Risk Attitude and Housing Wealth Effect

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Abstract

This paper examines whether the wealth effect on consumption change due to house price appreciation depends upon households' attitudes toward risk. The empirical investigation makes use of data from the U.S. Consumer Expenditure Survey. Firstly, households' investment behaviors on risky assets are studied and a measure of their risk attitudes is identified. Then, a pseudo panel dataset is constructed through grouping households by age and risk attitude, and the responses of households' consumption changes to house price fluctuations are estimated. The basic results are consistent with the findings of Campbell and Cocco. (2007). More importantly, we find a dependency between the housing wealth effect and household risk attitude; households who are less risk averse experience greater consumption changes in response to house price increases. A simple model is provided to demonstrate the theoretical possibility and economics of our empirical finding.

1 Introduction

The latest boom and bust of the U.S. housing markets and macroeconomy have drawn surging attention and research interests on relationships between house price fluctuations and households' consumption decisions. Including Case, Quigley and Shiller (2005) and Campbell and Cocco (2007), a number of papers have provided some eye-catching evidences of housing wealth effect on consumptions, although an overall consensus about the theoretical underpinnings of this effect has not been reached yet. This paper argues that the wealth effect can depend upon household risk attitude. A simple model is presented to elaborate the economics and show that this dependency is theoretically plausible, and microdata are obtained to identify the risk attitude, which is then used in estimating the impact of house price change on consumption change.

The research on the housing wealth effect concerns whether households will increase consumption in response to increase in their housing wealth due to house price appreciation. Case, Quigley and Shiller (2005) analyze macro panel data on 14 western countries as well as U.S. states and find that variations in aggregate housing wealth have significant effects upon aggregate consumptions. For instance, a 10% growth in the housing wealth is associated with an immediate 1% and 0.4% growth in consumption for the western countries and U.S. states, respectively. Benjamin, Chinloy, and Jud (2004) obtain a similar result as well. Carrol, Otsuka and Slacalek (2006) also use aggregate data but they distinguish immediate and long run effects; the immediate marginal propensity to consume from an increase in housing wealth is about 0.02, but over a time span of several years, the propensity to spend the extra wealth can be 0.04 to 0.1.

Compbell and Cocco (2007), instead, use microdata from U.K. They find that, on average, households are expected to experience a 0.6% to 1.2% growth in real non-durable consumption when the regional house prices grow by 1%. The identified impact is much greater than previous studies using aggregate data. Additionally, this elasticity can be as large as 1.7 for old homeowners and as small as 0 for young renters. The four studies above all consider changes in house prices and consumptions, yet there are studies attempting to consider levels. For our purpose, we shall consider changes.

Generally, a few issues need to be clarified and bear in mind, when one wish to discuss the housing wealth effect. Firstly, when house price changes are perfectly perceivable, the wealth effect might not exist. The Permanent Income Hypothesis suggests that households will "smooth" their intertemporal consumption path if they are able to borrow and save. Thus, for a household who has perfect foresight, lives in a deterministic economy, and is able to long and short a risk free bond, her periodic consumptions are the same and equal to a fraction of her permanent income; house price changes cannot create differentials between intertemporal consumptions, as the changes are perfectly perceived. However, when house price shocks exist, this household can only equate expected marginal utility of consumption across time. House price changes can result in different expected consumption levels across periods, unless the price shocks are purely non-aggregate shocks, the market is complete, and Arrow securities are available.

Second, households may not uniformly experience the wealth effect. Housing has dual roles. It is a consumption good–shelter—in essence, but its durability allows it to be an investment goods. The wealth effect should arise from those houses not used as the shelters of the owners[1], and the magnitude of the effect would be inversly related to the owners' bequest motive. Owners who simply use their houses as their shelters may not experience the wealth effect; any increases in house prices imply increases in the implicit rent which offsets the wealth effect, as pointed out in Sinai and Souleles (2005). Exceptions occur when the owner's expected life span is short and the bequest motive is not too strong, or when the owner expects a decrease in family size and plans to downsize the house. As the exceptions mostly occur on older owners, it is not suprising that the identified housing wealth effect is particularly pronounced for older homeowners in Compbell and Cocco (2007). Nevertheless, the authors also find significant housing wealth effect among young homeowners and no effect on young renters, suggesting relaxation of the binding borrowing constraint can play a role; with a higher home value, the young owner who can use the home as a collateral is able to borrow more.

Lastly, house price change's impact on aggregate consumption change may be far less than it's impact at individual level. As pointed out by Buiter (2008), a rise in house price redistributes wealth from households who short housing to those who long housing. The effects on consumption changes due to wealth redistribution will cancel out at the aggregate level. This could explain why the estimated housing wealth effect of Compbell and Cocco (2007) who use microdata is much bigger than the estimated effect of Case, Quigley and Shiller (2005) who use aggregate data.

This paper extends the literature by examining whether the housing wealth effect on consumption can depend upon household risk attitude. Intuitively, the risk attitude has a role to play. To see this, first note that a household being more risk averse is equivalent to the household having a more concave utility function according to the Pratt Theorem. More importantly, the consumption smoothing stated in the Permanent Income Hypothesis is not that a household will "smooth" consumptions through equating current period consumption to next period's expected consumption, but that the household will equate the current period's marginal utility to the discounted expected marginal utility of the next period. Since a lottery cannot yield the same expected marginal utility for two persons who only differ in their utility functions' degree of concavity, a two-period state-contingent consumption plan that is optimal to one of the persons may not be optimal to the other.

To make the point clearer, consider an example in which the second period utility is determined by a flip-the-coin game with equal chances for both states. The two gamblers know

[1]Indeed, there are people who own many houses and treat the houses as investment. This phenomenon is particularly significant in Asia.

the probabilities and have $u(x) = \frac{x^{1-\eta}}{1-\eta}$ where x is the state specific payoff. One of them has $\eta = 2$ and the other has $\eta = 3$. The payoff of each dollar of a stake is 1.5 and 0.5 dollars in the good and bad state, respectively. Let's do the calculation. Betting one dollar, the expected marginal utility is 2.2 for the risk taker (comparatively speaking) and 4.1 for the risk averser. If u also describes the preferences of the current period with certainty, the time discount factor is zero, and both gamblers have two dollars to allocate in the two periods, then the risk taker will bet 1.20 and the risk averser will bet 1.23. (The risk taker bets less because the risk does not hurt his second period as much as it would do to the risk averser, so the risk taker can reserve more money for the first period.) This example shows that households who only differ in their attitudes toward risk may choose different patterns of expected consumption changes. In the next section, the economics are further elaborated through a simple model which allows the household to hold housing assests and are suitable for examining the wealth effect.

