Portfolio Choice with House Value Misperception*

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Abstract

We use data on self-reported and market house values to present empirical evidence of house value misperception at the household level. We build an optimal portfolio choice model that features misperception, as observed in the data. In the model, households make consumption and portfolio decisions on housing and non-housing assets with transaction costs in the housing adjustments. They use subjective housing valuations, which may differ from market values, and decide each period whether to pay for observing the market value or not. Our model delivers several empirical implications that we test using household-level data

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1 Introduction

Academics have long recognized that households' estimates of their house values often are not aligned with market values. This misalignment is often explained as misperception or rational inattention and can have an important effect in the portfolio choices of households. In this paper, we study the portfolio allocation, consumption, and housing choice implications of such divergence between market and subjective house values. We setup and solve a portfolio choice model that accounts for house value misperception. We first present empirical evidence of house value misperception at the household level by comparing data on self-reported housing values from Panel Study of Income Dynamics (PSID) with market housing values. We find evidence indicating that homeowners misestimate their house values. We also find that overvaluation is negatively correlated with the age and the tenure of the household. The opposite is true for undervaluation. We also find that misperception varies substantially with socioeconomic status and geographical location.

We introduce the empirical evidence of house value misperception in a partial equilibrium model with an agent who makes consumption and portfolio choices of housing and non-housing goods and assets. In the model, the agent does not observe the market value of its house. Instead, she makes portfolio and consumption decisions using her own subjective house value, which may differ from its current unobservable market value. The agent has the possibility of paying a cost to observe the market value of her home. Moreover, the agent incurs a transaction cost when selling the house that she currently owns to buy a new one. The existence of transaction costs makes housing consumption lumpy. The existence of costly acquisition of information causes the discrepancy between subjective and market values, as the households are not willing to continuously update their information about the market value. We abstract from modeling the root causes of this divergence. This modeling approach results in two inaction regions (or two sets of action boundaries). One inaction region determines the states in which the agents do not update their information about the market value of their house. The other inaction region determines the states in which the agent, once they have the information about the market value of their house, decide not to sell their house and buy a new one, more adequate to their wealth. Our model delivers qualitative and quantitative implications for the optimal consumption and portfolio decisions subject to house value misperception and transaction costs. We test such implications using household-level data on wealth, self-reported housing values, consumption, and asset holdings available from the Panel Study of Income Dynamics (PSID). We construct a measure of house value misperception based on self-reported house values from the PSID surveys and house market data. In the empirical tests, we employ this measure to determine whether house value misperception affects housing and nonhousing portfolio holdings across households.

Our results build on existing literature of portfolio choice with transaction costs and predictability. First, we demonstrate the effects of house value misperception on the portfolio holdings of housing assets. As in the portfolio choice model with transaction costs in Grossman and Laroque (1990) (GL henceforth), an agent only moves to a more valuable house when her wealth-to-housing ratio reaches an optimal upper boundary. Similarly, an agent only moves to a less valuable house when her wealth-to-housing ratio reaches an optimal lower boundary. However, in our analysis, the agent decides whether to acquire information or not and, once she has acquired the information, whether to move to a new home or stay put. The boundaries determine the timing of acquiring information. When the agent pays the cost and observes the market value of her home, she has to decide whether the market-based wealth-to-housing ratio is such that it is worth paying the housing transaction cost and move to a different house.

We show the implications of house value misperception for housing adjustments. Not surprisingly, the model predicts that that housing tenure is longer when agents do not observe the market value of their home than assuming perfect observation of values. Empirically, we look at the distribution of deviations of subjective valuations from market values across postal zipcodes and compare average tenure between the highest percentiles of the distribution and the lowest. We observe that zipcodes with less misperception have shorter spells of housing ownership between moves.

Finally, we also reveal the implications of house value misperception and housing transaction for the portfolio choices of nonhousing assets. We find that the share of wealth invested in risky assets is lower for higher uncertainty about the market values, due to a higher risk aversion. In addition, when households tend to overvalue the house, the risk aversion is highest when the agents are closer to downsize their house. This is understandable, since overvaluation would imply a lower total wealth relative to housing wealth, potentially outside the inaction region (i.e., the house becomes too expensive for their wealth). The opposite is true for households that underestimate. Their underestimation is particularly risky near the point of buying a larger house because the actual value of the house may put the agents outside the inaction region (i.e., the house becomes too small for the wealth they hold). We also reveal that, conditional on moving, the change in risky asset holdings relative to wealth is higher (lower) for households that overestimate (underestimate) their house value.

Although there is a stream of literature that studies the effects of stock value misperception and rational inattention on investor's decisions, very little effort has been made in studying the effects of house value misperception.[1] Our paper builds upon the literature on portfolio choice models with fixed adjustment costs. We use the portfolio choice model in Grossman and Laroque (1990) as a benchmark model for our study. The GL model accounts for transaction costs but it does not account for price mispercetion. Our model is part of the literature that focuses on particular implications of portfolio choice in the presence of housing. Flavin and Yamashita (2002), Damgaard, Fuglsbjerg, and Munk (2003), Cocco (2005), Yao and Zhang (2005), Flavin and Nakagawa (2008), Van Hemert (2008), Stokey (2009), Fischer and Stamos (2013), and Corradin, Fillat, and Vergara-Alert (2014). This literature assumes that households accurately observe house prices and their models do not account for house value misperception. Our paper contributes to fill this gap.

Our paper also contributes to a new literature that studies how house value misperception affects households' decisions. Piazzesi and Schneider (2009) and Ehrlich (2013) analyze how house value misperception affect house prices in search and matching models. Davis and Quintin (2014) focus on how the misperception of house prices affects homeowners' decisions on mortgage defaults.

2 Analysis of House Value Misperception

There are some studies that focus on the empirical analysis of misperception in house values. Although, there is consensus on the existence of house value misperception, there is no agreement on its sign and magnitude. Kish and Lansing (1954) and Agarwal (2007) find that homeowners overestimate their house value by 3% to 4%. Benítez-Silva et al. (2008) obtain overestimation values on the range of 5% to 10%. Contrarily, Follain and Malpezzi (1981) and Goodman Jr and

[1]Misperception and "rational inattention" has been extensely studied for the stock markets, but not in the household finance literature. For example, see the models on portfolio choices for stocks with rational inattention in Duffie and Sun (1990), Gabaix et al. (2006), Reis (2006), and Abel, Eberly, and Panageas (2007).

Ittner (1992) find that homeowners underestimate the value of their house by about 2%.

In this paper, we study a measure of house value misperception at the household level and we apply it to the analysis of household finance. We use self-reported house values from the Panel Study of Income Dynamics (PSID) as a measure of subjective house value. Second, we use the Federal Housing Finance Agency (FHFA) house price index at the state level and the CoreLogic Home Price Index at the Metropolitan Statistical Area (MSA) and zip code level. The CoreLogic index is a repeat sales index and matches house price changes on the same properties in the public record files from First American and then computes separate indexes by: zip codes, counties, metropolitan statistical area, state, and nationally. Since the data are from public records, the HPI is representative of all loans in the market, not simply the conforming loan market of the GSEs like the FHFA index. The HPI is a monthly series beginning in 1975. With the appropriate HPI we construct the market value of the properties by inflating the purchase price of the house. We define house value misperception as the difference between the subjective and the market house price. A positive value of this difference indicates overvaluation, while a negative value indicates undervaluation.

