Housing, Wealth Composition and Expected Stock Return*

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Abstract

This paper considers a consumption-based asset pricing model where housing is explicitly modeled both as an asset and a consumption good. As a consumption good, housing expenditure share is modeled as a novel risk factor. As an asset, it is the major component of wealth other than financial asset. The fluctuation of aggregate housing-financial wealth ratio, as a consequence of irrational housing market, impacts the budget constraints of households. It increases household's exposure to risk and shifts the conditional distribution of consumption growth. Using United States aggregate data, we find that the fluctuation of housing-financial wealth ratio is a strong predictor for expected stock return. Conditional on this factor, the covariances of returns with aggregate risk factors explain high ratio of the cross-sectional variation in annual returns of size and book-to-market portfolio. The micro mechanism of this asset pricing model is also supported by the micro data during subprime crisis.

JEL classification: G0; G10; G12

Keywords: Housing wealth; Consumption-based asset pricing; Expected stock return; Wealth composition

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1 Introduction

Housing is widely accepted having a dual-role in real economy. It is the single most important consumption good supplying amenity for households, and, at the same time, the dominant asset in their portfolios. This research explicitly models this characteristic in the utility function to explain the variations in both expected returns across stocks and equity risk premium over time.

Our research starts with Flavin and Yamashita's(2002) point that housing is one asset in household's portfolio. In an uncertain environment, wealth composition should satisfy the mean-variance efficiency structure (Flavin and Nakagawa, 2008). If the stock market is efficient, as in the Fama's (1970) hypothesis, the fluctuation of wealth composition, measured by housing-financial wealth ratio, is triggered by irrational housing market. The fluctuation of wealth composition influences the budget constraints of households, and changes the distribution of consumption growth. This is a possible channel through that irrational housing market impacts the expected stock return.

This paper also connects the model to asset price data. The predictions of the model are confirmed by U.S. equity return data over time and in cross-section. The model finds a significant relationship between irrational housing market and risk premia. Risk premia of consumption growth in a hot housing market is higher. The consumption betas are time-varying. Conditional on the wealth composition, the covariances of returns with aggregate risk factors explain 80% of the cross-sectional variation in annual size and book-to-market portfolio returns.

Housing exactly plays a dual-role in our asset pricing model. As a consumption good, it is separated from the common consumption and modeled as an independent argument in the utility function. In Piazzesi, Schneider and Tuzel's (2007) general equilibrium model, housing consumption introduces a novel risk factor: shock of the non-housing expenditure share. This new argument in stochastic discount factor (SDF) is derived from the non-separable utility function, and represents the consumption composition risk.

As an investment good, housing is an asset in the households' wealth portfolio. The change in wealth composition reflects the change in the expected risk premia for individual asset. If housing market is irrational, a high housing-financial wealth ratio implies that housing market is hot. Investors expect housing to have high risk premium in future, and they will increase housing investment in their portfolio. When their expectations are broken, some of the investors will be suffered from tight budget constraints. Households with tight budget constraints may not have enough resource to satisfy full consumption insurance assumption[1]. Variation in households' consumption growth introduces a new factor to asset pricing model. This mechanism bridges the wealth composition and expected stock return. Four key elements play the key roles in this process. They are listed as follows:

Irrational Housing Market. The stock market efficiency is a widely discussed topic, and Fama (1970) concludes that the efficient market hypothesis is not neglected after reviewing a large number of articles on market efficiency research. This hypothesis asserts that financial markets are "informationally efficient", in other word, rational. Although the hypothesis is still controversial by some empirical results and behavior finance theory, economists will still accept this hypothesis in their models' assumption[2]. However, housing market is known to be less efficient and driven by irrational behaviors of households because of the special characteristics of housing, such as high transaction cost, indivisibility, and lack of short sell. This is supported by empirical evidence[3].

Portfolio. "Modern portfolio theory is a theory of investment, which attempts to maximize portfolio expected return for a given amount of portfolio risk, or equivalently minimize risk for a given level of expected return, by carefully choosing the proportions of various assets"[4]. It is so called "mean-variance efficiency framework". This leads to the development of the synthetic risk model known as "CAPM theory" (Sharpe,1964; Lintner,1965), widely used in the stock market. Flavin and Yamashita (2002) include housing as one of the assets in household's portfolio, and explain the owner-occupied housing decision based on this theoretical framework[5]. In the mean-variance efficiency framework, the composition of portfolio is determined by the expected return, volatility of assets, and the risk attitude of consumer. In a general equilibrium structure, the expected return and the volatility of assets both source from the uncertain environment. The portfolio composition is fixed if the risk attitude of consumer is constant. The composition

[1] "If markets are complete or if there is some other mechanism or set of institutions that implement a full-information Pareto-optimal allocation, then an individual's consumption should not respond to idiosyncratic income or wealth shocks."(Cochrane,1991).

[2] The continuous discussion on efficient market hypothesis can be found in Fama's(1998) other survey paper.

[3] The most important paper testing efficiency in housing market is published by Cash and Shiller(1989,1990). They build repeated sale housing price index for four metropolitan areas, and find very strong serial correlation. They conclude U.S. market for homes appears not to be efficient. Recently Shilling and Sing (2009) point out the irrational term in commercial real market can explain 4 percent of the variations among total 19 to 27 percent.

[4] http://en.wikipedia.org/wiki/Modern_portfolio_theory

[5] The researches on portfolio choice with exogenous returns in the presence of housing also can be found in Yamashita (2003), Cocco (2005), and Flavin and Nakagawa (2008).

of portfolio reflects the expected performance of asset in an uncertain environment.

Consumption Insurance. This idea comes from the permanent income hypothesis in macroeconomic area. Modigliani and Brumberg (1954) and Friedman (1957) note in their permanent income hypothesis and life cycle model that individuals tend to smooth their consumption over states of nature in order to maximum their utility functions over the life cycle. The consumption insurance in asset pricing model is viewed as a cross-sectional counterpart to the life cycle theory[6]. The full consumption insurance implies that heterogeneous consumers are able to equalize, state by state, their marginal rates of substitution. Therefore, the equilibrium in a heterogeneous-consumer economy is isomorphic in its pricing implications to the equilibrium of a representative-consumer economy (Wilson, 1968; Constantinides, 1982). This theoretical fundamental underlies most of macroeconomic asset pricing models, and thus the aggregate data can link with pricing models with representative agent. The primary testable implications of equilibrium in a representative-consumer are the set of Euler equations of consumption, enlightened by Lucas(1978). However, the model performs poorly in explaining security prices. Mehra and Prescott (1985) point out that the model predicts a mean equity premium that is too low and a mean interest rate that is too high given the observed low variability of aggregate consumption growth in U.S. market, and they call this phenomenon "equity premium puzzle". Modifications are suggested to mitigate the poor empirical performance of the model. Some start from the assumption of full consumption insurance, and this research is one of them.

Heterogeneous consumers and Limited Participation. If consumption insurance is incomplete, representative agent makes no sense in asset pricing model. The earlier studies suggest that the potential enrichment of the joint assumption — heterogeneous consumers and incompletely consumption insurance on asset pricing is illusory[7]. Constantinides and Duffie (1996) argue that the previous models with heterogeneous consumers, that have failed to improve the performance, have a common feature, that the individual income to aggregate income is time series stationary. They relax this assump-

[6] There is an extensive literature on the hypothesis of complete consumption insurance; see Cochrane (1991), Mace (1991), Altonji, Hayashi, and Kotlikoff (1992), and Attanasio and Davis (1996).

[7] For example, Mankiw (1986), Lucas (1994) and Telmer (1993) calibrate economies in which consumers face uninsurable income risk and borrowing or short-selling constraints, and conclude that consumers are able to come close to the complete-markets rule of complete risk sharing, even though consumers are allowed to trade in just one security in a frictionless market. Aiyagari and Gertler (1991) and Heaton and Lucas (1992, 1995, 1996) added transaction costs or borrowing costs in economies with uninsurable income risk and concluded that consumers are still able to come close to the complete-markets rule of complete risk sharing, unless the ratio of the net supply of bonds to aggregate income is restricted to an unrealistically low level.

tion by adding a factor, consumption growth distribution, in the SDF. This theory is empirical supported by U.S. Consumer Expenditure Survey (CEX) data (Brav, Constantinides and Geczy, 2002). Their idea is adopted by most of models with heterogeneous consumers[8]. That is, to define a non-stationary individual endowment to aggregate data ratio firstly, and then derive a distribution factor in the SDF. The tail of the distribution can be truncated, which implies limited participation in asset pricing market. Empirical data support this assumption. Based on the 1984 Panel Study of Income Dynamics (PSID) data, Mankiw and Zeldes (1991) find that only about 30% households own stocks in the U.S. Despite the tremendous growth of U.S. stock markets during 1990s, such limited market participation still exists. The 1998 Survey of Consumer Finances (SCF) shows that less than 50% of the U.S. households own stocks and/or stock mutual funds (including holding in their retirement accounts) (Cao, Wang and Zhang, 2005). In our model, all agents are heterogeneous and some of their participations on stock market are restricted by unexpected declines in housing price.

Our model is built on the consumption based asset pricing model (CCAPM) (Breeden, 1979; Breeden and Litzenberger, 1978; Campbell, 2003). The four key elements incorporate the irrational housing market risk into asset pricing. The *irrational housing market* introduces new source of risk; and *portfolio* theory points out that wealth composition can measure the irrational market. I assume *full consumption insurance* only happens for households without tight budget constraints. *Heterogeneous consumers and limited participation* is added to correct bias generated from the aggregate data due to lack of full consumption insurance.

The recent finance crisis is a natural incentive of this research. It is believed that a crisis starting from irrational market and the risk in housing market is fully laid on the financial market. As the press describes:

> "Housing peaked in 2005. By early 2006 it was widely recognized the boom was likely over, and by mid-2006 it was beyond question. In June 2006, sales of existing single-family homes were 9% below their year-earlier level, sales of new homes were down 15% and framing lumber prices were down 19%. The Dow Jones Wilshire index of home-building shares had fallen 41% from its July 2005 peak."
>
> —WSJ, 24/12/2007, "Egg Cracks Differ In Housing, Finance Shells"

[8]For example, Jouini and Clotilde (2007) discuss the heterogeneous belief; Chien and Lustig (2010) focuse on distribution of wealth; Gomes and Michaelides (2008) combine the idiosyncratic shocks and borrowing constraints and imply incomplete risk sharing among investors add risk to the pricing factor.

If we take a close look on the U.S. macroeconomic statistic, we find a puzzle on the link between consumption growth and equity premium. Before the financial crisis, in 2007, the equity premium in U.S. market was around 7%, and was consumption growth 1.5%. During the crisis, the market return was -49%, and the consumption growth was only about -1%. That implies a huge change in risk aversion coefficient; it is impossible.

Our model includes a new risk factor, deriving from the consumption growth distribution and limited participation, as a wedge between the different consumption "betas" before and after crisis. The declines in housing price change some households' budget constraints, because of the losses unexpectedly. These households must change their consumption growth and withdraw their equity from the stock market. The following are reported in the press:

> "At the start of 2008, with the U.S. economy weakening and job losses multiplying, the defaults began to spread as millions of Americans with plain-vanilla prime mortgages also ran into trouble making their payments. In some cases, borrowers found they had paid inflated prices for homes they could no longer afford. Others got into trouble by or borrowing against the equity in their homes. According to the Federal Reserve, Americans withdrew more than $1.1 trillion of equity from homes in 2006 and 2007."
>
> —WSJ, 29/12/2010, "Faces of the Home-Foreclosure Crisis"

This paper also presents micro evidence from the subprime crisis based on a rigorous dataset to illustrate the mechanism proposed by this model. 2009 Panel Study of Income Dynamics (PSID) survey includes questions on households' financial distress information during the crisis. The households' responses before (2007) and after (2009) the subprime crisis support the linkage between micro fundamentals and macro environment produced by the model. The data show that the nondurable goods consumption growth (indicated by food expenditure) and the participation in stock market have clear heterogeneous patterns between the unconstrained households and the households in distress. The micro data imply that the heterogeneity is embedded the risk of housing wealth.

This paper proceeds as follows. Section 2 discusses the past related work. Section 3 presents the model and pricing kernel. Sections 4 to 6 show the empirical evidences of asset pricing model. Section 7 analyzes the micro evidence to verify our model. The paper is concluded in section 8.

2 Related Literature

The main contribution of this paper is to link the expected stock return with the irrational housing market, and find housing-financial wealth ratio is a predictor of stock return. This research starts with a traditional consumption based asset pricing model. This model assumes that there is a single nondurable consumption good; and the pricing kernel is based on the intertemporal marginal rate of substitution (IMRS) of a representative agent. However, in long time horizon, this model is empirically queried by equity premium puzzle (Mehra and Prescott, 1985); and in cross-section, the nondurable consumption beta, which is the risk measurement in CCAPM, also fails to explain the cross-sectional variations of expected stock returns (see Breeden, Gibbons, and Litzenberger, 1989 and Mankiw and Shapiro,1986).

Reconginizing the limitations of the model in fitting the empirical results, a number of generalizations have been suggested to mitigate the poor empirical performance of the model. In a general equilibrium framework, two modifications for the utility function are suggested to add more volatility of consumption growth to the model. One is to use recursive function in utility representation (Epstein and Zin, 1989, 1991), which allows for the separation of the elasticity of intertemporal substitution (EIS) from the risk aversion. The second one is to add habit persistence in the preference(Boldrin, Christiano and Fisher, 2001; Constantinides, 1990), which has potential to account for the equity premium puzzle by implying only a modest degree of risk aversion on the part of households.