Using U.S. Consumer Expenditure Survey (CEX), we estimate the dependency between the wealth effect and household risk attitude through two steps. The first step makes use of household demographics to predict risk attitude. Arrow (1965) and Pratt (1964) propose the celebrated measure of relative risk aversion, which is the elasticity of marginal utility with respect to wealth. While Arrow and Pratt both postulate increasing relative risk aversion in wealth, the empirical literature has shown that the relative risk aversion can be increasing, constant or decreasing, depending on how wealth is defined (e.g. net wealth, human capital, income, etc.). Friend and Blume (1975) show that the relative risk aversion is inversely related to the share of wealth allocated for risky assets, and later research often uses that share as the proxy of relative risk aversion[2]. Morin and Suarez (1983) find that the ratio of risky assets to wealth is signficantly dependent upon household age, and a considerable amount of more recent research has examined the relationship between risk aversion and demographic variables. Halek and Eisenhauer (2001) provide a good literature review. Furthermore, using life insurance data from the Health and Retirement Study (HRS), they examine difference in relative risk aversion across demographic groups based on age, gender, education, nationality, race, materital and parental status, religion, health and behavior indicators, and employment status, income, and wealth. These demographic characteristics explain up to 47% of variation in household risk attitude.

We use the demographic and financial information available in CEX data to estimate households' risk attitudes. The ratio of risky assets to wealth is treated as the proxy of relative risk aversion, instead of Halek and Eisenhauer's measure specifically crafted for the context of life insurance. The regression identifies various influential demographic attributes and is able to obtain a R-square about 0.3, although CEX's demographic data are not as detailed as HRS, and

[2] Friend and Blume (1975) show the inverse relationship in several model settings. In the simplest set-up, the relationship is

$$\alpha_i = \frac{E(r_m - r_f)}{\sigma_m^2} \frac{1}{A_i}$$

where a_i is individual i's share of wealth putting in risky assets, and A_i is the individual's relative risk aversion. The subscripts m and f stand for market and risk free, respectively.

its financial data are not as good as the Survey of Consumer Finance[3].

For the second step estimation, a pseudo-panel dataset is constructed, and the approach of Campbell and Cocco (2007) is followed, to estimate the impact of house price change on consumption change. Stratifying the pseudo-panel households into three groups according to risk attitude, it is found that the coefficient estimate of housing price change is positive and decreasing in risk aversion. A simple statistical test suggests that comparing any two groups, the coefficient estimate of house price change of the less risk adverse group is always statistically greater than the more risk adverse group. Thus, the housing wealth effect on consumption depends upon household risk attitude.

The rest of this paper is organized as follows. Second 2 presents a simple motivating model, which shows that households who are less risk averse can experience a stronger wealth effect. The economics are also discussed. Second 3 introduces our data, and Section 4 provides more details on the estimation methods and presents the results. The final section concludes.

2 A Simple Motivating Model

This section presents a modeling example showing that housing wealth effect on consumption can exist and the effect is bigger for households who are less risk averse. As the model is motivational, we specify preferences and dynamics as simple as possible. Some possible extensions are discussed later.

Consider the utility maximization problem of a household who has two periods of life. The household inherits q_1 units of perfectly divisible housing stock at the beginning of period 1, but has no motive of leaving a bequest at the end of period 2. The household inelastically demands μ units of housing. Without lose of generality, let $\mu \to 0$. The household can sale or rent out the housing assets in exchange for income. Let p_1 and r_1 denote the price and rental rate of each unit of housing assets in period 1. Assume p_1 is an exogenous number and r_1 is dependent upon house prices. The house prices are perceived to grow at a constant rate γ periodically. Thus, $E_t\left[p_{t+1}\right] = \gamma p_t$. However, the actual prices are $p_{t+1,g} = \gamma p_t + \varepsilon$ and $p_{t+1,b} = \gamma p_t - \varepsilon$ in the good and bad states, respectively. The two states both have a $\frac{1}{2}$ chance to occur. Additionally, the household receives w_1 and w_2 units of labor income in periods 1 and 2, respectively.

The household has preferences over consumptions. Assume the periodic utility function is

$$u\left(c\right) = \frac{c^{1-\eta}}{1-\eta}$$

where η is the measure of the constant relative risk aversion (CRRA). It can be any strictly positive number except 1. Also, the household has a von Neumann-Morgenstern expected utility

[3] Among all public data sources, the SCF provides the most accurate financial information on American households. However, it is not suitable for our research. Firstly, SCF is a triennial survey and is cross-sectional. Second, all of its geographic information are not publically available, and this prevents from merging housing price indices.

representation. Thus, her utility maximization problem can be written as:

$$\begin{aligned} \max_{q_2, c_1, \{c_{2,s}\}_{s=g,b}} \quad & u(c_1) + \beta \sum_s \pi_s u(c_{2,s}) \\ s.t. \quad & c_1 = w_1 + r_1 q_2 + p_1 (q_1 - q_2) \\ & c_{2,s} = w_2 + p_{2,s} q_2 \qquad \forall s \end{aligned}$$

where q_2 denotes the quantity of housing assets which the household keeps until period 2, and $q_1 - q_2$ indicates the number of housing assets sold in period 1. For ease of elaboration, we first assume $w_1 = w_2 = 0$ and relax this assumption later.

Deriving the first order conditions allows us to obtain the following Euler equation:

$$u'(\hat{c}_1)(p_1 - r_1) = \beta \sum_s \pi_s u'(\hat{c}_{2,s}) p_{2,s} \tag{1}$$

On the one hand, increasing the holding of housing assets by one marginal unit in period 2, the household has to forgo $p_1 - r_1$ marginal units of period-1 consumption and bear $u'(c_1)(p_1 - r_1)$ units of decrease in period-1 utility. On the other hand, the extra proceeds from the housing sale in period 2 allow the household to consume $p_{2,g}$ and $p_{2,b}$ units more in the good and bad states, respectively, and her discounted period-2 expected utility increases by $\beta E(u'(c_2) p_2)$ units. The household will choose $\hat{q}_2$ such that the equality of the Euler equation holds, so she is indifferent between sailing the marginal housing asset in either period. Since $\lim_{c \to 0} u'(c) = \infty$ and u is strictly concave, there is a unique interior solution.

