0385*** (0.00745)	0.0130** (0.00625)	−0.00832* (0.00432)
ln(netwealth)	0.00454 (0.00903)	−0.0307** (0.0125)	0.00315 (0.0122)	−0.0304** (0.0141)	−0.0198** (0.00970)
ln(income)	0.00871*** (0.00191)	0.0108*** (0.00338)	0.00702*** (0.00226)	0.00902** (0.00366)	0.00348** (0.00165)
ln(house value)	0.109*** (0.0113)	0.0535*** (0.0170)	0.144*** (0.0125)	0.0344** (0.0167)	−0.0209* (0.0111)
ln(non-house asset)	0.0366*** (0.00543)	0.189*** (0.0101)	0.0315*** (0.00589)	0.171*** (0.0100)	0.0599*** (0.00531)
Gender	0.0245** (0.00962)	−0.0256* (0.0156)	0.0127 (0.0105)	−0.0323** (0.0149)	0.0252*** (0.00897)
Married = 1, otherwise = 0	0.0578*** (0.0107)	0.0147 (0.0147)	0.0462*** (0.0107)	−0.00290 (0.0174)	0.0151* (0.00806)
Age of household head	0.00756*** (0.00153)	0.0117*** (0.00252)	0.00806*** (0.00211)	0.00945*** (0.00268)	−0.00204 (0.00139)
Age 2 of household head	−0.00008*** (0.00002)	−0.00007*** (0.00002)	−0.00008*** (0.00002)	−0.00004*** (0.00003)	0.00002 (0.00001)
Years of education	−0.0101 (0.00645)	0.0654*** (0.0138)	−0.00528 (0.00858)	0.0618*** (0.0131)	0.000143 (0.00500)

Table 3 (continued)

	Coefficients				
	(1)	(2)	(3)	(4)	(5)
	First-stage: multi-home ownership	Risky share	First-stage: multi-home ownership	Risky share	Riskfree share
Square years of education	0.000443 (0.000318)	−0.00168*** (0.000598)	0.00004 (0.000415)	−0.00160*** (0.000565)	−0.000283 (0.000204)
Scale of social financing	−0.0147 (0.0151)	0.0288 (0.0206)	−0.0263 (0.0214)	0.0430** (0.0174)	−0.00702 (0.0101)
Constant	−1.683*** (0.148)	−3.442*** (0.214)	−1.971*** (0.197)	−3.034*** (0.191)	0.364*** (0.109)
Regional fixed effect	Yes	Yes	Yes	Yes	Yes
Wald F statistic	42.58		40.02		
Wald test of exog P-v		0.0015		0.0035	0.2417
Overidentification P-v			0.6355		
N	7685	7685	5513	5513	5513
	Coefficients		Marginal effect		
	(6)	(7)	(8)	(9)	
	First-stage: no. of house	Risky share			
Multiple houses			−0.0474*** (0.0174)	−0.0465 (0.0414)	
N of house		−0.114*** (0.0433)			
House price in 2014	−0.343*** (0.0568)				
House Price at purchase year	0.514*** (0.0881)				
Housing provident fund	0.0216 (0.0284)	0.0193 (0.0181)	0.00649 (0.00501)	0.0652*** (0.00827)	
Risk aversion	−0.00867 (0.00827)	−0.0547*** (0.00594)	−0.0150*** (0.00153)	0.0159*** (0.00411)	
Less economics-related info	−0.00882 (0.00909)	−0.0693*** (0.00583)	−0.0189*** (0.00154)	0.00937*** (0.00338)	
Knowledge in economics	0.115*** (0.0280)	0.00752 (0.0171)	0.00212 (0.00466)	−0.0228** (0.0101)	
Household size	0.0516*** (0.0107)	0.0119* (0.00632)	0.00353** (0.00168)	−0.00722* (0.00375)	
ln(netwealth)	0.00398 (0.0175)	−0.0304** (0.0143)	−0.00823** (0.00383)	−0.0172** (0.00843)	
ln(income)	0.0123***	0.00926**	0.00244**	0.00302**	