Besides focusing on the utility function, researchers also try to find more risk factors in the real economy to improve the performance of CCAPM. Considering heterogeneous consumers instead of representative agent, Cogley (2002) and Brav, Constantinides and Geczy (2002) find that the factor from distribution of consumption growth, such as the standard deviation and the skewness, reduces the size of the Euler equation errors for the stock return. Lettau and Ludvigson (2001a, b) empirically show that the ratio of consumption to wealth predicts the asset returns and conditional versions of CCAPM conditioning on the ratio of consumption to wealth perform much better than the unconditional versions. Santos and Veronesi (2006) incorporate the fluctuation of consumption to income ratio into asset pricing model and show it can forecast the stock return. Yogo (2006) shows that, conditional on high risk aversion, a model with consuming durables can account for time variations in the equity premium, as well as the size and value premia.

Our paper is related closely to the work of Piazzesi, Scheider and Tuzel (2007), and Lustig and Nieuwerburgh (2006). Piazzesi, Schneider, and Tuzel (2007) construct an equilibrium asset pricing model with housing and show that the composition of the consumption bundle appears in the pricing kernel, and matters for asset pricing. The housing expenditure share predicts stock returns. Lustig and Nieuwerburgh (2006) find that the ratio of housing wealth to human capital is related to the market price of risk and thus has asset pricing implications. They model this mechanism as collateral channel; where the collateral ratio influences asset pricing through the consumption growth distribution.

This research is also part of a small but growing literature that incorporates real estate into the asset pricing framework. Stambaugh (1982) tests CAPM with several market portfolios, constructed as a combination of asset classes, and some of them include proxies for residential real estate. Cochrane (1991, 1996) explores the explanatory power of residential and non-residential investment on the equity returns in the context of his production-based asset pricing framework. Cocco (2005), Flavin and Yamashita (2002), and Flavin and Nakagawa (2008) consider portfolio choice with exogenous returns in the presence of housing. Kullmann (2003) includes measures of both residential real estate returns and commercial real estate returns (as measured from REITs) in the market portfolio. Chu (2010) models the ratio of consumption to housing as a pricing factor in his intertemporal-CAPM. Tuzel (2010) explores the linkage between corporate real estate holding and stock return controlling for asymmetric adjustment cost of different capital.

3 Model

Our economy includes a continuous of infinitely lived heterogeneous households who consume nondurable consumption and housing service. Housing plays a dual-role in the model as both a consumption good and an investment good. The irrational activity of housing market breaks the assumption of full consumption insurance and changes the distribution of consumption growth in the cross-section, which creates a wedge between the market valuation of payoffs and the representative agent's intertemporal marginal rate of substitution (IMRS).

3.1 Environment and Preferences

In an uncertain environment, each households faces two types of uncertainty: one is the idiosyncratic component $y \in Y$; the other is the aggregate component $z \in Z$. The household in time t lives in an environment $(y_t, z_t) \in Y \times Z$. This set follows a Markov process with transition probabilities π that obeys:

$$\pi(z'|z) = \sum_{y' \in Y} \pi(y', z'|y, z) \quad \forall y \in Y, \ z \in Z$$

The economy has only two types of commodities: a nondurable consumption good, c and housing service, h. Preferences are standard. We use $\{x\}$ to represent an infinite stream $\{x_t(y_t, z_t)\}_{t=0}^{\infty}$. The households utility function is as follow:

$$U(\{c\}, \{h\}) = \sum_{(y', z')|(y,z)} \sum_{t=0}^{\infty} \beta\pi(y_t, z_t|y_0, z_0)u(c_t(y_t, z_t), h_t(y_t, z_t))$$

where β is the time discount factor, and the utility function kernel is defined as constant elasticity of substitution (CES) function over composite consumption goods (Eichenbaum and Hansen,1990) :

$$u(c_t, h_t) = \frac{1}{1-\gamma}\left[c_t^{\frac{\varepsilon-1}{\varepsilon}} + \psi h_t^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon(1-\gamma)}{\varepsilon-1}}$$

where $\psi > 0$, represents the weight of the housing services in utility function; γ is the coefficient of risk aversion, and ε is the intertemporal elasticity of substitution between nondurable consumption and housing services. Specially, this preference is separable when $\frac{\varepsilon-1}{\varepsilon} = 1-\gamma$; and if $\varepsilon = 1$ it is a Cobb-Douglas function.

When constraints are not bound, IMRS, $m_{t,t+1}^a$ of the representative agent is defined as

$$m_{t,t+1}^a = \beta\frac{u_1(c_{t+1}^a, h_{t+1}^a)}{u_1(c_t^a, h_t^a)} = \beta\left(\frac{c_{t+1}^a}{c_t^a}\right)^{-\gamma}\left(\frac{1+\psi\left(\frac{h_{t+1}^a}{c_{t+1}^a}\right)^{\frac{\varepsilon-1}{\varepsilon}}}{1+\psi\left(\frac{h_t^a}{c_t^a}\right)^{\frac{\varepsilon-1}{\varepsilon}}}\right)^{\frac{\varepsilon-\frac{1}{\gamma}}{\frac{1}{\gamma}(\varepsilon-1)}} \tag{1}$$

where the superscript a represents the variables can be measured by aggregate data. In the model, housing rental market is frictionless. So the relative rent price of housing services in time t is

$$\rho_t = \frac{u_2(c_t^a, h_t^a)}{u_1(c_t^a, h_t^a)}$$

Following Piazzesi, Schneider and Tuzel's (2007) paper, α_t is defined as non-housing expenditure share:

$$\alpha_t = \frac{c_t^a}{c_t^a + \rho_t h_t^a}$$

then IMRS $m^a_{t,t+1}$ is composed by two parts, consumption growth and composition effect.

$$m^a_{t,t+1} = \beta \left(\frac{c^a_{t+1}}{c^a_t}\right)^{-\gamma} \left(\frac{\alpha_{t+1}}{\alpha_t}\right)^{\frac{\varepsilon - \frac{1}{\gamma}}{\frac{1}{\gamma}(\varepsilon - 1)}}$$

3.2 Housing Market

For individual household, housing can be taken as both a consumption good and an investment good. In each period, he/she can rent out the housing to earn rental income. If each household is endowed with a labor income stream $\{\eta_t(y_t, z_t)\}^{\infty}_{t=0}$, the budget constraint of the household can written as,

$$a_{t+1}v_t + c_t + h_t\rho_t + h^o_{t+1}p^h_t = \eta_t + a_t(v_t + d_t) + h^o_t(1-\delta)p^h_t \tag{2}$$

where a is a vector of financial asset, v is a vector of price and d is a vector of dividend. In the economy, the composition of household's wealth is made up of both financial asset and housing. Housing is not only owner-occupied, it can also be rented out. h^o denotes housing owned by the household; and h denotes the housing services enjoyed by the household. If the household does not own house, h^o equates to 0. δ is the depreciation rate of housing.

The financial asset return $r^a_{t,t+1}$ and housing return $r^h_{t,t+1}$ are defined as

$$\begin{aligned} r^a_{t,t+1} &= \frac{v_{t+1} + d_{t+1}}{v_t} \\ r^h_{t,t+1} &= \frac{(1-\delta)p^h_{t+1} + \rho_{t+1}}{p^h_t} \end{aligned}$$

In the economy, a household can only accept the price and dividend of financial asset, and the price and rental of housing. the stream of them are determined by systematic shocks z_t. As z_t is a Markov process, the excess returns of both the financial asset and the housing are assumed as Brownian motion processes with a variance-covariance matrix as in Flavin and Nakagawa (2008). Housing and financial assets that make up the wealth portfolio of the household is represented as $\{a, h^o\}$. Given that the markets are perfect and frictionless, the composition of optimal portfolio in the mean-variance efficiency framework is a constant vector $M \equiv \{M_a, M_h\}$, where M_a and M_h denote the market value of financial asset and house[9]. We use the housing-financial wealth ratio ha

[9] The details of proof can refer to Flavin and Nakagawa (2008)'s paper.

to represent the composition of household's portfolio:

$$ha_t = \frac{h_t p_t^h}{a_t v_t}$$

This ratio is depended on the risks of two different asset in the uncertain environment, but independent of the idiosyncratic risk of the household.

In the model, the housing market is irrational. So both hot and cold market exist periodically. The household in housing market does have perfect foresight. If the ideal housing-financial wealth ratio in the same uncertain environment is constant, any fluctuations of the ratio indicate that the housing market is either hot or cold. Suppose in a hot housing market, all households tend to invest more wealth into the housing market because of irrational expectations. Then, the housing asset will constitute a higher weight in their portfolio.

The irrational housing market changes the conditional distribution of consumption across households and asset pricing. Equation (2) is the household budget constraint at time t. Suppose that in the previous hot housing market household allocates higher weight of housing wealth; ha_{t-1} is higher. The return of housing investment is lower than the household's expectation in next period. some households will face a tight budget constraint because misallocation of wealth portfolio. In the next part, we will discuss how the irrational behavior impacts the asset pricing.

3.3 Pricing Kernel

Following the hypothesis of full consumption insurance, household's consumption is independent of idiosyncratic shock, and its growth follows a simple pattern except it is bound by a tight budget constraint. When household enters a state of tight constraint, e.g. negative net wealth, the idiosyncratic shock is a determinant factor for consumption growth. The consumption growth rate with a tight constraint is lower than that under the full consumption insurance. These households are likely to withdraw investment from financial assets to satisfy their consumption requirement. As a result, some households will not invest on the financial assets. The tight constraint breaks the full consumption insurance hypothesis and the fraction of households with tight constraints depends on the housing-financial wealth ratio. In a hot housing market, marked as high housing-financial wealth ratio, more households will be affected by losses in housing investment. As a result, the fluctuations of the housing-financial wealth ratio change the conditional distribution of consumption across households and asset prices.

We use a set of consumption weights $\{w\}$ to characterize the household's consumption in the aggregate data. at time t, the consumption of household i is

$$c_t^i = w_t^i c_t^a$$

at time $t+1$ with aggregate environment z_{t+1}, the full consumption insurance growth is $\lambda(z_{t+1})$. For households without tight constraints,

$$c_{t+1}^i = \lambda(z_{t+1}) w_t^i c_t^a$$

For the household facing tight constraint, the consumption growth depends on both individual and aggregate shock; and the growth rate is $\tilde{\lambda}(y_{t+1}, z_{t+1})$

$$c_{t+1}^i = \tilde{\lambda}(y_{t+1}^i, z_{t+1}) w_t^i c_t^a \tag{3}$$

The aggregate consumption at time $t+1$ is the sum of consumption by individual household,

$$c_{t+1}^a = \left[\sum_{i=0}^{\tilde{I}} \lambda(z_{t+1}) w_t^i + \sum_{i=\tilde{I}}^{I} \tilde{\lambda}(y_{t+1}^i, z_{t+1}) w_t^i \right] c_t^a \tag{4}$$

where households marked from 0 to $\tilde{I}$ are not bound; households marked from $\tilde{I}$ to I are bound. I define

$$\xi_{t+1}^a = \sum_{i=0}^{\tilde{I}} \lambda(z_{t+1}) w_t^i + \sum_{i=\tilde{I}}^{I} \tilde{\lambda}(y_{t+1}^i, z_{t+1}) w_t^i \tag{5}$$

As $\tilde{\lambda}(y_{t+1}^i, z_{t+1}) < \lambda(z_{t+1})$, ξ_{t+1}^a increases with the fraction of households with a tight constraint. By linking housing-financial wealth ratio ha_t with the fraction change, ξ_{t+1}^a can be predicted by ha_t. From equations (3), (4) and (5),the set of consumption weights at time $t+1$ can be written as:

$$\left\{ \frac{\lambda(z_{t+1}) w_t^1}{\xi_{t+1}^a}, \frac{\lambda(z_{t+1}) w_t^2}{\xi_{t+1}^a}, ..., \frac{\tilde{\lambda}(y_{t+1}^i, z_{t+1}) w_t^i}{\xi_{t+1}^a}, \frac{\tilde{\lambda}(y_{t+1}^{i+1}, z_{t+1}) w_t^{i+1}}{\xi_{t+1}^a}, ... \right\} \tag{6}$$

By substituting equation (6) into equation (1), I derive the stochastic discount factor (SDF) of household without tight budget constraint; and only this fraction of households participates in the asset pricing. The SDF will be

$$m_{t,t+1} = m^a_{t,t+1} \left[\frac{\lambda(z_{t+1})}{\xi^a_{t+1}} \right]^\gamma$$

where the ξ^a_{t+1} decreases with ha_t. ξ^a_{t+1} constructs the liquidity factor g_{t+1}. Overall, the stochastic discount factor (SDF) in this model is written as

$$m_{t,t+1} = m^a_{t,t+1} g^\gamma_{t+1}$$

where m^a_{t+1} is the IMRS of a representative agent, which can be calculated by aggregate data as in Hansen and Jagannathan (1991). Following Lustig and Van Nieuwerburgh (2005), g_{t+1} is a liquidity factor contributed by the budget constraints. In stationary equilibrium, only households without tight constraints can participate in the asset market. So the fraction of households without tight constraints influences the liquidity factor in pricing kernel. In the model, the liquidity factor depends on the housing-financial wealth ratio. When the ratio is high, the constraints are tight because housing return is lower than the expectation. Many households are highly constrained, the liquidity factor enhances the risk of consumption change. The risk-free rate is low, inducing households to decrease assets at a high rate. When this ratio is low enough in a cold housing market, none of the households are constrained and interest rates are high.