The period-1 rent r_1 is

$$r_1 = (1 - \beta\gamma) p_1 \tag{2}$$

Generally, this relationship holds for every period, because the rental rate is perceived to grow at the same rate as the house price. To see this point, note that

$$E_1[p_\tau] = \sum_{t=\tau}^{\infty} \frac{E_1[r_t]}{1+i}$$

must hold if there is no arbitrage. Also, the risk free interest rate $i = \frac{1}{\beta} - 1$, if it is merely the market's time-discount factor.

Substitute the right hand side of the budget constraints for the consumptions in Eq. (1), we have

$$\hat{q}_2 = \left(\phi^{\frac{1}{\eta}} + \beta\right)^{-1} \frac{q_1}{\gamma}$$

where

$$\phi = \frac{2\gamma^{1-\eta} p_1^{1-\eta}}{(\gamma p_1 + \varepsilon)^{1-\eta} + (\gamma p_1 - \varepsilon)^{1-\eta}}$$

Note that $\phi \to 1$, as $\varepsilon \to 0$. Define the consumption change as $\overline{\Delta c} = \sum_s \pi_s \hat{c}_{2,s} - \hat{c}_1$, which is the expected change in consumption when the household moves into period 2. We have

$$\overline{\Delta c}=\left(\frac{1+\beta}{\phi^{\frac{1}{\eta}}+\beta}-1\right)p_1q_1$$

Thus, when $\varepsilon\to 0$, $\overline{\Delta c}\to 0$. That is, when there is no uncertainty, the perceived house-price growth itself cannot prevent consumption smoothing, so consumptions are equal across two periods. This result is in line with the Permanent Income Hypothesis. Nevertheless, when $\varepsilon>0$, $\overline{\Delta c}\neq 0$. Periodic consumptions cannot be perfectly smoothed, because housing assets here are not state contingent claims (In fact, housing price shocks are rather aggregate shocks but not idiosyncratic shocks), so the market is incomplete and perfect insurance is not possible.

Taking derivative of the consumption change with respect to house price change, we derive an expression of housing wealth effect on consumption, which suggests that the housing wealth effect is bigger among those households who are more willing to take risks. The expression is:

$$\frac{\partial\overline{\Delta c}}{\partial\gamma}=(1-\eta)\,\Phi \tag{3}$$

where

$$\Phi=\frac{\left(p_{2,g}^{\eta}-p_{2,b}^{\eta}\right)}{\eta}\times\frac{\varepsilon\,(1+\beta)\,\phi^{\frac{1}{\eta}}p_1q_1}{\left(p_{2,g}^{\eta}p_{2,b}+p_{2,b}^{\eta}p_{2,g}\right)\gamma\left(\beta+\phi^{\frac{1}{\eta}}\right)^2}>0 \tag{4}$$

Three points are worth mentioned here. Firstly, Eq. (3) shows that in this restrictive case (Recall wages are currently set to zero), the housing wealth effect is positive for less risk-averse households with $\eta<1$, but it is negative for more risk-averse households with $\eta>1$. Second, the first term of Eq. (4) indicates that $\frac{\partial\overline{\Delta c}}{\partial\gamma}$ is a positive bounded function of η. Moreover, when ε is very large in the sense that the house price in the bad state in period 2 can be almost zero, $\frac{\partial\overline{\Delta c}}{\partial\gamma}$ can exhibit a wavy shape. Nevertheless, as long as the parameters are empirically plausible, the housing wealth effect $\frac{\partial\overline{\Delta c}}{\partial\gamma}$ is decreasing in η. This point is illustrated by the numerical example presented in Figure 1. In summary, the two equations on $\frac{\partial\overline{\Delta c}}{\partial\gamma}$ show that the housing wealth effect on consumption is bigger for households who are less risk averse.

[Insert Figure 1 here]

In this modeling example, the consumption change $\overline{\Delta c}$ is smaller than 0 for any households with $\eta<1$. However, in the real world, some of these less risk-averse households may have positive consumption change. To reconcile, one may consider multiplying the periodic utility function by a weighting function as in Attanasio and Weber (1995) and Attanasio et al. (1999). For example, it may be assumed that $u(c)=\frac{c^{1-\eta}}{1-\eta}g(x)$, where x is a vector of household demographics. Suppose $x\in R_+^1$ indicates the family size and $g'>0$. Then, a household, who experiences an increase in family size in period 2, may have positive consumption change even though she has a small η, because she puts a higher weight on the second period consumption.

Empirically, a negative housing wealth effect may not be observed. The reason that Eq. (3) predicts a negative effect for any households whose η is greater than 1 is that the model currently assumes zero wage. We relax this restriction. Assume $w_1 = w_2 = w > 0$. Now, the model does not have a close form solution. Thus, we use a numerical example to illustrate the housing wealth effect on consumption due to a perceivable, one percentage point increase in house price, by the CRRA parameter and wage rate. Figure 2 presents the result. The solid curve indicates the housing wealth effect by η when $w = 0$, so it crosses 0 at $\eta = 1$. The other two curves show that, when the wage rate increases, the curve of the housing wealth effect shifts outward and crosses 0 at a higher value of η. This explains why a significantly negative effect is not observed in our regression analysis for pseudo-cohort individuals stratified by risk attitude group.

[Insert Figure 2 here]

3 The Data

This section is on our data construction. It starts from a brief discussion on the state level house price indices that we obtain. Then, it describes how quarterly data, quarter consumption change in particular, are constructed using information from the Consumer Expenditure Survey (CEX). Finally, it introduces the construction of pseudo panel data.

The state level house price indices used in this research are obtained from the Federal Housing Finance Agency (FHFA; formerly the Office of Federal Housing Enterprise Oversight). The FHFA is the federal agency which oversees Fannie Mae and Freddie Mac and other housing loan banks. It regularly publishes house price index, which is a weighted, repeat sales index measuring average price changes in repeat sales or refinancing on the properties. To prepare this index, FHFA review repeat mortgage transactions on single-family homes with mortgages being purchased or securitized by Fannie Mae or Freddie Mac. The house price index is a timely, accurate indicator of house price trends for single-family homes and is available at various geographic levels. At the state level, quarterly data are available. Thus, we merge the state level house price indices with CEX's household data.

