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On the Housing Provident Fund in China

By

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On the Housing Provident Fund in China

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An abstract of
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Abstract

On the Housing Provident Fund in China
By Xiangyu Gong

This thesis includes three papers studying the Housing Provident Fund (HPF henceforth) in China. HPF is a savings program founded by the Chinese government to assist households to save for housing expenditures and retirement.

Chapter 1 reviews literature on topics of saving, retirement and savings plans, and housing across countries, with a special emphasis on China. Saving rate and homeownership rate in China are among the highest in the world. The HPF is a unique program links household saving and housing decisions in China. Chapter 2 and Chapter 3 builds on the literature and address issues surrounding the HPF program, which help better understand the role of the HPF in the economy and provide insight into studying other programs and policies.

Chapter 2 implements a three-period partial-equilibrium life cycle model to examine the impact of HPF on housing demand and welfare. Two main features of HPF are incorporated into a standard life cycle model with borrowing constraint. The first feature is that contributions to the HPF are tax-free. The second feature is a withdrawal constraint which favors home-relate expenses. In particular, withdrawals prior retirement are allowed if the early withdrawals are used to cover home-related expenses. This model shows that HPF increases housing demand. Moreover, this model solves the optimal contribution rate of the HPF which maximizes welfare.

Chapter 3 uses Chinese household survey data to empirically investigate the other direction of the relationship between HPF ownership and housing demand, i.e. the impact of homeownership status on HPF ownership status. Since Chapter 2 shows that housing decision is affected by HPF enrollment status, the empirical model in this chapter disentangles the potential endogeneity of homeownership and HPF ownership status. The analysis shows that homeownership status significantly increases the probability of owning a HPF savings account after taking into account the potential endogeneity and controlling for other factors.

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# Chapter 1

# Literature Review: On the Saving, Retirement Plans and Housing

Xiangyu Gong*

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## 1.1 Introduction

Why do people save? What determines households' decision of owning a particular savings instrument or retirement savings account? Households need enough savings to insure themselves against income uncertainty, unanticipated consumption, future investment opportunities, retirement or medical needs, etc. Households' saving is also closely linked to their housing decisions. In order to purchase homes, people have to save to fulfill the down payment requirements. In many countries, housing asset represents a large component of household wealth. In order to assist people to save and promote homeownership, many countries have government or corporate programs,

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such as such as tax-deferred saving accounts and retirement savings plans, to offer incentives to encourage personal savings. What determines the participation and contribution of these savings plans? What are the effects of these programs on people's saving decisions and wealth?

This paper provides a review of studies that address these questions. The second section review several important empirical studies. The third section covers macroeconomics or theoretical studies in related topics. The last section provides further examples of studies in China.

## 1.2 Empirical Studies

### 1.2.1 Saving Behavior

There are various motives for individual and household saving. Keynes (1936) suggests eights savings motives, including the "life-cycle motive", the "precautionary saving motive", the "intertemporal substitution motive", the "improvement motive", the "independence motive", the "enterprise motive", the "bequest motive", and the "avarice motive".

The life-cycle motive states that individuals tend to smooth consumption and plan their consumption over the life cycle. Individuals save when they earn and dissave after they retire. Ando and Modigliani (1963) conduct tests using U.S. aggregate data from 1929 through 1959 and find that net worth is an important determinant of consumption, which supports the life cycle hypothesis of saving. Moreover, Browning and Crossley (2001) show favorable empirical evidence on individuals' consumption smoothing over the life cycle using 1968 to 1995 cross-sectional U.K. Family Expenditure Survey data.

Precautionary saving is additional saving in response to future income uncertainty besides savings resulting from the intertemporal allocation of resources over the life cycle. Individuals consume less and save more to ensure themselves against uncertain events such as income shocks. Many empirical studies acknowledge and support the precautionary motive. For example, Skinner (1988) finds that precautionary savings represent up to 56 percent of aggregate savings. In addition, Kazarosian (1997) measures income uncertainty using a panel data from the National Lon-

gitudinal Survey and finds that the wealth to permanent income ratio increases by 29% if income uncertainty double. The study concludes that income uncertainty has a strong positive influence on saving. Lusardi (1998) analyzes 1995 and 1998 SCF data and maintains that precautionary motive exists and is especially important for households older than the age of 62 and business owners.

The "bequest motive" is that people might save for their future generations. Kotlikoff (1988) provides evidence that intergenerational transfers play an important in U.S. wealth accumulation. Modigliani (1988) maintains that the pure bequest motive might only be important for households among the highest income group.

Other saving motives are briefly explained. The "intertemporal substitution motive" maintains that individuals may save to enjoy interests and an increase of value over time. The "improvement motive" suggests that individuals may save for improvement of future expenditures. The "independence motive" states that some individuals save for independence and financial freedom. The "enterprise motive" maintains that people save for investment and enterprise purposes. The "avarice motive".refers to the case that some individuals save due to their strong need to possess money.

In addition to the eight saving motives listed above, Browning and Lusardi (1996) add a "downpayment motive", suggesting that individuals may save to fulfill downpayment requirement for housing or other durable goods, and there is heterogeneity in the saving motives among individuals or for the same individual across time.

The saving rate is China has been one of the highest in the world in the past decade. However, it is hard to reconcile the high saving rate using only the eight traditional saving motives. Many empirical papers investigate data and institutional details of China and seek alternative explanations of the high saving rate in China. For example, Wei and Zhang (2011) propose an additional saving motive, the imbalanced sex ratio effect. The authors point out that as male-female sex ratio rises and becomes imbalanced, sons in China face increasing pressure in the marriage market. In order to enhance their competitiveness in the marriage market, families with sons will increase their savings. At the same time, families with daughters may not decrease their saving as they want to

maintain bargaining power after marriage. Chamon and Prasad (2010) empirically examine the life cycle pattern of household saving in China. The paper shows that high saving rates of younger and older cohorts relative to median-aged cohort can be reconciled by increasing private expenditures on housing, education for the younger cohort and rising healthcare expenditure for the older cohort in China. Underdevelopment of financial market in China may amplify the effects of these factors.

### 1.2.2 Retirement Plans

A large portion of U.S. households have little savings upon retirement and almost 20 percent of households have no savings at all in 1991. (Poterba et al. 1996). While people save for multiple reasons such as precautionary motives to against income uncertainty and fund consumption after retirement, the proliferation of government or corporate retirement programs can partly alleviate income risk and help employees with their retirement planning. Retirement savings programs such as Individual Retirement Accounts (IRAs) and 401 (k) accounts attract incremental saving. (Poterba et al. 1996). A handful of research has studied retirement savings accounts. The literature falls into two major strands. One strand of literature explores factors which affect individuals' participation and contribution decisions of retirement savings plans, and the second strand investigates the economic and social consequence of retirement savings accounts.

#### Plan Designs

The participation and contribution of retirement plans depend on various factors. Plan design may affect employees' decision of whether to participate or contribute the retirement plans.

First, enrollment processes may influence an employee participation decision. Madrian and Shea (2001) examine individual 401 (k) savings behavior using employee-level data from a large, publicly traded Fortune 500 company in the healthcare and insurance industry for the years of 1997 and 1999. The paper finds that automatic enrollment results in higher 401 (k) participation rate. Moreover, a large portion of employees simply chooses the default contribution rate and default

securities allocation under automatic enrollment.

Second, plans with favorable tax treatment or other additional benefits, such as 401 (k) and other tax-deferred accounts, may attract employees to participate. For example, tax-deferred accounts allow employees to make pre-tax contributions and pay tax upon withdrawals after retirement. Under progressive tax system, plans with favorable tax treatment would protect participants from being taxed at a high rate and thus provide incentives for individuals to enroll.

Third, employers usually match employee contributions to a certain percent. For example, Parke (1995) and Papke and Wooldridge (1993) analyze plan level data and find a significant positive correlation between participate rate and employer match rate of 401 (k) plans.

Another feature of retirement plans is whether the plan is defined benefit or defined contribution. In the defined benefit plans, the benefits are calculated based on an employee' final salary and job tenure. On the other hand, in the defined contribution plans, the retirement benefits depends on contributions and earnings or interests on the contributions. (Munnell an Sunden 2001). Under defined contribution, young and mobile workers can easily track their savings in various accounts. Over the recent years, defined contribution plans have gained increasing popularity among workers and substituted a large portion of defined benefit plans in the U.S. (Munnell et al. 2001).

The availability of investment choice of the retirement plans may affect individuals' participation decision. 401 (k) or similar retirement plans usually allow individuals to invest in a pool of financial instruments such as stocks and funds. Sethi-Iyengar et al. (2004) examine employee records across more six hundreds of 401 (k) plans and 69 industries provided by Vanguard and find that after controlling for plan-level and employee characteristics, offering too many funds may actually lower the probability of 401 (k) participation.

**Individual Characteristics**

Besides plan designs, participation and contribution decisions of retirement plans are affected by individual characteristics, such as income, age, education, job tenure, saving behavior, and so on.

Income is a major factor that affects retirement savings plan enrollment. For example, us-

ing federal tax returns data, Joulfaian and Richardson (2001) estimate a probit model and find that households with low earnings or dependents have a lower probability of enrolling in a plan, whereas workers with higher earnings and income are more likely to participate in a plan. Munnell et al. (2001) discuss reasons that income affects retirement plan participation and contribution. One plausible reason is that low-income employees tend to be liquidity constrained compared to high-income employees, thus they are less likely to save in a retirement plan. Moreover, low-income people usually have lower marginal tax rate under the progressive tax system, thus they are less motivated to save in tax-deferred accounts compared to the high-income group. And third, low-income employees have higher replacement rates from Social Security and fewer incentives to save in other plans.

Age is another important determinant of retirement plan participation and contribution, as employees' retirement savings behavior varies over the life cycle (Munnell et al., 2001). According to the life-cycle hypothesis, A young worker expects higher future income may save less. As income rises, an employee may be able to accumulate more for retirement.

In addition, studies across countries show that education and finance literacy also affect retirement plan participation and contribution. Fornero and Monticone (2011) investigate the Bank of Italy's Survey on Household Income and Wealth and find that financial literacy has a statistically significant and positive effect impact on the likelihood of pension plan participation. Similarly, Bucher-Koenen and Lusardi (2011) find a positive effect of financial literacy on retirement savings using the SAVE survey, a survey of Germany households. Klapper and Panos (2011) analyze Swedish Financial Supervisory 2010 consumer survey and find that financial literacy and an understanding of risk diversification have a significant and positive effect on retirement planning. The third chapter of this dissertation finds that homeowners are more likely to own the Housing Provident Fund account, a Chinese retirement savings plan which favors home-related expenses, after controlling for household characteristics and disentangling potential endogeneity of homeownership choice.

### Other Factors

Factors such peer effects or social network, individual savings behavior, intergenerational transmission of time preference, etc, can affect the individual decisions of whether enroll in the retirement savings plans or not. Using individual data from employees of a large university, Duflo and Saez (2002) find that employees decisions of enrolling in a tax-deferred account are affected by their colleagues' choices. Gouskova et al. (2010) use a theoretical model of preference formation and data from the Panel Study of Income Dynamics (PSID) and the Survey of Consumer Finances (SCF), and find that parents receiving pension income between age 66 to 70 is associated with about 9% increase in the likelihood of an adult child's having a pension.

### Impacts of Retirement plans

Many studies investigate how individual retirement plan decisions interact with their savings decisions, whether retirement savings substitute other types of savings, or whether retirement plans attract additional savings from individuals and household and the impact of participating in a retirement plan on wealth. Benjamin (2003) shows that on average, about 50% of 401(k) balances represent an increase in private savings by comparing 401 (k) eligible and ineligible households' wealth after controlling for household characteristics and other factors. Chernozhukov and Hansen (2004) use data from the Survey of Income and Program Participation to investigate the impact of participating a 401 (k) plan on asset allocation and wealth. This paper finds a positive and significant correlation between 401 (k) participation and net financial assets over the entire asset distribution. At the left tail of the asset distribution, the increase in net financial assets represents a pure increase in wealth, whereas at the right tail of wealth distribution the increase in net financial assets is likely to be substituted for other types of wealth.

### 1.2.3 Housing

Housing is closely linked to household savings and retirement decisions. For example, to fulfill downpayment, households need to accumulate enough savings. While households acquire homes, they also build up wealth which can be used to fund retirement in old age.

Many countries have government programs or financial innovations to help renters overcome the down payment requirements promote homeownership. For example, Engelhart (1997) shows that the Registered Home Ownership Savings Plan program, a targeted savings incentive for first-time home buyers in Canada during the 1970s and 1980s, increases the homeownership rate by 20%. Chambers et al. (2009) examine the U.S. homeownership rate between 1994 and 2005 and finds that mortgage market innovation which lessens the down payment constraint increases homeownership rate from 56% to 70%. Moreover, the paper finds that changes in demographic factors explain about 16% to 31% of the change in the homeownership rate.