In the next part, we show that housing wealth composition can explain some of the variations in U.S. stock returns over time and in the cross-section.

4 Data and Measurement

In order to test the model, we use the total housing-financial wealth ratio ha to predict the stock market return. Next we discuss the data used in the estimation and the construction of ha.

4.1 Measurement of Housing-Financial Wealth Ratio

ha is defined as the total housing wealth hv divided by total financial wealth av in certain time. The housing wealth is generated from Fixed Asset Tables (Bureau of Economic Analysis). The net stock current value of owner-occupied and tenant-occupied residential fixed assets for 1929–2009 , as reported in line 1 of the table 5.1."*current-cost net stock* *of residential fixed assets*", is defined as the total housing wealth hv^{fa}. We use the market residential real estate wealth hv^{rw} from the Flow of Funds data (Federal Board of Governors) from 1945–2009 in robustness test. This series is reported in line 3, "*the balance sheet of households, and nonprofit organizations (B.100)*". The total financial wealth data from 1929 to 2009 come from two sources. For 1945–2009, it is also from the Flow of Funds data, and found in line 8, "*the balance sheet of households, and nonprofit organizations (B.100)*". For 1929–1945, the direct financial wealth data are not available. NBER macro-history database (series 14145) gives the data on total deposits. We assume that the ratio of deposits to total financial wealth decreases slowly from 0.205 in 1929 to 0.198; its level in 1945 (FoF deposits series).

Figure 1(a) plots the growth rates of housing wealth and financial wealth during 1929-2009. The housing wealth is based on hv^{fa}. The financial wealth growth is procyclical, peaking during booms and hitting lows during recessions. It is therefore a good indicator for business cycles. The housing wealth growth is also procyclical, but is smoother than the financial wealth growth. The housing market is illiquid and irrational, adjusted at a slower rate to shocks. Figure 1(b) is a time-series plot of housing wealth growth minus financial wealth growth. The financial wealth growth generally exceeds that of housing wealth, except during the long recession period, for example 1929-1933, which is a long recession defined by NBER, and the recent crisis 2007-2008. This paper will test how the fluctuations in their ratio influence expected stock return.

As the model's definition, we use hv and av to calculate the housing-financial wealth ratio ha. We define $ha^{fa} = hv^{fa}/av$; and $ha^{rw} = hv^{rw}/av$. The fixed time effect on the wealth composition is controlled. We run an OLS regression with time t as an independent variable, and ha_t as a dependent variable. The coefficient of time is highly significant (p value is less than 0.001, not reported). The residual of this regression is used to represent the housing-financial wealth ratio excluding time effect, which are defined as $\tilde{ha}^{fa}$ and $\tilde{ha}^{rw}$. Figure 2 shows the trend of these four different measurements. Figure 2(a) shows ha^{fa} and the estimated $\tilde{ha}^{fa}$ from 1929 to 2009; Figure 2(b) shows ha^{rw} and the estimated $\tilde{ha}^{rw}$ from 1945 to 2009. The detrended housing-financial wealth ratio has a similar trend as the previous one, but the fluctuation is amplified. Figure 2(c) presents the comparison of housing-financial wealth ratios estimated using different housing wealth data. In general, they have similar trend and volatility.

Table 1 gives the summary statistics. The means of housing wealth and financial wealth growth are very close, at around 6% (7% in subsample). It is consistent with our model's assumption. In the market with perfect foresight, housing wealth and financial wealth have the same growth rates. The volatility of housing wealth growth is significantly lower than that of the financial wealth growth, and the autocorrelation of housing wealth is higher than financial wealth in the full sample and subsample. Compared with the financial wealth growth, some irrational factors drive housing wealth growth much historical correlated and slowly response to economy shock. And this fact implies that the housing-financial wealth ratio possibly measures the fluctuations in an irrational housing market. This table shows two different measurements of housing-financial wealth ratio, and both have the similar mean and autocorrelation.

4.2 Consumption Data

In this estimation, the consumption data include two series: one is nondurable consumption without housing, the other is housing consumption. Both of them are obtained from the National Income and Product Accounts (NPIA), Table 2.4.5, "*personal consumption expenditures by type of product*". The housing consumption is based on "*the housing rental for tenant-occupied house and imputed rental for owner-occupied house*". And this data can be found in line 50.

Following the literature in asset pricing area (see, for example, Lettau and Ludvigson, 2001; Piazzesi, Schneider and Tuzel, 2007), we define the nondurable consumption as the aggregate consumption of nondurables (line 25) and services (line 47), then excluding shoes and clothing (line 30) and housing consumption expenditure (line 50). All the expenditures are deflated by their respective price indexes in table 2.4.4, "*price indexes for personal consumption expenditures by type of product*". We also divide the consumption by the total population from line 18 in table 7.1, "*selected per capita product and income series in current and chained dollars*".

The influence of housing consumption is modeled as a composition risk of consumption here. The share of non-housing consumption α is the asset pricing factor. α is calculated based on non-housing consumption and housing consumption. From the descriptive statistics in table 1, we find that the share of non-housing consumption is highly persistent — its autocorrelation is 0.943 in the full sample and 0.977 in the subsample. The mean of its change is very small, and less than 0.001. The growth rate of non-housing consumption is less persistent; its autocorrelations over the two samples are 0.475 and 0.340, respectively. The volatilities of both non-housing consumption growth and share of non housing consumption in the full sample are larger than the corresponding volatilities in the subsample.

4.3 Financial Data

To test this model's forecasting ability, we use the stock market return, risk-free rate, and Fama-French portfolio returns as the test assets. The market return and risk-free rate are obtained from Robert Shiller's[10] website. Table 1 shows the summary statistics for these returns. The stock market returns have a high mean of 5.4 percent, and 6.4 percent after 1945 and high volatility. By contrast, the risk-free rate has a low mean of about 1 percent, and a low volatility of less than 0.001. We use the 25 size and book to market value Fama-French portfolios as the cross-sectional test assets. This data is from Kenneth R. French's[11] website.

5 Long-horizon Forecasts

In this section, we investigate the predictive power of the housing-financial wealth ratio in a longer horizon. The K-year continuously excess compounded log return of stock market is defined as $R^e_{t,t+K} = \sum_{k=1}^{K}(r^e_{t+k-1,r+k} - r^f_{t+k-1,r+k})$, where $r^e_{t+k-1,r+k}$ is the log market return from $t+k-1$ to $t+k$; and $r^f_{t+k-1,r+k}$ is the risk-free return from $t+k-1$ to $t+k$. Figure 3 gives a visual impression of the behavior of detrended housing-financial wealth ha together with the 10 year cumulative excess market return. The series exhibit a clear positive correlation, and especially the two series have a strong co-movement after 1945.

In addition, we project long-horizon excess returns on the housing-financial wealth ratio with the following equation.

$$R^e_{t,t+K} = b_0 + bha_t, + \varepsilon_{t,t+K}$$

We use different measurements of the housing-financial wealth ratio and run regressions over different time periods. The estimates of explanatory variable and the R^2 of the models are reported in table 2. The HAC Newey-West standard errors (Newey and West, 1987) with lag length K are also calculated and the significance of the coefficients based on Newey-West errors at 10% level is indicated in boldface. The p value of F-test for the coefficients based on Newey-West errors is also reported.

All the slope coefficients b are positive for the subsample. A high housing-financial wealth ratio predicts a high future risk premium, which is consistent with the model. For

[10] http://www.econ.yale.edu/~shiller/data.htm

[11] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

the full sample, the coefficient is positive but not significant. The explanatory power in short horizon is low, at less than 1%. However the explanatory power increases to 5% for non-detrended ha^{fa} and 7% for the detrended ha^{fa} in the long horizon.

The asset pricing factors have better prediction in the subsample from 1945 to 2009. Both the detrended and the non-detrended housing-financial wealth ratios based on fixed asset have significant slope coefficients on the long horizon returns. In the long term horizon, the explanatory power can reach about 35%. The housing-financial wealth ratio measured by the residential asset value also has a highly positive correlation with the long horizon return. The coefficient on ha^{rw} is positive but not significant. But the explanatory power in long term horizon also can reach more 10%. $\tilde{ha}^{rw}$ has better explanatory power than the non detrended one. The coefficients are significant, except for $K = 3$, and the explanatory power is 30%, which is about 3 times that of the non-detrended one.

From these regression results, we can find that the housing-financial wealth ratio has high predictability in the long horizon, and its long term explanatory power is better than that in the short term. We present two reasons here. Firstly, we use the housing-financial wealth ratio to capture the influence of irrational housing market. The influence is stronger in the long term than in the short term. Secondly, the housing-financial wealth ratio is a conditional factor on general consumption based asset pricing model. In the long horizon, consumption change is smoother. The conditional factor has more information on the return. The explanatory power is higher for the housing-financial wealth ratio in the long term horizon.

6 Cross-Sectional Test of the Linear Factor Model

In this section, We test the cross-sectional implication of the conditional consumption based asset pricing model by approximating it as a linear factor model. The test assets are 25 Fama-French portfolios. The cross-sectional estimation evaluates the predictability of asset pricing factor on different types of stocks. The results can be readily compared with those found in the large literature on cross-sectional asset pricing, which are also testable for the linear factor model.

6.1 The Linear Factor Model and Fama-MacBeth Procedure

First, we assume the liquidity factor in our model can be written as a linear function ϕ in ha_t,

$$\phi(ha_t) = b_0 + b_1 ha_t \tag{7}$$

The stochastic discount factor is a combination of the aggregate stochastic discount factor and the liquidity factor. A first-order Taylor approximation of the aggregate stochastic discount factor model is

$$-\frac{m^a_{t,t+1}}{E(m^a_{t,t+1})} \approx c + \gamma F^c_{t+1} + \frac{-\varepsilon + \frac{1}{\gamma}}{\frac{1}{\gamma}(\varepsilon - 1)} F^\alpha_{t+1} \tag{8}$$

where F^c_{t+1} represents $\Delta \ln(c^a_{t+1})$, and F^α_{t+1} represents $\Delta \ln(\alpha_{t+1})$. By combining the two parts of the stochastic discount factor, the linear factor model is

$$m_{t,t+1} = -\theta F_{t+1}$$

where θ is a vector of constants, $\theta = (const, \tilde{\theta})$ and F_{t+1} is the vector of asset pricing factors, $F_{t+1} = (1, \tilde{F}_{t+1})$, $\tilde{F}_{t+1} = (F^c_{t+1}, F^\alpha_{t+1}, ha_t, ha_t F^c_{t+1}, ha_t F^\alpha_{t+1})$. From equation (7) and (8), the associated factor loading are $\tilde{\theta}_1 = b_0\gamma$, $\tilde{\theta}_2 = b_0 \frac{-\varepsilon+\frac{1}{\gamma}}{\frac{1}{\gamma}(\varepsilon-1)}$, $\tilde{\theta}_3 = b_1 c$, $\tilde{\theta}_4 = b_1\gamma$, $\tilde{\theta}_5 = b_1 \frac{-\varepsilon+\frac{1}{\gamma}}{\frac{1}{\gamma}(\varepsilon-1)}$.

The model can be tested using the unconditional orthogonality conditions of the discount factor and the excess asset returns following Fama-Macbeth(1973) methodology. For a risky asset j with return $r^{e,j}_{t,t+1}$, we have

$$E\left[m_{t,t+1}(r^{e,j}_{t,t+1} - r^f_{t,t+1})\right] = 0$$

Using the definition of the risk-free rate and the covariance, the unconditional factor model implies an unconditional β-representation:

$$E(R^{e,j}_{t,t+1}) = \tilde{\theta} Cov(\tilde{F}_{t+1}, R^{e,j}_{t,t+1})$$

where $R^{e,j}_{t,t+1} = r^{e,j}_{t,t+1} - r^f_{t,t+1}$, is the excess return of asset j. This equation says that the premium on asset j is the price of risk $\tilde{\theta}$ times its quantity of risk $Cov(\tilde{F}_{t+1}, R^{e,j}_{t,t+1})$.

By defining the "beta" of asset j as $\beta = Cov(\tilde{F}_{t+1}, \tilde{F}'_{t+1})^{-1} Cov(\tilde{F}_{t+1}, R^{e,j}_{t,t+1})$, which can be interpreted as the coefficient vector in a multiple regression of $R^{e,j}_{t,t+1}$ on $\tilde{F}_{t+1}$. The linear factor model can be written as a beta pricing model.

$$E(R^{e,j}_{t,t+1}) = \lambda\beta \tag{9}$$

where $\lambda = \tilde{\theta}Cov(\tilde{F}_{t+1}, \tilde{F}'_{t+1})$ is the factor risk premium.

We apply the two-stage Fama-MacBeth procedure to estimate equation (9). In the first stage, for each asset j separately, excess returns are regressed on factors to uncover the "beta". In the second cross-sectional stage, average excess returns are regressed on the "beta" derived from the first stage to obtain the market prices of risk λ.

6.2 Results from Fama-MacBeth Procedure

We use all 25 size and book-to-market portfolios as the test assets. Table 3 reports the market price of risk λ estimated from the second stage of the Fama-MacBeth procedure. Below the estimates, we also report the OLS standard errors and Shanken(1992) standard errors, which correct for the fact that "betas" are generated regressors from the first time-series step. In the end of the table, both R^2 and adjusted R^2 are reported, to show the model's explanatory power.