This paper makes use of the Quarterly Family Interview Data of the CEX for the period from 1997 to 2009. The CEX program operated by the U.S. Bureau of Labor Statistics is mainly designed to collect American households' expenditures information to support the bureau's revisions of Consumer Price Index. Nevertheless, detailed household demographic and financial information is also available.

The CEX is a rotating panel of about four to six thousands of households each quarter. Once selected into the sample, the household is followed five consecutive quarters and interviewed once every three months. Only the last four interviews are published to avoid repetition; the first interview was to check consistency. When a household retires from the survey, a new one is added in. Generally, one fourth of households are new in each quarter of survey. To reduce labor costs, the administrators do not interview all households in the same month for each quarter of survey. As a result, this dataset is "interlaced". This unique data structure is illustrated in Figure 3.

[Insert Figure 3 here]

Figure 3 illustrates the data structure of CEX. There are 12 rows; each represents a data line. The first four lines belong to the first tranche, for which interviews are conducted in the first month of each quarter. The next four lines belong to the second tranche, and interviews are in the second month. The interviews for the last four lines are in the third month. The total number of households in these 12 lines was about 4000 in earlier survey years and 6000 in recent years. In the first line, an existing household finished the 5th interview in Oct. 2007. At the same time, a new household was added in and his/her first interview was done. However, this first interview was not published, so that the line is "smooth." In the survey, each household is asked about his or her past-three-months expenditure in the last and current quarters for each item of goods and services. This results in two variables for each item in each quarterly survey. For households in Tranche 1 (lines 1 to 4), they are interviewed in the very beginning of the current quarter, so their past-three-months expenditures all fall in the last quarter, and their expenditures in the current quarters are always zero. For households in Tranche 2, one of the past three months is in the current quarter (the months with dark gray background are in the current quarter of an interview), so when one divides these households' current quarter expenditure by past quarter expenditure, the mean is always around 0.5. For households in Tranche 2, dividing their current quarter expenditure by past quarter expenditure, the mean is always around 2.

Because CEX data are interlaced, we cannot simply sum up the two variables—last and current quarter expenditures—in the "quarterly" surveys and merge with quarterly house price indices. We restructure the data. For households in Tranche 1, last quarter expenditure in Q1 2008 survey was the expenditure in Q4 2007, and so on and so forth. For households in Tranche 2 and 3, the sum of the current quarter expenditure in Q4 2007 survey and the last quarter expenditure in Q1 2008 survey was the expenditure in Q4 2007, and so on and so forth. Keeping this in mind, we are able to construct a quarter data structure as illustrated in Figure 4. Then, the quarterly data are merged with quarterly house price indices. Nevertheless, we lost about 20% volume of data, because we have no information on those entries covered by slashes.

[Insert Figure 4 here]

In the regression analysis, consumption is defined as real non-durable consumption (just like Compbell and Cocco, 2007), which is the total expenditure minus housing expenditures (including rent, tax, down payment, mortgage installment, and maintenance costs) and other durable goods expenditure. Most of the existing empirical literature that tests consumption theories excludes durable goods. This is because durable goods provide households a series of service flows for a long period, but measuring the services flows using expenditure data is difficult. Thus, we follow the previous literature and exclude durable goods consumption, where purchases of vehicles constitute the main part. Additionally, we adjust non-durable consumption, as well as income, to real term using Consumer Price Index.

To estimate households' risk attitudes, we use household demographic and financial information available in CEX. Since the program only surveys households' financial information in their fifth interview, what we obtain is households' risk aversion according to the information in that interview. We assume households' risk attitude would not change dramatically with a year. So, the relative risk aversion estimated from the last interview is applied to the other three reported interviews.

This research concerns the housing wealth effect; how consumption change responses to house price change. The process is dynamic, but CEX does not have long time series information from respondents. The CEX is a continuous cross-sectional dataset with many short, unbalanced panels. However, we can overcome this problem by using the methodology introduced in Browning, Deaton and Irish (1985) and Deaton (1985) to construct pseudo panel data.

According to Deaton (1985), the pseudo panel data supply a method of tracking "cohorts" through the dataset. A "cohort" is a group with fixed membership, and individuals of the cohort can be identified as they show up in the survey. If the survey scale is large enough, successive surveys will generate successive random samples of individuals from each of the cohorts. Summary statistics from these random samples can generate a time series to infer behavioral relationships of the cohort as a whole just as if panel data were available. The key of pseudo-panel is to abstract a typical observation from the individual survey, and the idiosyncratic characteristic of single observation is hedged in the cohort. During the process of grouping cohort, some errors are inevitably created, but the results of cohort regression still convergence with the increase of sample size (Deaton 1985).

This research first considers age cohorts, which are defined based on the year of birth of the household head. Each cohort consists of households whose head was born within one of the following ten-year period: 1951-1960, 1961-1970, and 1971-1980. Then, three different risk aversion cohorts are constructed from each age cohort. Thus, there are nine cohorts from quarter 2 of 1997 to quarter 2 of 2010[4]. To keep consistent cohort results, if the number of observations in a cohort is less than 200 observations in a particularly survey quarter, that data point is excluded.

To obtain some insights about the consumption and income of cohorts, we calculate the aver-

[4] We use the CEX survey from 1997 to 2009, which include the surveys from 1997Q1 to 2010Q1. The first quarter data of 1997 cannot match to others, so it is not included. Because the financial information is only reported in last quarter, we excluded the data in last three quarters to make sure all observations can be matched with their financial information.

age quarterly consumption and income in different ages for each age cohort. Both consumption and income are adjusted to the U.S dollar in 1997. Figure 5 plots the patterns of both consumption and income over life cycle. The patterns are consistent with theories[5]; consumption is smooth and income is a hump shape over life cycle.

[Insert Figure 5 here]

4 Empirical Results

In this section, we first estimate households' risk attitudes from their liquid asset compositions and demographic characteristics; and then pin down the relationship between housing wealth effect and relative risk aversion.