To build this measure, we assume that house value misperception is zero when there is a housing transaction and we estimate deviations of the subjective house value from the market house value in the years after the sale. Although this assumption reduces the sample size to households that had moved during the period of study, it increases the accuracy of our measure and is consistent with previous studies. For example, Kuzmenko and Timmins (2011) show that the bias in self-reported housing prices is positively correlated with tenure. They document that that long-standing homeowners do not the incentive to acquire information on current house prices and, consequently, they report biased housing values. We also find this correlation, conditional on a cohort effect at purchase time. On average, households who bought the house in the trough of a housing bust tend to over estimate the value of their house over time, while those who bought in periods of substantially positive growth tend to underestimate the value of their house over the years. This effect cohort effect tends to dissipate after 6-7 years of tenure. The recent debacle in house prices starting in 2006 seems to cut across all cohorts and, for any tenure, households grossly overestimate their house values. Table 1 summarizes the misestimation by cohort and tenure.

We also look at the evolution of two magnitudes that are relevant in the model: the total wealth

Table 1: **House value misestimation and tenure of households.** Tenure is measured in years since the purchase of the current home, and it is represented in the columns. The misperception value is computed as described in the text: the value of purchased is indexed with zip code level HPI and compared with the self-reported value of the house each year. The median of this variable is 0.98. Bold indicates that the coefficient is above the median. All the coefficients are in % terms.

	Average	$1-2$	3	4	5	6	7	8	9	10
1984	3.37	**−3.06**	**−3.29**	**0.22**	7.41	11.93	6.44	15.33	2.30	1.49
1985	−0.25	**−4.18**	**−5.16**	**−7.43**	**−4.29**	5.05	6.58	2.94	8.23	**−4.47**
1986	−2.27	**−9.49**	**−5.09**	**−7.20**	**−9.76**	**−3.88**	1.72	7.41	2.12	11.69
1987	−2.73	**−7.53**	**−4.11**	**−9.40**	**−5.55**	**−10.97**	**−1.58**	1.09	4.47	4.37
1988	−1.78	**−1.36**	**−5.68**	**−3.35**	**−7.04**	**−6.19**	**−12.89**	**−0.39**	4.94	**−1.64**
1989	0.36	2.94	**0.88**	3.17	**−1.36**	**−7.85**	**−1.76**	**−10.69**	**−9.09**	7.39
1990	2.47	1.11	6.45	2.58	**−1.07**	**0.40**	**0.97**	**−1.53**	**−6.61**	**−6.13**
1991	3.45	1.67	5.60	9.40	3.77	2.26	2.05	2.02	5.45	**−4.01**
1992	2.29	**−1.85**	2.72	2.45	11.36	2.81	**−0.26**	2.90	**−3.15**	3.21
1993	1.69	1.68	**−3.35**	0.98	3.28	4.88	3.05	**−2.86**	2.84	4.96
1994	1.86	**−0.17**	**−2.46**	**−3.98**	1.49	5.21	6.08	3.36	2.29	5.17
1995	0.62	**−1.17**	**−1.76**	**−3.43**	**−6.14**	1.06	4.79	8.58	5.15	1.62
1996	0.05	**−0.64**	**−3.96**	**−2.04**	**0.29**	**−7.63**	**0.03**	2.80	10.24	2.27
1997	−0.88	**−1.04**	**−0.56**	**−6.54**	**−3.74**	**−1.35**	**−8.77**	**−3.93**	10.42	7.70
1999	−2.82	**−6.56**	**−4.86**	**−3.86**	**−7.60**	**−3.59**	**−4.71**	**−9.21**	**−2.91**	7.28
2001	−2.13	2.86	**−8.34**	**0.96**	**−4.84**	**−8.85**	**−0.70**	**−3.00**	**−8.02**	**−12.78**
2003	−1.57	**0.14**	**0.96**	**−10.41**	**−0.17**	**−3.73**	**−2.97**	3.28	9.06	**−11.04**
2005	−1.52	1.19	**−0.54**	**−0.20**	**−13.84**	**−5.17**	**−1.41**	**−2.20**	2.51	18.83
2007	8.26	14.82	11.42	9.09	17.61	**−4.18**	17.10	10.04	15.26	19.51
2009	11.32	8.03	25.42	17.33	12.65	16.69	**−3.12**	18.34	19.68	4.99
2011	11.83	1.63	7.50	26.77	17.18	12.87	21.33	8.61	7.92	23.50
2013	2.18	**−6.14**	**−3.66**	**−0.70**	13.09	5.99	1.25	4.66	2.57	3.19
Average		0.07	0.57	1.41	2.19	1.10	1.76	2.57	3.88	3.96

to housing ratio and the share of wealth invested in risky stocks. In particular, we observe that there are also important cohort effects, as with the misestimation. In order to follow a cohort of households buying a new house at a given year, we have to follow the diagonals of the table, as a 1990 homebuyer will have 3 years of tenure in 1993. Table 2 shows the wealth to housing ratio as a function of tenure. Rows indicate the year in which a new house was purchased, and columns indicate the years after that purchase. Table 3 is similar, showing the evolution of risky stock holdings over time, by cohort. Tables 2 and 3 ought to be read horizontally, as we have structured the cohorts in rows.

Misperceptioin, risky holdings, and wealth to housing ratio present a cohort effect. We have highlighted the values above the median to emphasize this cohort effect. Those households who buy a new house during a period of negative house price growth, like in the beginning of the 90s, present a persistent tendency to overvaluate. This pattern can be observed in table 1. Those households

Table 2: **Wealth to housing ratio and tenure of households.** Rows represent the year of the purchase of the house, T. Columns represent years after the purchase of the house, t. Every coefficient represents the average ratio of total wealth to housing wealth in year t for all the households that moved in year T. The median of this ratio is 1.727. Bold indicates that the coefficient is above the median.

	1985	1990	1995	2000	2002	2004	2006	2008
1984	1.376	1.414	**1.913**					
1989		1.420	1.545	1.595	1.690			
1994			**2.009**	**1.989**	**1.881**	**2.856**	**2.310**	**2.201**
1999				1.452	1.621	1.460	1.820	1.990
2001					**1.998**	**1.733**	**1.932**	1.596
2003						1.563	1.610	**1.782**
2005							1.460	1.606
2007								1.568

Table 3: **Risky stock holdings and tenure of households.** Rows represent the year of the purchase of the house, T. Columns represent years after the purchase of the house, t. Every coefficient represents the average ratio of risky stock holdings to total wealth in year t for all the households that moved in year T. The median of this ratio is 0.037. Bold indicates that the coefficient is above the median.

	1985	1990	1995	2000	2002	2004	2006	2008
1984	0.015	0.029	**0.078**					
1989		0.027	**0.057**	0.023	0.028			
1994			**0.038**	**0.050**	**0.044**	**0.054**	**0.068**	**0.086**
1999				0.024	**0.041**	**0.047**	**0.041**	0.033
2001					**0.043**	0.026	0.034	**0.040**
2003						0.023	0.033	0.029
2005							0.024	0.025
2007								0.021

buying a house between 1989 and 1991 keep overvaluing after every year until they have spent 10 years in the house. The same pattern can be observed in tables 2 and 3, where the rows have been arranged to keep track of the same cohort over time. Those cohorts starting in a new house with a wealth to housing ratio or share of risky stock holdings higher than the median, they stay higher than the median over time.

We take this as indicative evidence of the different portfolio allocation behavior as a function of the misperception. The model developed in the next section justifies different choices based on different levels of misperception and uncertainty around market values of housing and generates testable implications.

