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Short-Term Buyers and Housing Market Dynamics

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Abstract This study demonstrates that taking into account heterogeneous investment horizons will improve our understanding of housing price and trading dynamics. Using an OLG (Overlapping Generations) model in which agents have heterogeneous preferences and investment horizons, with transaction costs, short term investors are more sensitive to changes in economic fundamentals and are less likely to own (and trade) in a declining market. The model predicts that the ownership composition contains information about current and future house prices and trading dynamics. Empirically, we find that home owners' expected holding horizons co-vary negatively with house prices, and they also predict future (short term) returns.

Keywords Trading volume · Return predictability · Housing markets · Short term buyers

Introduction

This paper studies the implication of agent heterogeneity on house prices and transaction dynamics. Heterogeneous valuations arise because agents have different

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private values. Moreover, the valuation of a short-term investor also systematically differs from that of a long-term buyer. In general, transaction costs have a greater impact on short-term buyers' valuation. More importantly, home buyers with a shorter holding horizon in our model are more sensitive to changes in economic fundamentals; their valuations are reduced more when market conditions are expected to worsen (in the near term). In equilibrium, the trading activity is high (low) when prices are high (low) since there are more short-term investors in the owner population in a rising market and vice versa. In addition, the model has a novel prediction that the ownership composition of holding horizons contains valuable information regarding the current and expected price and trading dynamics.

We present a simple and stylized overlapping generations (OLG) model in the residential housing market. Assets of interest are in limited supply (relative to the number of buyers in the economy). In each period, two types of risk neutral agents are born. They differ, (i) in their asset holding horizons, and (ii) in their tastes for the housing good. The short horizon type will live for one period and thus sell the asset in one period. The long horizon type will sell in two periods at the end of the cycle. Whenever housing assets are available for sale, only buyers with relatively high valuations will become owners, given the limited supply.

Our model implies that the equilibrium house price is in general higher than the mean valuation of all potential home buyers in the economy. In addition, in the presence of a persistent rent growth rate, the transaction cost at the time of sale will have state-dependent and horizon-specific implications for agents' valuations. When the rent growth rate is expected to rise in the future, the adverse effect on the entire valuation is mitigated since the expected capital gain component is more favorable, compared to a declining market where the expected rent growth rate is low. Short horizon buyers' valuations in particular will be affected more since they are subject to a higher transaction cost per unit of time. Furthermore, their aggregate demand is higher when the price prospect is good, as a result of which more short horizon buyers are able to become owners at such times. This has two implications. First, it leads to a pro-cyclical price pattern and return predictability by owner's investment horizons. Second, this particular state-dependent ownership composition translates into more trading in the booming markets and vice versa.

The intuition is given by an increased short term demand (and its expected high turnover) when price is expected to rise. Using the model's implications, we empirically identify asset owners' ex ante holding horizons as a macro indicator and examine its relationship with house price movements. Using data from the American Housing Survey from 1985 to 2005, we find evidence consistent with the model's predictions. Using a censored normal regression for a pooled sample of over 8,400 observations, we first estimate owners' ex ante holding horizons at the time of purchase based on time-independent demographic and housing unit characteristics. The ex-ante investment horizon also isolates the effect of ex post market conditions on realized holding horizons. Therefore, we can reasonably argue that the results are not driven by the ex post market conditions. According to the model, there will be a state-dependent clientele in the expected ownership horizon, and we test this idea in the constructed panel data of around 120 Metropolitan statistical Areas (MSA) over a 20 year period. Using the average expected duration for home owners at the metropolitan level as the test variable, we find a strong negative co-movement between the expected duration series and house transaction prices at the MSA level. The evidence suggests that the proportion of short horizon homeowners will increase when prices are rising. This effect is statistically significant and is robust for a vector of control variables including time and location fixed effects.

We explore, based upon the model's prediction, the forecasting power of the expected duration for future returns. According to the model, more short horizon agents buy when returns are expected to be high in the near future. Thus, a lower expected duration on average this period is a positive signal about future short-term returns. The empirical findings are consistent with the model's predictions, especially when supply constraints are binding. We also show that the expected duration primarily has a strong explanatory power for the short-term price changes that are attributable to observed macro variables. This helps to differentiate from a speculative channel in which return predictability by owners' holding horizons is not related to macro fundamentals (e.g., a short-term feedback trading effect). In addition, our main empirical results are robust for alternative duration measures and different return horizons; and are not explained by the alternative interpretation based on differential access to information (that is potentially captured by the estimated expected duration measure).

The intuition for the investment horizon effect in this paper is similar to the clientele effect first proposed by Amihud and Mendelson (1986). In their deterministic model, investors with longer holding periods will be selected into the cross-section of assets with higher transaction costs, since they are able to amortize the (high) transaction costs over a longer period. Similarly in the housing literature, Shelton (1968) and later Boehm (1981) indicate that, given large transaction costs, the tenure choice (and thus demand for housing) depends on future expected mobility. Haurin and Gill (2002) utilize a unique data set that can readily identify expected duration, and confirm that the longer the household's expected duration, the greater the likelihood of home ownership. Our model builds on the existing economic insight and formally studies its implications for trading dynamics and return predictability by introducing transaction cost and heterogeneous valuation in a dynamic setting. The effective trading cost or illiquidity is greater (smaller) in a declining (booming) market, although the proportional transaction cost parameter remains constant over time. Given heterogeneous valuation within each group of agents, the equilibrium comprises of both short horizon and long horizon owners with a time-varying ownership composition.[1] There are disproportionately more short-term buyers being "priced out of" the owner-occupied market at times when the expected near term market fundamentals are weak and the effective trading cost will be higher.

Our paper is related to the literature on the price-volume pattern in the housing market, in which a number of housing market frictions has been proposed as explanations. For example, Stein (1995) and Ortalo-Magne and Rady (2006) argue that borrowing constraints as a result of credit market frictions restrict borrowers' demand for housing in down markets. In support of the theory, Lamont and Stein (1999) find that house prices are more sensitive to macro shocks when investors are highly levered (and thus are more likely to be subject to borrowing constraints).

[1] One can show that when all short-horizon (or long-horizon) agents have homogeneous valuations, there are a fixed (smaller) proportion of short horizon owners in equilibrium. Housing price appreciation (or the rate of return) is not associated and cannot be predicted by the relative short-horizon demand.