4.1 Estimation of Risk Attitude

Risk aversion can be characterized by concavity of the von Neumann-Morgenstern uility function. Pratt (1964) and Arrow (1965) suggest the elasticity of marginal utility with respect ot wealth, or $RRA = -wu''(w)/u'(w)$, is an appropriate measure of relative risk aversion. Arrow showed that this measurement is directly related to one's insistence on favorable odds when putting some fraction of wealth at risk, and Pratt demonstrated that RRA is proportional to the insurance premium one is willing to pay to avoid a given risk. Empirically, households' utility functions are difficult to identify, but investments in risky assets are much easier to observe. Thus, most of the emprical research works identify risk attitudes through the liquid asset compositions of households (e.g., Friend and Blume 1975; Siegel and Hoban 1982; Morin and Suarez 1983), as the relative risk aversion is inversely related to the share of assets allocated for risky assets (Friend and Blume, 1975).

The CEX supplies households' financial information, including their assets in the saving, checking and bond accounts and their wealth in the security account evaluated at the market value. Suming the balances of these four accounts gives the value of total liquid asset, and putting the balances of the security and bond accounts together leads to the value of risky asset.

It is found that about 70% of the households from our 1997 to 2010 CEX samples do not have risky assets. This, however, is a comfortable number, as Mankiw and Zeldes (1991) point out that American households' stock market participation rate is about 30%. We further look into the ratio of owning risky asset by age group and present the results in Figure 6. The average is about 30% and the pattern is a hump shape over the life cycle. We also compare the average ratio of our 30-39 and 40-49 age cohorts with the average ratio of those households who born between 1961 and 1970 and age between 36-45 year old reported in Malmendier and Nagel

[5] See the life-cycle consumption theories, such as Attanasio and Browing (1995), Carroll (1997) and Gourinchas and Parker (2002).

(2010) who use the Survey of Consumer Finance data. The ratios are almost the same. These results and comparison suggest that the CEX finanacial data is of good quality for our purpose.

[Insert Figure 6 here]

As 70% of households do not hold risky assets, directly using the ratio as a measurement of risk attitude fails to distinguish the risk attitudes for households with zero risky asset. Thus, we have to use the ratio of risky asset to total liquid asset of each household and the household's demographics to estimate the risk attitude. To handle the problem of limited dependent variable, a Tobit model (Tobin, 1958) is used. This model can estimate the relationship of a dependent variable, for which the observations are concentrated at the variable's limiting value (the bound), to explaintory variables. The technique is helpful in the situation, as an explainatory variable may be expected to influence both the probablity of limit responses and the size of non-limit rsponses. An alternative method is the Heckman correction model (Heckman, 1979), which is more widely used for selection bias. The Heckman correction places more emphasis on the bias resulted from individual selection behaviors, while the Tobit model makes more efforts on correcting the distribution of dependent variables from censored dataset. As the risky asset composition is a truncated distribution, the Tobit model is more suitable for our research.

The Tobit regression model can be written as

$$\begin{aligned} \alpha_i &= \alpha_i^* \text{ if } \alpha_i^* > 0 \\ \alpha_i &= 0 \text{ if } \alpha_i^* < 0 \end{aligned} \tag{5}$$

and

$$\alpha_i^* = \beta X_i + YEAR + \varepsilon_i$$

where α_i is individual i's ratio of risky asset to total liquid asset, X_i is a vector of i's demographic characteristics, and $Year$ is a vector of year specific fixed effects, which control time-dependent market environment. Eq. (5) expands the risky asset composition α from a trucated distribution to satisfy the normal linear model.

Table 1 reports the results of Tobit regression of risky asset composition on household demographics. The outcomes are very consistent with Halek and Eisenhauer (2001). The model in Column (1) not only controls income, total liquid asset, and family size, but also include detailed demographic dummy variables. The reported results show that the risky asset composition $\hat{\alpha}_i^*$ is decreasing in income but increasing in total assets. Thus, relative risk aversion is increasing in income but decreasing in total asset. Also, households with a larger family size have a higher share in risky asset–less risk averse. Households with a better educated or white head are less risk averse. Households without home ownership are more risk averse. Overall, the regression is able to explain 27% of variation in risky asset composition.

Guided by the results of Column (1), we only include the influential predictors in Column

(2). The education dummy distinguishes whether the household head has a college degree. Its value equals 1 if the head has a degree and 0 otherwise. The race dummy equals 1 if the head is white. The tenure dummy equals 1 if the household owns a house. All the coefficient estimates are significant at 1% level. The results are consistent with Column (1)'s prediction, and the decrease in pseudo R square is minimal. We use the results of column (2) to predict the risk attitude measurement based on their demographic characteristics. Higher predicted value implies this household is less risk aversion.

4.2 Housing Wealth Effect with Different Risk Attitude

The second step of estimation is to identify the housing wealth effect on consumption—growth in consumption in response to growth in house price. As CEX does not have home value information, the house price change is proxied by the change in house price index of the corresponding state. This is also the treatment of Campbell and Cocco (2007). The baseline model regresses consumption growth on house price growth, controlling household income and other characteristics. Specifically, we estimate:

$$\Delta c_{i,t+1} = \beta_0 + \beta_1 \Delta p_{i,t+1} + \beta_1 \Delta y_{i,t+1} + \beta_2 Z_{i,t+1} + \varepsilon_{i,t+1}$$

where the subscript i indicates the "cohort individual," $\Delta c_{i,t+1} = \ln(C_{i,t+1}) - \ln(C_{i,t})$ is the real non-durable consumption growth, $\Delta p_{i,t+1} = \ln(P_{i,t+1}) - \ln(P_{i,t})$ is the real house price growth, $\Delta y_{i,t+1} = \ln(Y_{i,t+1}) - \ln(Y_{i,t})$ is the real income growth, and $Z_{i,t+1}$ is a vector of other control variables. The time periods are defined by quaters. As explained in Deaton (1985), the values of the control variables of a cohort individual should be the weighted averages of the households in that cohort. In addition to house price and income changes, we control changes in family size and home owning rate, which is the percentage of households who are home owners in the corresponding cohort. The real interest rate is included to control the influence on consumption from market environment. Lastly, the changes of age and age square are also included to eliminate the errors of building cohorts[6].