Housing is a major component of wealth. It also provides housing services to the tenants. Fluctuation of housing price may affect people's consumption and saving decisions. For example, Campbell and Cocco (2005) estimate the effect of house prices on consumption using UK micro-data. The paper finds house price fluctuations significantly affect old homeowners but have little impact on young renters. Moreover, regional house prices affect regional consumption growth.

In addition to empirical studies of household saving and housing decisions, many studies are based on some theoretical framework of households consumption, saving and housing decisions. The next section reviews macroeconomics literature related to these topics.

## 1.3 Macroeconomics Literature

### 1.3.1 Saving Behavior

Many macroeconomics studies are devoted to understanding people's saving behavior. Ayagari (1994) incorporates precautionary savings motive and liquidity constraints into an otherwise stan-

dard growth model incorporate. In particular, agents face uninsured idiosyncratic labor endowment shocks. They might also face borrowing constraint in future periods. As a result, people accumulate excess savings or capital in order to smooth consumption under the uninsured idiosyncratic income shocks. In addition, when earnings variations are highly correlated, earnings are highly serial correlated and relative risk aversion is high, the presence of idiosyncratic income shocks can increase the saving rate by seven percentage. While the three parameters are low, the savings rates are not much different with and without insurance.

Similarly, Deaton (1991) finds that when agents are relatively impatient and labor income is independently and identically distributed over time, people tend to save more as buffer stock. Precautionary saving combined with borrowing constraints would provide incentives for agents to save. While income is positively autocorrelated but stationary, saving is still used to protect consumption against negative income shocks and contracyclical over the business cycle. While income is a random walk, impatient agents with liquidity constraint simply consume all income to optimize their lifetime utility, and there is no saving under this case.

Carroll (1997) argues that the typical household's saving is attributed to buffer-stock behavior rather than life-cycle and permanent income behavior. While under the life-cycle setting consumption growth is determined by preferences, under the buffer-stock case consumer set average consumption growth to average labor income growth. The buffer-stock motive help explain several empirical puzzles which can not be explained by the life-cycle motive.

Several macroeconomics papers investigate factors which can account for the high saving rate in China. For example, Modigliani and Cao (2004) implement a life cycle framework and find that income growth, demographic structure and inflation are three key factors driving the high saving rate in China. In addition, Curtis et al. (2015) show that demographic change plays an important role in shaping housing saving decision. The increase in saving rate in 1978 coincides with the start of demographic change. Since the major portion of population enters middle-age, adult children have to save to support their elderly parents. Moreover, the number of children in each family decreases. Since fewer children today means that current adults may incur less expenditures today

and get less support from their children in the future, current adults may save more for their own retirement.

### 1.3.2 Retirement Plans

To better understand households' retirement planning decisions and the impact of retirement plans, retirement plans and tax-deferred accounts are embedded into macro models of savings in many studies.

Scholz et al. (2006) solve a life cycle model which incorporates uncertain lifespan, uninsured earnings and medical expenses, progressive tax, government transfers, and pension and social security. After matching the aggregate moments, the model accounts for over 80 percent of the 1992 cross-sectional variation in wealth using the Health and Retirement Study panel dataset. The model also suggests that fewer than 20 percent of U.S. households have less wealth than their optimal levels, and the cohort aged 51-61 in 1992 were financially well prepared for retirement.

Retirement accounts may improve wealth accumulate and savings. For example, Gomes et al. (2009) solve a life cycle model with earnings risk and liquidity constraints incorporating tax-deferred retirement accounts (TDAs). Two types of households with TDAs are considered: households who directly hold stocks, and households who only hold stocks through the TDAs. The paper argues that TDAs promote wealth accumulation and increase consumption after retirement for the group of households with high marginal savings rate already. İmrohoroğlu et al. (1998) also argue that a modest IRA contribution limit similar to the one during the early 1980's raises the steady-state capital stock by about 6 percent. Around 9 percent of IRA contributions represent new saving.

Ho (2017) estimates a life cycle model and compares two types of TDAs: IRA and 401 (k). 401 (k) has a higher contribution limit than IRA, yet only half of the workers are eligible for it. The paper finds that IRA has already provided enough tax benefits for most households. While extending the 401 (k) benefits universally does not have a significant effect, raising the contribution limit will have a significant effect on the economy through the high-income households. The

welfare gain from a consumption tax reform decreases by more than 50 percent with the presence of TDAs in the U.S.

China also has developed several pension, retirement and savings programs over the recent years. Song et al. (2015) suggest that the current pension system in China is not sustainable, and build an overlapping generation models to compares alternative pension reforms and propose an optimal reform for China's pension system.

Chapter 2 of this dissertation contributes to the literature by investigating the impact of the Chinese Housing Provident Fund on the housing market and welfare in a life cycle model. Two features of the program are incorporated in the model: a mandatory individual saving account with a tax deduction on the HPF savings and interest income, and a withdrawal constraint on the HPF savings. This chapter finds that the demand for housing increases with the presence of the program. The program also distorts household's consumption and saving profile over the life cycle.

### 1.3.3 Housing

Since housing decision is closely linked to savings and retirement planning, many studies also incorporate tenure choice into a macroeconomic framework to investigate people's housing decision.

Housing decisions can be influenced by taxation or other government policies. Gervais (2002) analyze the preferential tax treatment of imputed rent income in the U.S. makes housing capital a more favorable asset than business capital and distorts the lifetime profile and composition of household savings. Individuals are better off when the imputed rents are taxed or mortgage payments are not deductible. Sommer and Sullivan (2018) argue that removing tax deduction on mortgage interest payments will result in lower house prices, higher homeownership rate, lower mortgage debt, and better welfare.

Housing decisions may also be affected by house prices shocks or income shocks. Attanasio et al. (2012) find that higher house price causes households to downsize, but does not prevent households from purchasing homes. Positive house price shocks increase consumption of old cohorts and decrease aggregate demand for housing, while positive income shocks increase both

consumption and aggregate housing demand.

In addition, borrowing constraints and transition costs play important roles in households housing decisions. Yang (2009) develops a model to match the life cycle profile of housing stock which first increases monotonically and then flattens out. The paper argues that in a life cycle mode, borrowing constraints are important in explaining the housing consumption pattern in early ages, and transaction costs help explain the slow downsizing pattern of housing stock in old ages. Halket et al. (2014) find that borrowing constraints, factors that affect propensities to save and move, such as house prices and transaction costs are important determinants of homeownership.

Housing decisions closely interact with retirement savings planning and other investment decisions. Chen (2010) incorporates housing into a life cycle model with social security. Housing is treated as a durable consumption which provides services to the households. The paper finds that unfunded social security significantly crowds out housing consumption over the life cycle but increase non-durable consumption at old ages. Moreover, after incorporating housing market frictions, social security decreases the aggregate homeownership rate and the average size of owner-occupied houses. Cocco (2004) shows that housing investment will reduce the stock participation of younger and poorer investors due to limited financial resources. House price risk crowds out stockholdings, especially for the low financial net -worth group. Marekwica et al. (2013) examine that investors with tax-deferred accounts and owner-occupied housing. The paper finds that investors with both types of investments would hold substantially less equity than investors have no access to either of the two investments.

Housing asset comprises a larger portion of average household wealth in China than the U.S. or most of the other countries in the world over the recent years. Therefore, it might provide additional insight to look into Chinese housing market as an example. The next section will discuss studies covering the housing market.

## 1.4 Chinese Housing Market and Policies

The Chinese economy has grown rapidly over the recent two decades. At the same time, the rate of return on investment has remained above 20 percent, higher than most of the developed and emerging economies. (Song et al. 2011). China has become the largest housing market in the world in terms of sales during the period of 2000 and 2014, and in 2014, housing becomes the largest assets in household wealth. (Fan et al. 2017). Due to the increasingly important role of the Chinese economy in the world, it is insightful to look into the Chinese housing market in details. The Chinese housing market shares many similarities with the housing market of other economies, yet it also has unique features and policies. Handful studies have documented or examined the Chinese housing market and policies. This section will review several articles to provide a basic understanding of the Chinese housing market and policies.

China launched a housing market privatization reform in the late 1980s. Prior to the privatizations, the government requires work unites to allocate houses to their employees according to job tenure and other criterions in the urban area. Urban households are not able to purchase or sell homes on the market before the reform. The Chinese housing reform provides a unique example to study the impact of housing market privatization. Wang (2011) uses China as an example to illustrate the equilibrium price effects of the housing privatization on two types of housing assets: one is house previously owned, and the other is house previously allocated by the government. The paper shows privatization increases household consumption of housing and induces a higher housing price.

Despite of the fast development of the housing market, the mortgage market is relatively less mature than developed countries such as the U.S. For example, Fan et al. (2017) document that the outstanding mortgages is about 14.5 percent of GDP in China, while it is about 72% in the U.S. This paper argues that the high housing demand and low dependence of mortgage loans in urban China can be reconciled by the existence of Chinese households' informal borrowing from relatives and friends. It is found that households borrow as much as possible from relatives before they seek financial assistance from banks, as the cost of borrowing from the informal channel is

likely to be lower than the bank mortgage interest rate.

To assist households to save for a downpayment and lower mortgage loan borrowing costs, the Chinese government launched a retirement savings program in 1991 that favors home-related purchases, the Housing Provident Fund program (HPF). This program provides tax benefits to the employee and employer-matched contributions. Moreover, HPF allows households to borrow mortgage loans against the HPF balance at an interest rate around 1-2% lower than the market rate up to a limit. And Finally, account holders can also withdraw the HPF balances prior to retirement as long as the early withdrawals are used to cover home-related expenses. Burell (2006) discusses the pros and cons of the HPF program. The paper points out that although the program help individuals accumulate savings for housing and promote homeownership, the actual coverage rate of the program is unclear. Moreover, HPF does not have stock or fund investment options for the holders, thus a large size of HPF savings are not able to be invested in the capital market. Chen and Deng (2014) examine the role of HPF in housing finance. Since the primary goal of the HPF is to promote homeownership and it is costly to the government to manage the program, Buttimer Jr (2004) models the complex program design and suggests optimal program parameters which provide incentives to employees to minimize the time they stay in the program before acquiring homes. Tang and Coulson (2016) find that HPF participants are more likely to be homeowners, but their average size of homes is relatively smaller due to the downpayment restrictions imposed on the HPF mortgage loans.

Due to the housing market is overheated in some cities in China recently, the government adopts home-purchase restrictions in several cities in recent years. The possibility of imposing property taxes in China is also under debate. Du and Zhang (2015) examine the consequences of each of the two policies. The paper finds that purchase restrictions lower the annual growth rate of house price in Beijing by about 7.7 percent, and the trial property tax decreases the annual growth rate of house price by about 2.5 percent in Chongqing but has no significant effect in Shanghai.

Besides housing policies and reforms, recent increase in housing demand in China can be explained by a few other factors. Wei and Zhang (2011) suggest that the sex ratio saving motive

may also affect the housing market. Chen and Wen (2017) build a life cycle model and find that the Chinese housing boom is attributed to speculations. The resource reallocation from unproductive firm to productive private firms and high economic growth of China is not sustainable. As a result, people acquire houses as an alternative store of value, and house prices are driven up. Garriga et al. (2017) build a multi-sector model and find that migration from rural to urban with land supply restrictions explain about 80 percent of urban house price increases in China.

Various sources of micro data are available to study Chinese saving, retirement planning, and housing market and policies.

One is the Chinese Household Finance Survey (CHFS) collected by the Southwestern University of Finance and Economics. This is a cross-section survey data collected every two years from 2011. The CHFS provides detailed information on household characteristics such as age, education, occupation, income, wealth and so on. Gan (2012) provides detailed information of CHFS. Multiple studies have looked into this dataset. For example, Tang and Coulson (2016) examine the impact of HPF on homeownership decisions in China using the 2011 wave of CHFS. Fu et al. (2016) also use this survey to estimate the effect of housing value variation on homeowners labor force participation.

Another important micro dataset is the China Health and Nutrition Survey (CHNS). This survey is designed and collected jointly by the Carolina Population Center at the University of North Carolina at Chapel Hill, the National Institute of Nutrition and Food Safety, and the Chinese Center for Disease Control and Prevention. The CHNS are available in the years of 1989, 1991, 1993, 1997, 2000, 2004, 2006, 2009, and 2011. The CHNS contains information about nutrition, public health, economics, and demographic information and so on about Chinese households and individuals, which is rich for conduct research about Chinese household and individuals. For example, Xu (2017) analyzed the impact of the Housing Provident Fund in China from 1989 to 2009 using the CHNS. Huang and Gan (2017) investigate the effects of Urban Employee Basic Medical Insurance on healthcare expenditures and health status.

## 1.5 Concluding Remarks

Numerous studies have investigated people's saving, retirement planning, and housing decisions. These decisions are not isolated, but rather they interact with each other and are usually jointly determined by households and individuals. Policies directly affecting one decision might also affect other two decisions.This paper summarizes a few important papers in each of the three topics, and highlights studies about the Chinese economy and contributions of Chapter 2 and 3 in the literature. Table 1 and Table 2 classify the papers into groups by topics and countries in Appendix A.