Table 3 (continued)

	Coefficients		Marginal effect	
	(6)	(7)	(8)	(9)
	First-stage: no. of house	Risky share		
	(0.00391)	(0.00374)	(0.000989)	(0.00143)
ln(house value)	0.227*** (0.0173)	0.0367** (0.0170)	0.00929** (0.00455)	−0.0181* (0.00967)
ln(non-house asset)	0.0594*** (0.00941)	0.172*** (0.0101)	0.0462*** (0.00273)	0.0519*** (0.00459)
Gender	0.0135 (0.0173)	−0.0335** (0.0149)	−0.00872** (0.00403)	0.0219*** (0.00779)
Married = 1, otherwise = 0	0.0645*** (0.0146)	−0.00347 (0.0168)	−0.000785 (0.00469)	0.0131* (0.00699)
Age of household head	0.0114*** (0.00350)	0.00931*** (0.00262)	0.00255*** (0.000725)	−0.00177 (0.00120)
Age 2 of household head	−0.000122*** (0.00004)	−0.00004* (0.00003)	−0.00001* (0.000007)	0.00002 (0.00001)
Years of education	−0.0228 (0.0144)	0.0604*** (0.0136)	0.0167*** (0.00348)	0.000124 (0.00434)
Square years of education	0.000366 (0.000637)	−0.00158*** (0.000580)	−0.000432*** (0.000152)	−0.000245 (0.000177)
Scale of social financing	−0.0662** (0.0298)	0.0417** (0.0174)	0.0116** (0.00466)	−0.00609 (0.00875)
Constant	−1.983*** (0.278)	−2.954*** (0.187)		
Regional fixed effect	Yes	Yes	Yes	Yes
Wald F statistic	36.92			
Wald test of exog P-v		0.0272		
Overidentification P-v	0.5034			
N	5513	5513	5513	5513

(1) Robust standard errors clustered at the city level are reported in parentheses in columns (1)–(7); delta-method standard errors are reported in parentheses in columns (8)–(9). (2) Regional fixed effects including a dummy variable, take the value of one if the household lives in Central China, East China, South China, North China, northwest China, southwest China, or northeast China. These are included in all columns to control for time-invariant regional conditions that might affect both the price of housing and the portfolio choice decision. (3) Data used for the estimation are urban household ownership of at least one house in CHFS 2015. (4) ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively. (5) The results reported in columns (8)–(9) are marginal effects for all samples

This is reflected by the positive linear and negative quadratic coefficients of age. This result is in accordance with existing literature on the reason underlying why many US households do not own any stocks at all (Cocco et al. 2005; Flavin and Yamashita 2002).

Table 4 Subsample estimation by scale of social financing, marginal effect

	Risky share		
	(1)	(2)	(3)
	Lower third	Middle third	Upper third
Multiple houses	− 0.0214 (0.0342)	− 0.0738*** (0.0206)	− 0.0455 (0.0289)
Housing provident fund, yes = 1	0.00148 (0.0107)	0.00782 (0.00710)	0.0112* (0.00656)
Risk aversion	− 0.0120*** (0.00238)	− 0.0175*** (0.00263)	− 0.0155*** (0.00324)
Less economics-related information	− 0.0140*** (0.00232)	− 0.0221*** (0.00252)	− 0.0200*** (0.00270)
Knowledge in economics	0.00407 (0.00668)	− 0.00565 (0.00930)	0.00698 (0.00746)
Household size	0.00206 (0.00244)	0.00542* (0.00298)	0.00362 (0.00369)
ln(netwealth)	− 0.0115 (0.00920)	− 0.00720* (0.00423)	− 0.00567 (0.00539)
ln(income)	0.00388* (0.00218)	0.000391 (0.00144)	0.00331*** (0.00110)
ln(house value)	0.0108 (0.00964)	0.0139** (0.00644)	0.00335 (0.00702)
ln(non-house asset)	0.0390*** (0.00367)	0.0457*** (0.00335)	0.0552*** (0.00610)
Gender, male = 1, female = 0	− 0.0116* (0.00638)	− 0.00900 (0.00682)	− 0.00337 (0.00626)
Married = 1, otherwise = 0	0.00111 (0.00762)	0.0103 (0.00890)	− 0.0121** (0.00603)
Age of household head	0.00287** (0.00127)	0.00294** (0.00119)	0.00136 (0.00141)
Age square of household head	− 0.00002 (0.00001)	− 0.00001 (0.00001)	− 0.000001 (0.00001)
Years of education of household head	0.0145** (0.00639)	0.00959** (0.00378)	0.0285*** (0.00660)
Square years of education	− 0.000368 (0.000273)	− 0.000215 (0.000166)	− 0.000817*** (0.000297)
Scale of social financing	0.0228** (0.0114)	− 0.0179 (0.0411)	0.000625 (0.0270)
N	1845	1888	1780