As mentioned in the data section, we build cohorts in two dimensions. In the first dimension, there are three age cohorts based on household head's birth year. The second dimension is on the risk attitude. From the first step estimation, the predicted risky asset composition is obtained. According to the predicted values, the top (third) tercile of households are in the least risk-averse group; the next tercile of households are with medium risk aversion, and the remaining households are the most risk averse. Thus, each age cohort can be further separated into three cohorts with different risk attitudes; there are nine cohort individuals. These individuals are stratified by risk attitude group and regressions are run by strata.

Table 2 reports the regression outcomes by risk attitude. Overall, we find positive housing

[6] In ideal condition, the change of age should be constant for each age cohort. The variation of age change captures the errors during the process of building cohorts.

wealth effect, as the coefficient estimates of house price changes are all positive in the three columns. More importantly, the coefficient is decreasing in risk aversion, and the one for the least risk-averse group is significant. This suggests that the housing wealth effect is bigger for households who are less risk averse. Comparing the wealth effect we discover from examining the U.S. consumer expenditure survey and the effect identified by Compbell and Cocco (2007) through investigating the British consumer expenditure survey, the effect's standard errors in our paper are similar in magnitude to the standard errors in their paper, but our coefficient estimates are much smaller. However, this is exactly what Case, Quigley and Shiller (2005) find: The housing wealth effect in the U.S. is substantially smaller than the effect in other western countries. The regression results also indicate significant dependency between consumption growth and other variables. Income growth and increase in family size both drive consumption growth.

Table 3 reports the results of a t-test examining whether the coefficient of the housing wealth effect of one group is significantly different from another. The table shows that the coefficient of the medium risk-aversion group is larger than that of the most risk-averse group at 5% significance level, and the coefficient of the least risk-aversion group is larger than other groups at 1% significance level. Thus, the housing wealth effect is decreasing in risk aversion, which is consistent with our model prediction.

As a remark, pseudo-panel is a method to build a continuous observation from survey data. In our case, the demographic characteristics of individual observations are hedged in cohorts; it efficiently avoids the possible multi-linearity problem between demographic variables and risk aversion because our risk attitude measurement is predicted from demographic variables. However, it also brings in more errors in variables (EIV) because the observations in cohorts are not perfectly hedged. These errors may import more variance into the regression and increase the standard errors of coefficients. But the regression on the pseudo-panel does present relationship between variables. Our results demonstrate a clear pattern of decreasing housing wealth effect in risk aversion.

5 Conclusion

This paper argues that the housing wealth effect—change in household consumption induced by change in house prices—should be dependent upon households' attitudes toward risk. We illustrate the economics using a simple model in which households hold housing assets. The model can deliver the housing wealth effect as long as the house price growth has a shock component. More importantly, the model predicts that the magnitude of the wealth effect decreases in household's relative risk aversion.

The estimation results also suggest that households who are less risk averse experience greater housing wealth effect. The relative risk aversion is predicted by household demographics, and households are stratified into three groups according to this risk attitude. For the least risk-averse group, households are expected to experience a significant 0.25% growth in real non-durable consumption in response to a 1% growth in house price. For the medium and most risk-averse groups, their consumption growths are only 0.07% and 0.1%, respectively. For any two groups, the less risk-averse group always has a significantly higher elasticity than the other. Thus, the housing wealth effect is negatively dependent upon household's relative risk aversion.

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Table 1. The Tobit regression of risk attitude on demographic variables

Variables	(1)		(2)	
	Coef.	Std. Dev.	Coef.	Std. Dev.
Ln(Income)	-0.0239**	0.0051	-0.0243**	0.0051
Ln(Total Asset)	0.2015**	0.0021	0.2058**	0.0021
Ln(Family Size)	0.0556**	0.0078	0.0344**	0.0079
Education			0.1029**	0.0090
first through eighth grade or never	NA	NA		
ninth through twelfth grade	0.1196**	0.0323		
high school graduate	0.2166**	0.0278		
less than college graduate	0.2732**	0.0279		
associate's degree	0.2811**	0.0293		
bachelor's degree	0.3268**	0.0280		
master's degree	0.3371**	0.0295		
professional/doctorate degree	0.2934**	0.0330		
Race			-0.0893**	0.0120
Asian	NA	NA		
Native	0.0728	0.0584		
Pacific island	0.0888	0.1024		
Black	0.0888**	0.0242		
Multi-race	0.1256*	0.0499		
white	0.1450**	0.0190		
Tenure			0.0697**	0.0107
owned with mortgage	NA	NA		
owned without mortgage	-0.0942**	0.0100		
rented	-0.0855**	0.0106		
Age			0.0089**	0.0015
Age Square			-0.0001**	0.0000
Age Dummies	Yes		No	
Year Dummies	Yes		Yes	
Obs.	42958		42958	
Pseudo R^2	26.72		26.64	

Notes: (1) The dependent variable is risky asset composition, i.e., the ratio of risky asset to total liquid asset. (2) Standard errors in parentheses; (3) ** and * indicates significance at the 1% and 5% level. (4) In column (2), education dummy equals to 1 if the household head has a bachelor degree or above, and 0 otherwise; race dummy equals to 1 if the head is white; tenure dummy equals to 1 if this family owns its house.

Table 2. The cohort regression for each risk attitude group

VARIABLES	Δc		
	(1)	(2)	(3)
	Most Risk Aversion	Medium Risk Aversion	Least Risk Aversion
Δp	0.0660	0.105	0.249*
	(0.157)	(0.173)	(0.144)
Δy	0.451**	0.388**	0.249**
	(0.0701)	(0.105)	(0.0730)
Δfamily size	0.295**	0.0278	0.296**
	(0.106)	(0.127)	(0.124)
Δhome owning rate	0.141	0.194	0.0693
	(0.132)	(0.125)	(0.133)
Real interest rate	-0.111	-0.270	-0.0709
	(0.259)	(0.273)	(0.250)
Δage	0.0330	0.0500	0.0319
	(0.0493)	(0.0529)	(0.0482)
Δage square	-6.54e-05	-0.000365	8.29e-05
	(0.000647)	(0.000673)	(0.000602)
Constant	-0.00629	-0.00408	-0.00495
	(0.00608)	(0.00623)	(0.00574)
Observations	141	141	141
R^2	34.5	22.26	30.26