Genesove and Mayer (1997) find, using Boston condominium market transaction data, that highly leveraged sellers tend to experience a longer time on the market. Motivated by the prospect theory by Kahneman and Tversky (1979), Genesove and Mayer (2001) and Engelhardt (2003) find empirical evidence to support the sellers' loss aversion hypothesis. Building on the seminar search model (Wheaton 1990), Krainer (2001) and Novy Marx (2009) argue that search costs are lower in cold markets, making both sellers and buyers wait more when prices are low. Cauley and Pavlov (2002) and Qian (2012) model the home owners' delay in selling as a rational response to the value of waiting.

This paper contributes to the literature on return predictability in the housing market. For example, Case and Shiller (1989), Meese and Wallace (1994) as well as many others, provide considerable evidence that house prices are not a random walk. One popular explanation resorts to speculation by irrational agents. Cutler et al. (1990) explore the role of feedback traders–those who base their trading strategies on past price movements in generating positive serial correlation in returns. Case and Shiller (1988) and Case et al. (2003) find home buyers' expectations of future house prices are greatly affected by their recent experience, causing irrational speculation. We identify a novel variable–the home owners' expected holding horizon–that has forecasting power for returns.

Our paper is also related to a growing literature that examines how heterogeneous beliefs (combined with short sales constraints) explain the joint dynamics of price and trading activity.[2] The strand of research was pioneered by Harrison and Kreps (1978), and recent contributions have derived specific micro mechanisms (Scheinkman and Xiong 2003; Hong et al. 2006). Though differing in the exact source, the heterogeneous valuation in our model among short-horizon and long-horizon buyers implies a time-varying ownership composition, which is crucial for generating the pro-cyclical trading frequency.

The Model

We present a simple and stylized trading model with a fixed housing supply in a two period overlapping generations model.

In each period, two types of agents are born in the economy. One type lives for two periods (long horizon) and the other type lives for one period (short horizon). We normalize the mass of each type in the economy to 1, so agents with a total mass of two are born in each period. Agents are both risk neutral and maximize their life time utility with respect to a housing good and numeraire consumption. Both types of buyers are financially unconstrained and they either buy the owner-occupied house out of their wealth at the first period or live in the rental market and pay rents period-by-period.[3] The (unconstrained) wealth assumption is mainly to isolate the effect of borrowing constraints.

Characterizing consumers into the long and short holding types is a parsimonious way to capture the feature that buyers in the housing market have different planning

[2] Please refer to Hong and Stein (2007) for a detailed summary.

[3] For convenience, we are assuming there is a long-lived risk neutral landlord in this economy that does not consume housing and is passively collecting rents in the rental market.

or life horizons. Compared with previous assumptions that each household is exposed to the same random mobility shock, this modeling approach is a simple way to allow different mobility needs in the cross section. Short horizon buyers could be driven by higher mobility needs, changes in family structure, or age (e.g., elderly who have a shorter remaining life span). Long horizon buyers could be younger in age or more settled-down in their career and/or family.[4] To illustrate this point, using the American Housing Survey's 2003 recent mover data, on average, owners spend 8.17 years in their previous homes. However, 75 % of owners live in their previous homes for less than 11 years. Among them, 50 % of owners have duration of only 3 years or less. These calculations show a great diversity of holding horizons for home owners. Despite the caveat that the realized duration depends on the ex post market conditions, there is evidence in the residential mobility literature that the actual mobility behavior is driven largely by the expected mobility, which in turn is a function of movers' household and socioeconomic characteristics such as age, marital and retirement status (Ioannides and Kan 1996; Kan 1999).

There is a fixed supply of owner-occupied housing with a mass of Q and to capture limited housing supply, we assume Q is smaller than the number of potential buyers. The owner-occupied housing is indivisible and may be available for sale at any time t. Upon purchase of the owner-occupied house, a winning buyer has to consume the entire unit after she acquires the asset until the end of her horizon.

There is also a rental market in fixed supply. As with the owner-occupied market, each renter consumes exactly one unit of rental housing and she also consumes the rental unit until the end of her horizon. For convenience, there are $3-Q$ rental housing in the economy so that the total mass of housing supply equals that of the consumers in this economy in a given period.

Whether agents live in the owner-occupied market or the rental market, they need to pay for the housing services. The cost of housing services or the imputed rent per period at time t is exogenously given by $\eta_i R_t$. R_t is the common observable component of the imputed rent process at time t and is driven by fluctuations in the macroeconomic conditions. If consumers live in the rental market, $\eta_i=1$, $\forall$i and they will pay R_t as the rental cost. Therefore, R_t can be interpreted as the market rent at time t. The (market) rent level is growing at a rate of Y_t. We model the evolution of Y as a first-order Markov Chain, which takes on two values Y^L and Y^H with the following transition matrix:

$$\begin{pmatrix} \lambda & 1-\lambda \\ 1-\lambda & \lambda \end{pmatrix}$$

When $0.5<\lambda<1$, the rent growth rate is persistent. High growth states are more likely to be followed by high growth states as well. If $\lambda<0.5$, the rent growth rate is

[4] This seems to be a different take from the traditional housing demand literature, in which household formation (and thus their expected duration) is an endogenous function of market conditions. However, we view the exogenously fixed holding horizon as the assumption conditional on the effect of market conditions on household formation. That is, given the prevalent conditions, we assume there is still cross-sectional heterogeneity in potential home buyers' ex ante holding horizon expectations, which are mainly driven by their demographic characteristics. Nevertheless, there remains the caveat that the holding horizon expectations might be systematically correlated with prevalent market conditions through the household formation channel. In the empirical section, we take that into account for test identification.

more likely to switch between the states, and it is state-independent if $\lambda=0.5$. This modeling approach is similar to Krainer (2001) and Sinai and Souleles (2005) who model the rent level as an exogenous and persistent process. For the rest of the analysis, we follow the existing literature and assume that $\lambda>0.5$ to capture the macro fundamental's persistence. In addition to the market rent, there is an idiosyncratic component η_i associated with homeownership that is specific to each consumer during her life cycle (Williams 1995; Krainer 2001). This is to capture the feature that different buyers often have idiosyncratic consumption benefits associated with ownership and thus are willing to pay different prices. η is an i.i.d. uniform random variable distributed on the support of $(1-\psi, 1+\psi)$, where $\psi>0$. Another way to look at it is the private value premium agents are willing to pay for owning as opposed to renting the same house. There is also a constant risk free asset that yields a rate of return of $r>0$.