Delta-method standard errors are reported in parentheses. ***, **, and * represent significant at the 1%, 5%, and 10% levels, respectively. The results reported in the table are marginal effects for all samples

4.3 Heterogeneity

4.3.1 The development degree of local financial markets

This subsection examines how the development degree of the regional financial market affects the decision on the fraction of risky financial assets of both total assets and liquid portfolios. Specifically, the provincial scale of social financing was used as proxy for the development degree of local financial markets. The scales of social financing are divided into three categories: lower third, middle third, and upper third. The IV-Tobit results are presented in Table 4.

The proportion of risky financial assets in both total assets and liquid portfolios for households living in regions with the medium development level of financial markets were found to affect the ownership of multiple housing more. Specifically, the share of risky financial assets for households in regions with the medium development level of financial markets, are significantly reduced by 7.38 percentage-point. In contrast, a modest crowding effect was found for households in regions with the lowest and highest development degree of local financial markets.

4.3.2 Household net wealth

This subsection examines whether a difference in the impact of multiple-housing ownership exists across different wealth groups. Similar to the result shown in Table 3, for each wealth class, multiple-housing ownership negatively affects the proportion of risky financial assets in both total assets and liquid portfolios. However, the impact of housing price on multiple-housing ownership differs across wealth groups. Columns (1)–(3) of Table 5 report the impact of multi-home ownership on the fraction of risky financial assets for three wealth groups: lower third, middle third, and upper third.¹⁰ Such a crowding-out effect is only significant among the high-wealth population. For instance, as shown in Table 5, IV-Tobit regression estimates indicate that owning multiple houses leads to a 8.17 percentage-point reduction in the share of risky financial assets relative to non-house assets for the richest one-third of households. In contrast, 2.15 percentage-point decrease was found for the middle third wealth group and a 2.86 percentage-point decrease was found for the poor. Estimated coefficients of other determinants are similar to those reported in Table 3.

In summary, owning multiple houses significantly reduces the holdings of relatively high-risk financial assets for high-wealth households, reflecting a strong asset substitution effect in which residences take the place of risky financial assets.

4.4 Further discussion on endogeneity

So far, the endogeneity issue has been discussed. A further potential endogeneity problem originates from the housing value, which is highly related to the ownership of multiple houses and cannot be exogenous (Chetty et al. 2017). Ignoring its potential endogeneity might again bias the estimation.

Table 6 compares the 2SLS estimated results that do not consider the potential endogeneity of housing value [columns (1)–(2)] and those that consider these [columns (3)–(5)]. Specifically, for the data in columns (1)–(2) the housing value was assumed to be

¹⁰ The lower third group contains households whose net wealth is lower than 1/3 quantile, the middle third group contains household whose net wealth ranges between 1/3 and 2/3 quantile, and the upper third group contains household whose net wealth exceeds 2/3 quantile.