3 The Model

We study the consumption and portfolio choices of an agent in an economy with a risk-free asset and two types of consumption goods: non-housing and housing goods, with uncertain price evolution.Transactions in the housing market are costly. The infinitely lived agent has non-separable Cobb-Douglas preferences over housing and non-housing goods. She derives utility over a trivial flow of services generated by the house.[2] The utility function can be expressed as:

$$u(C,H) = \frac{1}{1-\gamma}(C^{\beta}H^{1-\beta})^{1-\gamma}, \tag{1}$$

where H is the service flow from the house (in square footage) and C denotes non-housing consumption. $1-\beta$ measures the preference for housing relative to non-housing consumption goods, and γ is the coefficient of relative risk aversion.

The housing stock depreciates at a physical depreciation rate δ. If the agent does not buy or sell any housing assets, the dynamics of the housing stock follows the process:

$$dH = -\delta H dt, \tag{2}$$

for a given initial endowment of housing assets H_0. The agent does not observe the price of her house continuously. Instead, the agent pays an observation cost ϕ_o to observe the market value of the house at any given time. As long as the agent does not pay the cost, he receives no signal about the market value. After observing the market value of the house, the household decides whether to change the size of the house or not. We assume that the subjective value of the house, P, follows a geometric Brownian motion for a given initial price P_0:

$$dP = P\mu dt + P\sigma dZ, \tag{3}$$

where μ and σ are constant parameters.

We assume that the misperception of the household takes the form of a constant percentage difference between the market value and the subjective value, m^i. For simplicity, misperception

[2] This specification can be generalized as long as preferences are homothetic. Davis and Ortalo-Magne (2011) show that expenditure shares on housing are constant over time.

takes two values: m^l and m^h denote constant parameters that define the undervaluation and overvaluation in house prices. We assume that the agent does not know with certainty the regime nor the past regimes since the last time that she observed the "true" market house price. However, the agent knows about the existence of house value misperception, the value of the parameters m^l and m^h and the probability π.

The value of the riskless bond simply follows

$$dB = rBdt \tag{4}$$

Let W denote the value of the agent's wealth in units of non-housing consumption. Wealth is composed of investments in financial assets and the subjective value of the current housing stock:

$$W = B + \Theta + HP, \tag{5}$$

where B is the wealth held in the riskless asset and Θ is the amount invested in the risky asset.

The price of the risky asset, S, follows a geometric Brownian motion:

$$dS = S\ \alpha_S dt + S\ \sigma_S dZ_1. \tag{6}$$

The agent decides how long to remain without acquiring information, τ. Once the agent pays the cost to acquire the information, $\phi_o PH$, the true market value is revealed and she has to change the size of the house or to stay in the same house for another period τ until the next acquisition of information depending on the realization of m. If the household moves to a new house, she incurs a transaction cost that is proportional to the value of the house that she is selling, $\phi_a PH$. The agent also makes her consumption and portfolio decisions using her subjective valuation while she has no other information on the market value of the house. The evolution of wealth is

$$\begin{aligned} dW = {} & [r(W - HP) + \Theta(\alpha_S - r) + (\mu_P - \delta)HP - C]dt \\ & + (\Theta\sigma_S + HP\rho_{PS}\sigma_P)dZ_1 + HP\sigma_P\sqrt{1-\rho_{PS}^2}dZ_2. \end{aligned} \tag{7}$$

The value function of the problem for acquiring information is:

$$
\begin{aligned}
V(W,H,P) = \max_{C,\Theta,H',\tau} E\Bigg[&\int_0^\tau u(C, He^{-\delta t})dt \\
&+ \mathbb{I}_{H'>H} e^{-\rho\tau}(1-\pi)V\left(W(\tau), He^{-\delta\tau}, P(\tau)\right) + \pi\widetilde{V}\left(W(\tau), H(\tau), P(\tau)\right) \\
&+ \mathbb{I}_{H'<H} e^{-\rho\tau}\pi V\left(W(\tau), He^{-\delta\tau}, P(\tau)\right) + (1-\pi)\widetilde{V}\left(W(\tau), H(\tau), P(\tau)\right)\Bigg], \qquad (8)
\end{aligned}
$$

where $W(\tau) = W(\tau^-) - \phi_o P(\tau)H(\tau^-) + m^i P(\tau^-)H(\tau^-)$, $P(\tau) = P(\tau^-)(1+m^i)$, $H(\tau) = H'$ and $H(\tau^-) = He^{-\delta\tau}$ when the agent acquires information.

Conversely, the value of adjusting housing, H', is:

$$
\widetilde{V}(W,H,P) = \max_{C,\Theta,H',\tau} E\left[\int_0^\tau u(C, He^{-\delta t})dt + e^{-\rho\tau}\widetilde{V}\left(W(\tau), H(\tau), P(\tau)\right)\right], \qquad (9)
$$

where $W(\tau) = W(\tau^-) - \phi_a P(\tau)H(\tau^-) - \phi_o P(\tau)H(\tau^-) + m^i P(\tau^-)H(\tau^-)$.

4 Equilibrium of the Model

The value function of this problem, $V(W(t), H(t), P(t))$, satisfies the following Hamilton-Jacobi-Bellman (HJB) partial differential equation

$$
\sup_{C,\Theta,H',\tau} E\left(dV\left(W,H,P\right) + u\left(C,H\right)dt\right) \quad = \quad 0. \qquad (10)
$$

Equilibrium is defined as a set of allocations $H(t), B(t), \Theta(t)$, and $C(t)$, a policy function that describes the optimal timing of acquisition of information τ, such that the household maximizes her lifetime utility and the period-by-period budget constraint is satisfied.

We can use the homogeneity properties of the value function to formulate the problem in terms of the wealth-to-housing ratio, $z = W/(PH)$, as follows:

$$
V(W,H,P) = H^{1-\gamma}P^{\beta(1-\gamma)}\ V\left(\frac{W}{PH}, 1, 1\right) = H^{1-\gamma}P^{\beta(1-\gamma)}v\left(z\right). \qquad (11)
$$

This formulation simplifies this problem to solving for $v(z)$. The homogeneity properties are shared by V and $\widetilde{V}$, which allows us to use 11 in the solution of the problem at the boundary where the agent decides to acquire information and potentially to adjust housing. Furthermore, let c denote the scaled control $c = C/(PH)$ and θ the scaled control $\theta = \Theta/(PH)$.

The wealth-to-housing ratio, z, is the only state variable of this problem. The optimal timing for re-balancing wealth composition and the size of housing and non-housing adjustments are determined by this state variable. A solution for the equilibrium of the model consists of a value function $v(z)$ defined on the state space, where bounds $\underline{z}_o$ and $\overline{z}_o$ define an inaction region for the information acquisition problem, while $\underline{z}_a$ and $\overline{z}_a$ are the bounds for adjusting housing and z^*_H is the optimal return point. Finally, the consumption and portfolio policy c^* and θ^* are defined on $(\underline{z}_o, \overline{z}_o)$. The function $v(z)$ satisfies the Hamilton-Jacobi-Bellman equation on the inaction region. Value matching and smooth pasting conditions hold at the two sets of upper and lower bounds, and an optimality condition holds at the return point.