# Chapter 2

# A Life Cycle Analysis of the Housing Provident Fund in China

Xiangyu Gong*

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**Chapter Abstract**

This paper investigates the impact of preferential withdrawal rules of retirement saving plans on welfare and on household consumption and saving decisions. Specifically, using data from the Chinese Housing Provident Fund (HPF henceforth), this paper investigates a preferential withdrawal rule which favors housing consumptions. The HPF is a social welfare program aiming to fund retirement and assist home financing. Unlike 401(k) in the U.S., which has strict withdrawal rules before the age of $59\frac{1}{2}$, participants in the HPF program are allowed to withdraw savings before retirement without paying any penalty, providing that the early withdrawals are used to cover home-related expenses. To study the impact of this preferential withdrawal rule, this paper builds

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a life-cycle model which incorporates two main features of the the program: an individual savings account with tax benefits on the contributions and interest income, and a preferential withdrawal constraint which favors housing consumption. It is found that demand for housing increases with the presence of the preferential withdrawal constraint. This paper provides insight into retirement saving plan designs and reforms by companies and the policymakers.
Keywords: Housing Demand; Taxation; Mortgage Subsidies; Saving Incentives; Retirement.
JEL codes: E2, J3, N9, R2

## 2.1 Introduction

To attract individuals to save for retirement, retirement saving plans provide various benefits to the participants, such as tax benefits, and contributions matched by employers, etc. These plans also have a set of rules and restrictions to discourage individuals from taking early withdrawals. It could be costly to withdraw savings from these plans before a certain age. For example, in the U.S., the IRS imposes a 10% early withdrawal penalty if an individual is younger than $59\frac{1}{2}$. Although there certain exceptions to the 10% early withdrawal penalty, individuals will not be able to make new 401(k) contributions in the following six months after withdrawal.

Unlike 401(k) or many retirement savings accounts, the Chinese Housing Provident Fund (HPF thereafter) imposes preferential early withdrawal rules on the savings. This program was launched during the housing privatization reform in the early 1990s, aiming to fund retirement and assist home purchases. In order to promote homeownership and housing consumption, individuals are allowed to withdraw HPF savings and interest income before retirement without being penalized, as long as these withdrawals are used to cover home-related expenses. These home-related early withdrawals are not subject to any penalty. Individuals who take out home-related early withdrawals are allowed to continue to make contributions and continue to enjoy benefits from the program without any gap.

This paper investigates the consequence of this preferential withdrawal restriction on house-

holds' consumption and housing allocation and welfare. The Chinese HPF provides a unique example of preferential withdrawal rules of retirement saving plans, thus may shed light on the 401(k) or other similar retirement saving plans designs or reforms.

Although several empirical and microeconomics studies have investigated the impact of the program on housing demand, they are silent about the welfare effects of the program. This paper fills the gap of the existing literature by providing a life-cycle model which help investigate the welfare effect of the program and pin down the optimal policy parameters to maximize participants' lifetime utility.

In order to study the effects of the preferential withdrawal restriction, this paper builds an over-lapping generation model to mimic the HPF. The model incorporates two features of the HPF that might potentially affect household's consumption and housing decisions. The first feature is a preferential tax treatment on the HPF savings and associated interest income. In general, employee contributions to the HPF saving account and the interests income on the contributions are tax-free. As a result, households might tend to delay their consumption at early age, and keep their savings in the HPF account for consumption after retirement. The second feature is a preferential withdrawal constraint. Before retirement, individuals are allowed to withdraw the HPF savings and interests for home-related expenses. After retirement, individuals could withdraw all the remaining balance in the HPF account. This rule could potentially provide incentives for individuals to allocate more resources into housing rather than consumption or other types of wealth before retirement because the HPF savings are only available for housing-related expenses before retirement. The next section provides institutional details of the HPF program. Section 3 describes the model. Section 4 presents the model parameters. Section 5 presents the results. Section 6 concludes.

## 2.2 Institutional Details

### 2.2.1 Background

In the early 1990s, the Chinese government launched the Housing Provident Fund to assist the urban housing privatization reform. Before the reform, there was no private market which allowed owners and buyers to make residential housing transactions in the urban area. Urban workers' houses were mainly assigned by their work units or state-owned-enterprise employers. In 1988, the government set up a ten-year plan to promote the private housing market in the urban area. The number of newly built residential properties has increased drastically since then. Along with the housing privatization, the Chinese government developed and launched the Housing Provident Fund program in 1991 to assist retirement saving and promote homeownership. The HPF becomes one of the major social welfare programs in China after the housing privatization, and continue to play an important role in households saving, housing consumption, and retirement decision makings.

This program covers a large number of firms in the urban area across the country. Participating firms include state-own enterprises, private enterprises, collective enterprises, and foreign-invested enterprises, etc. Participation rates vary across cities. In 2006, the HPF program covered 60 percent of all salaried workers in urban areas. The participation rate varied widely across cities, ranging from 50%~90%. More developed areas generally have higher participation rate (Ye and Wu 2008).

The government regulates the contribution rates of the HPF savings. Specifically, the government requires the monthly contribution rate to be 5% to 12% of the individual employees' income, up to a certain cap. In the meanwhile, employers are required to match the employee contributions to a certain extent.

There is no penalty imposed on early withdrawals from the HPF, as long as the withdrawals are used to cover home-related expenses, such as rents, costs of purchasing houses, downpayment, mortgage loan payment, maintenance, renovation, and so on. On the other hand, plans like 401(k) plans in the U.S. have stricter withdrawal rules. Early withdrawals are subject to 10% penalty fee.

Even if there are exceptions, for example, 401(k) plans allow individuals to take early withdrawals for hardship reasons and does not charge any penalty, the individuals still need to go through paperwork, and they could not continue to make contributions into the plan in the following six months. Considering the efforts requires to apply for hardship withdrawals, and the lost benefits of not making contributions for six months, 401(k) has much stricter and costly withdrawal rules than the HPF program. The following section provides a life-cycle model to study the impact of the preferential withdrawal rule.

## 2.3 Model

In this section, four economic environments are presented. First, A discrete time overlapping generations model is considered to resemble an economy with no retirement saving plans. Second, a retirement saving plan with mandatory saving requirement is incorporated in the baseline model. The retirement savings enjoy a tax advantage, and there is no withdrawal constraint before retirement. Third, a full withdrawal constraint is imposed so that individuals can not take early withdrawals. Lastly, a withdrawal constraint favorable to the housing market is imposed, which mimics the economy with the housing provident fund.

**Economy without HPF**

In each period, a homeowner derives utility from non-housing consumption $c_j$ and housing services from the occupied housing capital $h_{j+1}$. Without loss of generality, one unit of housing capital is assumed to provide one unit of housing services. Moreover, the homeowner is allowed to borrow up to a proportion $0 < \gamma < 1$ of the value of the housing capital. Therefore, housing capital plays a dual role in the economy: it not only provides housing services, but also provides collateral for the homeowner to borrow against from the financial institutes. Assume that housing capital depreciates at a rate $0 < \delta < 1$ in each period. The model consists of three periods: young, median age and old. There is no HPF in presence in this economy.

$$\max_{c_j, h_j, a_{j+1}} \sum_{j=1}^{3} \beta^{j-1} U(c_j, h_j)$$

s.t.

$$c_j + h_{j+1} + a_{j+1} = (1-\tau_y) y_j + (1-\delta) h_j + (1+r) a_j$$

$$a_{j+1} \geq -\gamma h_{j+1}$$

$$c_j, h_{j+1} \geq 0$$

**Economy with HPF Program, No Withdrawal Constraint**

In this economy, there is a HPF program which provides tax benefits to the participants. Suppose that there is no withdrawal constraint on the HPF savings, and the homeowner is able to withdraw all HPF savings in each period.

$$\max_{c_j, h_j, a_{j+1}} \sum_{j=1}^{3} \beta^{j-1} U(c_j, h_j)$$

s.t.

$$c_j + h_{j+1} + a_{j+1} = (1-\tau_y)(1-\tau_f) y_j + \tau_f y_j + (1-\delta) h_j + (1+r) a_j$$

$$a_{j+1} \geq -\gamma h_{j+1}$$

$$c_j, h_{j+1} \geq 0$$

Note that without the presence of a withdrawal constraint, the HPF program is simply a saving program providing tax benefits.

**Economy with HPF Program, Full Withdrawal Constraint**

First, in the case of full withdrawal constraint, the HPF savings can only withdraw upon retirement in period $Jr$. The HPF provides a lump-sump income to the household at retirement.

$$\max_{c_j,h_j,a_{j+1}} \sum_{j=1}^{3} \beta^{j-1} U(c_j, h_j)$$

s.t.

$$c_j + h_{j+1} + a_{j+1} = (1-\tau_y)(1-\tau_f) y_j + (1-\delta) h_j + (1+r) a_j, \quad 1 \le j \le Jr - 1 = 2$$

$$c_j + h_{j+1} + a_{j+1} = (1-\tau_y) y_j + \sum_{i=1}^{Jr-1} (1+r)^{Jr-i} \tau_f y_i + (1-\delta) h_j + (1+r) a_j, \quad j = Jr = 3$$

$$a_{j+1} \ge -\gamma h_{j+1}$$

$$c_j, h_{j+1} \ge 0$$

**Economy with HPF Program, Preferential Withdrawal Constraint**

In this economy, the HPF allows for early withdrawals only for housing-related expenses. The withdrawals are therefore bounded by homeowner's housing expenses.

$$\max_{c_j,h_j,a_{j+1}} \sum_{j=1}^{3} \beta^{j-1} U(c_j, h_j)$$

s.t.

$$c_j + h_{j+1} + a_{j+1} = (1-\tau_y)(1-\tau_f) y_j + w_j + (1-\delta) h_j + (1+r) a_j \quad 1 \le j \le Jr - 1 = 2$$

$$c_j + h_{j+1} + a_{j+1} = (1-\tau_y) y_j + \sum_{i=1}^{Jr-1} (1+r)^{Jr-i} (\tau_f y_i - w_i) + (1-\delta) h_j + (1+r) a_j \quad j = Jr = 3$$

$$a_{j+1} \geq -\gamma h_{j+1}$$

$$c_j, h_{j+1} \geq 0$$

where

$$w_j = \sum_{i=1}^{j} (1+r)^{j-i} \tau_f y_i - \sum_{i=1}^{j-1} (1+r)^{j-i} w_i$$

and assuming that

$$w_j \leq h_{j+1} - (1-\delta) h_j$$

‘

Under a full withdrawal constraint, the impact of the HPF program is that it provides an additional lump-sum income which equals to the HPF balance upon retirement. On the other hand, with preferential withdrawal constraint, this lump-sump HPF saving becomes available to be withdrawn upon the period in which the household purchases the housing capital. Since the amount of HPF savings in each period is a small portion of income, this paper assumes that this amount is less than housing expenses, and thus the homeowner is able to withdraw all HPF savings in each period for simplicity.

## 2.4 Parameters

Model parameters are set as the following to illustrate the impact of the HPF.

- model period: $n = 20$ years per period.
- preference:
  - $\theta = 1.25$ preference parameter.

- $\beta = 0.96$.

- Earnings:
  - Normalize $e_1 = 1$
  - $e_2 = e_1 * 2$
  - $\tau_y = 0.25$ income tax

- House Asset:
  - $p = 6$ house price index
  - $\gamma = 0.7$ is the maximum LTV ratio of the mortgage debt.
  - Annual depreciate rate: 0.05. Then $1 - \delta = (1 - 0.05)^n$. Then n-year depreciation rate is $\delta = 1 - (1 - 0.05)^n$ per period, and the value of depreciation is $\delta p$ per house unit.

- Interest rate:
  - Setting interest rate $\tilde{r} = 0.05$ per year. Then the n-year interest rate $(1 + r) = 1.05^n$ per period.

## 2.5 Results

Figure 1 compares the analytical results for the economy with no HPF, the economy with HPF providing tax benefits and no withdrawal constraint, and the economy with HPF which provides tax benefits but also imposes preferential withdrawal constraint.

The blue line represents the economy without the presence of the HPF. The red line shows the economy with HPF providing only tax benefits but no withdrawal constraint. The orange represents the economy with a preferential withdrawal rule. Lifetime utility increases with contribution rate $\tau_f$ in the tax-benefit-only case. After imposing the preferential withdrawal constraint, lifetime utility is still the same as the tax-benefit only case if the withdrawal constraint is not binding. In

this case, the HPF tax benefits is a pure wealth effect. As a result, consumption and housing both increase at the same proportion. Consumption and housing profiles are not affected.

On the other hand, once $\tau_f$ exceeds the optimal level, households contribute more than they optimally plan to save. In this case, the withdrawal constraint is binding, and lifetime utility becomes less than the one with only tax benefits. As a result, in order to relax the withdrawal constraint and maximize utility, agents might intentionally increase their housing expenses so that they can take withdrawals from the HPF accounts before retirement. In this case, consumption and housing profile is distorted, and housing consumption increases at a higher rate than non-housing consumption.