Every agent in the economy observes the (realized) macro component of the market rent process. The η realization for each agent, however, is purely private information. Specifically, new agents (of the short and the long types) are born at the beginning of time t. Every agent in the model observes the market rent R_t. Every agent in the model observes her own idiosyncratic value η. For the owner-occupied houses that are available for sale at time t, agents determine their reservation values and each buys one unit of house if her valuation is higher than the market price. At the end of her holding horizon, the owner sells the house and pays a proportional transaction cost C. The assumption that sellers bear all the transaction costs is for convenience and allowing trading costs on the buyer side will not change the fundamental insight of the model. Agents whose valuations fall below the market price live in the rental market until the end of their life cycle.

Lemma 1 *Define*

$$r_{s,t} = R_t,\ \ g_{s,t} = (1-C)\frac{E_t[P_{t+1}]}{1+r},$$

$$r_{;,t} = R_t + \frac{E_t[P_{t+1}]}{1+r},\ \ g_{l,t} = (1-C)\frac{E_t[P_{t+2}]}{(1+r)^2}, \tag{1}$$

The aggregate demand at time t for the short (long) horizon buyers (denoted by $D_{s,t}(D_{l,t})$) *are characterized as below,*

$$D_{s,t}(P_t) = \min\left[\max\left[\frac{(1+\psi) - \frac{P_t - g_{s,t}}{r_{s,t}}}{2\psi}, 0\right], 1\right]$$

$$D_{l,t}(P_t) = \min\left[\max\left[\frac{(1+\psi) - \frac{P_t - g_{l,t}}{r_{l,t}}}{2\psi}, 0\right], 1\right] \tag{2}$$

Where P_t *is the owner-occupied housing market's equilibrium price at time t.*

Proof See Appendix.

Since the total mass of each type of buyer population is one and each agent is assumed to buy one unit of housing, the aggregate demand for each type of buyers is simply the proportion of agents that have a valuation higher than the market price. The agents whose valuations fall below the market price will be living in the rental market, and at time t the total mass of new born agents who become renters are $\left(2 - D_{s,t} - D_{l,t}\right)$. In words, only buyers with higher (private) valuations are able to own. Intuitively, that implies that in equilibrium, house price reflects the higher valuations among all potential buyers.

We restrict the equilibrium concept to the steady-state stationary equilibrium, in which the equilibrium price is a function of the macro states only. In order to solve the equilibrium price, we make use of the homogeneity property and scale the price by the rent level (i.e. P_t/R_t). The following proposition characterizes the equilibrium using the scaled price variable.

Proposition 1 *In the steady state stationary equilibrium, the equilibrium price-to-rent ratio, p^L and p^H are the solutions to the following system of equations,*

$$D_s^L\left(p^L\right) + D_l^L\left(p^L\right) + \lambda D_l^L\left(p^L\right) + (1-\lambda)D_l^H\left(p^H\right) = Q$$

$$D_s^H\left(p^H\right) + D_l^H\left(p^H\right) + \lambda D_l^H\left(p^H\right) + (1-\lambda)D_l^L\left(p^L\right) = Q \tag{3}$$

Where

$$D_s^L\left(p^L\right) = \min\left[\max\left[\frac{(1+\psi) - \frac{p^L - g_s^L}{r_s^L}}{2\psi}, 0\right], 1\right], D_l^L\left(p^L\right) = \min\left[\max\left[\frac{(1+\psi) - \frac{p^L - g_l^L}{r_l^L}}{2\psi}, 0\right], 1\right]$$

$$D_s^H\left(p^H\right) = \min\left[\max\left[\frac{(1+\psi) - \frac{p^H - g_s^H}{r_s^H}}{2\psi}, 0\right], 1\right], D_l^L\left(p^L\right) = \min\left[\max\left[\frac{(1+\psi) - \frac{p^H - g_l^H}{r_l^H}}{2\psi}, 0\right], 1\right] \tag{4}$$

And,

$$r_s^L = 1, \; g_s^L = \frac{\lambda Y^L p^L + (1-\lambda) Y^H p^H}{1+r}$$

$$r_l^L = 1 + \frac{\lambda Y^L + (1-\lambda)Y^H}{1+r},\ g_l^L = \frac{\left[\left(\lambda^2 Y^L + (1-\lambda)^2 Y^H\right) Y^L p^L + \lambda(1-\lambda)(Y^L + Y^H) Y^H p^H\right]}{(1+r)^2}$$

$$r_s^H = 1,\ g_s^H = \frac{\lambda Y^H p^H + (1-\lambda) Y^L p^L}{1+r}$$

$$r_l^H = 1 + \frac{\lambda Y^H + (1-\lambda)Y^L}{1+r},\ g_l^H = \frac{\left[\left(\lambda^2 Y^H + (1-\lambda)^2 Y^L\right) Y^H p^H + \lambda(1-\lambda)(Y^L + Y^H) Y^L p^L\right]}{(1+r)^2}, \tag{5}$$

Proof See Appendix.

Proposition 1 essentially uses the market clearing condition to pin down the equilibrium price-to-rent ratio in the steady-state equilibrium. The total amount of the owner-occupied housing supply is fixed to be Q, however, part of the owner-occupied housing stock is not up for sale at a given time. This is because the long horizon owners who have bought their houses in the previous period are still consuming housing during this period and will only sell until the end of this period.

The system of equations in (3) is non-linear with no easy closed-form solutions, but a numerical solution can be easily obtained. The first observation is that given the equilibrium price (pair), understanding the trading dynamics is trivial. At any time t, trading volume is equal to the aggregate demand from both the short horizon and the long horizon buyers ($D_s^{state} + D_l^{state},\ state = L, H$). Equivalently, it is the proportion of the owner-occupied housing stock that is available for sale.

In order to better understand the effect of the model's key elements, we first calculate a benchmark price-to-rent ratio in the absence of transaction costs and idiosyncratic consumption values. One can easily show that the equilibrium price-to-rent ratio under no transaction costs and no private values associated with ownership is equal to,

$$\widetilde{p^L} = \frac{(1+r)(1+r+(1-2\lambda)Y^H)}{(1+r)^2 - Y^H Y^L (1-2\lambda) - \lambda(1+r)(Y^H + Y^L)}$$

$$\widetilde{p^H} = \frac{(1+r)(1+r+(1-2\lambda)Y^L)}{(1+r)^2 - Y^H Y^L (1-2\lambda) - \lambda(1+r)(Y^H + Y^L)}, \tag{6}$$

In the traditional literature where housing prices are viewed as the present value of rents, the values in (6) would be the equilibrium price-to-rent ratios. Since our model features transaction costs and private values toward home ownership, (6) are no longer the price-to-rent ratio of the owner-occupied market. They are instead used as benchmarks for comparison.