Column (1) shows the result of standard CCAPM. It explains 8% of the cross-sectional variation in excess returns of the size and book-to-market portfolios between 1929 and 2009. The HCAPM model (Piazzesi, Schneider and Tuzel, 2007) that includes nonseparable preferences between nondurable goods and housing predicts a composition risk on the asset pricing model. Column (2) shows the composition of non housing consumption risk increases the R^2 to 63%. HCAPM has a higher explanatory power than general CCAPM. Column (3) through (6) investigate the housing-financial wealth ratio model with different measurements. In each of the regression, R^2 is larger than 65%. The fixed asset measurement has longer time-series data than the residential real estate value measurement. Their R^2s are much higher. The coefficient of interaction between consumption composition change and housing-financial wealth ratio $\lambda_{a,ha}$ is positive and significant based on Shanken-corrected standard errors. This is consistent with our model's predication.

We also run several other asset pricing models to do a comparison with our model's predictability. Table 4 shows the results with data from 1929 to 2009. The last column reports the results of wealth ratio model with non-detrended fixed asset measurement. In the standard CAPM (Sharpe, 1964; Lintner,1965), the return on the wealth portfolio is proxied by the market return R^{vw}, as shown in column (1). It explains 29% of the variations in annual returns. The Fama and French (1993) three-factor model adds a size and a book-to-market factor to the standard CAPM. The size factor is the return on a hedged portfolio that goes long in small firms and short in big firms (*smb*). The value factor is the return on a hedge portfolio that goes long in high book-to-market firms and short in low book-to-market firms (*hml*). The model accounts for 85% of the cross-sectional variation in our series. All coefficients of asset pricing factors are significant in this model. Lettau and Ludvigson (2001a) explore a conditional version of CCAPM model with the consumption-wealth ratio as the scaling variable. The market price of consumption risk increases in time with the low consumption-wealth ratio. The Lettau and Ludvigson's model explains 41% of the annual cross-sectional variations. In the economy of Santos and Veronesi (2001), the fluctuations of labor income over consumption are considered in the model. The conditional model explains 70% of the annual returns in column (4). Column (5) reports a collateral HCAPM in Lustig and Van Nieuwerburgh's (2005) paper, which adds the housing and income ratio as an asset pricing factor into HCAPM. It explains 86% of the annual cross-sectional variations. As noted by Lettau and Ludvigson (2001b), the size of the correction is larger using macroeconomic factors compared with using purely financial variables. Indeed, table 4 shows that the Shanken-corrected standard errors are larger for the macroeconomic asset pricing factor and few coefficients are significant.

Figure 4 provides a visual summary of the empirical success of the housing-financial wealth ratio model. The vertical axis is the predicted excess return based on different models; and the horizontal axis is the realized average excess return. The points represent the 25 Fama-French portfolios, and the corresponding horizontal distance to the diagonal line represents the pricing errors. From the figures we clearly find that the pricing errors for the wealth ratio model (panel d) are smaller than CAPM (panel a) and CCAPM (panel c). It has the close performance with Fama-French three-factor model (panel b). Figure 4 also reveals that the small value portfolio (the lowest quantile in both size and book-to-market value) and the small growth portfolio (the lowest quantile in size and the highest quantile in book-to-market value) have the largest pricing error in CAPM, CCAPM and Fama-French three-factor model. The wealth ratio model does a good prediction for them. The predicted return for small value portfolio is almost the same the realized one. The pricing error for small growth portfolio is 1.85%, less than 3.25% for Fama-French model. Some studies (D'Avolio, 2002; Jones and Lamont, 2002; Lamont and Thaler, 2003) point out that the small growth stocks are more limit to arbitrage and the frictionless equilibrium models have difficulty on explaining the small growth portfolio.

6.3 Sensitivity Analysis

As a first robustness check, we relax the Markov assumption imposed on the aggregate weight shock by including additional k lags of the aggregate factors in the empirical specification of the aggregate weight process. We introduce two lags of consumption growth and expenditure share change as additional asset pricing factors in the unconditional cross-sectional model. Table 5 shows the estimates for different specifications. We use the detrended fixed asset measured wealth ratio as asset pricing factor; and column (1) repeats the results of the model without historical information. Column (2) and (3) add the interaction of lagged consumption growth and wealth composition. Column (4) and column (5) continue to add the interaction of lagged expenditure composition change and wealth composition. The goodness of fit of the cross-sectional estimation does not improve significantly by adding more lagged aggregate factors. When one lag of consumption growth is added in the model, the explanatory power increases by about 8% (comparing column (2) with column (1)). The extra factors are mostly insignificantly. We can conclude that the Markov assumption in linear model fits the data rather well. The expected return can be predicted by the historical data.

Secondly, the theory uses the wealth composition to measure the hot or cold housing market. A hot housing market damages the budget constraints for more households in future. We estimate the model with one period lagged wealth composition variables because the exact housing market cycle is not known. Table 6 shows the results of the linear model with a longer lagged wealth ratio. We use the detrended fixed asset measured wealth ratio as the asset pricing factor; and column (1) repeats the results of the model with the wealth ratio at time t. Column (2) through (4) show the results of our model with lag $L = 1, 2, 3$ for the wealth ratio. The fits, as measured by the cross-sectional R^2 or by pricing errors, is lower compared to the linear factor as reported in column (1); but still higher than HCAPM model. Furthermore, the coefficients on the interaction between consumption growth and lagged wealth ratio $L = 1, 2$ are positive and significant, which are consistent with the model's prediction.

Thirdly, we re-constructed the data into a new long horizon sample. The annual excess returns are accumulated into $T+1$ year cumulative excess return, $R^e_{t,t+T+1} = \sum_{\tau=0}^{T} R^e_{t+\tau,t+\tau+1}$. The consumption growth and expenditure composition are computed between t and $t+T+1$, $\Delta \ln c_{t,t+1+T} = \ln c_{t+1+T} - \ln c_t$ and $\Delta \ln \alpha_{t,t+1+T} = \ln \alpha_{t+1+T} - \ln \alpha_t$. The detrended fixed asset measured wealth composition at time t is still used as the asset pricing factor. Table 7 shows the results for $T = 0$ through $T = 7$. Column (1) repeats the same sample's results when $T = 0$. For column (2) to column (7), the time horizon of returns increases with T. In a long time horizon, the cumulative excess returns tend to be smoother, and the consumption growth explains less on the return variations. We find that the model still has high explanatory power on return variations even in a long horizon with smoother returns.

6.4 Time-varying Consumption Betas

Why does the wealth composition model can help explain the value premium? In the model, stock riskiness is determined by the covariance of its returns with aggregate risk factors conditional on the state variable ha, which measure the housing market condition. The conditional covariance reflects time-variation in risk premia. For a consumption based CAPM, the risk exposure is time-varying because of changing housing market conditions. The proposed model predicts that the hot housing market pushes up the risk exposure on consumption. In addition, if time variation in risk premia is important in explaining the value premium, stock with high book-to-market ratios should have a larger covariance with aggregate risk factors in risky times.

We estimate the risk exposure ("beta") for each of the 25 size and book-to-market portfolios. Actually this is the first step of the Fama-MacBeth two step procedure. In order to get the time-varying consumption "beta" of each portfolio, we impose a CCAPM model with time-varying wealth composition:

$$R^{e,j}_{t,t+1} = \beta^j_0 + \beta^j_c \Delta \ln c_{t+1} + \beta^j_{ha,c} ha_t \Delta \ln c_{t+1} \tag{10}$$

Equation (10) allows the covariance between return and consumption growth to vary with different ha_t. We run this regression with the detrended fixed asset measured ha from 1929 to 2009. Based on the estimates, the consumption beta is calculated as $\beta^j_t = \beta^j_c + \beta^j_{ha,c} ha_t$. Table 8 shows the statistic of consumption betas for different portfolios. Column (1) shows the average consumption betas. We also define the top 30% ha_t sample as hot housing market and the bottom 30% ha_t sample as cold housing market. Average consumption betas for both markets are reported in column (2) and column (3) respectively. Table 8 shows that the exposure for consumption risk in the hot housing market is higher than that in the cold housing market for most portfolios. The value stocks (BE/ME group 4 and 5) have higher consumption beta than the growth stocks (BE/ME group 1 and 2) in the hot housing market. However in cold market, consumption betas of all portfolios are not significantly different. The standard deviations of consumption beta for different housing market report that the hot housing market has higher variations for consumption beta than that in the cold housing market.

7 Micro Evidence from Subprime Crisis

The "subprime crisis", which is widely linked with housing market, started from the financial market, and subsequently caused serious spillover effects on the global economy. Our model starts from a micro perspective and emphasizes households' tight budget constraints in an irrational housing market. The micro dataset from suprime crisis provides an opportunity to understand the micro mechanism behind the macro factor pricing model.

7.1 Measurement of Distress

In our model, the wedge between the consumption growth and the expected stock return is caused by the heterogeneity among households. We use household level Panel Study of Income Dynamics(PSID) data to analyze households' financial conditions and consumption growth in a declining housing market. More importantly, the 2009 PSID survey collects the delinquency and foreclosure information, which makes this research possible. More details of this dataset are given in the appendix.

The proposed model describes one state in which households face tight budget constraints, because their housing prices are lower than their expectations. Practically, it is difficult to find data to measure the tight budget state. Base on 2009 PSID survey[12], we take the delinquency and foreclosure as the indicator of households in distress, to represent households with tight budget constraint in this section.[13]

Table 9 shows the micro statistics from 2001 to 2009. The first line is the number of foreclosures in each year of the sample of the 2009 PSID survey. Higher foreclosure indicates that more households face tight budget constraints. The number increases since 2001, and peaks in 2008. In the second line of table 9, I list the stock market participation in PSID 2001, 2003, 2005, 2007 and 2009 samples. The number is the ratio of households with any shares of stock in publicly held corporations, mutual funds, or investment trusts

[12] PSID 2009 survey questioned the foreclosure information since 2001 and delinquency information around 2009. More details can be found in the appendix.

[13] In classic mortgage default model, foreclosure could caused by either negative equity value or liquidity constraint (tight budget constraint). Recent literature reports a high weight of households hold negative equity mortgage, and strategic defaulters (caused by negative equity value) are few out of total defaulters. (see Foote, Geradi and Willen, 2008; Guiso, Sapienza and Zingales, 2011; Liu, Riddiough and Sing, 2012)

over the total observations. This participation rates are lower than 20% expect for 2001, which is slightly above 20%. [14] Taking a close look at the data, large variations exist across different years. Out of the total sample, households hold stocks in 2001 around 7% more than households also hold stocks in 2009, the post subprime crisis periods in 2009.

Table 9 clearly shows that the number of foreclosure and the stock market participation have the same trends. A high rate of foreclosure implies more households are in distress, which means that less households will participate in the stock market. We also include the macro asset pricing factor, housing-financial wealth ratio ha, in line 3. A high rate of foreclosure and less stock market participation rate always come after higher housing-financial wealth ratio, which is referred to as "hot housing market" in the asset pricing model. This can proof the asset pricing factor has a good performance as representation of micro pricing foundation.

7.2 Determinants of Distress

Taking the delinquency in 2009 PSID survey as the indicator of households in distress during this period, we scrutinize the linkage of house asset holding and distress after an overly hot property market. Of the total 6890 observations in the 2009 PSID survey, 237 households report that they have experienced (after 2007) or are experiencing distress. We carefully link the households to the 2007 PSID survey and in terms of their wealth allocation, income and other demographic information before the subprime crisis. A logit model is run to test the determinants of distress during the subprime crisis. The results are reported in table 10.

Three categories of variables are used to predict the distress of households. The first one is the wealth allocation. Model 1 includes the house value weight[15], mortgage weight, stock weight and personal business weight; and Model 2 uses the house equity weight[16]

[14] However, Mankiw and Zeldes (1991) use PSID 1984 survey data and report that about 30% households own stocks. The difference in the results could be due to different statistic methodologies used. In 1984 PSID survey, the stock holdings also include indirectly stock holdings through IRA (Individual Retirement Arrangement); but now stock account does not include stocks in employer-based pensions or IRAs. Some research (Cao, Wang and Zhang, 2005; Kullmann and Siegel, 2005) report a much higher stock market participation rate based on the Survey of Consumer Finances (SCF) because it oversamples richer households. e.g. according to the 1998 SCF, 19.2% of the households hold stock directly, and 16.5% hold stock through mutual funds. if indirect stock holding in pension or retirement funds are included, the percentage of households' stocks ownership rate increases to 48.8%. Compared with these statistics, the PSID stock market participation rate is within a reasonable range.

[15] This denotes house owning value over the net wealth. The net wealth is the total financial wealth plus house owning value minus total debt. The followings are similar.

[16] House equity is the house owning value minus the total mortgage on this house.

instead of house value weight and mortgage weight. The logit regression shows that high housing wealth allocation from both house value weight and house equity weight will significantly increase the likelihood of distress. This result is consistent with the story. Higher investment on housing can bind some households' budget constraints in a overly hot/irrational housing market. If market condition is good, house owners accumulate their wealth in their housing assets. In contrary, the households face distress due to loss of housing assets when the market condition deteriorates.