Proposition 1 *The solution of the optimal portfolio choice problem defined above presents the following properties:*

1. *$v(z)$ satisfies*

$$\widetilde{\rho} v(z) = \sup_{c,\theta} \left\{ u(c) + \mathcal{D}v(z) \right\}, \quad z \in (\underline{z}_o, \overline{z}_o), \tag{12}$$

where

$$\begin{aligned}\mathcal{D}v(z) =&((z-1)(r+\delta-\mu_P+\sigma_P^2(1+\beta(\gamma-1))) \\ &+\theta(\alpha_S - r - (1+\beta(\gamma-1))\rho_{PS}\ \sigma_S\sigma_P) - c)v_z(z) \\ &+\frac{1}{2}((z-1)^2\sigma_P^2 - 2(z-1)\hat{\theta}\ \rho_{PS}\ \sigma_P\sigma_S + \theta^2\sigma_S^2)v_{zz}(z),\end{aligned} \tag{13}$$

$$v(z) = M\frac{(z-\phi_o)^{(1-\gamma)}}{1-\gamma}, \quad z \notin (\underline{z}_o, \overline{z}_o) \tag{14}$$

$$\widetilde{v}(z) = \widetilde{M}\frac{(z-\phi_a-\phi_0)^{(1-\gamma)}}{1-\gamma}, \quad z \notin (\underline{z}_a, \overline{z}_a) \tag{15}$$

and $\widetilde{M}$ is defined as

$$\widetilde{M} = (1-\gamma)\sup_{z\geq\epsilon} z^{\gamma-1}\widetilde{v}(z), \tag{16}$$

2. *The return point* z_a^* *attains the maximum in*

$$\widetilde{v}(z^*) = \widetilde{M}\frac{z_a^{*(1-\gamma)}}{1-\gamma}. \tag{17}$$

3. *Value matching and smooth pasting conditions hold at the two thresholds* $(\underline{z}_a, \overline{z}_a)$

$$\widetilde{v}(z) = \widetilde{M}\frac{(\hat{z} - \phi_a - \phi_o)^{(1-\gamma)}}{1-\gamma}, \tag{18}$$

$$\widetilde{v}_z(z) = \widetilde{M}(\hat{z} - \phi_a - \phi_o)^{-\gamma}, \tag{19}$$

for $\hat{z}_a = \underline{z}_a, \overline{z}_a$ *and at the two thresholds* $(\underline{z}_o, \overline{z}_o)$

$$v(z) = (1-\pi)v\left(\frac{\overline{z}_o}{1+m^l}\right) + \pi\widetilde{M}\frac{(\overline{z}_a - \phi_a - \phi_o)^{(1-\gamma)}}{1-\gamma}, \tag{20}$$

$$v(z) = \pi v\left(\frac{\underline{z}_o}{1+m^h}\right) + (1-\pi)\widetilde{M}\frac{(\underline{z}_a - \phi_a - \phi_o)^{(1-\gamma)}}{1-\gamma}. \tag{21}$$

4. *Given a wealth-to-housing ratio* z*, where* $v(z) > M\frac{(z-\phi_o)^{1-\gamma}}{1-\gamma}$*, the agent chooses a optimal consumption* $c^*(z)$ *and portfolio* $\theta^*(z)$ *and* $b^*(z)$

$$c^*(z) = \left(\frac{v_z(z)}{\beta}\right)^{1/(\beta(1-\gamma)-1)}, \tag{22}$$

$$\theta^*(z) = -\omega\frac{v_z(z)}{v_{zz}(z)} + \frac{\rho_{PS}\sigma_P}{\sigma_S}(z-1), \tag{23}$$

$$b^*(z) = 1 - (1+\theta^*(z))/z, \tag{24}$$

for the constant ω *defined as* $\omega = \left[\alpha_S - r + (1-\beta(1-\gamma))\rho_{PS}\sigma_P\right]/\sigma_S^2$.

Figure 1 uses a simple setup to provide intuition on the equilibrium of the model. Consider that an agent has a total wealth-to-housing ratio between 2.5 and 3.0 at the initial time $t = 0$ (i.e., point 0 in Figure 1). Assume that $t = 0$ belongs to a time interval in which the agent overvalues her house. The agent must pay a transaction cost every time she adjusts her housing consumption and also an observation cost every time she decides to appraise her house and see the market value. Therefore, she does not continuously update the house and she does not pay for an appraisal until she has accumulated a sufficient amount of wealth to compensate for the observation costs and, in case she decides to move, for the transaction cost. When the subjective wealth-to-housing ratio, $\tilde{W}/(\tilde{P}H)$ in the figure, reaches the upper bound of the inaction region for information acquisition (point 1), the agent pays the observation cost, observes the market and decides whether to sell the house and purchase another house. Because the agent is overvaluing the value of her house when she reaches this upper boundary at time τ_1, she observes that her current wealth-to-housing ratio is actually higher than what she anticipated (point 1') and she decides to move to a bigger house. This decisions takes her wealth-to-housing ratio down to its optimal level (point 1*).

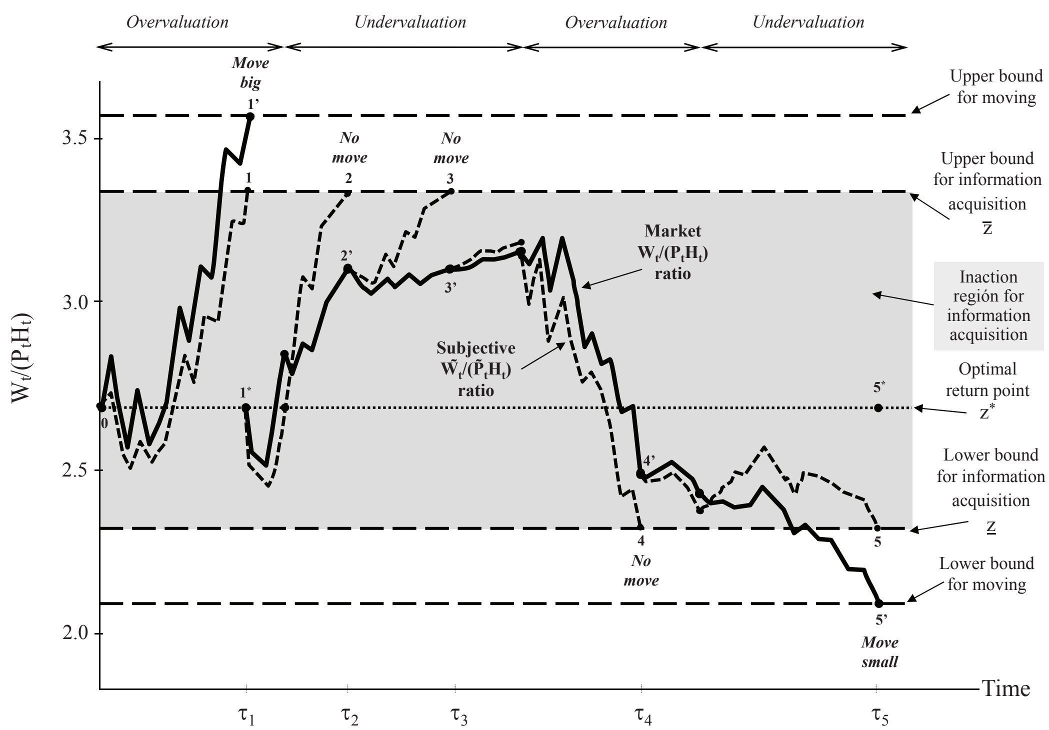

Figure 1: **Mechanism of the model.** The figure plots a hypothetical path of the subjective wealth-to-housing ratio and its corresponding market wealth-to-housing ratio. It shows the four scenarios that the agent can face: reaching the upper boundary of the inaction region when she overvalues her house; reaching the upper boundary of the inaction region when she undervalues her house; reaching the lower boundary of the inaction region when she overvalues her house; and reaching the lower boundary of the inaction region when she undervalues her house. When the subjective wealth-to-housing ratio reaches the upper bound, the agent checks whether the benefits of resizing the house overweight the transaction costs.