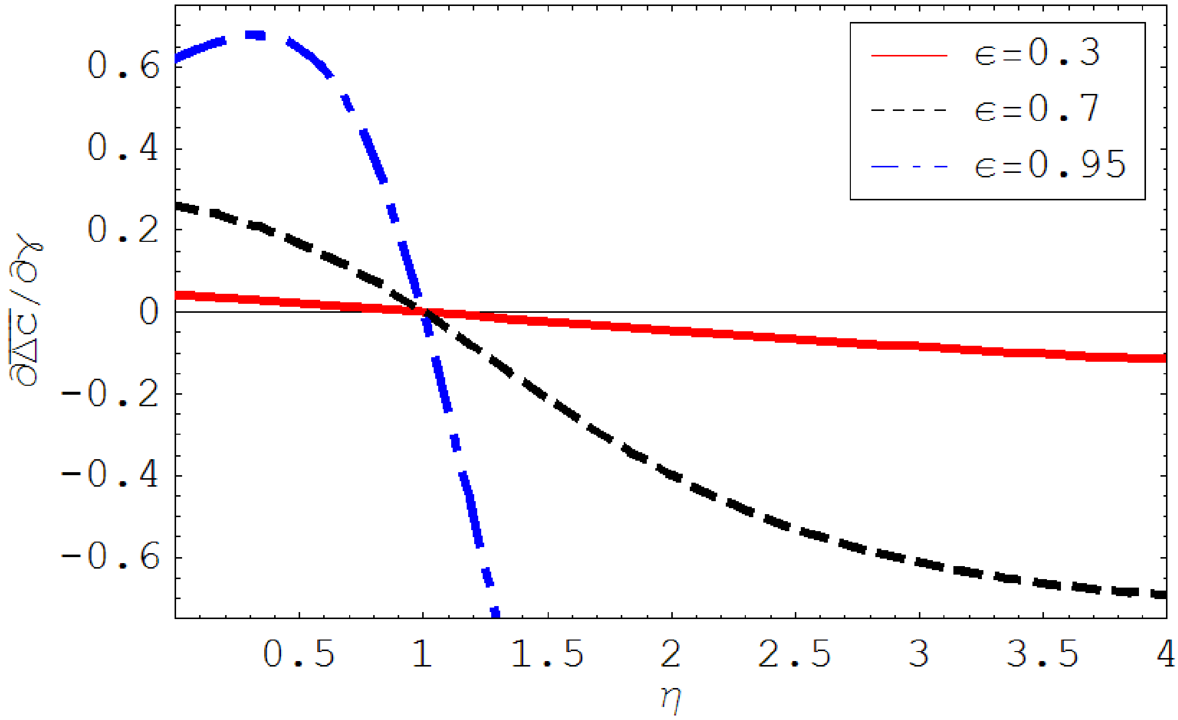
Notes: (1) Standard errors in parentheses; (2) ** and * indicates significance at the 5% and 10% level.

Table 3. T-test of the wealth effects for each risk attitude group

	(1) Most Risk Aversion	(2) Medium Risk Aversion	(3) Least Risk Aversion
Wealth Effect	0.066	0.105	0.249
Std. Dev.	0.157	0.173	0.144
H0:	Wealth effect in col(1)>col(2)		Wealth effect in col(2)>col(3)
T-test value	1.9601*		7.6412**

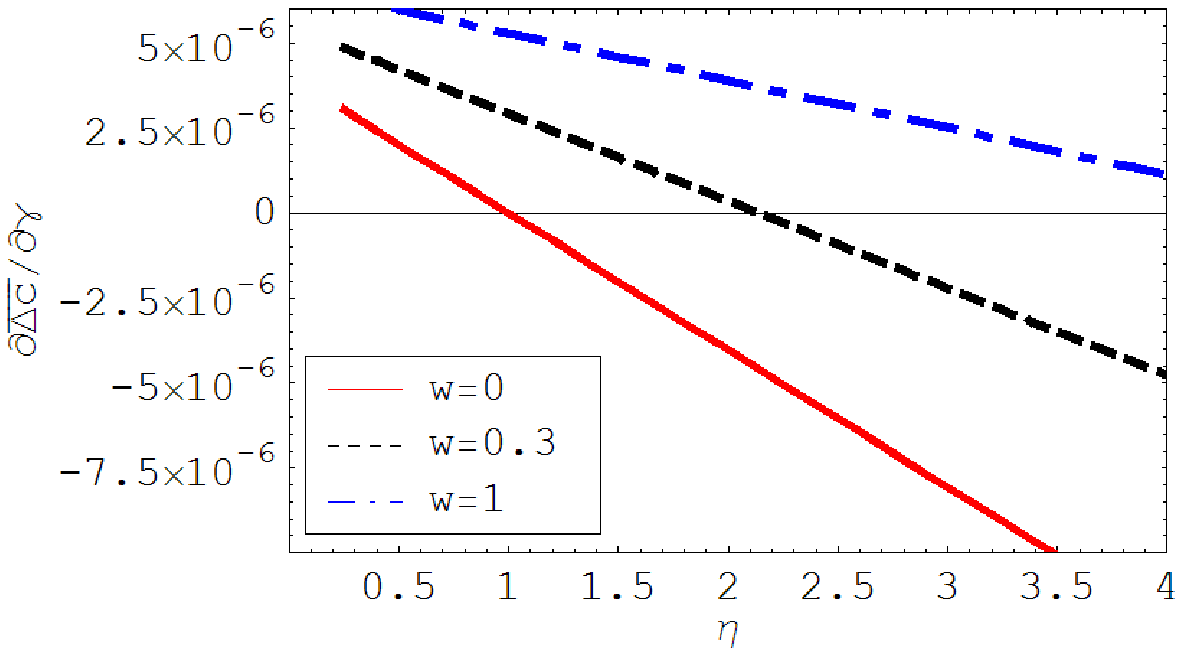
Note: ** and * indicates significance at the 1% and 5% level.

Figure 1: Consumption change with respect to house price change by η and ε.



Note: For the rest of the parameters, $\beta = 0.9$; $\gamma = 1.05$; $p_1 = 1$; $q_1 = 1$; $w = 0$.

Figure 2: Consumption change with respect to house price change by η and w.