Policymakers could solve for the optimal contribution rates for individuals with different income growth rates. When making regulations, they could require the firms to set contribution rate to be in the range of optimal contribution rates, in order to achieve their policy goals of improving the welfare of individuals.

## 2.6 Concluding Remarks

This paper provides a simple three-period life-cycle model to illustrate the impact of the Chinese HPF on housing demand and welfare. While the tax benefits of HPF is a pure income effect to the participants, the preferential withdrawal constraint might distort households' consumption and housing profile. In both cases, housing demand increases. While it is interesting to extend the model into a multi-period model and calibrate it using macro and micro data, the qualitative results are expected to be similar to this simple model.

# Chapter 3

# Disentangling the Housing Provident Fund Ownership Status and Homeownership in China

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**Chapter Abstract**

This paper investigates the impact of homeownership on the Housing Provident Fund (HPF henceforth) enrollment status in China. The HPF is a retirement savings program combined with features favoring home-related expenses. Homeownership is potentially endogenous as the HPF status might in turn influences households' housing tenure status. To disentangle the causality between the homeownership and HPF status, this paper implements a binary choice model with an endogenous treatment effect variable, where the HPF status is the dependent variable, and homeownership

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is the endogenous treatment variable. Since there is no credible outside instrument variable, the identification strategy relies on the facts that homeownership is nonlinear in age while the HPF ownership rate is close to linear in age. It is found that homeownership causes roughly 27% increase of HPF ownership rate after controlling for other factors. A post-estimation test of endogeneity confirms that the homeownership is indeed endogenous.
Keywords: Homeownership; Taxation; Mortgage Subsidies; Saving Incentives; Retirement.
JEL codes: D1, J3, R2, N9

## 3.1 Introduction

Housing is one of the largest components of household wealth in China. To purchase homes, households have to borrow or accumulate enough savings. While governments in many countries provide support such as mortgage-interest deduction and tax credits to homebuyers, the Chinese government launched the HPF in the early 1990's to assist people to accumulate savings and purchase homes. This program consists of an individual savings account with several unique features. Similar to many retirement savings plans such as 401 (k) or 403 (b) in the U.S., in each month employees contribute a proportion, typically ranging from 5% to 12%, of their monthly into their HPF individual saving accounts. Employers are mandated to match the employee contributions to a certain percentage. These contributions earn interest income at banks' deposit rates, and both contributions and interests are tax-free. However, unlike the other programs, savings in the HPF accounts can be withdrawn prior to retirement as long as the early withdrawals are used for home-related expenses, such as rent, down payments or mortgage payments, home purchases, maintenance, and improvements. Moreover, HPF participants are allowed to borrow against their HPF savings at a subsidized mortgage interest rate, which is around 2% lower than the regular interest rate. Therefore, the HPF is a unique retirement savings program favoring housing expenses. The soaring property prices in China has ignited a debate about whether the HPF has an impact on the housing decision. Does the HPF solely improve housing affordability, or does it affect people's

homeownership decisions and induce higher housing demand? While some people believe that the HPF benefits promote homeownership, others might argue that people do not buy houses because of these benefits. Indeed, homebuyers have to meet several fixed saving goals for their houses, such as minimum downpayment requirement and a series of monthly mortgage payments. Therefore, they might prefer to own the HPF accounts and strategically channel a portion of their savings into them to accelerate savings accumulation and lower borrowing costs. The causal relationship between the homeownership status and HPF status remains an unanswered question.

This paper contributes to the literature by disentangling the causal relationship between the HPF status and homeownership. When investigating the impact of the HPF on homeownership, the HPF ownership is potentially endogenous. First, homeowners are likely to own HPF accounts to take advantage the HPF benefits such as subsidized mortgage loans. Second, there might be confounding factors affecting both households' homeownership and HPF enrollment status. For example, households with sophisticated investment skills or higher levels of financial literacy are likely to be aware of and own the HPF accounts, and in the meanwhile, they are likely to maintain a good financial status and afford homes. Ignoring such potential endogeneity will render the parameter estimates biased. Therefore, rather than study the impact of the HPF on homeownership, this paper takes a step back to investigate the causal effect of homeownership status on HPF status by estimating an endogenous treatment effect model. After taking into account the endogeneity, it is found that homeownership increases the probability of HPF ownership by 23.9% for the group of existing homeowners. If randomly select a household from the entire sample, homeownership increases the probability by 26.9% on average. A post-estimation test of endogeneity is performed to confirms that the homeownership is indeed endogenous. Note that while one could investigate this problem through a structural life-cycle model similar to Chen (2010) and Yang (2009), this type of model generally requires many assumptions to match the data well. The estimation results will provide empirical evidence to support assumptions made in the life-cycle model.

Previous research has studied the economic effects of the HPF. Tang and Coulson (2017) implement a bivariate probit estimation to study the impact of the HPF on homeownership probability

and the probability of owning a small unit. They find that the impact of the HPF on homeownership is significantly positive, and the average size of homes acquired by HPF participants is smaller than otherwise might be, as the HPF mortgage loans impose restrictions on the size of homes. Buttimer et. al (2004) build a utility-based model to study the optimal time for HPF participants to purchase homes after enrolling in the program, as one original policy goal of the HPF was to facilitate the housing privatization reform in China. Chen and Deng (2014) provide a detailed description of the structure and scheme of the Chinese HPF and compares it with various provident fund plans in other countries. The vast majority of previous studies do not explicitly address what determine the HPF status, which is an important issue when estimating the impact of the program. Despite the HPF program is a so-called "mandatory" saving program, eligible employees could opt out if they do not want to save in the program, and firms may not offer the HPF benefits under circumstances such as employees' unawareness of the HPF benefits or a lack of law enforcement. Therefore, instead of treating the program as mandatory and the HPF status as exogenous, this paper maintains that employees play an important role in determining their HPF status. For example, if the employers do not offer the HPF benefits, eligible employees could change jobs with better employment benefits or report their employers to the local Housing Provident Fund Management Centers, (for example, Beijing Housing Fund Management Center manages and oversees the HPF in Beijing), which will punish the firms by imposing a sizable penalty fee. Employers will then have an incentive to offer the HPF benefits if they want to attract new employees, lower turnover rate, and avoid legal penalty. Therefore, employees can indirectly affect their employers' HPF provision and their own HPF status. Treating the HPF status as exogenously determined might bias the estimated effects of the program.

The rest of the paper is organized as follows. Section 2 provides detailed information of the data, empirical facts and institution background of the HPF. Section 3 describes an econometric model which studies the causal effect of homeownership on HPF status and explains the estimation and identification strategy. Section 4 reports the regression results. Section 5 discusses the results and policy implications. And section 6 concludes. The main finding is that the homeowners are

26.9% more likely to own the HPF accounts, after accounting for the potential endogeneity and controlling for other factors.

## 3.2 Institutional Background, Data, and Facts

### 3.2.1 HPF and the Housing Reform in China

Before 1988, the Chinese government claimed full ownership of land and prohibited transactions of private houses. The government provided land and subsidies to state-owned work units, who then built and assigned homes to their employees. Employees were put on a waiting list for homes based on their characteristics such as employment status and connections, and the assigned houses were usually free or highly subsidized (Wang, 2011). However, the old system of distributing homes through the government and work units failed to meet the needs of employees and the fast growth of the economy. By 1978, at least eight million, almost half of urban households, were waiting for homes to be assigned by their work unit. Moreover, employees who were assigned homes may not be satisfied with the conditions of their homes. For example, the average living area per person in the urban area was only 3.6 square meters in 1978. Poor management and maintenance was also a problem due to tenants lack of incentive to spend money on their assigned state-owned houses. To resolve these issues, the Chinese government initiated a housing reform in 1988 to privatize the housing sector and encourage people to purchase homes by themselves.

In order to facilitate the housing market privatization, the government implemented a series of reforms and policies. For example, tenants of state-owned houses were offered the option to purchase their assigned dwellings at very low prices (Wang, 2011). Various financial instruments, such as mortgage loans, were developed to support the urban residents' purchase of houses. Instead of assigning houses as a form of compensations, state-owned enterprises provide rent subsidies their employees, helping them to cope with rising housing expenses. Further, inspired by the Central Provident Fund system in Singapore, the Chinese government developed and launched the Housing Provident Fund program in 1991 to assist retirement savings and promote homeownership.

Upon the end of the privatization, housing has become one of the most critical sectors in the Chinese economy. Average homeownership in the urban cities has achieved around 90% by the year of 2013. Most policies to facilitate the housing reform and encourage homeownership were terminated. For example, the housing rent subsidy was terminated in most cities 2013, and state-owned work units no long assign houses to their employees but instead raise wages or provide compensation to cover costs of purchasing homes. On the other hand, it is unable for the government to immediately abandon the HPF program, given the large sizes of HPF savings and HPF mortgage loans accumulated over the past decade. Due to the enormous rise in property prices in China and the large balance sitting in the HPF accounts, the HPF has become an increasingly important policy tool for policymakers.

In addition to the original goal of promoting savings and homeownership at the formation of the HPF, the government adapts the HPF to the current state of the economy for multiple policy goals, such as improving housing affordability while stabilizing the economy. For instance, to stabilize the value of the currency and promote economic growth, the People's Bank of China (PBC) announces bank deposit and loan interest rates as well as the HPF saving and mortgage loan interest rates for every few months as part of the Chinese monetary policy. The HPF saving interest rates are the same as the deposit rates, but the gap between the borrowing rates of HPF loans and regular loans varies over time. The HPF loans' interest rates are subsidized by the government and typically one to two percent lower than the regular loans' interest rates. Nevertheless, holding other things equal, the default risk on the HPF loans is smaller than regular loans, as only people who contribute HPF for more than six months are allowed to borrow HPF loans, and this group of people usually have stable financial and employment status. Another example of modifying the design of HPF to make it suitable to the current economic conditions is imposing restrictions on the HPF loans with subsidized interest rates to curb speculation in the housing market. First, only one HPF loan at a time is allowed per married couple. Second, there is a maximum amount of loans one could borrow against the HPF savings. This cap of the HPF loans varies across provinces and is closely linked to the local housing prices. For instance, the cap in 2017 is set to be 1.2 million

Chinese yuan for the first home and 0.8 million yuan for the second home per married couple in Beijing, whereas the cap is 0.7 million yuan for the first home in Xi'an. Third, the required down payment of the HPF loans depends on the type of houses. If the home is a first home and under 90 square meters, the required downpayment is 20% of the value of the home. If the home is a first home but larger than 90 square meters, the required downpayment is 30%. If the home is a second home, the downpayment is no less than 60%, and the interest rate charged is also 10% higher than the HPF loan rate. Tang and Coulson (2017) find that HPF owners tend to purchase homes with smaller sizes.

HPF has as become an important policy tool and may shape households' saving, housing and retirement decisions. Since the overall effectiveness of a program may depend on the coverage rate of the program, a natural question arises about what are the determinants of the HPF status. The next subsection provides an overview of the HPF enrollment status.

### 3.2.2 HPF Ownership

The HPF has grown into a sizable social welfare program in terms of the number of participants and balance since its inception in 1991. Firms and work units in urban areas are mandated by the government to provide the HPF benefits to their eligible employees. Participating employers include state-owned enterprises, private enterprises, collective enterprises, and foreign-invested enterprises, etc. According to the annual report released by the Ministry of Housing and Urban-Rural Development of China, in 2016, more than 130.65 million of individuals made contributions into the HPF program, with total annual contributions amounted to 1.66 trillion Chinese yuan. The remaining balance in the program at the end of 2016 was 4.56 trillion yuan, about 6.13 % of the GDP in 2016. On the other hand, despite the HPF is a "mandatory" program, several studies showed that many urban employees are not covered by the program. According to the 2015 Annual Report of China's Social Security, only about 31% of employed people make contributions to the HPF program, and less than one third of employed people enroll in the HPF program in 2015. Ye and Wu (2008) find that the HPF program covered 60 percent of all salaried workers in urban areas

in 2006. This suggests that some eligible employees may not own HPF accounts, and the HPF status is potentially determined by various factors. Figure 2 displays the proportions of employers and employees who made contributions to the HPF in 2016.

While there is no literature look into the determinants of the HPF status, the literature of other types of pension or retirement savings programs has investigated factors affecting the participation of those programs. Some focus on the determinants of participation at the individual employee level. Madrian and Shea (2001) investigate the impact of automatic enrollment on 401 (k) participation and savings decisions by individual employees. Some focus at the firms level. For instance, Tepper (1981) finds that tax structure would have an impact on corporations' decision of pension plan provision and investment policies. Bernheim and Garrett (1996) find that employer-provided financial education increases the probability of 401(k) participation by 11.8%. And Papke (1995) finds that 401(k) participation is 10.2% higher in companies with a 50% match than in companies with no match.This paper uses household-level data, as the HPF is closely linked to housing, one of the major component of household assets.