Assume that the agent starts undervaluying her house (she does not know it) at some time after $t = \tau_1$. The wealth-to-housing ratio evolves over time until it reaches the upper bound again (point

2) at time $t = \tau_2$. The agent then pays the observation cost, learn the market value of her house and, therefore the market value of her wealth-to-housing ratio, which lays in the inaction region (point 2'). She decides not to move and the wealth-to-housing ratio evolves over time until it reaches the upper bound again (point 3) at time $t = \tau_3$. Because she learns that she is undervaluying her house, her market wealth-to-housing ratio is still in the inaction region (point 3'), thus she does not move and updates her wealth-to-housing ratio. The scenario of undervaluation and increasing wealth-to-housing ratio (points 2, 2', 3, and 3') is a symmetrical situation to the one in which the agent overvalues her house and reaches the lower boundary of the inaction region (points 4 and 4'). Finally, assume that at some time after $t = \tau_4$ the agent starts undervaluying her house again but now her wealth-to-housing ratio decreases. When her subjective wealth-to-housing ratio reaches the lower bound at time $t = \tau_5$, she acquires the information about her house value. In this case, it is optimal for her to move and purchase a less valuable house, which takes her wealth-to-housing ratio up to its optimal level (point 5').

5 Numerical Results and Testable Implications of the Model

The problem described and analyzed in Sections 3 and 4 cannot be solved in closed-form. Therefore, we implement a numerical approach to derive the solution of this optimal control problem. We use the numerical results of the model to provide the main testable implications of the model.

Table 4 reports the parameters that we use for the benchmark calibration of the model. Regarding the parameters of the utility function, we assume a curvature of the utility function γ of 2, a rate of time preference ρ equal to 2.5%, and a degree of house flow services $1 - \beta$ equal to 40%. We set the annual risk-free rate to 1.5% and the drift and standard deviation of the risky asset to 7.7% and 16.55%, respectively. These figures are consistent with the long-term return and standard deviation of U.S. aggregate stock indices. We assume that the transaction cost is the 6% of the total value of the house and we set the physical depreciation rate of the house at 2%.

We also assume that the standard deviation of the house price growth is equal to 14%. We also parameterize the housing value misperception as a constant proportion of the value of the house, up 20% and down 20% for households that undervalue and overvalue their home, respectively. Finally, Table4 reports the conditional probability of overvaluation, for the benchmark case at 50%.

Table 4: **Parameter used for benchmark calibration.**

Variable	Symbol	Value
Curvature of the utility function	γ	2
House flow services	$1-\beta$	0.4
Time preference	ρ	0.025
Risk free rate	r	0.015
Housing stock depreciation	δ	0.02
Transaction cost	ϕ_a	0.06
information cost	ϕ_o	0.06
Risky asset drift	α_S	0.077
Standard deviation risky asset	σ_S	0.1655
Correlation house price - risky asset	ρ_{PS}	0.25
Standard deviation house price	σ_P	0.14
House price drift	μ_P	0.03
Overvaluation	m_H	20%
Undervaluation	m_L	-20%
Probability	π	0.5

In the remainder of this section, we introduce the main predictions of the model on portfolio holdings as a function of misperception dispersion (Subsection 7.1), portfolio holdings as a function of overvaluation (Subsection7.2), and size of the inaction region in the presence of misperception (Subsection 5.3).

The solution of the model, as described in section 4 consists of a policy function that takes the shape of action boundaries to 1) acquire costly information about the market value of the house, and 2) engage in a costly housing transaction. Figure 2 summarizes the numerical solution of the model. The solid line in the figure shows the difference between the indirect utility function of not acquiring information and not moving, versus acquiring information and updating the house value and move or not move, depending on the misperception sign. When this difference goes to zero, it is optimal for the agent to pay the cost of acquiring information, which brings her to, either he moving boundary, or back into the inaction region. If the moving boundary is hit, the agent moves to a new house and the wealth to housing ratio returns to the optimal point on the dotted line.

The relevant magnitudes of the solution to this calibration of the model are summarized in table 5. Table 2 presents 5 sets of results, all in terms of values of wealth to housing ratios. The first one displays the Grossman-Laroque boundaries for transaction, with no costly acquisition of

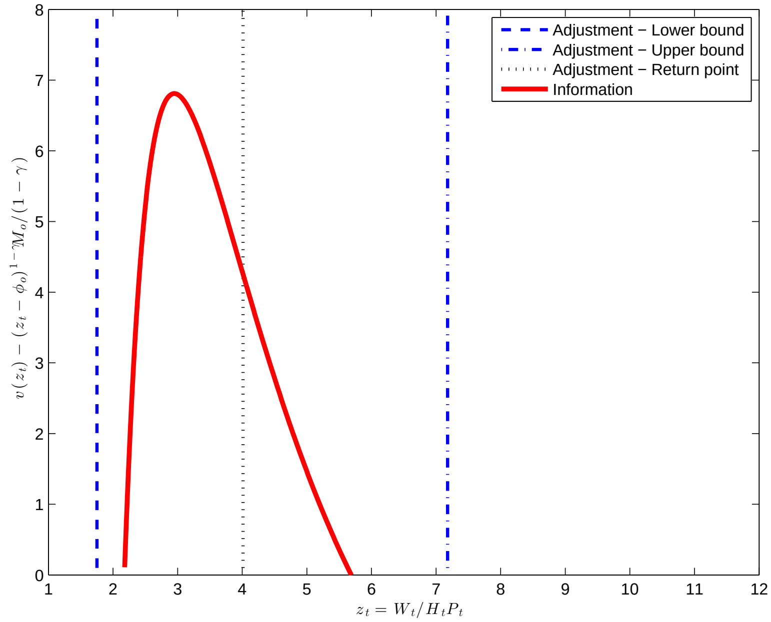

Figure 2: **Equilibrium:** Values for the difference between the (scaled) value function in the continuation region and the value function of acquiring information and potentially moving. The solid line represents the difference in values. The boundaries for acquiring information lie at the points where the solid line crosses zero. The vertical dashed lines represent the boundaries for moving. The vertical dotted line represents the optimal return point after the household moves to a new house.

information (and the same parameterization as in our benchmark case). The second row displays our benchmark results. What we observe is that the inaction region in the presence of costly acquisition of information is wider than in the case with perfect information. Agents move to a bigger (smaller) house when their wealth to housing ratio is higher (lower) than with perfect information. Nonetheless, in terms of expected time, there are two opposite forces. On the one hand, they acquire information earlier than they would transact a house with perfect information, but then they have a 50/50 chance of actually moving to a new home. If they planning on moving to a bigger house and realize that they were overvaluating their house, they do not engage in a transaction. In terms of the model, they are reverted back to the inaction region, instead of pushed to the transaction boundaries. An analogous argument holds for the lower boundary and agents wishing to downsize their house.

Then, we perform sensitivity analysis to the dispersion of misperception and to the probability of overvaluation. The third row shows the relevant boundaries when the market value can be 30% over or under the subjective valuation, as opposed to 20% in the benchmark case. The last

Table 5: **Model sensitivity:** Model outcomes for the acquisition of information boundaries and for the transaction boundaries, and for the return points under different parameterizations. The row GL considers no costs of information. Benchmark is the results of the model with the benchmark parameterization of table 4. Increase misperception increases misvaluation to 30%. Overvaluation and undervaluation place a probability of 75% of overvaluing and undervaluing, respectively.