Given the model assumptions, this benchmark ratio is equivalent to the inverse of the rental market's cap rate. In other words, the present value of all future rents (or the fair market price for a rental unit) is equal to the current rent level multiplying by the corresponding ratio in (6). Figure 1 shows the relationship between the equilibrium price-to-rent ratios (scaled by the benchmark ratios in (6)) and some key parameters in the model (see Table 1 for the parameter values used). Then the comparison on the equilibrium house price is based on whether its price-to-rent ratio is higher or lower than its rental market counterpart.

The first plot in Fig. 1 shows how transaction cost affects the equilibrium price-to-rent ratio. As expected, increasing the proportional transaction cost lowers the equilibrium price-to-rent ratio, since agents rationally take that into account and price it in equilibrium. When C=0, notice that the equilibrium price-to-rent ratio is above one in each macro state. This is because agents in the model attach a private consumption benefits with home ownership and they may be willing to pay more to own rather than rent. Although we do not assume the private values are always positive (the distribution is Uniform on $[(1-\psi), (1+\psi)]$ with $\psi>0$), in equilibrium only agents with high private values become owners and the housing price will reflect their (high) valuations. In addition, when C=0, the equilibrium price-to-rent ratio is the same across the two rent growth state, implying the prices are equally high (relative to benchmark) in both the high growth rate state and the low growth rate state. However, when C becomes positive, the price-to-rent ratio is higher in the low growth rate state than in the high growth rate state. This implies that owner-occupied housing assets are more favorably priced in the low growth rate. This first appears counter-intuitive, but within the framework of a two-state switching economy, a current low rent growth rate means that the expected growth rate will be higher and vice versa. In other words, one should expect the market conditions to improve (worsen) when the current growth rate is low (high). Therefore, the above result should be interpreted as that house prices are higher when the market conditions are expected to be better. In addition, when the rent growth rate is persistent (i.e., $\lambda>0.5$), high prices tend to be followed by high prices in the short run and vice versa, implying predictability.

The intuition underlying the pro-cyclical price-to-rent ratio can be better understood by studying the impact of transaction cost on buyers' valuations across states. Owners get less at the time of sale due to the existence of (proportional) transaction cost, which will depress their valuations ex ante. Comparing across states, the adverse effect of the transaction cost on valuation will be stronger if the prospect on the capital gain component is bad. Taken together, the price will be decreased more when economic fundamentals are expected to worsen, leading to a lower price-to-ratio at such times.

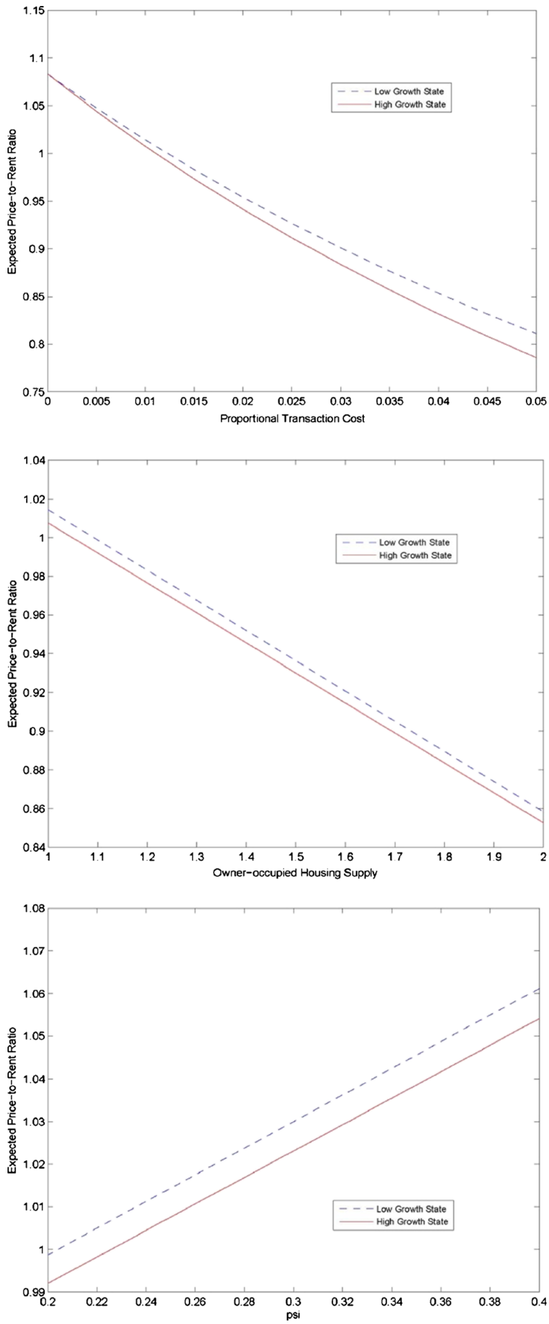


Fig. 1 The equilibrium price-to-rent ratio in the owner-occupied market. For all the following figures, the price-to-rent ratio is relative to the price-to-rent ratio in the absence of transaction costs and private values (i.e., the inverse of the rental cap rate). The first graph plots the equilibrium price-to-rent ratio as a function of transaction costs C, while keeping the other parameters fixed. The second graph plots the equilibrium price-to-rent ratio as a function of owner-occupied housing market size Q, holding everything else constant. The third graph plots the equilibrium price-to-rent ratio as a function of private value range parameter ψ, holding others fixed. The values of the model parameters are listed in Table 1

The second and the third plot in Fig. 1 show the equilibrium price-to-rent ratio as a function of the owner-occupied market size Q and private value distribution parameter ψ. As expected, the more limited the housing supply is, the higher the price-to-rent ratio will be. And if some people attach more extreme private values toward home ownership (i.e. the private value distribution is more dispersed), the equilibrium price-to-rent ratio is also higher, even though the mean of the private value distribution remains unchanged. This is again due to the fact that house prices are only drawn from the right tail of the valuation distribution.