### 3.2.3 Other Social Welfare Programs in China

The HPF is not the only social welfare program in China, but it is the most special one in terms of its designs and features. The current Chinese social welfare system consists of six major programs known as "Five Insurances, One Fund." "Five Insurances" includes pension, occupational injury insurance, medical insurance, maternity insurance, and unemployment insurance, and "One Fund" is the housing provident fund. The HPF has more flexible withdrawal rules which favors the housing sector compared with other programs. Moreover, households could borrow against their HPF savings, which might amplify the economic effect of each Chinese Yuan saved in the program via leverage. And finally, in most cities, the contribution rate of the HPF is usually the highest among the six programs. Take Beijing as an example, in 2017, the employee contribution rate of the HPF is 12%, pension insurance is 8%, medical insurance is 2%, and others zero percent of the base. These contribution rates are determined by the government. While the central government

sets guidelines of the HPF at the national level, local government administrates specific issues and manage the funds. For example, while the central government suggests the subsidized mortgage interest rate and a range of plausible contribution rates, the local governments set the rates for their own cities each year based on the local economy and housing market conditions.

### 3.2.4 Data and Sample

This paper uses the 2011 wave of the China Household Finance Survey (CHFS) to investigate the impact of homeownership and other household characteristics on the HPF status. The CHFS was launched in 2011 and is collected in every two years by the Southwest University of Finance and Economics in Chengdu, China. The 2011 wave is one-year cross-sectional survey data containing approximately 8,400 households and 29,500 individuals. The survey interviews a large sample of the Chinese population about demographics, assets and debts, occupation, income, expenditure, insurance and social welfare plans, including the HPF program. Sampling weights are provided so that it is a nationally representative survey, and inferences made from the data are inferences of the population. Although the survey emphasizes urban households and interviews more urban households than rural households, this would not be an issue as the HPF is only available to the urban workers. In sum, this survey is suitable for the purpose of this paper.

The original dataset contains 8438 households. Several households are dropped off from the sample. First, following Tang and Coulson (2017), only households with at least one urban Hukou family members are considered. This is because the House Provident Fund is only available to workers with the urban Hukou. This excludes 2185 households in the sample, 25.90% of the original sample. Second, following Tang and Coulson (2017) again, six households whose size of the house is less than 10 square meters are removed. Third, the paper only focuses on households whose heads are in the typical working age or have recently retired. In particular, 115 households with heads' ages less than age 25 and 241 households with heads' ages over 75 are excluded, i.e. about 4% of the original dataset. Households whose heads' ages are less than 25 are not considered, as this group contains outliers that might contaminate the analysis. For example, a

large proportion households below age 25 might not have entered the labor force due to education, thus they are not eligible for the HPF benefits. Although some of them have already worked before, it is hard to find this information from the survey. Moreover, the homeownership rate is extremely high for this group of households. A large portion of homeowners under age 25 receive transfers of homeownership or financial supports for home purchases from their parents, and including them in the analysis might distort the results. Since this group only represents 4% of the sample, it is plausible to exclude them in the sample. Fourth, 423 households who are not eligible for the HPF are removed from the sample. This group is about 5% of the original sample. Non-eligible individuals include those retired before the introduction of the HPF program, those below the minimum working age of 16 at the survey year, and those who have rural Hukou. As long as one member in the household is eligible for the HPF, the entire household is considered as eligible. Fifth, households with missing value of relevant variables for the analysis, such as homeownership and HPF status, are excluded. And last, non-positive income households are dropped from the sample, and bottom and top 1% income households are trimmed. The sample size reduces to 4664. Table 3 reports the summary statistics on household demographics of the full sample.

Since the data set used in this paper is a cross-section, only homeownership and HPF status are observed at a particular point in time, but the status changes are not observed. Therefore, this paper only consider the causal relationship between the states.

### 3.2.5 Facts from the 2011 CHFS

This section documents four stylized facts of the HPF, homeownership and household characteristics using the sample from the 2011 CHFS. Fact 1 compares the number of participants of various saving instruments, including the HPF. Fact 2 documents pattern of percentage of owning the HPF in age household. Fact 3 documents the nonlinear pattern of homeownership rate in age. And Fact 4 compares several major characteristics of households with and without an HPF account. These facts help better understand how large is the HPF program and who might take advantages of the program.

**Fact 1.** The HPF is the fourth largest savings instruments in terms of the number of participants.

Table 4 presents the household ownership rate of various saving instruments using in the sample from the 2011 CHFS dataset. Around 24% eligible households own the HPF accounts in the full sample. The HPF ranks the fourth most important saving tools for the households. About 97% households keep cash and gold, 69% households own bank deposits, and 41% households save in other types of social welfare accounts such as pension and annuity in the sample. Note that since only households who are eligible for the HPF in the 2011 CHFS data set are included, the percentage of households owning the HPF measures the HFP ownership rate condition on eligibility. On the other hand, the percentage of households owning other social welfare accounts should not be interpreted as a measure of ownership rate conditional on the eligibility of other social welfare accounts.

**Fact 2.** The rate of owning HPF accounts decreases with age.

Table 4 reports the age profile of household ownership rates of various savings instruments in the sample. One surprising fact is that the rate of owning HPF accounts decreases with age. Unlike the HPF, the rate of possessing Tax Deferred Accounts such as Individual Retirement Accounts (IRAs) and 401(k)s usually increase with age or job tenure (Joulfaian and Richardson, 2001).

The negative age effect on the HPF ownership rate is consistent with the institution background of the HPF and the housing market development in China. The HPF was formed in 1991 to assist the housing market privation reform. Besides the HPF, the government implemented various policies or programs to encourage homeownership and improve housing affordability within a limited period of time. Thus, households who had already owned homes prior to the launch of the HPF or who enjoyed benefits from other programs would have less incentive to participate in the HPF at that time. For example, tenants of state-owned houses were offered the opportunity to buy either full or partial property rights to their current homes at a highly subsidized price during the reform. Households who had worked for years by that time were likely to have enough savings

to purchase these homes at highly subsidized prices. Not only their demand for HPF loans are low, returns on the HPF savings are also smaller for the households with longer job tenure than the young households, as the number of compounding periods before retirement decreases. Therefore, the value of owning the HPF accounts was smaller for the older generations. On the other hand, households who were young during the reform may miss the opportunity of purchasing subsidized houses if they did not have enough savings or were not employed. These group of households will have stronger desire to participate in the HPF if they plan to purchase homes. Moreover, drastic house-price appreciation since 2003 has made homes less affordable to the younger generations. Since saving or borrowing through the HPF would reduce the cost of purchasing homes, younger households would have strong incentive to participate in the HPF and exploit the benefits. Since only one wave of data is used, the age effect is actually a mix of age effect and cohort effect.

**Fact 3.** The age profile of homeownership displays a hump in China in 2011.

Table 5 documents that the age profile of homeownership rate. Homeownership rate first increases rapidly in age for young households. It peaks around the age of late 50s, then decreases slowly. The turning point is around the age of retirement in China, i.e. retirement age is around 60 for males and around 55 for females in China. This hump-shaped pattern is consistent with intuition and will be utilized as a source of identification, both of which will be explained in greater details in the model and identification section.

**Fact 4.** The average non-housing wealth, value of housing asset and education level are higher for households who own the HPF accounts.

Table 6 reports the heads' median age, average non-housing wealth, value of housing asset, education level and homeownership rate for households with and without an HPF account based on the 2011 CHFS sample. Note that the homeownership rate are very close for the two groups, which might seem a little puzzling. However, the median age is much lower for households with the HPF than without the HPF, and it is possible that younger households have lower homeownership rate

than their older counterparts. Fact 4 only suggests that these variables might be correlated with the HPF status, and the model estimation will control for these household characteristics.

## 3.3 Model Estimation and Identification

This section presents the econometric model and identification strategy. This paper adopts a binary choice model with an endogenous treatment effect indicator, where the dependent variable is HPF status, and the endogenous treatment is homeownership status. This paper wants to study the impact of homeownership on the HPF status. Homeownership status is potentially endogenous, as it could be affected by the HPF status. Therefore, the endogeneity issue is be taken into account in the model and identification, and a post-estimation test of the endogeneity is implemented to examine whether the treatment is endogenous.

In particular, the endogenous treatment-effect model is given by:

$$y_{i0} = E(y_{i0}|\mathbf{x}_i) + \epsilon_{i0}, \tag{3.1}$$

$$y_{i1} = E(y_{i1}|\mathbf{x}_i) + \epsilon_{i1}, \tag{3.2}$$

$$t_i = E(t_i|\mathbf{z}_i) + v_i, \tag{3.3}$$

$$y_i = t_i y_{i1} + (1 - t_i) y_{i0}, \tag{3.4}$$

$$E(\epsilon_{ij}|\mathbf{x}_i) = 0 \text{ for } j \in \{0, 1\}, \tag{3.5}$$

where $y_{i1}$ is the potential HPF enrollment status for homeowners, and $y_{i0}$ is the potential HPF enrollment status for renters. $y_i$ is the observed HPF enrollment status. The treatment $t_i$ is the observed homeownership status, where $t_i = 1$ for homeowners and $t_i = 0$ for renters. $\mathbf{x}_i$ is a group of covariates including information of social, economic, employment and demographic characteristics of the households, and $\mathbf{z}_i$ represent potential instruments.

The endogeneity of treatment $t_i$ comes from the correlation between $v_i$ and $\epsilon_{ij}$ for $j \in \{0, 1\}$.

Following Dong (2010) and Escanciano et. al. (2016), let

$$E(\epsilon_{ij}|t_i) = v_i\beta_{2j} \text{ for } j \in \{0,1\}, \tag{3.6}$$

where $\beta_{2j}$ are unknown constants, and the treatment is endogenous if $\beta_{2j} \neq 0$.

Give the binary nature of $y_{ij}$, the model that we wish to fit is a probit model

$$E(y_{ij}|\mathbf{x}_i, v_i, t_i = j) = \Phi(\mathbf{x'}_i\beta_{1j} + v_i\beta_{2j}), \tag{3.7}$$

where $\Phi$ is the standard normal cumulative distribution function, and $\beta_{1j}$ are unknown constants.

However, there are no credible instruments for the model given the available data. Instead, following Dong (2010) and Escanciano et. al. (2016), this paper utilizes non-linearity of $E(t_i|\mathbf{z}_i)$ with regard to $\mathbf{z}_i$ as a source of identification. In particular, non-linear terms in $\mathbf{x}_i$ can be used as instruments $\mathbf{z}_i$. Denote $\mathbf{z}_i = \mathbf{x}_i^*$, where $\mathbf{x}_i^*$ includes the original $\mathbf{x}_i$'s as well as powers of $\mathbf{x}_i$ ($age^2$ as seen in Figure 3 below).

The parameters of (3) and (7), the average treatment effect, $\tau_{\text{ATE}} \equiv E[y_{i1} - y_{i0}]$, the average treatment effect on the treated, $\tau_{\text{ATET}} \equiv E[y_{i1} - y_{i0}|t_i = 1]$, and the potential-outcome means, $\bar{\tau} \equiv E[y_{i0}]$, are estimated using the Generalized Method of Moments (GMM). For example, denote $n^* = \sum_{i=1}^{n} h_i$, where $h_i$ represents the sampling weight of the $i$th observation in the survey, and denote $\widetilde{\mathbf{x}}_i \equiv [\mathbf{x}_i', \hat{v}_i]'$.

The empirical moment conditions in the GMM estimation are given by:

$$\frac{1}{n^*}\sum_{i=1}^{n} t_i\widetilde{\mathbf{x}}_i\Big[y_i\frac{\phi(\mathbf{x'}_i\widehat{\beta}_{1j}+\widehat{v}_i\widehat{\beta}_{2j})}{\Phi(\mathbf{x'}_i\widehat{\beta}_{1j}+\widehat{v}_i\widehat{\beta}_{2j})}-(1-y_i)\frac{\phi(\mathbf{x}_i'\widehat{\beta}_{1j}+\widehat{v}_i\widehat{\beta}_{2j})}{\Phi(\mathbf{x}_i'\widehat{\beta}_{1j}+\widehat{v}_i\widehat{\beta}_{2j})}\Big]h_i = 0, \tag{3.8}$$

$$\frac{1}{n^*}\sum_{i=1}^{n} (1-t_i)\widetilde{\mathbf{x}}_i\Big[y_i\frac{\phi(\mathbf{x}_i'\widehat{\beta}_{1j}+\widehat{v}_i\widehat{\beta}_{2j})}{\Phi(\mathbf{x}_i'\widehat{\beta}_{1j}+\widehat{v}_i\widehat{\beta}_{2j})}-(1-y_i)\frac{\phi(\mathbf{x}_i'\widehat{\beta}_{1j}+\widehat{v}_i\widehat{\beta}_{2j})}{\Phi(\mathbf{x}_i'\widehat{\beta}_{1j}+\widehat{v}_i\widehat{\beta}_{2j})}\Big]h_i = 0, \tag{3.9}$$

$$\frac{1}{n^*}\sum_{i=1}^{n} \mathbf{x}_i^*\left\{t_i\frac{\phi(\mathbf{x}_i^{*\prime}\widehat{\pi})}{\Phi(\mathbf{x}_i^{*\prime}\widehat{\pi})}-(1-t_i)\frac{\phi(\mathbf{x}_i^{*\prime}\widehat{\pi})}{1-\Phi(\mathbf{x}_i^{*\prime}\widehat{\pi})}\right\}h_i = 0, \tag{3.10}$$

$$\frac{1}{n^*}\sum_{i=1}^{n} \left\{\Phi(\mathbf{x}_i^{'}\widehat{\beta}_{10}+\widehat{v}_i\widehat{\beta}_{20})-\widehat{\bar{\tau}}\right\}h_i = 0, \tag{3.11}$$

$$\frac{1}{n^*}\sum_{i=1}^{n} \left\{\Phi(\mathbf{x'}_i\widehat{\beta}_{11}+\widehat{v}_i\widehat{\beta}_{21})-\widehat{\bar{\tau}}-\widehat{\tau}_{\text{ATE}}\right\}h_i = 0, \tag{3.12}$$

and similarly for $\tau_{\text{ATET}}$.