Table 5 Subsample estimation by net-wealth, marginal effect

	Risky share		
	(1)	(2)	(3)
	Netwealth < q(1/3)	q(1/3) < Netwealth < q(2/3)	Netwealth > q(2/3)
Multiple houses	−0.0286 (0.0411)	−0.0215 (0.0324)	−0.0817*** (0.0189)
Housing provident fund, yes = 1	−0.00175 (0.00772)	−0.00128 (0.00693)	0.00938 (0.00937)
Risk aversion	−0.0128*** (0.00259)	−0.0153*** (0.00266)	−0.0185*** (0.00348)
Less economics-related information	−0.0139*** (0.00304)	−0.0240*** (0.00295)	−0.0206*** (0.00237)
Knowledge in economics	0.00368 (0.0105)	0.00246 (0.00931)	0.00424 (0.00581)
Household size	0.00306 (0.00296)	0.000668 (0.00350)	0.00463 (0.00333)
ln(netwealth)	−2.58e−05 (0.00262)	−0.0106 (0.0225)	−0.0875*** (0.0174)
ln(income)	0.00466** (0.00228)	0.00243 (0.00192)	0.00264 (0.00176)
ln(house value)	−0.000112 (0.00491)	0.00903 (0.0123)	0.0743*** (0.0163)
ln(non-house asset)	0.0382*** (0.00378)	0.0594*** (0.00754)	0.0709*** (0.00545)
Gender, male = 1, female = 0	−0.0133* (0.00715)	−0.00332 (0.00661)	−0.0131* (0.00755)
Married = 1, otherwise = 0	−0.00164 (0.00784)	0.00177 (0.00762)	−0.00660 (0.00827)
Age of household head	0.00179 (0.00136)	0.00204 (0.00138)	0.00418*** (0.000849)
Age square of household head	−0.000009 (0.00001)	−0.000009 (0.00002)	−0.00002*** (0.000008)
Years of education of household head	0.0202** (0.00936)	0.0141*** (0.00545)	0.0151* (0.00837)
Square years of education	−0.000635 (0.000404)	−0.000431** (0.000219)	−0.000267 (0.000350)
Scale of social financing	0.0115** (0.00536)	0.00403 (0.00731)	0.0149* (0.00811)
N	1606	1910	1997

Delta-method standard errors are reported in parentheses. ***, ** and * represent significance at the 1%, 5% and 10% levels, respectively. The results reported in the table are marginal effects for all sample

exogenous and the only endogenous variable is the ownership of multiple houses. However, both the housing value and the ownership of multiple houses have been considered to be endogenous variables in columns (3)–(5). Under both scenarios, a significant crowding-out

Table 6 Estimation results with two endogenous variables

	(1)	(2)	(3)	(4)	(5)
	First-stage multiple housing owner	Risky share	First-stage multiple housing owner	First-stage: ln(house value)	Risky share
Multiple housing owner		−0.0889*** (0.0254)			−0.0716*** (0.0247)
House price 2014	−0.261*** (0.0358)		−0.214*** (0.0348)	0.328*** (0.0687)	
House price at b year	0.346*** (0.0560)		0.372*** (0.0655)	0.185** (0.0787)	
Housing provident fund	0.0418** (0.0167)	−0.0103* (0.00596)	0.0457*** (0.0172)	0.0270 (0.0197)	−0.0127** (0.00611)
Risk aversion	−0.00867 (0.00624)	−0.0195*** (0.00216)	−0.00932 (0.00646)	−0.00454 (0.00807)	−0.0190*** (0.00219)
Less economics-related information	−0.00675 (0.00553)	−0.0228*** (0.00188)	−0.00991* (0.00548)	−0.0221*** (0.00772)	−0.0217*** (0.00199)
Knowledge in economics	0.0759*** (0.0142)	0.00907 (0.00890)	0.0773*** (0.0140)	0.0104 (0.0225)	0.00746 (0.00907)
Household size	0.0385*** (0.00746)	0.00611*** (0.00221)	0.0419*** (0.00739)	0.0236*** (0.00844)	0.00442* (0.00237)
ln(netwealth)	0.00314 (0.0122)	−0.00192 (0.00632)	0.105*** (0.0202)	0.711*** (0.0896)	−0.0412** (0.0204)
ln(income)	0.00701*** (0.00226)	0.00254*** (0.000922)	0.00704*** (0.00229)	0.000188 (0.00484)	0.00237*** (0.000992)
ln(non-house asset)	0.0315*** (0.00590)	0.0410*** (0.00412)	0.0230*** (0.00801)	−0.0594** (0.0270)	0.0437*** (0.00480)
Gender, male = 1, female = 0	0.0128 (0.0106)	−0.00955* (0.00505)	0.0104 (0.0109)	−0.0171 (0.0125)	−0.00841 (0.00514)
Married = 1, otherwise = 0	0.0461***	−0.00130	0.0484***	0.0164	−0.00358