Note: For the rest of the parameters, $\beta = 0.9$; $\gamma = 1.05$; $\varepsilon = 0.03$; $p_1 = 1$; $q_1 = 1$.

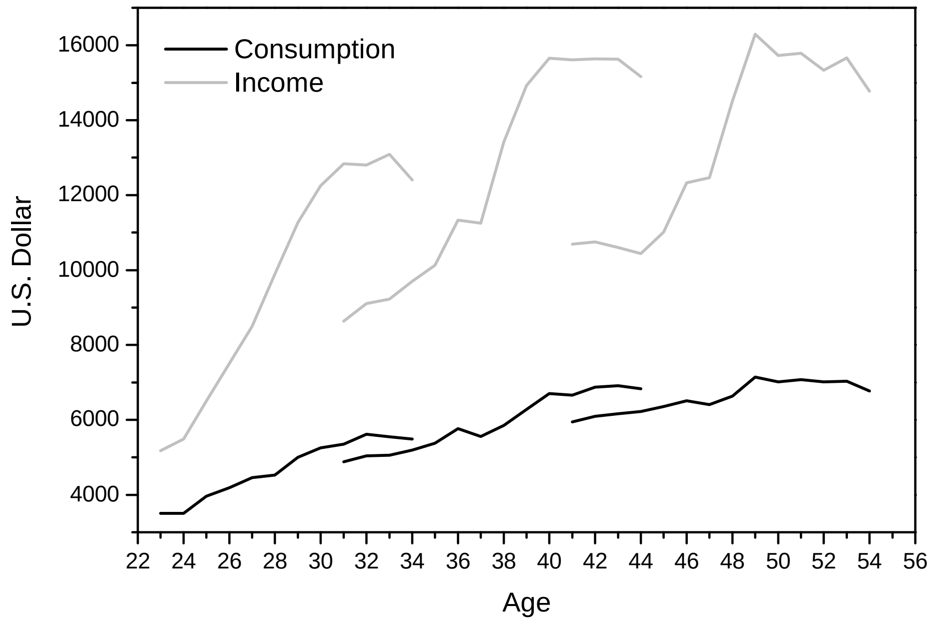
Figure 3. Structure of Consumer Expenditure Survey (CEX) data

	Q3 2007			Q4 2007			Q1 2008			Q2 2008			Q3 200			Q4 2008			Q1 2009			Q2 2009		
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1	4			*1* 5			2			3			4			5 *1*			2			3		
2	*1* 5			2			3			4			5 *1*			2			3			4		
3	2			3			4			5 *1*			2			3			4			*1* 5		
4	3			4			5 *1*			2			3			4			*1* 5			2		
5		4			*1* 5			2			3			4			5 *1*			2			3	
6		*1* 5			2			3			4			5 *1*			2			3			4	
7		2			3			4			5 *1*			2			3			4			*1* 5	
8		3			4			5 *1*			2			3			4			*1* 5			2	
9			4			*1* 5			2			3			4			5 *1*			2			3
10			*1* 5			2			3			4			5 *1*			2			3			4
11			2			3			4			5 *1*			2			3			4			*1* 5
12			3			4			5 *1*			2			3			4			*1* 5			2

Figure 4. Reconstruction of Consumer Expenditure Survey (CEX) data

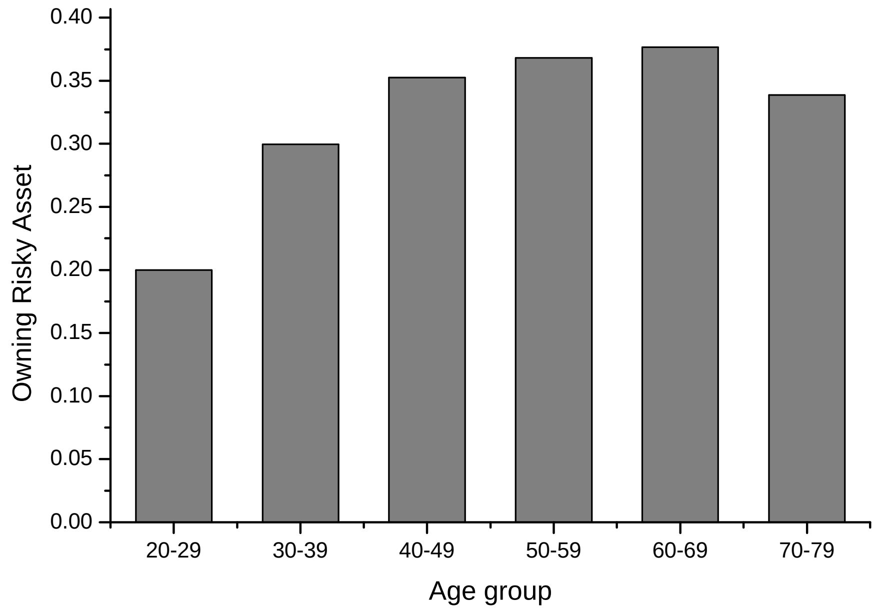
	Q3 2007			Q4 2007			Q1 2008			Q2 2008			Q3 200			Q4 2008			Q1 2009			Q2 2009		
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1	4			*1* 5			2			3			4			5 *1*			2			3		
2	*1* 5			2			3			4			5 *1*			2			3			4		
3	2			3			4			5 *1*			2			3			4			*1* 5		
4	3			4			5 *1*			2			3			4			*1* 5			2		
5		4			*1* 5			2			3			4			5 *1*			2			3	
6		*1* 5			2			3			4			5 *1*			2			3			4	
7		2			3			4			5 *1*			2			3			4			*1* 5	
8		3			4			5 *1*			2			3			4			*1* 5			2	
9			4			*1* 5			2			3			4			5 *1*			2			3
10			*1* 5			2			3			4			5 *1*			2			3			4
11			2			3			4			5 *1*			2			3			4			*1* 5
12			3			4			5 *1*			2			3			4			*1* 5			2

Figure 5.Conusmption and income over life cycle



Notes: (1) The figure plots the quarterly consumption (dark line) and income (grey line) over life cycle for three different cohorts. The data is from CEX. (2) The vertical axis is the U.S. dollar in 1997 level.

Figure 6. Risky asset owning rate by age



Note: The figure plots the ratio of household with risky asset by age. The data is from CEX.