There are two sources of non-linearity that could be used for identification. The first source is that the propensity score, $E(t_i|\mathbf{x}_i^*) = \Phi(\mathbf{x}_i^{*\prime}\pi)$, is a standard normal cumulative distribution function, which is monotonic and nonlinear over a large support. The second source of non-linearity is that the covariates of the treatment equation, $\mathbf{x}_i^*$, contain a quadratic term, $age^2$, as justified by Figure 3 below.

The identification strategy provided by Escanciano et. al. (2016) requires two sufficient conditions: there is at least one continuous covariate in $\mathbf{x}_i^*$ and the function $\mathbf{x}_i^{*\prime}\pi$ has large support on the real line. In the model, the covariate, $age_i$, is continuous and have large support. In addition, the function $\mathbf{x}_i^{*\prime}\pi$ includes covariate such as $age_i$ and the natural logarithm of total household financial assets $\log(wealth)_i$, which all have large support on the entire real line by definition.

To see why the sufficient conditions guarantees that identification hold, take equation (8) as an example. Combining equation (3) and the propensity score yields an estimator $\widehat{v}_i = t_i - \Phi(\mathbf{x}_i^{*\prime}\widehat{\pi})$. Plug $\widehat{v}_i$ into equation (8), then the argument in the parentheses of the standard normal becomes $t_i\widehat{\beta}_{2j} + \mathbf{x}_i'\widehat{\beta}_{1j} - \Phi(\mathbf{x}_i^{*\prime}\widehat{\pi})\widehat{\beta}_{2j}$.

It is impossible to distinguish between parameters $\widehat{\beta}_{1j}$ and $\widehat{\beta}_{2j}$ if the function $t_i - \Phi(\mathbf{x}_i^{*\prime}\widehat{\pi})$ is a linear combination of $\mathbf{x}_i$. However, the monotonic standard normal cumulative distribution

function is nonlinear if the arguments $\mathbf{x}_i^{*\prime}\widehat{\pi}$ have large support on the real line, and the argument $\mathbf{x}_i^{*\prime}\widehat{\pi}$ also contains a quadratic term of $age_i$, one of the covariates in $\mathbf{x}_i$. These two sources of nonlinearities help identify the parameters of linear component, $\widehat{\beta}_{1j}$, and the parameter of the nonlinear component, $\widehat{\beta}_{2j}$, in equation (8). This identification strategy also applies to the other GMM equations.

To check the identifying assumptions using the sample, Ordinary Least Squares (OLS) regressions are done to study the effects of $age$ on the homeownership dummy and the HPF status dummy. The top panel of Figure 3 shows the impacts of age on homeownership rate and HPF ownership rate, and the bottom panel shows the impacts of age group. Households are divided into subgroups by heads' age in five-year bins from age 25 to 74, and each group is marked by the smallest age of the group. For example, age group 25 includes households with heads' age between 25 and 29. From the Figure 3 , the age profile of homeownership rate displays a hump, with a peak around the age of late 50s, while the age profile of HPF status is closed to linear. The downward slope of the HPF status curve illustrates that as age increases, the HPF ownership rate decreases. The impacts of age group show similar patterns. The nonlinearity in homeownership rate over age suffices us to identify the parameters.

The downward sloping trend of HPF ownership rate over age is explained in Fact 2. And the hump-shaped pattern of homeownership in age is documented in Fact 3. Chambers et. al. (2009) document similar hump-shaped pattern of homeownership rate in age for the U.S. in 1994. This hump shape pattern of homeownership rate is consistent with economic intuition and is closely linked to the life-cycle hypothesis (LCH). The LCH assumes that individuals intend to smooth consumption over the life-cycle and are forward-looking. According to the LCH, individuals save when they earn and dis-save when they are retired, and wealth displays a hump over the life cycle. Housing is one of the major components of household wealth and an important savings mechanism in many countries. For instance, housing asset is 40.7% of household wealth in China, whereas it is 32.3% in the U.S. in 2011 (Gan, 2013). Due to the lack of a mature financial system in China, households tend to allocate a large portion of their savings into housing. Homeowners purchase

houses when they earn and may liquidate their housing equity after retirement. The homeownership rate for young households are relative low as they are probably financially constrained and not able to borrow mortgage loans. As age increases, households gradually accumulate enough savings to acquire homes. The homeownership rate peaks around the age of late 50's in China in Figure 3. When getting older, households retire and dis-save. Some of them might liquidate their housing equity to fund retirement or for medical reasons (Venti and Wise, 2004). However, there are no financial instruments such as reverse mortgage loans which allow households to transfer illiquid housing asset into liquid cash without changing the homeownership status in China. Therefore, some households have to sell their homes and the homeownership rate slightly decreases for the old ages. In addition, as an alternative of selling homes on the market, Chinese households might transfer homes to their children for both altruism and exchange motives. For instance, some parents transfer homes to their children to increase the attractiveness of the children on the marriage market in China. Besides, insufficient pension or medical insurance coverage for the old cohorts in China might leaves the burden of funding retirement to the retirees themselves or their family members. Therefore, elderly parents may transfer the houses to their children in exchange for financial support and partly insurance against potentially high health expenditure.

## 3.4 Results

The definitions and summary statistics of all original covariates are presented in Table 3 above. For the model estimation, several covariates are transformed to replace the original ones. In particular, a new variable 'Education' is created to replace the original variable 'Edu' by recategorizing eduction attainments into three groups: less than high school, high school, and college or more. Moreover, instead of using wealth, natural logarithm of wealth is used in the estimation. The summary statistics of the new variables are reported in Table 7 .

Tables 8-11 report the regression results of the model. Two model specifications are reported. The first model specification is assuming the treatment is exogenous and is estimated using inverse-

probability weighted regression-adjustment (IPWRA) estimators. The second model is endogenous treatment with robust error and is estimated using GMM estimators. Tables 8-11 are outcomes from the same estimations but represent different components of the model. In particular, Table 8 reports the estimated average treatment effect, $\widehat{\tau}_{\text{ATE}}$, and the estimated average treatment effect on the treated group, $\widehat{\tau}_{\text{ATET}}$. Table 9 in the appendix reports the estimated regression adjustment coefficients for both control group (renters) and treated group (homeowners) and the estimated treatment equation coefficients from the average treatment effect estimations for both models. And Table 11 in the appendix reports the estimation results for the average treatment effect on the treated model for both models.

Model I shows the results if we ignore the potential endogeneity of the homeownership decision. The estimated average treatment effect is 1.41% and the estimated average treatment effect on the treated is 1.2% in model I, and neither estimated effect is significant. On the other hand, model II assumes that there is some unobservable factor that affects both homeownership and the HPF status, and the homeownership is endogenous. Under model II, the estimated average treatment effect is 26.9%, suggesting that the average HPF ownership rate is 26.9% higher when all households are homeowners than if they were renters. The estimated average treatment effect on the treated is 23.9%, suggesting that for the particular group of existing homeowners, the average HPF ownership rate is 23.9% higher than if non of them are homeowners. Both estimated effects are significant. In magnitude, the estimated effects in the exogenous treatment effect model are much less than the ones that allows for endogenous treatment assignment. This is because the treatment variable, homeownership, is potentially correlated with unobservables factors that also affects the HPF status. As a consequence, part of the estimated treatment effect are taken aways from the unobserved error terms in the exogenous treatment effect model. After disentangling the endogeneity in model II, the treatment effect of homeownership becomes much larger.

Endogeneity could arise if there are unobservable factors that determine HPF status are correlated with the homeownership decision. A post-estimation Wald test of endogeneity is performed for model II. The null hypothesis of the test, $H_0$, is that the unobservables of the treatment as-

signment and potential-outcome models are uncorrelated. If there is no correlation between the unobservables, then there is no endogeneity. From Table 8, the test result rejects the null hypothesis of no endogeneity. This suggests that unobservable factors that determines HPF enrollment status also affect the decision of homeownership. Therefore, the estimated treatment effect parameter in model I is potentially misleading.

Some intuition behind the large treatment effect of homeownership on HPF status is warranted. First, renters might be currently financially constraint. If they expect an increase in future income, they are likely to smooth their consumption over the life cycle by saving less or delay the purchase of homes in the current period. Therefore, they are less likely to own HPF savings accounts. Second, prior to 2014, the HPF benefits are only available to the cities where the HPF savings are made. However, households usually rent because they have not decided which city to purchase homes and live in the future. For example, many young households might relocate to different cities. If they move, they would not be able to take early withdrawals and subsidized mortgage loans in the new cities. Therefore, renters usually wait and see, and they are less likely to own the HPF accounts due to the geographic limitation of the benefits until they settle down. On the other hand, homeowners are more likely to have the HPF accounts. Homeowners enjoy greater benefits from the HPF than renters if they borrow the HPF loans with subsidized interest rate. Besides, homeowners may be more aware of the benefits of the HPF. Homeowners usually commit to pay monthly mortgage loans. While renters are able to allocate their consumption and savings in a relatively flexible manner, homeowners have to fulfill a series of fixed saving goals. Without the HPF, people acquire homes by directly using their savings or borrowing from the bank. With the presence of the HPF, homebuyers are able to channel their savings into houses through their HPF accounts and borrow HPF loans, which help homebuyers achieve the saving goals more easily and lower borrowing costs. Thus, homeowners have much higher probability to own the HPF accounts than renters.

## 3.5 Discussion

Housing is one of the major components of wealth for homebuyers. While the HPF may shape people's homeownership status, the effectiveness of the program could be affected by people's housing tenure status due to an endogeneity issue. The literature has been silent about whether HPF accounts ownership causes people to own homes or vice versa. This paper contributes to the literature by disentangling the causal effect of homeownership on HPF status by exploiting the nonlinearility of homeownership in age. The results show that homeowners are about 27% more likely to own HPF accounts, and the effect is statistically significant. The findings shed light on the design of retirement saving programs, such as the 401(K) and other tax-deferred retirement saving programs. People's demand for a certain type of assets or savings instruments will increase the probability of owning the retirement accounts which offers incentives in favor of such assets.

## 3.6 Concluding Remarks

This paper disentangles the causal effect of HPF status and homeownership by households in China using an endogenous treatment effect model. Identification is achieved using the method proposed by Dong (2011) and Escanciano (2016), in particular, the linear relationship between HPF ownership rate and age and the nonlinear relationship between homeownership and age help identify and estimates the parameters. The main result shows that homeownership corresponds to 26.9% increase in HPF ownership rate, which is significant. This paper does not study the impact of the HPF on homeownership rate or housing consumption due to data limitations. Other interesting and relevant questions include what is the impact of the HPF on wealth distribution, or does the HPF substitutes other forms of savings such as back deposits, stocks, and bonds? Both questions are beyond the scope of this paper, and the author will leave them to future studies.