Model 1 reports households with more mortgage have a low probability in distress. The mortgage weight of households measures the ability of gaining credit. It is not surprising that households without borrowing constraint are less likely to be in distress. Both model 1 and model 2 show that stock wealth is not correlated with the probability of households in distress; and households with bigger personal business are more likely to be in distress. Heaton and Lucas (2011) suggest that entrepreneurial risk is important in asset pricing. Our micro evidence also implies that entrepreneurial risk significantly impacts the households' financial conditions.

We control the scale of income and total wealth in the regression. The coefficients on income square are significantly negative in both models, which imply that middle income families have higher probability to be in distress. The middle income families can enter the housing market but they face more fragile budget constraint compared with high income families. The scale of total wealth is not significant in the regressions. In addition, demographic variables are also included. The results show that families with middle age, female and low education head have higher likelihood to be in distress. The family size and marriage status are also related to the financial status.

7.3 Consequence of Distress

A declining housing market drives some households into distress. What does this mean in the asset pricing? This question can be empirically explained from two aspects. Firstly, we check whether the distress impacts the stock market participation. To avoid endogeneity issues, table 11 shows the descriptive statistics of the number of households in distress by the stock market participation. In 2009, most households in distress did not hold any stocks; 11 delinquency households with stock holding in 2007 withdrew their stocks in 2009. We also use the number of foreclosure as robustness tests, and find the similar trend.

The consumption insurance is tested following the methodology of Cochrane (1991).

He runs cross-sectional regressions of consumption growth on a variety of exogenous variables and found that the full insurance is only rejected by unpredictable shock, such as long illness and involuntary job loss, but not for spells of unemployment and loss of work due to strike. The PSID does not have information of nondurable goods consumption, most researchers (Cochrane, 1991; Mankiw and Zeldes,1991) use food consumption instead as the proxy. We follow this standard methodology, and first run cross-sectional regressions of consumption growth on distress dummy. The results are shown in Panel A of Table 12. The coefficient on the delinquency dummy is significantly negative and it remain significant even after controlling the income growth. Consumption insurance is rejected by the distress. As the model's prediction, households in distress will adjust their consumption and the representative agent assumption will not be reasonable. Panel B reports the robustness test with a foreclosure dummy, and the results show that households in foreclosure have low consumption growth.

The behavior of distressed households in stock market participation and consumption growth shows that asset pricing model that assume homogenous households will be rejected by micro facts. The effort that we put in the general consumption based asset pricing model is to correct it from the house market perspective. The micro evidence shown in this sector demonstrates a clear linkage between housing wealth and the basic pricing risk factor.

8 Conclusion

This paper introduces the irrational housing market into the consideration of asset pricing. When the high expectation of agents in housing market cannot be met by the real market environment, some of them will face bound budget constraints. The full consumption insurance assumption will not be satisfied and as a result, consumption growth varies among investors. We document that the housing-financial wealth ratio can be taken as the measurement of the irrational market, which helps predict the stock returns. Our empirical results also find the evidence of the wealth composition's prediction. The housing-financial wealth ratio is highly related to the long horizon excess return; and conditional it, the CCAPM shows higher explanatory power for the cross-sectional variations in stock returns. The micro evidence from the recent subprime crisis explicitly supports the micro mechanism of the model.

Why does the wealth composition model work better than the standard CCAPM? The answer lies in allowing for time-variation of consumption exposure in risk-sharing.

The standard CCAPM implies that risk-sharing is always perfect among individuals. Based on this assumption, representative agents and aggregate data work well in this type of models. However this assumption is not realistic. The consumption growth distribution violates the assumption of representative agent, and thus the prediction based on aggregate data is obviously biased. The wealth composition is the factor used in our model to correct this bias.

A Panel Study of Income Dynamics (PSID) Data

The PSID is a longitudinal study of a representative sample of US households and individuals since 1968. From 1968 to 1996, the survey was conducted every year; but in 1997 data collection frequency was changed from an annual to a biennial. The questions of PSID cover many aspects of households' activity besides income. Of particular interests for the study are topics involving financial distress information. In 2009, the surveyed families were asked new content about mortgage distress in terms of foreclosure activity, falling behind in payments, mortgage modification, and expectations about mortgage payment difficulties in the coming 12 months. Especially, the foreclosure information is tracked back since 2001.

The house value data is collected based on the self-assessed market value of owner-occupied house, and the mortgagor is asked about the value of remaining mortgage balances. The wealth information is divided into several parts in PSID since 1999, i.e. other real estate assets, business, stocks, annuities, savings, bond and insurance, and debt. We calculate the net wealth of households by summing of all wealth accounts and deleting obligations. The net house equity value is calculated as the house value minus the remaining mortgage.

We use food consumption data to represent the nondurable goods consumption information. The food consumption is calculated by the sum of food expenditure made by both food stamp and cash every week. The ratio of food consumption every week between 2009 and 2007 survey, after taking the nature log, is used to measure the consumption growth.

The demographic information is also required in our research. The families' size, number of children and income are collected from the respective survey. The household head's characteristics of the families are also included, e.g. age, sex, marriage status, and education. The descriptive statistics are shown in Table 13

References

[1] Aiyagari, S. Rao, and Mark Gertler, 1991, Asset returns with transactions costs and uninsured individual risk, Journal of Monetary Economics 27, 311-331.

[2] Altonji, Joseph G., Fumio Hayashi, and Laurence J. Kotlikoff, 1992, Is the extended family altruistically linked? Direct tests using micro data, The American Economic Review 82, 1177-1198.

[3] Attanasio, Orazio, and Steven J. Davis, 1996, Relative wage movements and the distribution of consumption, The Journal of Political Economy 104, 1227-1262.

[4] Boldrin, Michele, Lawrence J. Christiano, and Jonas D. M. Fisher, 2001, Habit persistence, asset returns, and the business cycle, The American Economic Review 91, 149-166.

[5] Brav, Alon, George M. Constantinides, and Christopher C. Geczy, 2002, Asset pricing with heterogeneous consumers and limited participation: Empirical evidence, The Journal of Political Economy 110, 793-824.

[6] Breeden, Douglas T., 1979, An intertemporal asset pricing model with stochastic consumption and investment opportunities, Journal of Financial Economics 7, 265-296.

[7] Breeden, Douglas T., Michael R. Gibbons, and Robert H. Litzenberger, 1989, Empirical test of the consumption-oriented capm, The Journal of Finance 44, 231-262.

[8] Breeden, Douglas T., and Robert H. Litzenberger, 1978, Prices of state-contingent claims implicit in option prices, The Journal of Business 51, 621-651.

[9] Campbell, John Y., 2003, Chapter 13 consumption-based asset pricing, in M. Harris G.M. Constantinides, and R. M. Stulz, eds.: Handbook of the economics of finance (Elsevier).

[10] Cao, H. Henry, Tan Wang, and Harold H. Zhang, 2005, Model uncertainty, limited market participation, and asset prices, Review of Financial Studies 18, 1219-1251.

[11] Case, Karl E., and Robert J. Shiller, 1989, The efficiency of the market for single-family homes, The American Economic Review 79, 125-137.

[12] Case, Karl E., and Robert J. Shiller, 1990, Forecasting prices and excess returns in the housing market, Real Estate Economics 18, 253-273.

[13] Chien, YiLi, and Hanno Lustig, 2010, The market price of aggregate risk and the wealth distribution, Review of Financial Studies 23, 1596-1650.

[14] Chu, Yongqiang, 2010, An intertemporal capital asset pricing model with owner-occupied housing, Real Estate Economics 38, 427-466.

[15] Cocco, Joao F., 2005, Portfolio choice in the presence of housing, Review of Financial Studies 18, 535-567.

[16] Cochrane, John H., 1991, Production-based asset pricing and the link between stock returns and economic fluctuations, The Journal of Finance 46, 209-237.

[17] Cochrane, John H., 1991, A simple test of consumption insurance, The Journal of Political Economy 99, 957-976.

[18] Cochrane, John H., 1996, A cross-sectional test of an investment-based asset pricing model, The Journal of Political Economy 104, 572-621.

[19] Cogley, Timothy, 2002, Idiosyncratic risk and the equity premium: Evidence from the consumer expenditure survey, Journal of Monetary Economics 49, 309-334.

[20] Constantinides, George M., 1982, Intertemporal asset pricing with heterogeneous consumers and without demand aggregation, The Journal of Business 55, 253-267.

[21] Constantinides, George M., 1990, Habit formation: A resolution of the equity premium puzzle, The Journal of Political Economy 98, 519-543.

[22] Constantinides, George M., and Darrell Duffie, 1996, Asset pricing with heterogeneous consumers, The Journal of Political Economy 104, 219-240.

[23] D'Avolio, Gene, 2002, The market for borrowing stock, Journal of Financial Economics 66, 271-306.

[24] Eichenbaum, Martin, and Lars Peter Hansen, 1990, Estimating models with intertemporal substitution using aggregate time series data, Journal of Business & Economic Statistics 8, 53-69.

[25] Epstein, Larry G., and Stanley E. Zin, 1989, Substitution, risk aversion, and the temporal behavior of consumption and asset returns: A theoretical framework, Econometrica 57, 937-969.

[26] Epstein, Larry G., and Stanley E. Zin, 1991, Substitution, risk aversion, and the temporal behavior of consumption and asset returns: An empirical analysis, The Journal of Political Economy 99, 263-286.

[27] Fama, Eugene F., 1970, Efficient capital markets: A review of theory and empirical work, The Journal of Finance 25, 383-417.

[28] Fama, Eugene F., 1998, Market efficiency, long-term returns, and behavioral finance, Journal of Financial Economics 49, 283-306.

[29] Fama, Eugene F., and Kenneth R. French, 1992, The cross-section of expected stock returns, The Journal of Finance 47, 427-465.

[30] Fama, Eugene F., and Kenneth R. French, 1993, Common risk factors in the returns on stocks and bonds, Journal of Financial Economics 33, 3-56.

[31] Fama, Eugene F., and James D. MacBeth, 1973, Risk, return, and equilibrium: Empirical tests, The Journal of Political Economy 81, 607-636.

[32] Flavin, Marjorie, and Shinobu Nakagawa, 2008, A model of housing in the presence of adjustment costs: A structural interpretation of habit persistence, The American Economic Review 98, 474-495.

[33] Flavin, Marjorie, and Takashi Yamashita, 2002, Owner-occupied housing and the composition of the household portfolio, The American Economic Review 92, 345-362.

[34] Foote, Christopher L., Kristopher Gerardi, and Paul S. Willen, 2008, Negative Equity and Foreclosure: Theory and Evidence, Journal of Urban Economics 64, 234-45.

[35] Friedman, Milton, 1957. A theory ofthe consumption function (Princeton University Press, Princeton, NJ).

[36] Gomes, Francisco, and Alexander Michaelides, 2008, Asset pricing with limited risk sharing and heterogeneous agents, Review of Financial Studies 21, 415-448.

[37] Guiso, Luigi, Paolo Sapienza, and Luigi Zingales, 2011, The Determinants of Attitudes Towards Strategic Default on Mortgage, Chicago Booth School of Business, University of Chicago.

[38] Hansen, Lars Peter, and Ravi Jagannathan, 1991, Implications of security market data for models of dynamic economies, The Journal of Political Economy 99, 225-262.

[39] Heaton, John, and Deborah Lucas, The effects of incomplete insurance markets and trading costs in a consumption-based asset pricing model, Journal of Economic Dynamics and Control 16, 601-620.

[40] Heaton, John, and Deborah Lucas, 1995, The importance of investor heterogeneity and financial market imperfections for the behavior of asset prices, Carnegie-Rochester Conference Series on Public Policy 42, 1-32.

[41] Heaton, John, and Deborah J. Lucas, 1996, Evaluating the effects of incomplete markets on risk sharing and asset pricing, The Journal of Political Economy 104, 443-487.

[42] Jones, Charles M., and Owen A. Lamont, 2002, Short-sale constraints and stock returns, Journal of Financial Economics 66, 207-239.

[43] Jouini, ElyEs, and Clotilde Napp, 2007, Consensus consumer and intertemporal asset pricing with heterogeneous beliefs, Review of Economic Studies 74, 1149-1174.

[44] Kullmann, Cornelia, 2001, Real estate and its role in asset pricing, SSRN eLibrary.

[45] Lamont, Owen A, and Richard H Thaler, 2003, Can the market add and subtract? Mispricing in tech stock carve-outs, The Journal of Political Economy 111, 227-268.

[46] Lettau, Martin, and Sydney Ludvigson, 2001, Consumption, aggregate wealth, and expected stock returns, The Journal of Finance 56, 815-849.

[47] Lettau, Martin, and Sydney Ludvigson, 2001, Resurrecting the (c)capm: A cross-sectional test when risk premia are time-varying, The Journal of Political Economy 109, 1238-1287.

[48] Lintner, John, 1965, Security prices, risk, and maximal gains from diversification, The Journal of Finance 20, 587-615.

[49] Liu, Bo, Timothy Riddiough, and Tien Foo Sing, 2012, Strategic defaulters and irrational non-defaulters: a split population survival time analysis. National University of Singapore.

[50] Lucas, Deborah J., 1994, Asset pricing with undiversifiable income risk and short sales constraints: Deepening the equity premium puzzle, Journal of Monetary Economics 34, 325-341.

[51] Lucas, Robert E., Jr., 1978, Asset prices in an exchange economy, Econometrica 46, 1429-1445.