	Adjust Lower Bound	Info. Lower Bound	Return Point	Info. Upper Bound	Adjust Upper Bound
GL	2.12	-	4.55	-	8.14
Benchmark	1.75	2.18	4.21	5.97	7.17
Increase misperception	1.743	2.486	4.03	5.02	6.54
Overvaluation - $\nabla\pi$	1.608	1.994	4.49	5.19	6.24
Undervaluation - $\Delta\pi$	1.93	2.41	4.71	5.919	7.113

two rows show sensitivity to the probability of being over or under valuating. The model shows that when misperception can be wider, the inaction region is overall lower than in the benchmark case. The inaction region for acquisition of information is narrower, which means that agents will acquire information more often than in the benchmark case. With respect to the house transaction, households will move to a bigger house earlier, yet they will delay a downsize of the house. Finally, a decrease in the probability of overvaluing also has an effect of shifting down the inaction region but it does not narrow the inaction band for information acquisition. The return point is higher, which means that after changing the house, the value of the house relative to the household's wealth is lower than in the benchmark case. This is exacerbated when we increase the probability of undervaluing the house.

The comparison of the Grossman-Laroque framework and our model with misperception can also be evaluated in terms of risky holdings. As we can see in figure 3, the risky holdings in a model with costly acquisition of information are lower than in a Grossman-Laroque for any level of wealth to housing ratio. The figure also illustrates the fact that the inaction region is narrower, as the edges of both the solid and the dashed lines determine the information boundaries.

5.1 Risky holdings and as a function of misperception dispersion

Figure 4 describes what happens when households are subject to a more disperse distribution of misperception. In this particular case, we show the policy function for the share of risky stock holdings when misperception can be up to 20% vs. an alternative 30% deviation. The model

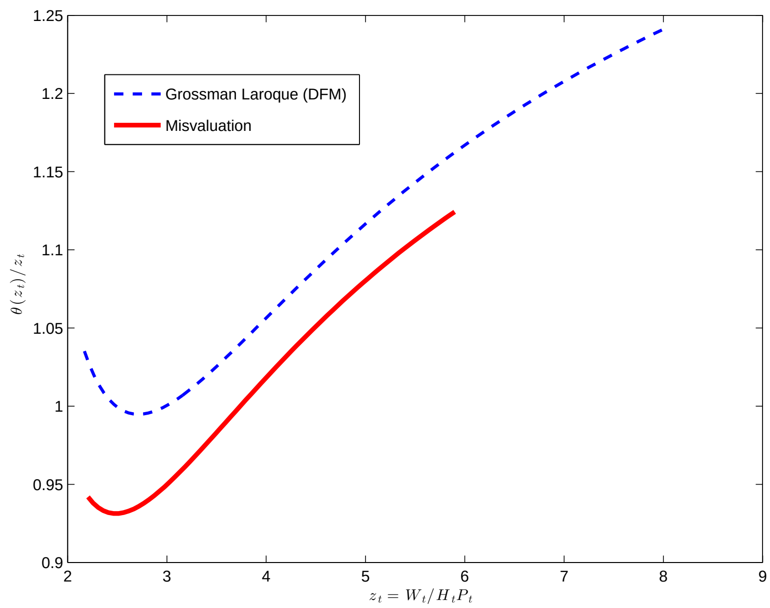

Figure 3: Share of wealth invested in risky holdings, $\theta(z_t)/z_t$ as a function of wealth to housing ratio, z_t. Solid line represents our benchmark model, and the dashed line represents a model with costless information (no misvaluation).

predicts that the higher the misperception dispersion, the lower the risky asset holdings. This result is a direct implication of a higher risk aversion that the households experience when misperception is more volatile. In addition, the inaction region also becomes narrower. The households acquire information more often as misperception becomes wider.

5.2 Risky holdings and housing as a function of overvaluation

In terms of the effects of overvaluation or undervaluation on risky stock holdings, figure 5 summarizes the results and compares to the benchmark of equal probability of over or under valuation. The overvaluation dashed line represents a household with a probability of overvaluing their house of 75%, while the dash-dotted line represents a household with a probability of undervaluing of 75%.

Let's focus on the lower boundary. That is the region of wealth-to-housing ration where the household is close to acquire information to evaluate whether to downsize the house or not. If the risk of overvaluing is higher (dashed line), there is a higher risk that after the information is revealed, the agent needs to downsize the house. That increases risk aversion relative to a situation where the risk of overvaluing is lower, conditional on wealth. Therefore, we observe less risky stock

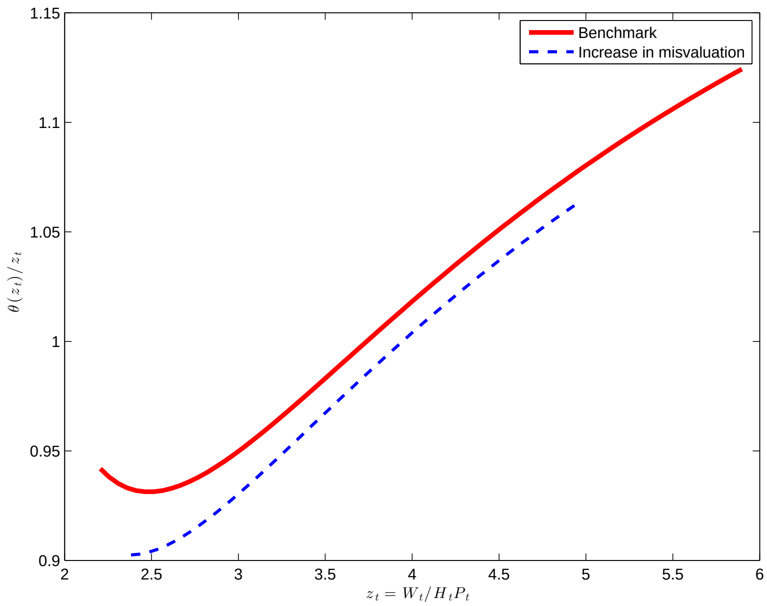

Figure 4: Share of wealth invested in risky holdings, $\theta(z_t)/z_t$ as a function of wealth to housing ratio, z_t. Solid line represents our benchmark case, and the dashed line represents the model with a misperception of $\pm 30\%$.

holdings for overvaluing households around the lower boundary.

Analogously, as the agent approaches to the upper bound, a higher risk of undervaluing, which results in hitting the boundary, results in higher risk aversion. Therefore, we observe less risky stock holdings for undervaluing households around the upper boundary.

5.3 Inaction region and misperception

Independently of the stock holdings, the model has prediction on the size of the inaction region as we have seen in table 5, the general effect is that the presence of misperception results in a shrinkage of the inaction region. The model predicts that, the higher the misperception, the more often agents will acquire information, and also they will transact housing more often, everything else equal.