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## Appendix A. Tables

Table 1: Literature by Topics.

| Saving | Retirement and Savings Program | Housing |
|---|---|---|
| | Non-China | |
| Ando and Modigliani (1963) | Parke and Wooldridge (1993) | Engelhart (1997) |
| Kotlioff (1988) | Papke (1995) | Gervais (2002) |
| Skinner (1988) | Poterba et al. (1996) | Cocco (2004) |
| Modigliani (1988) | Imrohoroglu et al. (1998) | Campbell and Cocco (2005) |
| Deaton (1991) | Joulfaian and Richardson (2001) | Yang (2009) |
| Ayagari (1994) | Madrian and Shea (2001) | Chambers et al. (2009) |
| Browing and Lusardi (1996) | Munnell and Sunden (2001) | Chen (2010) |
| Carroll (1997) | Munnell et al. (2001) | Attanasio et al. (2012) |
| Kazarosian (1997) | Duflo and Saez (2002) | Halket et al. (2014) |
| Browing and Crossley (2001) | Benjamin (2003) | Sommer and Sullivan (2018) |
| | Chernozhukov and Hansen (2004) | |
| | Sethi-Iyengar et al. (2004) | |
| | Scholz et al. (2006) | |
| | Gomes et al. (2009) | |
| | Chen (2010) | |
| | Gouskova et al. (2010) | |
| | Bucher-Koenen and Lusardi (2011) | |
| | Fornero and Monticone (2011) | |
| | Klapper and Panos (2011) | |
| | Ho (2017) | |
| | China | |
| Modigliani and Cao (2004) | Song et al. (2015) | Buttimer Jr (2004) |
| Chamon and Prasad (2010) | Chapter 2 | Burell (2006) |
| Wei and Zhang (2011) | | Fan et al. (2007) |
| Curtis et al. (2015) | | Wang (2011) |
| | | Chen and Deng (2014) |
| | | Du and Zhang (2015) |
| | | Fu et al. (2016) |
| | | Tang and Coulson (2016) |
| | | Chen and Wen (2017) |
| | | Garriga et al. (2017) |
| | | Xu (2017) |
| | | Chapter 3 |

Table 2: Literature by Methodologies.

| Empirical Studies | | |
|---|---|---|
| Non-China | | China |
| Ando and Modigliani (1963) | Joulfaian and Richardson (2001) | Buttimer Jr (2004) |
| Kotlioff (1988) | Munnell and Sunden (2001) | Burell (2006) |
| Lusardi (1998) | Munnell et al. (2001) | Fan et al. (2007) |
| Modigliani (1988) | Duflo and Saez (2002) | Chamon and Prasad (2010) |
| Skinner (1988) | Benjamin (2003) | Wang (2011) |
| Parke and Wooldridge (1993) | Chernozhukov and Hansen (2004) | Wei and Zhang (2011) |
| Papke (1995) | Sethi-Iyengar et al. (2004) | Chen and Deng (2014) |
| Browing and Lusardi (1996) | Campbell and Cocco (2005) | Du and Zhang (2015) |
| Poterba et al. (1996) | Chambers et al. (2009) | Fu et al. (2016) |
| Engelhart (1997) | Gouskova et al. (2010) | Tang and Coulson (2016) |
| Kazarosian (1997) | Bucher-Koenen and Lusardi (2011) | Xu (2017) |
| Browing and Crossley (2001) | Fornero and Monticone (2011) | Chapter 3 |
| Madrian and Shea (2001) | Klapper and Panos (2011) | |

| Theoretical/Macro Studies | | |
|---|---|---|
| Non-China | | China |
| Deaton (1991) | Gomes et al. (2009) | Modigliani and Cao (2004) |
| Ayagari (1994) | Yang (2009) | Chen (2010) |
| Carroll (1997) | Chen (2010) | Curtis et al. (2015) |
| Imrohoroglu et al. (1998) | Attanasio et al. (2012) | Song et al. (2015) |
| Gervais (2002) | Halket et al. (2014) | Chen and Wen (2017) |
| Cocco (2004) | Ho (2017) | Garriga et al. (2017) |
| Scholz et al. (2006) | Sommer and Sullivan (2018) | Chapter 2 |

Table 3: Summary Statistics on Household Demographics from 2011 CHFS.

| Variables | Mean | Std. | Definition |
|---|---|---|---|
| *hpf* | .24 | .43 | HPF enrollment dummy. HPF=1 if a household participates in the HPF, otherwise HPF=0. |
| *own* | .91 | | Homeownership dummy. Own=1 for home owners, and Own=0 for renters. |
| *age* | 48 | | Median age of the household heads. |
| *married* | 0.90 | | The fraction of married households. Marriage status is categorical: 0-single, 1-married, 2-other (divorced, separated). |
| *edu* | 3.83 | 1.79 | Categories for education: 1-no school, 2-elementary, 3-middle-school, 4-high school, 5-junior skill school, 6-associate degree, 7-4-year college, 8-master graduate,9-doctoral graduate. |
| *kids* | 0.76 | 0.76 | Number of kids. |
| *liv* | 3.52 | 1.55 | Number of people living together. |
| *emp* | 1.93 | 1.32 | Number of people employed in the household. |
| *leader* | 0.058 | 0.27 | Number of people in the household that hold leadership position in government, party organizations, enterprises and other entities. |
| *owner_agr* | 0.27 | 0.44 | Owner of an agricultural business:1-yes,0-no |
| *owner_indu* | 0.14 | 0.35 | Owner of an industrial business:1-yes,0-no. |
| *localp* | 0.74 | 0.27 | Fraction of people in the household having local registered hukou. |
| *ruralp* | 0.29 | 0.34 | Fraction of people in the household having rural registered hukou. |
| *wusoe* | 0.11 | 0.36 | Number of people in the household employed by state-owned enterprises. |
| *wugov* | 0.050 | 0.24 | Number of people in the household employed by the government. |
| *wealth* | 8.18 | 24.66 | Total household financial assets excluding real estate in 2010 (in 10,000 RMB) |
| *n* | 4,664 | | Sample size |

Table 4: Household Ownership Rates of Saving Instruments (Unit: Percentage).

| Age Group | Cash | Deposits | Social Welfare | HPF | Stock | Fund | Others |
|---|---|---|---|---|---|---|---|
| 25-29 | 98 | 75 | 50 | 38 | 10 | 8 | 2 |
| 30-34 | 98 | 74 | 51 | 45 | 22 | 10 | 2 |
| 35-39 | 97 | 72 | 49 | 37 | 19 | 9 | 2 |
| 40-44 | 97 | 72 | 47 | 35 | 16 | 8 | 2 |
| 45-49 | 96 | 66 | 44 | 31 | 13 | 6 | 2 |
| 50-54 | 95 | 66 | 37 | 26 | 13 | 6 | 1 |
| 55-59 | 98 | 64 | 34 | 18 | 9 | 4 | 1 |
| 60-64 | 97 | 66 | 31 | 6 | 10 | 5 | 1 |
| 65-69 | 97 | 68 | 30 | 6 | 6 | 3 | 1 |
| 70-74 | 95 | 71 | 18 | 3 | 8 | 7 | 1 |
| Full Sample | 97 | 69 | 41 | 24 | 13 | 7 | 2 |

Note: (a) Cash includes cash holdings and value of gold holdings. (b) Social welfare includes savings in three social welfare accounts other than the HPF account, i.e. basic social welfare, new rural social welfare, and annuity. (c) Others include foreign assets, bonds, derivatives, trusts, brokerages, etc.

Table 5: Homeownership by Age.

| Age Group | Homeownership Rate |
|---|---|
| 25-29 | 0.66 |
| 30-34 | 0.88 |
| 35-39 | 0.90 |
| 40-44 | 0.93 |
| 45-49 | 0.94 |
| 50-54 | 0.92 |
| 55-59 | 0.96 |
| 60-64 | 0.93 |
| 65-69 | 0.90 |
| 70-74 | 0.89 |
| Full Sample | 0.90 |

Note: (a) Data source: 2011 CHFS. (b) Full sample size is 4664.

Table 6: Household Characteristics by HPF Status.

| | Median age | Edu | Wealth | Homeownership rate | Housing asset |
|---|---|---|---|---|---|
| $hpf = 0$ | 51 | 3.30 | 5.11 | .90 | 5.11 |
| | | (1.43) | (18.39) | (.29) | (18.39) |
| $hpf = 1$ | 42 | 5.51 | 17.95 | 0.89 | 17.95 |
| | | (1.81) | (37.86) | (.33) | (37.86) |

Note: (a) *hpf*=0 if the household does not participates in the HPF program, and *hpf*=1 if at least one family member in the household participates in the HFP program. (b) The unit is 10,000 RMB for wealth. (c) Standard deviations are provided in parentheses.

Table 7: Descriptive Statistics of Transformed Variables.

| Variables | Mean | Std. | Definition |
|---|---|---|---|
| $education$ | 1.57 | .70 | Categories for education:<br>1-less than high school,<br>2-high school,<br>3-college or more. |
| $age^2$ | - | - | Square of age. |
| $\log(wealth)$ | 9.51 | 2.18 | Natural logarithm of total household financial assets excluding real estate (in 10,000 RMB) in 2010. |
| $n$ | 4,664 | | Sample size. |

Note: (a) Data source: 2011 CHFS.

Table 8: Treatment Effect.

| | I. Exogenous | II. Endogenous |
|---|---|---|
| $\widehat{\tau}_{\text{ATE}}$ | 0.0141 | 0.269*** |
| | (0.0219 ) | (0.0185) |
| $\widehat{\tau}_{\text{ATET}}$ | 0.0120 | 0.239*** |
| | (0.225588 ) | (0.00933) |
| $n$ | 4,664 | 4,664 |
| **Test of endogeneity- $\tau_{\text{ATE}}$** | | |
| $\chi^2(2)$ statistics | - | 11.68 |
| p-value | - | 0.0029 |

Note: (a) Dependent variable: HPF status. Treatment variable: Homeownership dummy. (b) Average Treatment Effect $\tau_{\text{ATE}} \equiv E[y_{i1} - y_{i0}]$. (c) Average Treatment Effect on the Treated $\tau_{\text{ATET}} \equiv E[y_{i1} - y_{i0}|t_i = 1]$. (c) Model I, the exogenous treatment effect model, is estimated using inverse-probability weighted regression-adjustment (IPWRA) estimators. (d) Standard errors are provided in parentheses. * p<0.05, ** p<0.01, *** p<0.001, where p are p-values.

Table 9: Regression Adjustment (RA) and Treatment Assignment Estimates for $\tau_{\text{ATE}}$.

| | I. Exogenous-RA | | II. Endogenous-RA | | Treatment |
|---|---|---|---|---|---|
| | Renters | Homeowners | Renters | Homeowners | Assignment |
| *age* | -0.0510*** | -0.0244*** | -0.0571*** | -0.0297*** | 0.124*** |
| | (0.0130) | (0.00418) | (0.0158) | (0.00532) | (0.0256) |
| $age^2$ | - | - | - | - | -0.00112*** |
| | - | - | - | - | (0.000254) |
| *married* | 0.176 | 0.250 | -0.474 | 0.159 | 0.0551 |
| | (0.375) | (0.140) | (0.328) | (0.158) | (0.122) |
| *kids* | 0.0829 | -0.153 | -0.300 | -0.247* | 0.189 |
| | (0.276) | (0.0956) | (0.333) | (0.106) | (0.0967) |
| *liv* | -0.0246 | -0.0466 | -0.0858 | -0.0467 | 0.0197 |
| | (0.147) | (0.0421) | (0.147) | (0.0450) | (0.0485) |
| log(*income*) | .251** | 0.0669 | 0.184 | -0.00463 | 0.167*** |
| | (0.114) | (0.0466) | (0.146) | (0.0547) | (0.0462) |
| log(*wealth*) | 0.302*** | 0.179*** | 0.205** | 0.162*** | 0.0455* |
| | (0.0787) | (0.0227) | (0.0738) | (0.0256) | (0.0229) |
| *emp* | -0.205 | 0.164*** | -0.0571 | 0.101 | 0.174*** |
| | (0.203) | (0.0438) | (0.210) | (0.0536) | (0.0468) |
| *wusoe* | 0.575 | 1.142*** | 1.117** | 1.078*** | 0.0981 |
| | (0.339) | (0.150) | (0.357) | (0.158) | (0.0983) |
| *wugov* | 1.030 | 0.344** | 0.794 | 0.340* | -0.0606 |
| | (0.665) | (0.133) | (0.562) | (0.142) | (0.144) |
| *leader* | 0.0756 | 0.492* | -0.395 | 0.366 | 0.545*** |
| | (0.442) | (0.216) | (0.552) | (0.221) | (0.139) |
| *owner_agr* | 0.627 | -0.0616 | 0.571 | -0.188 | 0.682*** |
| | (0.566) | (0.160) | (0.775) | (0.163) | (0.151) |
| *owner_indu* | -0.662 | -0.619*** | -1.369* | -0.649*** | -0.0117 |
| | (0.482) | (0.110) | (0.549) | (0.118) | (0.146) |
| *localp* | 1.204* | -0.0264 | -0.117 | -0.221 | 0.296 |
| | (0.541) | (0.206) | (0.606) | (0.229) | (0.198) |
| *ruralp* | -2.387** | -1.806*** | -3.273*** | -1.751*** | 0.129 |
| | (0.738) | (0.246) | (0.978) | (0.244) | (0.215) |
| *constant* | -4.555** | -2.549*** | -1.991 | -0.736 | -4.828*** |
| | (1.464) | (0.505) | (1.816) | (0.859) | (0.723) |
| *n* | 4,664 | 4,664 | 4,664 | 4,664 | 4,664 |

Note: (a) Renters are the control group and homeowners are the treated group. (b) Model I is estimated using inverse-probability weighted regression-adjustment (IPWRA) estimators. (c) Estimated coefficients in treatment equations are the same for both models. (d) Education and regions are controlled for but not included in this output table. (e) Survey sampling weights are applied in all estimations. (e) Standard errors are provided in parentheses. * p<0.05, ** p<0.01, *** p<0.001, where p stands for p-values.