[52] Lustig, Hanno N., and Stijn G. Van Nieuwerburgh, 2005, Housing collateral, consumption insurance, and risk premia: An empirical perspective, The Journal of Finance 60, 1167-1219.

[53] Mace, Barbara J., 1991, Full insurance in the presence of aggregate uncertainty, The Journal of Political Economy 99, 928-956.

[54] Mankiw, N. Gregory, 1986, The equity premium and the concentration of aggregate shocks, Journal of Financial Economics 17, 211-219.

[55] Mankiw, N. Gregory, and Matthew D. Shapiro, 1986, Risk and return: Consumption beta versus market beta, The Review of Economics and Statistics 68, 452-459.

[56] Mankiw, N. Gregory, and Stephen P. Zeldes, 1991, The consumption of stockholders and nonstockholders, Journal of Financial Economics 29, 97-112.

[57] Mehra, Rajnish, and Edward C. Prescott, 1985, The equity premium: A puzzle, Journal of Monetary Economics 15, 145-161.

[58] Mian, Atif, and Amir Sufi, 2010, The great recession: Lessons from microeconomic data, American Economic Review 100, 51-56.

[59] Modigliani, Franco, and Richard Brumberg, eds., 1954. Utility analysis and the consumption function: An iterpretation of cross-section data (Rutgers University Press, New Brunswick).

[60] Newey, Whitney K., and Kenneth D. West, 1987, A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix, Econometrica 55, 703-708.

[61] Piazzesi, Monika, Martin Schneider, and Selale Tuzel, 2007, Housing, consumption and asset pricing, Journal of Financial Economics 83, 531-569.

[62] Santos, Tano, and Pietro Veronesi, 2006, Labor income and predictable stock returns, Review of Financial Studies 19, 1-44.

[63] Shanken, J, 1992, On the estimation of beta-pricing models, Review of Financial Studies 5, 1-55.

[64] Sharpe, William F., 1964, Capital asset prices: A theory of market equilibrium under conditions of risk, The Journal of Finance 19, 425-442.

[65] Shilling, James D., and Sing Tien Foo, 2010, The puzzling behavior of commercial real estate prices, Working paper (DePaul University & National University of Singapore).

[66] Stambaugh, Robert F., 1982, On the exclusion of assets from tests of the two-parameter model : A sensitivity analysis, Journal of Financial Economics 10, 237-268.

[67] Telmer, Chris I., 1993, Asset-pricing puzzles and incomplete markets, The Journal of Finance 48, 1803-1832.

[68] Tuzel, Selale, 2010, Corporate real estate holdings and the cross-section of stock returns, Review of Financial Studies 23, 2268-2302.

[69] Wilson, Robert, 1968, The theory of syndicates, Econometrica 36, 119-132.

[70] Yamashita, Takashi, 2003, Owner-occupied housing and investment in stocks: An empirical test, Journal of Urban Economics 53, 220-237.

Table 1: **Summary Statistics of Hostorical Data**

The summary statistics are computed over the sample from 1929 to 2009 and the subspample is from 1945 to 2009. $\Delta \ln c$ is the nondurable goods conusmption growth; α is the share of non-housing consumption in total consumption; and $\Delta \ln \alpha$ is the growth of non-housing consumption share; $\Delta \ln hv^{fa}$ is the total housing wealth growth from fixed asset account; $\Delta \ln av$ is the financial wealth growth; ha^{fa} is the housing-financial wealth ratio; r^e is the log return on the S&P compsition index; r^f is the risk-free rate. hv^{rw} is the housing wealth from FoF data, which is only availeble after 1945. $\Delta \ln hv^{rw}$ is the housing wealth growth based on this data, and the ha^{rw} is the housing-financial wealth retio based on this data. All the data presented in this table is annual data.

	$\Delta \ln c$	α	$\Delta \ln \alpha$	$\Delta \ln hv^{fa}$	$\Delta \ln av$	ha^{fa}	r^e	r^f	$\Delta \ln hv^{rw}$	ha^{rw}
Mean	0.018	0.825	0.000	0.062	0.067	0.453	0.054	0.010		
Auto. corr.	0.475	0.943	0.542	0.628	0.381	0.906	0.019	0.629		
1945-2009 sample:										
Mean	0.019	0.826	-0.001	0.071	0.071	0.429	0.064	0.010	0.077	0.438
Auto. Corr.	0.340	0.977	0.551	0.643	0.098	0.903	0.013	0.559	0.662	0.919
standard deviations and correlations										
$\Delta \ln c$	0.024									
α	0.351	0.017								
$\Delta \ln \alpha$	0.530	0.147	0.007							
$\Delta \ln hv^{fa}$	0.453	0.517	0.320	0.055						
$\Delta \ln av$	0.581	0.445	0.280	0.429	0.076					
ha^{fa}	-0.203	-0.032	0.203	-0.043	-0.212	0.081				
r^e	0.105	0.052	0.054	0.061	0.514	-0.104	0.188			
r^f	-0.421	-0.661	-0.470	-0.697	-0.348	-0.020	0.021	0.000		
1945-2009: standard deviations and correlations										
$\Delta \ln c$	0.016									
α	-0.218	0.015								
$\Delta \ln \alpha$	0.408	-0.229	0.004							
$\Delta \ln hv^{fa}$	0.202	0.438	0.287	0.041						
$\Delta \ln av$	0.189	0.009	0.002	0.244	0.060					
ha^{fa}	-0.209	0.338	-0.182	0.320	0.008	0.061				
r^e	0.034	-0.112	-0.338	-0.262	0.744	-0.138	0.169			
r^f	0.023	-0.607	-0.201	-0.633	-0.013	-0.072	0.275	0.000		
$\Delta \ln hv^{rw}$	0.220	0.397	0.017	0.785	0.390	0.272	0.035	-0.397	0.060	
ha^{rw}	-0.125	-0.370	0.095	-0.021	-0.027	0.464	-0.111	0.307	0.009	0.070

Table 2: **Long-Horizon Predictability Regressions**

The results are for the regression $R^e_{t,t+K} = b_0 + bx_t + \varepsilon_{t+K}$, where $R^e_{t,t+K}$ are the cumulative excess returns on the S&P composite index over a K-year horizon. Panel A reports the results for the full sample from 1929 to 2009; panel B reports the results for the sample from 1945 to 2009. Each subsample report the results for different housing-financial wealth ratio measurements x_t. Here x_t is respectively ha^{fa}, $\tilde{ha}^{fa}$, ha^{rw}, and $\tilde{ha}^{rw}$. The superscript fa and rw represent the data sources of housing value, fixed asset and FoF. The tilde marks the data streams have been detrended. In each subsample, the first line reports the coefficient of x_t and significance level at 10% is indicated in boldface; second line is the Newey-West HAC standard errors σ^{nw}. The standard errors are corrected for serial correlation of order K, where K is the holding period. The third line reports the $p - val$ of the regression based on Newey-West standard errors. The fourth line is the R^2 of the regression.

Horizon K	1	2	3	4	5	6	7	8	9	10
Panel A: Full Sample										
Subpanel 1: Housing-Fiancial Wealth Ratio ha^{fa}										
b	0.150	0.418	0.594	0.635	0.786	0.934	1.109	1.082	1.372	1.538
σ^{nw}	0.297	0.516	0.608	0.669	0.777	0.917	1.352	1.383	1.593	1.756
$p - val$	0.616	0.420	0.331	0.346	0.315	0.312	0.415	0.437	0.392	0.384
R^2	0.004	0.016	0.027	0.024	0.030	0.039	0.038	0.036	0.051	0.056
Subpanel 2: Housing-Fiancial Wealth Ratio after Detrended $\tilde{ha}^{fa}$										
b	0.250	0.591	0.778	0.754	0.970	1.144	1.408	1.438	1.854	2.128
σ^{nw}	0.270	0.457	0.549	0.633	0.757	0.934	1.425	1.469	1.753	1.988
$p - val$	0.357	0.200	0.161	0.237	0.204	0.225	0.327	0.331	0.294	0.288
R^2	0.008	0.021	0.030	0.023	0.031	0.039	0.042	0.044	0.065	0.077
Panel B: 1945-2009										
Subpanel 1: Housing-Fiancial Wealth Ratio ha^{fa}										
b	**0.641**	**1.193**	**1.528**	**1.960**	**2.514**	**2.922**	**4.272**	**4.247**	**4.910**	**5.388**
σ^{nw}	0.360	0.633	0.823	0.945	1.032	1.102	1.292	1.298	1.445	1.594
$p - val$	0.080	0.064	0.068	0.042	0.018	0.010	0.002	0.002	0.001	0.001
R^2	0.056	0.096	0.116	0.144	0.182	0.203	0.295	0.293	0.334	0.350
Subpanel 2: Housing-Fiancial Wealth Ratio after Detrended $\tilde{ha}^{fa}$										
b	**0.520**	**0.830**	0.997	**1.274**	**1.690**	**2.002**	**3.060**	**3.133**	**3.668**	**4.025**
σ^{nw}	0.294	0.491	0.636	0.753	0.872	1.014	1.260	1.303	1.644	1.866
$p - val$	0.082	0.096	0.122	0.096	0.058	0.053	0.018	0.020	0.030	0.036
R^2	0.037	0.046	0.050	0.063	0.086	0.100	0.160	0.169	0.201	0.220
Subpanel 3: Housing-Fiancial Wealth Ratio ha^{rw}										
b	0.352	0.451	0.431	0.598	0.969	1.272	2.056	2.282	2.737	3.021
σ^{nw}	0.262	0.455	0.633	0.770	0.964	1.232	1.740	1.811	2.263	2.538
$p - val$	0.185	0.326	0.499	0.441	0.319	0.306	0.242	0.213	0.232	0.239
R^2	0.022	0.018	0.012	0.018	0.034	0.048	0.084	0.100	0.125	0.139
Subpanel 4: Housing-Fiancial Wealth Ratio after Detrended$\tilde{ha}^{rw}$										
b	**0.684**	**1.157**	1.310	**1.708**	**2.378**	**2.858**	**4.180**	**4.301**	**4.927**	**5.332**
σ^{nw}	0.401	0.667	0.825	0.807	0.749	0.838	1.116	1.129	1.495	1.772
$p - val$	0.093	0.088	0.117	0.039	0.002	0.001	0.000	0.000	0.002	0.004
R^2	0.053	0.075	0.072	0.094	0.138	0.166	0.243	0.257	0.293	0.304

Table 3: **Fama-Macbeth Regression Results**

This table shows the results of Fama-MacBeth procedure for our models. The first column is the CCAPM model with conusmption growth $\Delta \ln c_{t+1}$ as pricing factor. And column 2 follows the model in Piazzesi, Schneider and Tuzel (2007)'s paper, adding $\Delta \ln \alpha_{t+1}$ as pricing factor. Column (3) to column (6) are our model's results. The pricing factors are $\Delta \ln c_{t+1}$, $\Delta \ln \alpha_{t+1}$, x_t, $x_t \Delta \ln c_{t+1}$, $x_t \Delta \ln \alpha_{t+1}$. x_t is ha^{fa}, $\tilde{ha}^{fa}$, ha^{rw}, $\tilde{ha}^{rw}$ respectively. Column (1) to column (4) uses the data from 1929 to 2009, column (5) and (6) is for 1945–2009. The last line reports the R^2 and the adjusted R^2 just below it. OLS standard errors are in parathese, and Shanken-corrected standard errors are in brackets.Significance level at 10% , based on corrected standard errors, is indicated in boldface.

Model	CCAPM	HCAPM	ha^{fa}	$\tilde{ha}^{fa}$	ha^{rw}	$\tilde{ha}^{rw}$
	1	2	3	4	5	6
Intercept	8.69	4.50	**7.28**	**5.73**	**7.60**	**9.63**
	(1.97)	(1.47)	(1.43)	(1.13)	(2.56)	(2.25)
	[2.34]	[1.93]	[2.31]	[1.57]	[5.16]	[4.79]
λ_c	1.53	0.74	-0.54	0.02	1.21	1.13
	(1.08)	(0.71)	(0.86)	(0.53)	(0.86)	(0.73)
	[1.31]	[0.98]	[1.23]	[0.78]	[1.74]	[1.56]
λ_α		**0.59**	**0.43**	**0.41**	0.26	0.20
		(0.13)	(0.11)	(0.10)	(0.11)	(0.10)
		[0.18]	[0.20]	[0.16]	[0.22]	[0.22]
λ_{ha}			0.49	1.78	5.38	1.43
			(2.01)	(1.87)	(2.84)	(2.07)
			[3.48]	[2.70]	[5.78]	[4.48]
$\lambda_{ha,c}$			-0.23	0.06	0.74	0.16
			(0.34)	(0.05)	(0.31)	(0.06)
			[0.58]	[0.08]	[0.63]	[0.12]
$\lambda_{ha,\alpha}$			**0.20**	0.01	0.12	0.01
			(0.07)	(0.02)	(0.05)	(0.01)
			[0.12]	[0.03]	[0.09]	[0.02]
R^2	7.96	63	82.08	84.17	68.06	72.74
	3.96	59.63	77.36	80.01	59.65	65.57

Table 4: **Comparison of Asset Pricing Model**

This table shows the results of Fama-MacBeth procedure for different models. Column (1) is the basic CAPM mode with the value-weighted market return R^{vw}_{t+1} as pricing factor. Column (2) is three factor Fama-French model with factor R^{vw}_{t+1}, the excess return associated with the size R^{smb}_{t+1} and value R^{hml}_{t+1}. The column (3) is a conditional CCAPM model with factor conumpstion growth $\Delta \ln c_{t+1}$, cay_t and $cay_t \Delta \ln c_{t+1}$. Column (4) is a conditional CAPM with factors market return $R^{vw}_{t,t+1}$, labor income and consumption ratio lc_t and $lc_t R^{vw}_{t,t+1}$. Column (5) is the collateral housing asset pricing model with fatcors $\Delta \ln c_{t+1}$, $\Delta \ln \alpha_{t+1}$, and the collateral ratio, defined as the ratio of housing and income my_t, and $my_t \Delta \ln c_{t+1}$, $my_t \Delta \ln \alpha_{t+1}$. Column (6) is the model in this paper with factors $\Delta \ln c_{t+1}$, $\Delta \ln \alpha_{t+1}$, ha_t, and $ha_t \Delta \ln c_{t+1}$, $ha_t \Delta \ln \alpha_{t+1}$. Here the ha is ha^{fa}. The last line reports the R^2 and the adjusted R^2 just below it. OLS standard errors are in parathese, and Shanken-corrected standard errors are in brackets.Significance level at 10%, based on corrected standard errors, is indicated in boldface.