Table 6 (continued)

	(1)	(2)	(3)	(4)	(5)
	First-stage multiple housing owner	Risky share	First-stage multiple housing owner	First-stage: ln(house value)	Risky share
Age of household head	(0.0107) 0.00809*** (0.00212)	(0.00507) 0.00528*** (0.000881)	(0.0111) 0.00836*** (0.00213)	(0.0110) 0.00189 (0.00269)	(0.00508) 0.00518*** (0.000892)
Age 2 of household head	-8.10e-05*** (2.04e-05)	-3.40e-05*** (8.36e-06)	-8.04e-05*** (2.02e-05)	4.66e-06 (2.56e-05)	-3.43e-05*** (8.54e-06)
Years of education	-0.00519 (0.00867)	-0.00543** (0.00272)	-0.00260 (0.00913)	0.0181* (0.00956)	-0.00595** (0.00255)
Square years of education	3.24e-05 (0.000419)	0.000510*** (0.000137)	6.12e-05 (0.000454)	0.000201 (0.000495)	0.000486*** (0.000126)
Scale of social financing	-0.0273 (0.0214)	0.00928 (0.00587)	-0.0167 (0.0203)	0.0744** (0.0344)	0.000894 (0.00806)
ln(house value)	0.143*** (0.0127)	0.0121 (0.00838)			0.0615*** (0.0230)
Constant	-1.958*** (0.196)	-0.595*** (0.0764)	-1.513*** (0.232)	3.105*** (0.683)	-0.674*** (0.0621)
Regional fixed effect	Yes	Yes	Yes	Yes	Yes
Wald F statistic	40.01		62.34	46.8	
Wald test of exog P-v		0.00			0.00
Overidentification test pv	0.6355				
R ²	0.252	0.206	0.227	0.786	0.198
N	5513	5513	5513	5513	5513

Robust standard errors clustered at the level of city are reported in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively. The results reported in the table are marginal effects for all samples

effect of the ownership of multiple houses on the share of risky financial assets was found relative to non-housing assets. Moreover, the estimated magnitudes are also similar to each other. As shown in Table 6, compared to households with only one house, for those with multiple houses, the share of risky financial assets relative to non-house assets decreased by 8.89 percentage-point when only the ownership of multiple houses is considered as endogenous. This result slightly decreased to 7.16 percentage-point when both the housing value and the ownership of multiple houses are treated as endogenous variables.

5 Conclusions

Multi-home ownership is an important phenomenon for Chinese households since the rate of households that own multiple houses is relatively high among the world and house assets play a crucial role in asset allocation. However, studying the impact of multi-home ownership on the portfolio decision of a family in China is still less developed in academic research. This study examines how the household's portfolio allocations are affected by multiple-house ownership, accounting for the endogeneity problem induced by unobserved factors such as risk attitudes and preferences using the city-level housing prices. The obtained results demonstrate that the proportion of risky financial assets decreased by 4.74 percentage points for households owning more than one house. These results also indicate that such a crowding-out effect is more significant and pronounced for households in regions with medium development degree of financial markets and for high-wealth households, who choose to hold a safer portfolio after purchasing their second residence. Basically, our findings are consistent with existing studies exploring the impact of housing ownership on household asset portfolios (Grossman and Laroque 1990; Chetty and Szeidl 2007; Flavin and Yamashita 2002; Fratantoni 2001; Kullmann and Siegel 2005).

The main findings of this study provide useful implications for the understanding of both the property market and the financial market in China from the household level. In particular, this study elucidates how both markets are correlated through household endogenous asset allocation decisions.

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