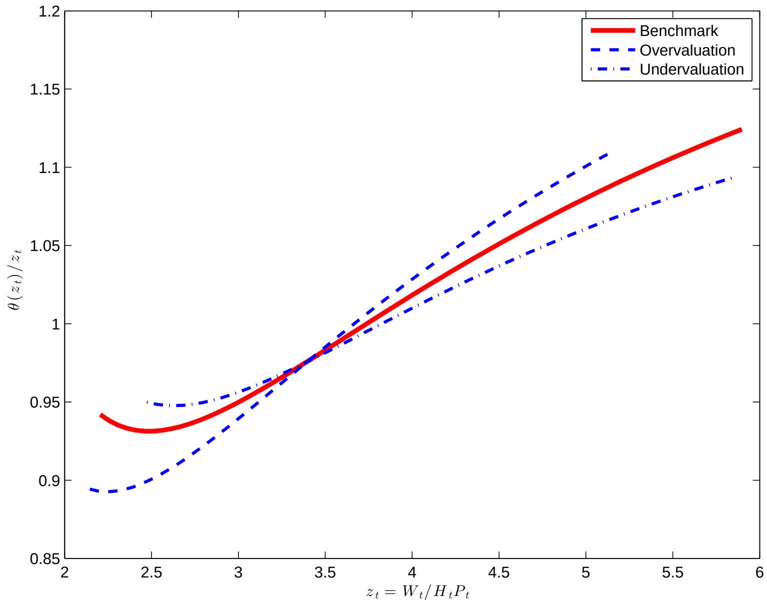

Figure 5: Share of wealth invested in risky holdings, $\theta(z_t)/z_t$ as a function of wealth to housing ratio, z_t. The benchmark model is represented in solid line, the dashed line corresponds to a household that is more likely to overvalue (lower π), and the dash-dotted line corresponds to a household that is more likely to undervalue (higher π).

6 Data

We use household level data to test the testable implications of the model. We utilize the data from the PSID from 1984 to 2013. PSID contains data on asset holdings and housing wealth at the household level. We calculate financial wealth as the sum of an individual's house value, their second house value (net of debt), business value (net of debt), other assets (net of debt), stock holdings (net of debt), checking and savings balances, IRAs and annuities less the mortgage principal on the primary residence. Other assets include bonds and insurance.[3] We divide these variables into two groups: risky assets and safe assets. Risky assets include stock holdings, IRAs and annuity holdings. The safe assets comprise other assets (net of debt), checking balances, and savings balances, less the outstanding mortgage principal on the primary residence. The variables regarding financial wealth are net of debt, with the sole exception of the primary residence value.

Table 6 presents the descriptive statistics for the main variables that we use in the empirical analysis. We present the means and standard deviations of the relevant variables. The most important variable in the model is the wealth-to-housing ratio, z. Stock holdings are approximately 10.2%

[3]For comparability across different survey waves, we exclusively focus on first mortgages.

of financial wealth, and safe assets without debt holdings represent 10.9% of financial wealth, or 14.1% for households that buy a more valuable house. We report statistics on stock holdings without retirement assets (IRA, 401k). We define the dummy m_{BIG} (m_{SMALL}) to identify households selling the current house to buy a more (less) valuable house in the same U.S. census region.

Table 6: **Descriptive statistics**. Sample averages and standard deviations (in parenthesis) for the main variables used in our analysis from PSID. The ratio $z = W/(P \cdot H)$ corresponds to the ratio of financial wealth net of debt over housing value without considering human capital as part of the wealth. Financial wealth is the summation of individual's house value, their second house value (net of debt), business value (net of debt), other assets (net of debt), stock holdings (net of debt), checking and savings balances, IRAs and annuities less the mortgage principal on the primary residence. Stock is equity in stocks and mutual funds including (not including) equity in IRAs, equity in 401k and thrifts (retirement assets). Safe asset includes other assets (net of debt), checking and savings balances, less (including) the principal on the primary residence (debt). Age corresponds to the age of the household head. m_{BIG} and m_{SMALL} are dummy variables that account for individuals who moved to a house having a higher and lower value, respectively.

	PSID
$z = W/(PH)$	1.388
	(1.645)
Stock share	0.102
(financial wealth) Θ/W	(0.225)
Stock (without retirement assets) share	0.056
(financial wealth) $\widehat{\Theta}/W$	(0.146)
Stock (without retirement assets) share	0.189
(liquid wealth) $\widehat{\Theta}/\widehat{W}$	(0.339)
Safe asset share	-1.051
(financial wealth) B/W	(2.199)
Safe asset (without debt) share	0.109
(financial wealth) $\widehat{B}/W$	(0.246)
Age	49.094
	(15.02)
m_{BIG}	0.063
	(0.243)
m_{SMALL}	0.023
	(0.149)
Num. Obs.	20189

Finally, we report summary statistics for variables that we use to distinguish between changes in housing that occur for reasons that are exogenous to the model and changes in housing that occur because individuals have a total wealth-to-housing ratio that is close to the boundary. To account for moves that are required for exogenous reasons, we use variables that capture changes in the household around each home purchase. Consequently, we control for changes in family size, marital status, and employment status in our empirical specification.

Our model does not explicitly study the portfolio choices of renters. We focus our study on understanding the portfolio decisions of homeowners. In our model, renting would be equivalent to holding zero equity in a house, as in Stokey (2009). We identify the households moving to a different house in the PSID because this survey explicitly reports whether there has been a move since the previous interview. The percentage of owners who move is much lower than the percentage of renters who move. This finding is consistent with the fact that renters face lower transaction costs than homeowners. The percentage of movers to a different U.S. census region or U.S. state is very low among owners. Finally, new homeowners represent 3.79% of the total homeowners in the PSID.

7 Empirical Results

In this section, we use the household survey data that we described in Section 6 to test the main predictions of the model that we developed in Section 5. In Subsection 7.1, we test the effect of the size of house price misperception on risky stock and housing portfolio choices that hypothesis 1 formalizes. In Subsection 7.2, we test hypothesis 2 on the effect of over- and undervaluation on the portfolio holdings of risky stock and housing assets.

7.1 Risky holdings and housing as a function of misperception dispersion. Empirical results

The model predicts that the higher the misperception, the lower the risky holdings. We employ the following reduced form model to test this hypothesis (1.1):

$$\frac{\theta_{it}}{z_{it}} = \gamma_0 + \gamma_1 \cdot D^m_{it} + \Gamma \cdot X_{it} + u_{it}, \tag{25}$$

where $\frac{\theta_{it}}{z_{it}}$ is the fraction of risky stock to total wealth; D^m_{it} is the measure of misperception dispersion, that is the positive distance of the misperception to the mean of the misperception; and X_{it} contains a set of variables that control for ex-ante changes in the housing stock for reasons not related to the wealth-to-housing ratio such as changes in employment status, family size and marital status. This parameter also includes age and gender of the head of the household.

Moreover, the model predicts that the higher the misperception, the lower the ratio of total wealth to housing ratio. We use the following reduced form model to test this hypothesis (1.2):

$$z_{it} = \gamma_0 + \gamma_1 \cdot D^z_{it} + \Gamma \cdot X_{it} + u_{it}, \tag{26}$$

where z_{it} is the wealth to housing ratio of household i at time t; D^z_{it} is the same measure of misperception dispersion; and X_{it} contains a set of control variables.

Table 7 shows the results of the test of hypotheses 1.1 and 1.2. Columns [1]-[3] show different specifications of equation (25). The sign of the coefficient related to the measure of misperception measure is negative and significant in all of them. Columns [4] and [5] presents the tests given by equation (26). The sign of the coefficient related to the measure of misperception measure is negative in both specifications and it is significant at the 5% level when we add controls to the regression. Overall, these results show that an increase of the misperception dispersion decreases both the risky and housing holdings of the households.