Figure 2 provides the comparative statistics of the transaction volume in equilibrium. The first plot shows the trading volume as a function of transaction costs. The decreasing relationship is easy to understand. The higher the proportional transaction cost, the worse the expected net capital gains. Thus it requires a larger private value in order to make owning worthwhile relative to renting, which in turn leads to decreased aggregate demand and trading volume. Comparing across states, except for the case where C=0, trading volume is always higher when the rent grow rate (and market price) is expected to be high. The intuition is as follows. While the transaction cost depresses valuation in general, it hurts the short horizon type's valuation even more. This is because with a shorter time horizon, the same amount of cost will be discounted less. Alternatively, the transaction cost per unit of time is higher for short horizon owners. This observation, combined with the valuation effect of the transaction cost across states, implies short horizon buyers' aggregate demand is more sensitive to changes in fundamentals and it will experience a sharper decrease when the price prospect is bad. Therefore, we are more likely to observe a large increase in short horizon owners in a rising market than a big positive change in long horizon ownership, and vice versa in a declining market environment.

This is verified by Fig. 3, which shows, given the benchmark values, there will be more short horizon buyers in a booming market and more long horizon buyers in a declining market. The implication for the trading volume is as follows. The fact that there are more short horizon owners and fewer long horizon owners in this period means that there will be more turnovers in the next period. Given the macro

Table 1 Model key parameters

	Model parameter	Benchmark value
High growth rate	Y^H	1.05
Low growth rate	Y^L	0.95
Rent growth rate persistence	λ	0.9
Private value distribution parameter	ψ	0.25
Risk free interest rate	r	0.1
Proportional transaction cost	C	0.01
Owner-occupied housing supply	Q	1
Upper support of conversion cost distribution	$\overline{\kappa}$	0.2
Lower support of conversion cost distribution	$\underline{\kappa}$	0

The following table lists the model's main parameters and the associated benchmark values used in the numerical calculation and comparative statistics analysis.

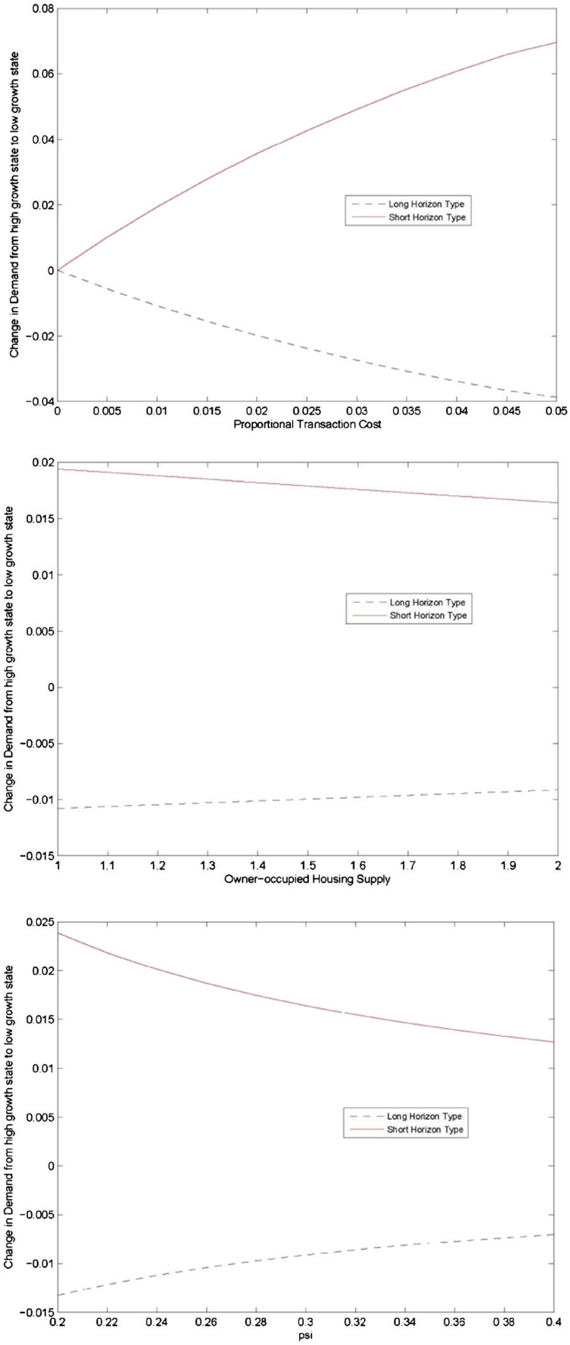


Fig. 2 The equilibrium trading volume in the owner-occupied market. The first graph plots the equilibrium trading volume as a function of transaction costs C, while keeping the other parameters fixed. The second graph plots the equilibrium transaction volume as a function of owner-occupied housing market size Q, holding everything else constant. The third graph plots the equilibrium transaction volume as a function of private value range parameter ψ, holding others fixed. The values of the model parameters are listed in Table 1

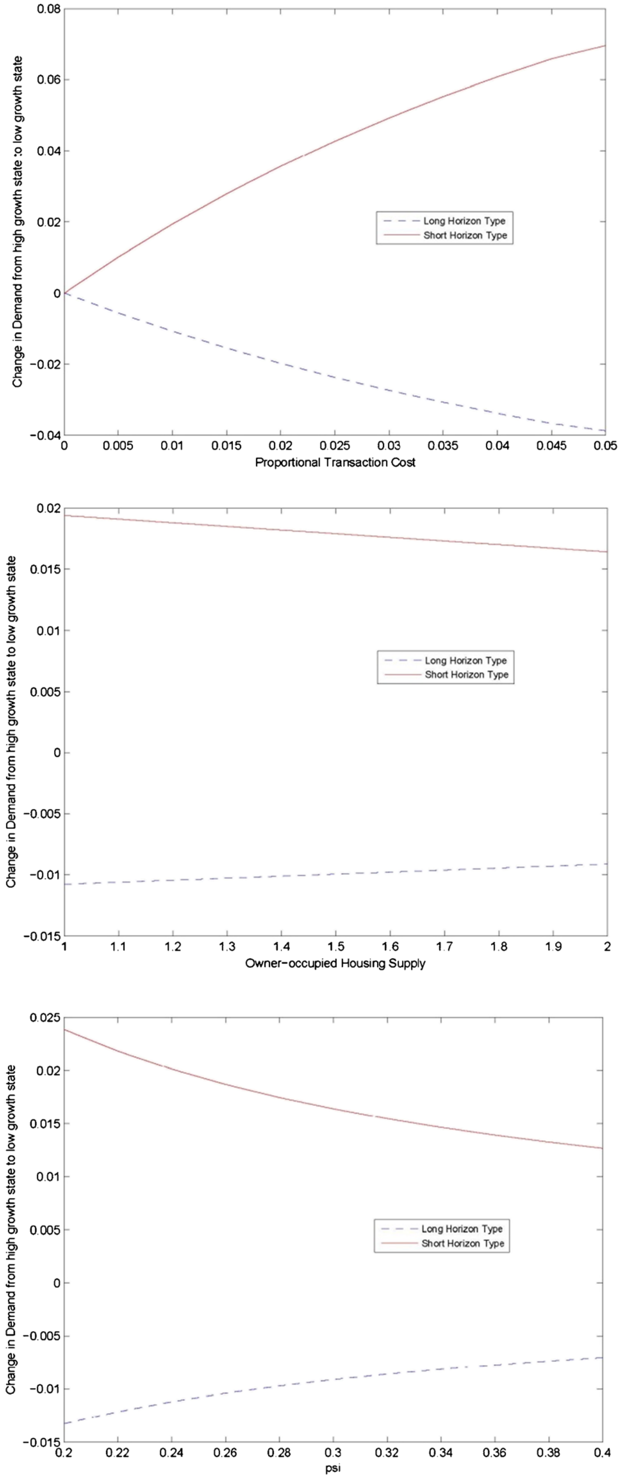
persistence in the short run, in equilibrium, the state of the economy featured with more short horizon buyers will have a higher transaction volume on average. Therefore, trading volume is higher when the rent growth rate and house price are expected to rise. This relationship is pretty robust as we vary other model parameters, as can be seen from other plots in Figs. 2 and 3. It is also worth mentioning that the trading volume increases in the private value's dispersion parameter ψ, since a higher ψ implies higher equilibrium price (Fig. 1) and more agents of both groups will be buying given a better capital gain expectation.