Model	CAPM	Fama-French	*cay*-CCAPM	*lc*-CCAPM	*coll*-HCAPM	This Paper
	1	2	3	4	5	6
Intercept	-2.80	**16.59**	1.94	-0.83	**4.75**	**7.28**
	(4.62)	(3.69)	(3.31)	(3.34)	(1.12)	(1.43)
	[5.27]	[4.72]	[4.73]	[4.33]	[1.47]	[2.31]
λ_1	**11.45**	**-9.07**	1.46	0.02	0.41	-0.54
	(3.72)	(3.55)	(1.01)	(0.03)	(0.50)	(0.74)
	[4.84]	[5.10]	[1.46]	[0.04]	[0.71]	[1.23]
λ_2		**3.86**	-0.88	**0.08**	**0.35**	**0.43**
		(0.60)	(1.38)	(0.03)	(0.10)	(0.11)
		[1.75]	[2.02]	[0.04]	[0.15]	[0.20]
λ_3		**5.73**	-1.37	**0.17**	-3.76	0.49
		(0.67)	(0.89)	(0.07)	(2.36)	(2.08)
		[1.80]	[1.29]	[0.10]	[3.22]	[3.48]
λ_4					-0.07	-0.23
					(0.10)	(0.34)
					[0.15]	[0.58]
λ_5					**-0.06**	**0.20**
					(0.02)	(0.07)
					[0.03]	[0.12]
R^2	29.18	85.66	41.06	69.93	86.26	82.08
	26.1	83.61	32.64	65.64	82.64	77.36

Table 5: **Cross-Sectional Results with Lagged Consumption**

Shown here is the estimation of the market prices of risk λ, using the Fama-MacBeth procedure for 1929-2009. The pricing factors are consumption growth $\Delta \ln c_{t+1}$, non-housing consumption share change $\Delta \ln \alpha_{t+1}$, the housing-financial wealth ratio ha_t and their interaction. From column (2) to column (5) the regressions also include the interaction of ha_t and lags of consumption growth and non-housing consumption share change. In this table, ha is measured by $\widetilde{ha^{fa}}$. The last line reports the R^2 and the adjusted R^2 just below it. OLS standard errors are in parathese, and Shanken-corrected standard errors are in brackets. Significance level at 10%, based on corrected standard errors, is indicated in boldface.

	$Lag = 0$	$Lag = 1$	$Lag = 1,2$	$Lag = 1$	$Lag = 1,2$
	1	2	3	4	5
Intercept	**5.73**	**11.44**	**13.27**	**11.45**	**12.79**
	(1.14)	(1.36)	(1.15)	(1.27)	(1.45)
	[1.58]	[2.62]	[2.26]	[2.45]	[2.74]
$\Delta \ln c_{t+1}$	0.02	-0.22	-0.58	-0.52	-0.55
	(0.53)	(0.36)	(0.34)	(0.37)	(0.36)
	[0.78]	[0.73]	[0.71]	[0.76]	[0.73]
$\Delta \ln \alpha_{t+1}$	**0.42**	**0.42**	**0.38**	**0.38**	**0.35**
	(0.10)	(0.07)	(0.06)	(0.07)	(0.08)
	[0.16]	[0.16]	[0.15]	[0.16]	[0.16]
ha_t	1.78	0.99	1.19	0.87	0.73
	(1.88)	(1.35)	(1.29)	(1.27)	(1.47)
	[2.71]	[2.70]	[2.64]	[2.54]	[2.87]
$ha_t \Delta \ln c_{t+1}$	0.06	**0.13**	**0.12**	0.10	0.09
	(0.05)	(0.04)	(0.04)	(0.04)	(0.05)
	[0.08]	[0.08]	[0.08]	[0.08]	[0.11]
$ha_t \Delta \ln \alpha_{t+1}$	0.00	0.02	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]
$ha_t \Delta \ln c_t$		-0.09	-0.08	-0.09	-0.09
		(0.04)	(0.04)	(0.04)	(0.04)
		[0.09]	[0.08]	[0.08]	[0.09]
$ha_t \Delta \ln \alpha_t$				-0.02	-0.02
				(0.01)	(0.01)
				[0.02]	[0.02]
$ha_t \Delta \ln c_{t-1}$			-0.10		-0.11
			(0.05)		(0.05)
			[0.09]		[0.10]
$ha_t \Delta \ln \alpha_{t-1}$					-0.03
					(0.01)
					[0.02]
R^2	84.17	92.98	94.71	94.17	94.92
	80.01	90.64	92.57	91.78	91.87

Table 6: **Cross-Sectional Results with Lagged Housing-Financial Wealth Ratio**

This table shows the estimation of Fama-MacBeth procedure with lag housing-financial wealth ratio ha. The other asset pricing factor is as same as our basic model and only ha is changed to the lagged value. In this table, ha is measured by $\widetilde{ha^{fa}}$. The last line reports the R^2 and the adjusted R^2 just below it. OLS standard errors are in parathese, and Shanken-corrected standard errors are in brackets. Significance level at 10%, based on corrected standard errors, is indicated in boldface.

L	$lag = 0$	$lag = 1$	$lag = 2$	$lag = 3$
	1	2	3	4
Intercept	**5.73**	**5.74**	**6.03**	**7.28**
	(1.14)	(1.14)	(2.26)	(2.52)
	[1.58]	[1.61]	[3.10]	[4.34]
$\Delta \ln c_{t+1}$	0.02	0.47	0.00	1.92
	(0.53)	(0.64)	(0.95)	(0.92)
	[0.78]	[0.94]	[1.32]	[1.60]
$\Delta \ln \alpha_{t+1}$	**0.42**	**0.49**	**0.32**	**0.58**
	(0.10)	(0.12)	(0.14)	(0.13)
	[0.16]	[0.18]	[0.21]	[0.23]
ha_{t-L}	1.78	0.14	0.72	2.42
	(1.88)	(2.51)	(3.17)	(2.99)
	[2.71]	[3.62]	[4.40]	[5.21]
$ha_{t-L}\Delta \ln c_{t+1}$	0.06	**0.12**	**0.13**	0.06
	(0.05)	(0.05)	(0.07)	(0.08)
	[0.08]	[0.07]	[0.11]	[0.14]
$ha_{t-L}\Delta \ln \alpha_{t+1}$	0.00	0.01	**0.03**	0.03
	(0.01)	(0.01)	(0.01)	(0.02)
	[0.02]	[0.01]	[0.02]	[0.03]
R^2	84.17	79.20	70.99	67.58
	80.01	73.72	63.36	59.05

Table 7: **Cross-Sectional Results with Overlapped Return**

This table reports the estimation of Fama-MacBeth procedure for a long time period T. The dependent variables are the excessed returned Fama-Frech portfolio returns for time t to $t+T$. The asset pricing factors are the consumption growth from time t to $t+T$, Non housing consumption share change from time t to $t+T$, ha in time t, and their interaction. In this table, ha is measured by $\tilde{ha}^{fa}$. The last line reports the R^2 and the adjusted R^2 just below it. OLS standard errors are in parathese, and Shanken-corrected standard errors are in brackets. Significance level at 10%, based on corrected standard errors, is indicated in boldface.

	$T=0$	$T=1$	$T=2$	$T=3$	$T=4$	$T=5$	$T=6$
	1	2	3	4	5	6	7
Intercept	**5.73**	**11.10**	**21.13**	**31.49**	**51.44**	**85.48**	**111.21**
	(1.14)	(2.50)	(3.42)	(4.01)	(4.52)	(5.51)	(8.00)
	[1.58]	[4.02]	[8.36]	[11.00]	[13.04]	[16.83]	[26.44]
$\Delta \ln c_{t,t+1+T}$	0.02	0.38	1.64	-1.02	-1.04	0.52	-0.57
	(0.53)	(0.79)	(1.20)	(1.77)	(2.03)	(2.73)	(3.85)
	[0.78]	[1.35]	[2.98]	[4.89]	[5.90]	[8.38]	[12.75]
$\Delta \ln \alpha_{t,t+1+T}$	**0.42**	**0.87**	**1.79**	**1.63**	**1.86**	**2.72**	3.04
	(0.10)	(0.15)	(0.24)	(0.32)	(0.30)	(0.42)	(0.68)
	[0.16]	[0.28]	[0.61]	[0.90]	[0.90]	[1.32]	[2.25]
ha_t	1.78	1.73	0.55	0.59	1.03	1.30	1.13
	(1.88)	(2.18)	(2.57)	(3.03)	(2.60)	(2.78)	(3.66)
	[2.71]	[3.58]	[6.33]	[8.35]	[7.54]	[8.55]	[12.12]
$ha_t \Delta \ln c_{t,t+1+T}$	0.06	0.16	0.30	0.12	0.08	0.01	-0.08
	(0.05)	(0.09)	(0.17)	(0.27)	(0.29)	(0.39)	(0.57)
	[0.08]	[0.16]	[0.42]	[0.75]	[0.85]	[1.19]	[1.90]
$ha_t \Delta \ln \alpha_{t,t+1+T}$	0.00	-0.02	-0.05	-0.16	-0.20	-0.25	-0.30
	(0.01)	(0.02)	(0.04)	(0.06)	(0.06)	(0.06)	(0.09)
	[0.02]	[0.04]	[0.10]	[0.18]	[0.16]	[0.19]	[0.29]
R^2	84.17	84.43	83.04	78.19	84.66	84.17	77.46
	80.01	80.34	78.58	72.45	80.63	80.00	71.53

Table 8: **Consumption Beta**

Consumption betas are computed as $\beta_t = \beta_c + \beta_{ha,c} ha_t$. We define the top 30% ha_t mark the housing market is hot; and the bottom 30% is cold market.In this table, ha is measured by $\tilde{ha}^{fa}$. 24 observations for each state. The porfolio from 1 to 5 mark the size from small to big and value from low to high. The bottom of this table reports the mean and standard errors of different housing markets.

Portfolio Size	BE/ME	Average	Hot Housing Market	Cold Housing Market
	1	2.21	2.41	2.04
	2	2.28	2.06	2.48
1	3	2.49	4.19	0.95
	4	2.42	3.50	1.43
	5	1.73	2.57	0.96
	1	2.26	3.19	1.40
	2	1.81	3.31	0.44
2	3	1.26	2.29	0.31
	4	1.19	2.22	0.26
	5	2.30	2.69	1.95
	1	0.34	1.44	-0.67
	2	1.41	1.97	0.89
3	3	2.28	3.34	1.30
	4	2.10	2.54	1.70
	5	2.35	2.45	2.26
	1	0.42	0.82	0.05
	2	0.70	0.97	0.46
4	3	1.53	2.10	1.02
	4	1.44	1.37	1.51
	5	1.17	0.14	2.11
	1	1.05	1.48	0.64
	2	1.11	1.79	0.49
5	3	1.94	2.07	1.82
	4	2.08	1.79	2.34
	5	1.90	2.52	1.32
Average		1.67	2.21	1.18
Std. Dev.		0.64	0.91	0.81

Table 9: **Time-varying Stock Market Participation and Foreclosure**

The first line is the number of foreclosures in respective year of the PSID 2009 smaple. The second line is the stock market participation rate and data is from PSID 2001, 2003, 2005, 2007 and 2009 survey. The third line is the housing-financial asset ratio.

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009
Foreclosure	9	13	15	23	28	33	46	79	47
Participation	22.64		19.96		18.27		17.66		15.69
ha	0.46	0.54	0.51	0.52	0.56	0.52	0.46	0.47	0.42

Table 10: **Logit Regression on Determinants of Distress**

This table shows the results of logit model. The dependant variable is the state variable whether household is in distress (delinquency). And the independant variables include the wealth allocation, the scale of income and wealth, and other demographic variables of households. The independant variables are from PSID 2007 survey. ** and * denote significance in 5% and 10% level.