Table 7: **Test of Hypotheses 1.1 and 1.2** Coefficients are estimated by using a standard OLS model. The measure of value misestimation is the difference between the self-reported estimation of households' house values and market house values. PSID provides the self-reported values. CoreLogic provides the market values at the zip code level. Columns (1)-(3) show the results of the test of hypothesis 1.1, which uses the fraction of risky holdings, $\frac{\theta_{it}}{z_{it}}$, on the left-hand side of the regressions. Columns (4)-(5) show the results of the test of hypothesis 1.2, which use the fraction of risky holdings, $\frac{\theta_{it}}{z_{it}}$, on the left-hand side of the regressions. t-statisitcs in brackets. *** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.

	Risky stock (Hyp. 1.1)			Housing (Hyp. 1.2)	
	[1]	[2]	[3]	[4]	[5]
D_{it}	-0.00018^{*}	-0.00029^{***}	-0.00024^{***}	-0.00125	-0.00279^{**}
	[-1.95]	[-3.21]	[-2.74]	[-1.00]	[-2.27]
year	0.00496^{***}	0.00373^{***}	0.00348^{***}	0.03065^{***}	0.01370^{**}
	[11.66]	[8.69]	[8.35]	[5.33]	[2.37]
z_{it}			0.01808^{***}		
			[15.22]		
controls	No	Yes	Yes	No	Yes
constant	-9.83925^{***}	-7.44509^{***}	-6.96638^{***}	-59.32305^{***}	-26.47635^{**}
	[-11.6]	[-8.73]	[-8.42]	[-5.19]	-2.31
R^2	0.035	0.076	0.131	0.007	0.053
Obs.	3683	3683	3683	3683	3683

7.2 Risky holdings and housing as a function of overvaluation. Empirical Results

The model predicts that the household's risky holdings depend on its wealth-to-housing ratio and the regime of house price misperception. Specifically, it predicts that the higher the house price overvaluation, the the higher the share of risky assets in the household's portfolio (Hypothesis 2.1). Moreover, the higher the house price overvaluation, the the lower the wealth to housing ratio (Hypothesis 2.2).

To test Hypothesis 2.1, we create a dummy $D_{it}^{overval}$ that takes the value of 1 when the house price misperception of household i at time t is above the mean of the misperception and zero otherwise. We also include z_{it} and the interaction between the dummy $D_{it}^{overval}$ and z_{it}. We instrument using lagged variables on the right hand side of the following regression:

$$\frac{\theta_{it}}{z_{it}} = \gamma_0 + \gamma_1 \cdot z_{it} + \gamma_2 \cdot D_{it}^{overval} + \gamma_3 \cdot z_{it} \cdot D_{it}^{overval} + \Gamma \cdot X_{it} + u_{it}, \tag{27}$$

where $\frac{\theta_{it}}{z_{it}}$ is the amount invested in risky assets over total wealth by agent i at time t.

Table 8 presents the results for the test of Hypothesis 2.1. The coefficient estimates ifor z_{it} imply that a increase in the wealth to housing ratio increases the risky share in the portfolio. This result is consistent with the numerical results of the model. The coefficient on the interaction between mistestimation and the wealth to housing ratio is negative as expected, although it is not statistically significant. These results suggest that housing holdings have a substantial and significant effect on risky stock holdings. Therefore, house price misperception affects risky stock holdings through the home equity channel. This result is consistent with our model predictions. On average, households hold a higher amount of risky stocks when they overvalue their house prices.

Finally, we test Hypothesis 2.2 using lagged variables on the right hand side of the following regression:

$$z_{it} = \gamma_0 + \gamma_1 \cdot misperception_{it} + \Gamma \cdot X_{it} + u_{it}, \tag{28}$$

where z_{it} is the wealth to housing ratio of household i at time t; $misperception_{it}$ is the house price misperception; and X_{it} are controls. Table 9 presents the results for the test of Hypothesis

Table 8: **Test of Hypothesis 2.1**. Risky asset holdings over total wealth. OLS estimates. t-statisitcs in brackets.

	[1]	[2]	[3]	[4]
z_{it}	0.00873***	0.00781***	0.01823***	0.01822***
	[34.19]	[28.93]	[15.34]	[14.44]
D_{it}			-0.00614***	-0.00618*
			[-1.86]	[-1.67]
$D_{it} \cdot z_{it}$				-0.00004
				[0.98]
year		-0.00041***	0.00329***	0.00329***
		[-3.70]	[7.74]	[7.74]
Controls	No	Yes	Yes	Yes
constant	0.02441***	-7.44509***	-6.59006***	-6.96638***
	[27.72]	[-8.73]	[-7.80]	[-8.42]
R^2	0.054	0.085	0.130	0.130
Obs.	3683	3683	3683	3683

2.1. The coefficient estimates ifor $misperception_{it}$ imply that a increase in the wealth to housing ratio reduces the risky share in the portfolio. This result is consistent with the numerical results of the model. The coefficient on the interaction between mistestimation and the wealth to housing ratio is negative as expected, although it is not statistically significant. These results suggest that housing holdings have a substantial and significant effect on risky stock holdings. Therefore, house price misperception affects risky stock holdings through the home equity channel. This result is consistent with our model predictions. On average, households hold a higher amount of risky stocks when they overvalue their house prices.

Table 9: **Test of Hypothesis 2.2**. Total wealth to housing holdings. OLS estimates. t-statisitcs in brackets.

	[1]	[2]	[3]	[4]
$misperception_{it}$	-0.00145	-0.00181	-0.00127	-0.00162^{*}
	[-1.54]	[-1.96]	[-1.35]	[-1.76]
year			0.02984^{***}	0.01416^{**}
			[5.21]	[2.40]
Controls	No	Yes	No	Yes
constant	1.62765^{***}	0.71377^{***}	-57.732^{***}	-27.41654^{**}
	[70.28]	[6.04]	[-5.07]	[-2.34]
R^2	0.001	0.051	0.008	0.053
Obs.	3683	3683	3683	3683

8 Conclusions

House price misperception affects the optimal behavior of households. When households misestimate the value of their houses because acquiring information on the true market value is costly, they invest less in risky stocks, they tend to move more less frequently, but acquire information more frequently than engage in transactions under free information. When households overvalue their houses, they tend to hold less risky stock as they get closer to a situation where they would like to downsize their house because they become more risk averse. Moreover, when households overvalue their houses, smaller movements in the wealth-to-housing ratio are required to trigger the purchase of a new home.

To reach these conclusions, this paper extends the seminal work in Grossman and Laroque (1990) by considering that households may overestimate or underestimate the value of their houses. We document important differences in the magnitude of house value misperception across U.S. states. In our model, households find costly to acquire information on the market value of their house and thus overestimate or underestimate. This misvaluation affects their consumption and portfolio choice decisions as described above.

Empirical tests using household level data confirm the main implications of the model. Our empirical results illustrate that the over- and underestimation of house values affects the likelihood of buying a new home and the households' investments in housing. We also confirm that housing price misperception has substantial effects on financial portfolios. In sum, our paper demonstrates that the effects of transaction costs and costly acquisition of information are key elements of both housing and non-housing portfolio allocation decisions. We focus on the analysis of these decisions using a partial equilibrium model that takes house price predictability as given. Studying the aggregate general equilibrium implications of house value misperception is an interesting line of future research. We do not study in depth the effects on consumption and leverage, but the model has the tools to evaluate the impact of costly acquisition of information on consumption and leverage decisions. We plan on following this next steps in our research agenda on portfolio choice and housing.

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