To summarize, change in the aggregate demand for each group of agents has important implications in our model. Because the short horizon agents' valuations are more sensitive to transaction costs, their aggregate demand is affected more extensively by an expected change in fundamentals. Therefore, the observed change in the aggregate demand for the short horizon buyers will be correlated with price changes in the housing market. Changes in short horizon demand should predict returns because short horizon investors are buying precisely at the time when prices are expected to rise. The implication for a pro-cyclical trading volume is also driven by higher aggregate short-term demand when the market is expected to rise in the future. In the empirical section, we will examine, (i) whether there is increase in short term demand in response to favorable macro and house price prospects, and (ii) whether changes in short horizon demand can be utilized to forecast future house prices.

Supply Conditions

In the above model, the owner-occupied housing supply is held fixed with a quantity of Q. The idea that only buyers with high private values become owners implies that the limited asset supply is a crucial condition. This is similar to assuming no short sales in the equity market context. An extreme counter example is a case of perfectly elastic supply of housing in which case supply constraints (or, short sales constraints) are not binding. However, there are several migrating housing market factors that make supply impacts less of a concern for our model's implications. First, it is well-known that land is a scarce resource and is in limited supply. Furthermore, supply is inelastic in the short run. Second, a large portion of the housing market dynamics is driven by the existing housing stock, rather than by new supply. Data on the US new and existing home sales[5] show that both sales and inventory of new homes is a small portion of the existing homes. For example, during the boom years (2005–2008) when one might suspect there would be more construction and new supply, the sales of existing homes is on average 7 times larger than the sales of new homes. Taken together, restricting our model's attention to a fixed housing supply is a reasonable starting point. That being said, supply does respond to market conditions and the magnitude of the micro channel effect identified in our paper most likely will depend on how responsive supply is. A full model of housing supply is beyond the scope of this paper, but a reasonable conjecture would be that the mechanism described in the model will be better manifested in areas with supply constraints and/or areas with scarce natural amenities (e.g. coastal areas). We will explore this testable implication in the empirical exercise.

[5] The source is from National Association of Homebuilders and the table is available on www.housingeconomics.com.


0.08
0.06
0.04
0.02
0
−0.02
−0.04
Change in Demand from high growth state to low growth state
Long Horizon Type
Short Horizon Type
0 0.005 0.01 0.015 0.02 0.025 0.03 0.035 0.04 0.045 0.05
Proportional Transaction Cost
0.02
0.015
0.01
0.005
0
−0.005
−0.01
−0.015
Change in Demand from high growth state to low growth state
Long Horizon Type
Short Horizon Type
1 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2
Owner−occupied Housing Supply
0.025
0.02
0.015
0.01
0.005
0
−0.005
−0.01
−0.015
Change in Demand from high growth state to low growth state
Long Horizon Type
Short Horizon Type
0.2 0.22 0.24 0.26 0.28 0.3 0.32 0.34 0.36 0.38 0.4
psi

◀ **Fig. 3** The aggregate demand in equilibrium. The following figures show the change in aggregate demand of each type of agents across states. The first graph plots the change in ownership rate for each of the short and the long type across states as a function of transaction costs C. The second graph is a plot against owner-occupied housing market size Q, and the third graph shows the relationship as a function of private value range parameter ψ. The values of the model parameters are listed in Table 1

Empirical Evidence

Testable Hypotheses

The novel implication of our trading model is the time-varying (ex-ante) investment horizon in the owner population and its relationship with the current and future house prices. This directly provides two hypotheses for empirical testing.

H1: The ownership composition is likely to be more short-term oriented as the housing market conditions improve. In other words, on average the expected duration of home ownership at the time of purchase should be negatively correlated with the prevailing house prices as well as macro conditions.
H2: The average new owners' expected duration predicts future (short-term) returns.

The intuition for the two hypotheses is as follows. Since buyers with different time horizons have different sensitivities to future market conditions, this would create a "market timing" effect. There will be more short horizon owners in a booming market when prices are expected to rise in the near future, and vice versa.

Data

We use biennial national sample data from the American Housing Survey (AHS) from 1985 to 2005. For each housing unit in the sample, we identify every owner during those 20 years with his socioeconomic characteristics such as age, sex, race, marital status, family size, income, education, owner status(first time) and mortgage characteristics. In addition, we collect the physical characteristics such as the unit type, square footage, the number of rooms, current value, last transaction price as well as its MSA code.[6] For our purpose, we delete observations in which the housing unit is not owner-occupied. We confine our sample to owners with age greater than 25 at the time of the move-in date, since a younger age implies that ownership is more likely to be acquired by means other than purchase. We focus on home purchases that occurred after year 1970 since data is limited for purchases made before 1970, and we suspect the measurement error is larger for earlier observations. We also delete from our sample households with missing (or obviously wrong) move-in dates and those that lie outside the MSA area. We convert the dollar value of incomes and house prices into real terms (in 2006 dollars) using the consumer price index from the Bureau of Labor Statistics.