	Model 1		Model 2	
	Coef.	Std. Err.	Coef.	Std. Err.
House/Wealth	0.106**	0.053		
Mortgage/Wealth	-0.107**	0.054		
House Equity/Wealth			0.099**	0.051
Stock/Wealth	-0.950	0.884	-0.977	0.895
Business/Wealth	0.427**	0.216	0.427**	0.215
Income/10,000	0.107	0.074	0.108	0.074
Income Square/100,000,000	-0.007*	0.004	-0.007*	0.004
Wealth /100,000	0.018	0.088	0.018	0.088
Wealth Square/10,000,000,000	-0.004	0.007	-0.004	0.007
Age	0.257**	0.059	0.257**	0.059
Age of Head Square	-0.003**	0.001	-0.003**	0.001
Head Male	-0.739**	0.302	-0.742**	0.302
Family Size	0.207*	0.125	0.208*	0.125
Married	0.578*	0.337	0.578*	0.337
Divorced or Seprated	0.289	0.281	0.293	0.281
Number of Children	-0.023	0.149	-0.025	0.149
College Degree	-0.441*	0.186	-0.439*	0.186
Pseudo R2	8.84		8.82	
Obs.	4871		4871	

Table 11: **Stock Market Participation by Different Types Families**

This table shows the number of delinquency families (first line) or foreclosure families(second line). 2009 has two catagories (stock holding or not); and 2007 has four catagories based stock market participation in both 2007 and 2009.

Year	Stock Market Paticipation			
2009	Holding		Not	
Delinquency	12		203	
Foreclosure	2		33	
2007	Holding	Not	Holding	Not
Delinquency	9	3	11	192
Foreclosure	2	0	1	32

Table 12: **Test of Consumption Insurance**

This table shows the cross-sectional regression of food consumption growth. The regression model is $ln(C_{2009}/C_{2007}) = \beta_0 + \beta_1 ln(I_{2009}/I_{2007}) + \beta_2 Dummy$ The dummy variable in panel A is whether households have difficulties on paying mortgage installment; and it is whether households have a foreclosure in panel B. All coefficients are significant in 1% level.

Income Growth		Distress		Statistic	
Coef.	Std. Err.	Coef.	Std. Err.	Obs.	Distress
Panel A					
		-0.177	0.050	6847	203
0.100	0.013	-0.169	0.050	6804	202
Panel B					
		-0.430	0.127	6856	31
0.099	0.013	-0.427	0.128	6813	30

Table 13: **Descriptive Statistics of PSID Data**

All data is from PSID 2007 and 2009 survey. House owning dummy is one if households own a house, otherwise zero. Stock participation dummy is one if households have stocks, otherwise zero. College Degree is one is the head of household has a college degree or above, otherwise zero. The food consumption growth and income growth is the ratio of respective value between 2009 and 2007 after taking nature log.

	2007		2009	
	Mean	Std. Dev.	Mean	Std. Dev.
House Value	143363	235358	123973	211046
House Owning Dummy	0.614	0.487	0.591	0.492
Mortgage	58193	107516	58088	109616
Stock	31606	332636	24569	370731
Stock Participation Dummy	0.177	0.381	0.157	0.364
Business	38654	667963	31773	397043
Total Wealth	222540	1152099	194035	1502218
Food Consumption	152	1428	128	104
Income	65262	83705	68923	105425
Age	45	16	45	16
Head Male	0.695	0.460	0.691	0.462
Family Size	2.666	1.462	2.638	1.481
Married	0.492	0.500	0.475	0.499
Divorced or Seprated	0.185	0.388	0.192	0.394
Number of Children	0.837	1.164	0.820	1.170
College Degree	0.481	0.500	0.487	0.500
	Mean		Std. Dev.	
Food Consumption Growth	-0.005		0.706	
Income Growth	0.084		0.670	

Figure 1: **Housing Wealth and Financial Wealth Growth: 1929-2009**

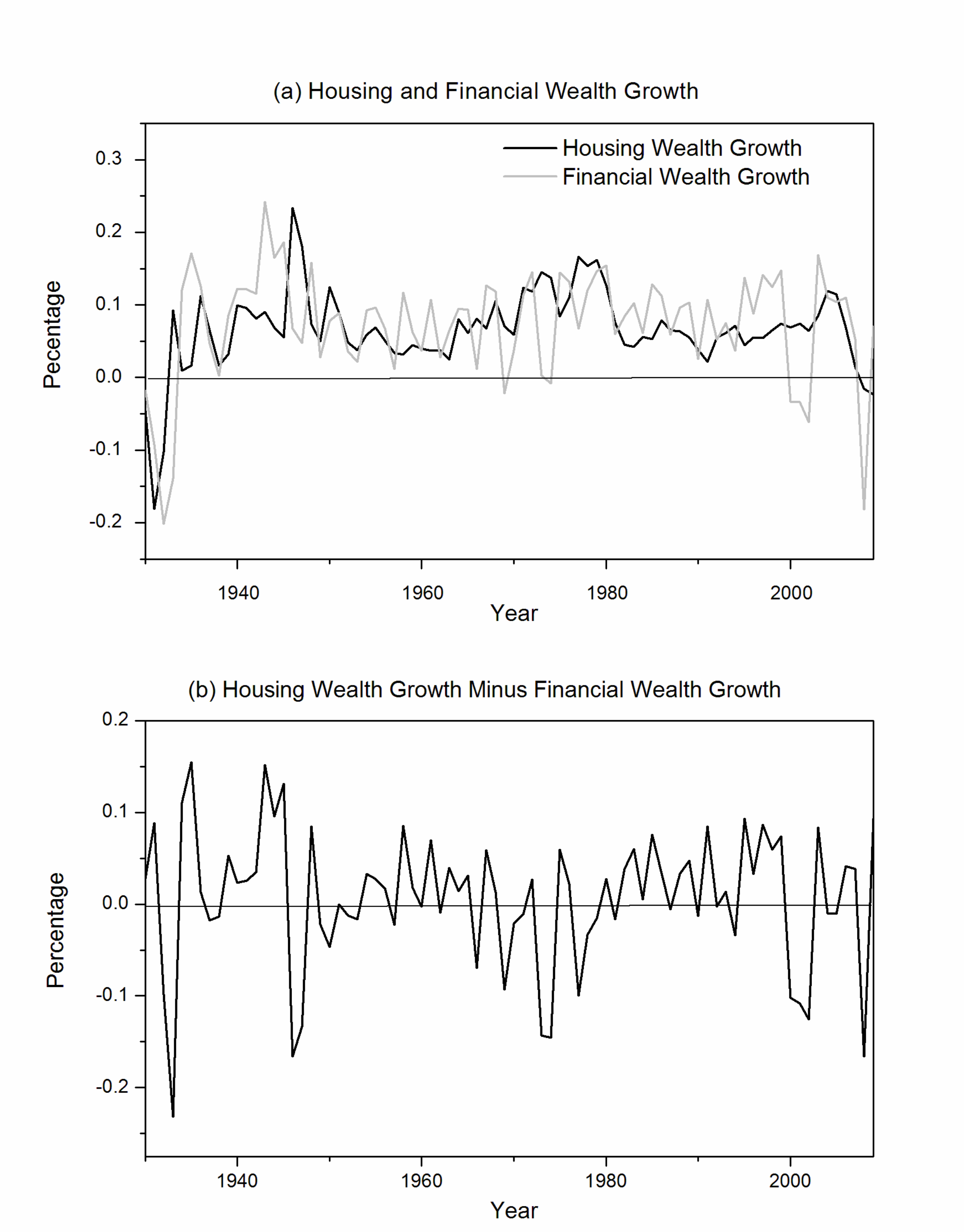

Figure 2: **Comparison of Housing–Financial Wealth Ratio Measurements**

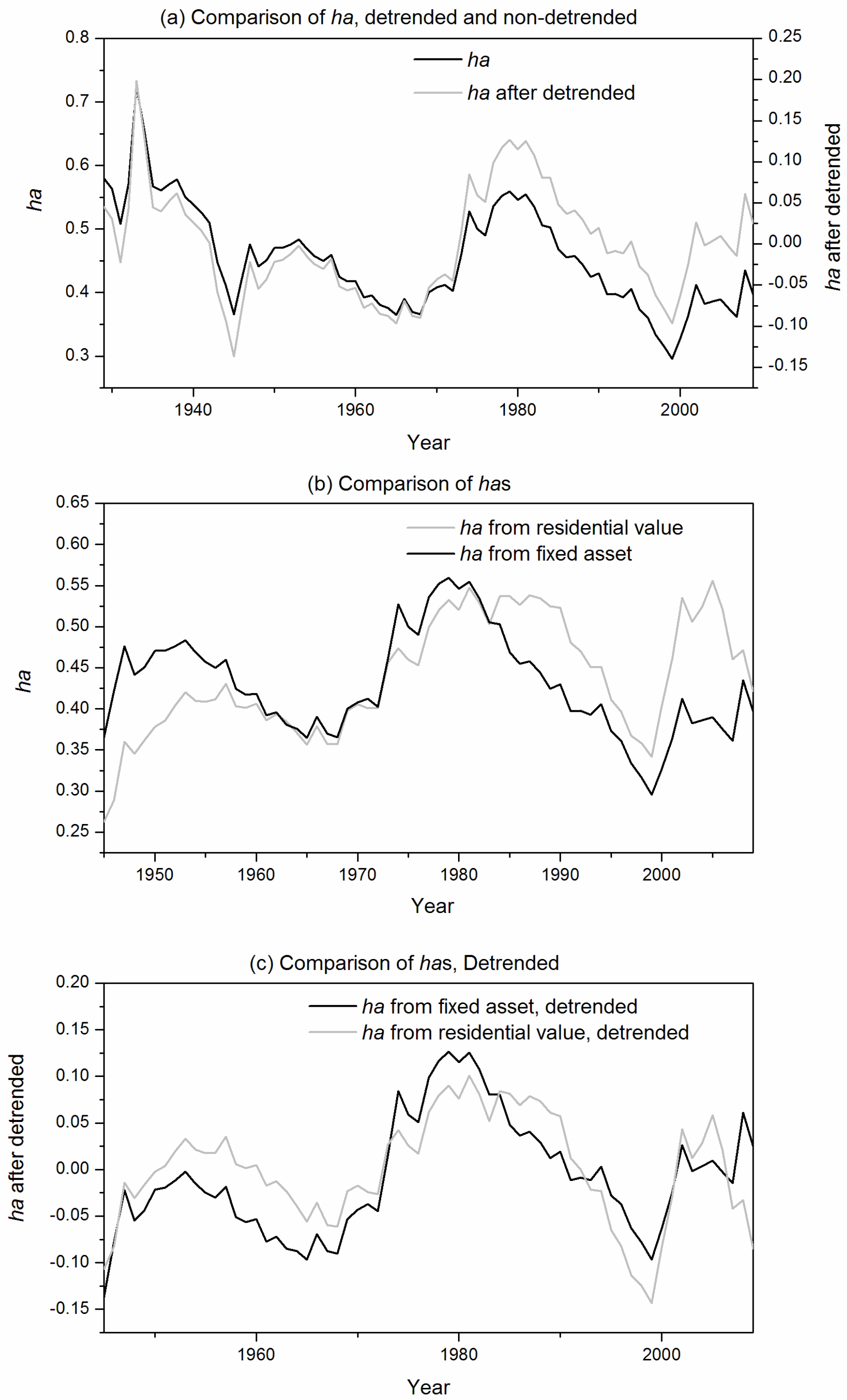

Figure 3: **The Housing–Financial Wealth Ratio and 10-yrs Cumulative Excess Return**

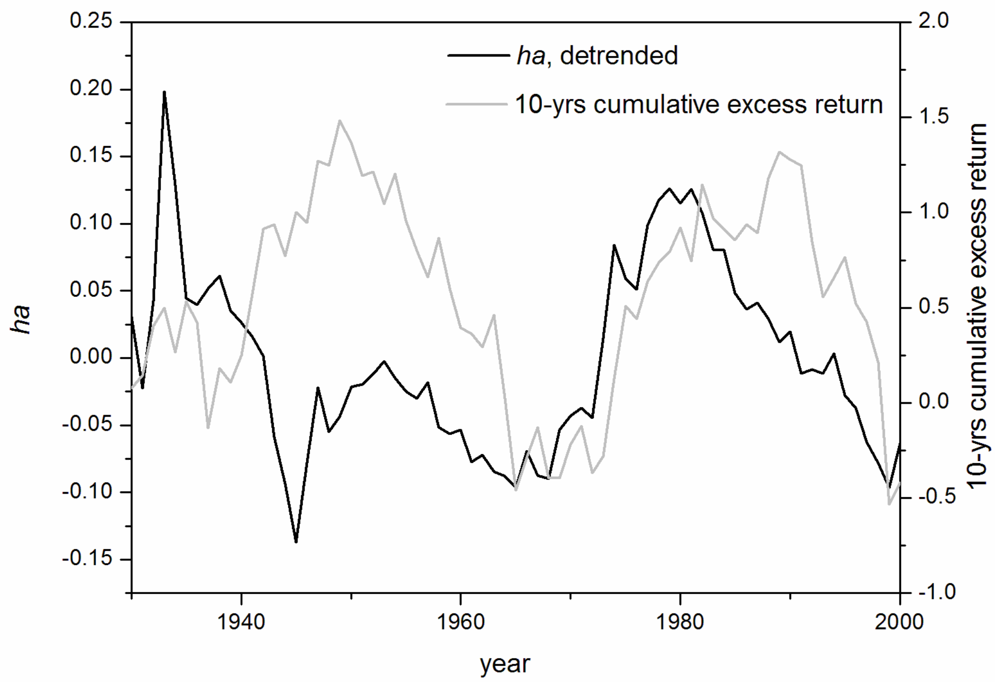

Figure 4: **Realized versus Predicted Returns for the Fama-Frenche Portfolios**