Table 10: Regression Adjustment (RA) and Treatment Assignment Estimates for $\tau_{\text{ATET}}$.

| | I. Exogenous-RA | | II. Endogenous-RA | | Treatment |
|---|---|---|---|---|---|
| | Renters | Homeowners | Renters | Homeowners | Assignment |
| *age* | -0.0537*** | -0.0244*** | -0.0571*** | -0.0297*** | 0.124*** |
| | (0.0141) | (0.00422) | (0.0158) | (0.00532) | (0.0256) |
| $age^2$ | - | - | - | - | -0.00112*** |
| | - | - | - | - | (0.000254) |
| *married* | 0.254 | 0.277* | -0.474 | 0.159 | 0.0551 |
| | (0.408) | (0.140) | (0.328) | (0.158) | (0.122) |
| *kids* | 0.107 | -0.166 | -0.300 | -0.247* | 0.189 |
| | (0.286) | (0.0953) | (0.333) | (0.106) | (0.0967) |
| *liv* | -0.0339 | -0.0432 | -0.0858 | -0.0467 | 0.0197 |
| | (0.152) | (0.0418) | (0.147) | (0.0450) | (0.0485) |
| log(*income*) | 0.284* | 0.599 | -0.184 | -0.00463 | 0.0167*** |
| | (0.124) | (0.0459) | (0.146) | (0.0547) | (0.0462) |
| log(*wealth*) | 0.307*** | 0.180*** | 0.205** | 0.162*** | 0.0455* |
| | (0.0845) | (0.0226) | (0.0738) | (0.0256) | (0.0229) |
| *emp* | -0.228 | 0.150*** | -0.0571 | 0.101 | 0.174*** |
| | (0.207) | (0.0434) | (0.210) | (0.0536) | (0.0468) |
| *wusoe* | 0.548 | 1.131*** | 1.117** | 1.078*** | 0.0981 |
| | (0.342) | (0.152) | (0.357) | (0.158) | (0.0983) |
| *wugov* | 1.019 | 0.327* | 0.794 | 0.340* | -0.0606 |
| | (0.678) | (0.134) | (0.562) | (0.142) | (0.144) |
| *leader* | 0.124 | 0.486* | -0.395 | 0.366 | 0.545*** |
| | (0.444) | (0.214) | (0.552) | (0.221) | (0.139) |
| *owner_agr* | 0.568 | -0.0824 | 0.571 | -0.188 | 0.682*** |
| | (0.572) | (0.158) | (0.775) | (0.163) | (0.151) |
| *owner_indu* | -0.628 | -0.644*** | -1.369* | -0.649*** | -0.0117 |
| | (0.489) | (0.108) | (0.549) | (0.118) | (0.146) |
| *localp* | 1.363* | -0.0102 | -0.117 | -0.221 | 0.296 |
| | (0.595) | (0.204) | (0.606) | (0.229) | (0.198) |
| *ruralp* | -2.232** | -1.740*** | -3.273*** | -1.751*** | 0.129 |
| | (0.743) | (0.243) | (0.978) | (0.244) | (0.215) |
| *constant* | -4.974** | -2.500*** | -1.991 | -0.736 | -4.828*** |
| | (1.594) | (0.505) | (1.816) | (0.859) | (0.723) |
| *n* | 4,664 | 4,664 | 4,664 | 4,664 | 4,664 |

Note: (a) Renters are the control group and homeowners are the treated group. (b) Model I is estimated using inverse-probability weighted regression-adjustment (IPWRA) estimators. (c) Estimated coefficients in treatment equations are the same for both models. (d) Education and regions are controlled for but not included in this output table. (e) Survey sampling weights are applied in all estimations. (e) Standard errors are provided in parentheses. * p<0.05, ** p<0.01, *** p<0.001, where p stands for p-values.

Table 11: Marginal Effects of the Exogeneous and Endogenous Treatment Models.

| | Exogenous Treatment Model | | Endogenous Treatment Model | |
|---|---|---|---|---|
| | Outcome Dep. Var.: $hpf$ | Treatment Dep. Var.: *own* | Outcome Dep. Var.: $hpf$ | Treatment Dep. Var.: *own* |
| own | .0493 | | .372 | |
| | .0265 | | (.0436) | |
| *age* | -.00484 | .0131 | -.00576 | .00134 |
| | (.000741) | (.00292) | (.000779 ) | (.000350 ) |
| *married* | .0460 | .00580 | .0237 | .00438 |
| | (.0255) | (.0128) | (.0258 ) | (.00970 ) |
| *kids* | -.0254 | .0199 | -.0395 | .0150 |
| | (.0179) | (.0103) | (.0183 ) | (.00778) |
| *liv* | -.00986 | .00208 | -.0115 | .00157 |
| | (.00793) | (.00508) | (.00827 ) | (.00386 ) |
| log(*income*) | .0112 | .0176 | .000406 | .0133 |
| | (.00833) | (.00491) | (.00876) | (.00379 ) |
| log($wealth$) | .0373 | .00480 | .0325 | .00362 |
| | (.00446) | (.00238) | (.00468 ) | (.00184) |
| *emp* | .0300 | .01828 | .0169 | .0138 |
| | (.00817) | (.00491) | (.00924 ) | (.00389) |
| *wusoe* | .224 | .0103 | .220 | .00780 |
| | (.0323) | (.0105) | (.0305 ) | (.00791 ) |
| *wugov* | .0664 | -.00638 | .0690 | -.00481 |
| | (.0255) | (.0152) | (.0264) | (.0115) |
| *leader* | .0938 | .0573 | .0908 | .04329 |
| | (.0417) | (.0153) | (.0411) | (.0118 ) |
| *owner_agr* | -.0115 | .0718 | -.0438 | .0542 |
| | (.0305) | (.0153) | (.0312 ) | (.0117) |
| *owner_indu* | -.130 | -.00123 | -.131 | -.000928 |
| | (.0220) | (.0153) | (.0221) | (.0116) |
| *localp* | .0242 | .0312 | -.0149 | .0235 |
| | (.0372) | (.0212) | (.0389) | (.0161 ) |
| *ruralp* | -.352 | .0135 | -.350 | .0102 |
| | (.0437) | (.0228) | (.0433 ) | (.0173 ) |
| *n* | 4,664 | 4,664 | 4,664 | 4,664 |

Note: (a)Marginal effects of the outcome model and treatment model in both exogenous and endogenous treatment model are reported. (b) Education and regions are controlled for but not included in this output table. (c) Survey sampling weights are applied in all estimations. (d) Standard errors are provided in parentheses. * p<0.05, ** p<0.01, *** p<0.001, where p stands for p-values.

## Appendix B. Figures

Figure 1: Welfare by Contribution Rate.

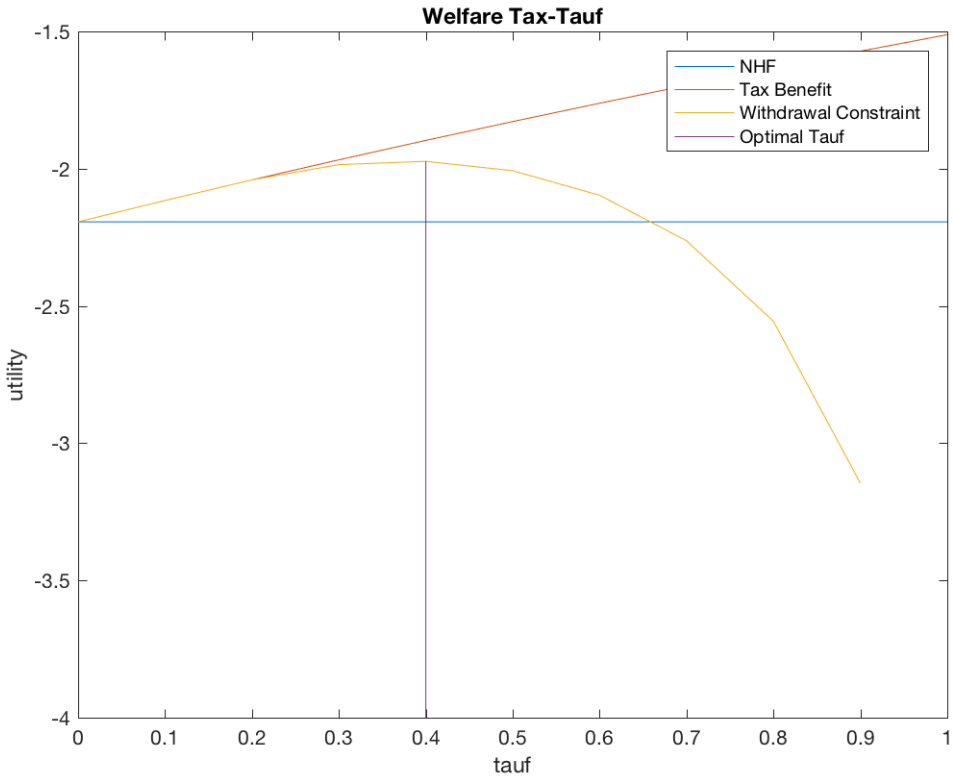
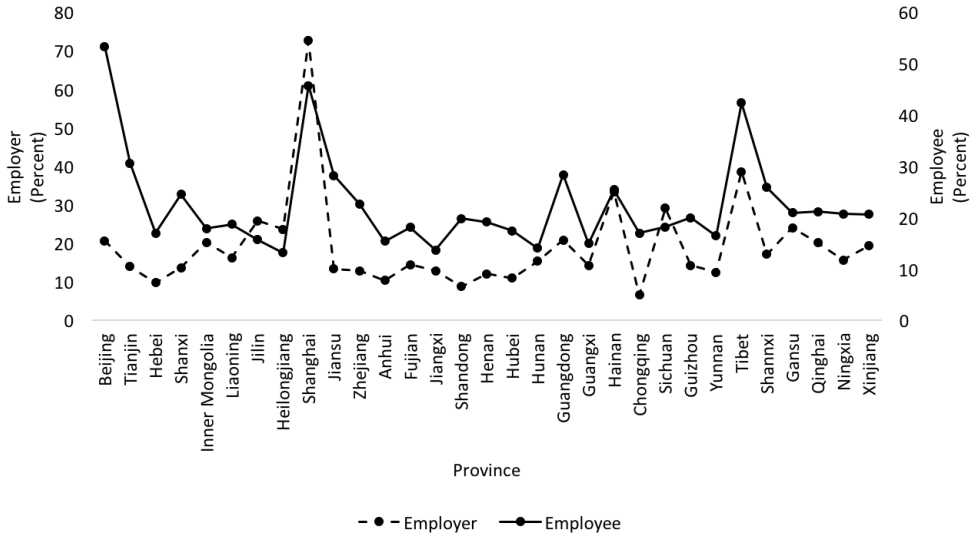
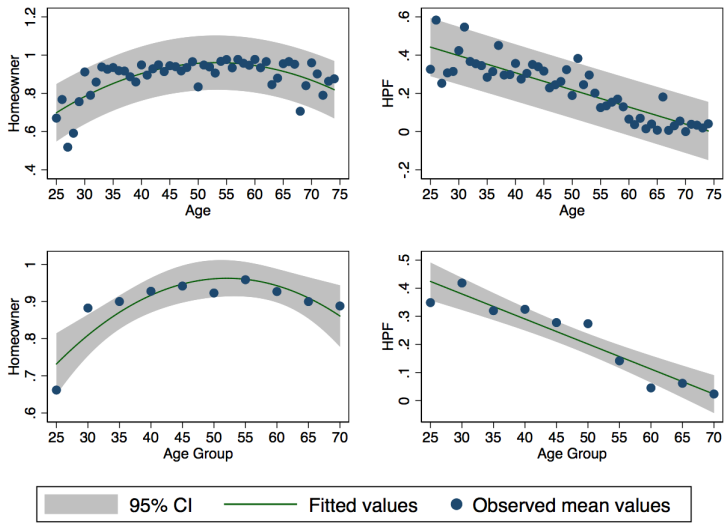


Figure 2: HPF Participation by Employees and Employers in 2016.




Note: (a) Source: 2016 Annual report of the Housing Provident Fund by the Ministry of Housing and Urban-Rural Development of China, and annual data from the National Bureau of Statistics of the People's Republic of China. (b) Dash line is the number of employers who made contribution as a proportion of total number of work units by province. (c) Solid line is the number of employee as a proportion of urban population by province.

Figure 3: Age Effects on Homeownership and HPF Participation Rates.




Note: (a) The left-panel plots are from simple OLS regression of homeownership on $age$ and $age^2$, the quadratic term of variable age. (b) The right-panel plots are from simple OLS regression of HPF participation rate on $age$ only. (c) The gray areas represnt 95% confidincence intervals(CI) of individual forecasts for the observations, i.e. ± 1.96×s.e. of the individual forecasts. The CI includes both the uncertainty of the mean prediction and the residual.