[6] In AHS, metropolitan areas are categorized by the 1980 Primary Metropolitan Statistical Area (PMSA) definition.

Table 2 Summary statistics

Panel A				
Variables	Description	Mean	Std. Ev.	N
Household level				
age	age	40.94	12.51	12,165
mar	marital status dummy	0.74	0.44	12,165
sex	dummy=1 if household head is male	0.73	0.44	12,165
white	dummy=1 if white	0.89	0.32	12,165
per	family size	3.16	1.44	12,165
highsch	dummy=1 if owner finished high school	0.77	0.42	12,165
college	dummy=1 if owner finished college	0.42	0.49	12,165
realinc	household income (in real terms)	88,792	68,532	12,155
frstho	dummy=1 if first time home owner	0.35	0.48	12,165
invest	dummy=1 if purchased it for investment	0.01	0.10	12,165
type	type of the housing unit dummy(=1 if house)	0.995	0.07	12,162
yearbuilt	year the housing unit was built	1965	22.14	12,165
unitsf	square feet of the housing unit	2,150	872	11,472
rooms	number of rooms in the unit	6.98	1.72	12,165
hown	owner's rating of neighborhood quality	8.62	1.58	11,998
howh	owner's rating of unit as a place to live	8.80	1.36	12,020
realprice	purchase price of unit and land	197,440	133,796	11,023
loan-to-value	1st mortgage amount/purchase price (%)	78.15	21.12	9,018
trade	year current owner moved in	1991	8.53	12,165
duration	duration of ownership	11.55	8.73	12,165
cn	dummy=1 if duration is censored	0.67	0.47	12,165
Aggregate level				

Table 2 (continued)

meansmsainc	average income by smsa				61,999	13,542	4,699
meansmsaunemploy	average unemployment rate by smsa (%)				3.11	1.26	4,699
rates	10 year constant maturity treasury rate				1.92	.31	12,165
meansmsaownerpct	average ownership rate by smsa(%)				61.90	14.63	4,699
collegept	average % of college graduates by smsa				32.02	8.34	4,699
oldpt	average % of>65 year olds by smsa				20.39	5.21	4,699
middlept	average % of 40–65 year olds by smsa				41.24	5.03	4,699
marriedpt	average % married by smsa				54.93	5.54	4,699
Panel B							
Purchase Year	Age	White (%)	College (%)	%>Age 65	Unit Size	First Time Home buyer (%)	LTV (%)
1985	40	91.9 %	42.4 %	5.6 %	2,196	28.9 %	76.2 %
1986	42	90.1 %	45.1 %	6.6 %	2,205	26.8 %	77.9 %
1987	41	92.4 %	45.8 %	5.2 %	2,271	18.4 %	72.5 %
1988	41	92.1 %	44.8 %	5.2 %	2,206	25.2 %	78.6 %
1989	40	91.4 %	45.3 %	6.3 %	2,204	29.2 %	77.1 %
1990	40	89.9 %	44.9 %	6.5 %	2,186	23.7 %	76.3 %
1991	41	90.8 %	46.5 %	5.7 %	2,211	28.4 %	78.2 %
1992	40	91.0 %	46.8 %	5.3 %	2,223	27.9 %	80.7 %
1993	41	89.2 %	42.5 %	5.6 %	2,175	26.0 %	81.5 %
1994	41	88.4 %	40.8 %	6.3 %	2,190	24.1 %	81.4 %
1995	42	90.1 %	44.9 %	6.0 %	2,270	30.3 %	79.5 %
1996	40	86.7 %	41.1 %	5.4 %	2,150	54.7 %	81.7 %
1997	41	86.5 %	40.8 %	4.5 %	2,167	54.0 %	82.5 %
1998	41	85.3 %	43.0 %	4.7 %	1,994	21.6 %	80.6 %
1999	41	85.2 %	40.5 %	6.9 %	2,020	32.8 %	80.9 %
2000	42	86.5 %	41.7 %	6.7 %	2,069	66.7 %	77.4 %

Table 2 (continued)

2001	42	83.3 %	41.9 %	8.5 %	2,000	60.4 %	79.8 %
2002	42	90.2 %	48.7 %	5.6 %	2,037	62.6 %	77.3 %
2003	43	85.7 %	46.6 %	8.4 %	2,001	59.3 %	79.3 %
2004	42	85.4 %	45.9 %	6.4 %	1,993	61.8 %	77.2 %
2005	44	86.3 %	42.5 %	6.4 %	1,993	60.9 %	81.0 %

The pooled sample is taken from the national sample of AHS from 1985 to 2005. We restrict the sample of owner-occupied observations only. Panel A reports the owner or house characteristics at time of purchase, with purchase years ranging from 1970 to 2005. We also report annual income, unemployment as well as other demographic data at the MSA level from CPS and the interest rate data from GFD. The values of owners' income and house value at time of purchase are in 2006 dollars, deflated by the consumer price index from the Bureau of Labor Statistics. Panel B presents the summary statistics of home buyer profiles in AHS over time, from 1985 to 2005.

The final pooled sample consists of 12,165 owner observations with purchase years ranging from 1970 to 2005. The summary statistics are presented in Panel A of Table 2, and are based on the variable values in the purchase year for each owner observation. Since ownership duration is the key variable of interest, we calculate it for each owner of each housing unit as the difference between the move-in dates of consecutive owners. Our tests also require a measure of macro conditions at the MSA level. We compute and use the MSA annual household income, unemployment rate as well as other aggregate demographic variables from Current Population Survey. We also obtain the 10 year constant-maturity bond yield as interest rates from the Global Financial Database.

Panel B of Table 2 shows the time series pattern of home buyers' profiles in the survey. A typical home buyer is in his early forties throughout the 20 year sample period. Similarly, the proportion of home buyers with a college degree as well as the average loan-to-value ratio at the time of purchase does not exhibit a strong time trend. There seems to be a (modest) decline in the proportion of home buyers who are white and in the average size of the housing unit purchased. On the other hand, there is a notable jump in the proportion of first time home buyers in our sample after 2000, which could be a result of the improved access to the credit market and increased home affordability in the recent years.

Empirical Specification

To test the hypotheses of our model, we need to construct a measure of the ex-ante holding horizon for a home owner at the time of purchase. Although we do observe realized durations from the AHS survey, there are several problems with using them directly. First, realized holding horizons are affected by a number of factors that are unknown ex ante. For example, owners are forced to move due to an unexpected change in job or family status. Furthermore, realized durations will be affected by the ex post unexpected market conditions. Second, many of the observed durations in the sample are censored. From Table 2, two thirds of the observations are censored since we only observe home ownership status until year 2005. In sum, realized duration as observed in the sample will be biased and inconsistent. As a result, the first step of our empirical test is to form an estimator taking into account these issues.

Motivated by existing empirical work (Kan 1999), we model the expected duration for each homeowner as the projection of the observed duration on a vector of demographic and housing unit specific characteristics at the time of purchase. Although hazard models are more popular for estimating (especially the time-varying determinants of) duration, since the objective of this exercise is to extract the time-invariant and market-independent determinants of duration, we perform the estimation instead using ordinary MLE instead. Specifically, the expected duration for owner i is $d_i = E\left[D_i^*|X_i\right]$, where D_i is the observed duration for i and X_i is a vector of explanatory variables. In the absence of censoring, d_i can be directly estimated using an OLS or a simple MLE specification. We handle the censoring problem by censored maximum likelihood estimation. The true realized duration is given by D_i^* , and

$$D_i^* = X_i\beta + \epsilon, \epsilon \sim N\left(0, \sigma^2\right)$$

We only observe,

$$D_i = \begin{cases} D_i^* \ if \ c_i = 0 \\ D_i^c \ if \ c_i = 1 \end{cases}$$

Where c_i is a censoring indicator. Then the likelihood function for owner i is given by,

$$L_i = \left[\phi\left(\frac{D_i - X_i\beta}{\sigma}\right)\right]^{1-c_i}\left[1 - \phi\left(\frac{D_i - X_i\beta}{\sigma}\right)\right]^{c_i}, \quad (7)$$

where $\Phi(\cdot)$ and $\phi(\cdot)$ are cdf and pdf of the standard normal distribution respectively. The log likelihood is then given by $\sum_i^N lnL_i$, which is maximized with respective to (β, σ)

The predicted value (i.e., $d_i \equiv X_i\beta$) is our estimate for the expected duration for owner i. Given that the key variable of future tests is estimated in the first stage, our statistical inference in later tests is inevitably subject to the errors-in-variables problem. In particular, the conventional way of calculating standard errors may be misleading given we have estimated regressors. We treat this problem in several ways. First, we perform tests based on the average expected duration of owners in a given MSA area in order to minimize the effect of estimation imprecision on the expected duration. Second, we use an alternative measure of (expected) short term buyers by creating a dummy variable based on the estimated expected duration, which also reduces the measurement error. Finally, we use as an additional robustness check bootstrapped confidence intervals for the standard errors in later tests.

Then we proceed to the first test of our hypotheses, which is to see whether there is correlation between the average expected duration at the time of purchase and the macro conditions at that time. We compute the average expected duration for a given purchase year at the MSA level. For macro conditions, we use the MSA level average household income and unemployment rate from CPS as well as nationwide interest rates and inflation. We expect that, using implications from our model, the local income levels should be negatively correlated with the average expected duration since short horizon buyers tend to become owners when macro fundamentals are high. Unemployment is another extreme case of bad income shock and a higher unemployment rate implies a more (severe) negative shock, which should be associated with the expected duration in a positive fashion. Note that most of these macro variables have a strong time trend, so regressing on the level will in general lead to incorrect inference. We deal with this issue by using the differenced values on both sides of the equation. Econometrically, the test takes the form,

$$\Delta_{t,t-1}\ \overline{\widetilde{d_j}} = \gamma\Delta_{t,t-1}z_j + \eta, \quad (8)$$

where $\overline{\widetilde{d_j}}$ is the average predicted duration (in log) in area j and z_j are the corresponding macro conditions for area j.[7]

[7] For later tests, we use the logged values as regressors for all variables in levels.

The second specification we employ to test the model is that the expected duration should co-move negatively with house prices as well. Home buyers are not concerned about the general economic conditions per se except for the relevant macro fundamentals that will be projected into the house prices. Although a priori there are some candidates of macro variables that are important determinants of house prices, those are subject to measurement errors. In addition, we do not observe the entire list of pricing factors and the test using direct macro variables will inevitably have omitted variable problems. The observed housing prices should be a better statistic to test our model. Thus in the second specification of the first test, we check whether such a (negative) relation between the expected duration and price exists.

After that, we perform a stronger test. That is, our model not only implies the existence of correlation between price and expected duration, but it also suggests that the current expected duration has forecasting power for future price changes. Mathematically, the tests take the following forms,

$$\Delta_{t,t-1}\overline{p_j} = \xi\overline{\widetilde{d_{j,t-1}}} + \eta v_{j,t-1} + \nu_{j,t-1}, \tag{9}$$

$$\Delta_{t,t-1}\widetilde{\overline{p_j}} = \widetilde{\xi}\overline{\widetilde{d_{j,t-1}}} + \widetilde{\eta} v_{j,t-1} + \widetilde{\nu_{j,t-1}}, \tag{10}$$

where $v_{j,t}$ is a vector of control variables[8] and $\overline{p_j}$ is the average transaction price in area j for a given year computed from AHS. Equation (9) tests whether ξ is different from zero, i.e., whether the expected duration can predict future price changes in that area. To control for the observed price change that arises from pure shock and is not predictable by macro fundamentals, we also perform a test in equation (10), where $\widetilde{\overline{p_j}}$ is the projected price change in area j using observable macro variables. Our model implies the forecasting power of expected duration is with respect to the predictable return component, thus we expect (10) to be a more powerful test. In addition, (10) can also help to distinguish our mechanism from a speculation story. If the forecasting power of the current expected duration arises solely from a speculative channel through which feedback speculators quickly flip the property and bid up the prices, one should expect the coefficient $\widetilde{\xi}$ to be zero.

Results

Construction of the Expected Investment Horizons

Table 3 presents the estimation results for the expected duration. Predictors for the expected duration include owner's age, gender, race, educational status, first time homeowner status, property for investment indicator, type of housing unit, building

[8] There are MSA years in our sample when we do not observe any home purchases (according to the American Housing survey). In such situations, we use the next adjacent MSA year observation to construct housing return and the change in the expected duration for our main regressions. The missing observations appear to be randomly distributed over the 20 year period (1985–2005), implying that our final panel is unlikely to be biased in terms of more missing observations in a bust period. In addition, we include as a control variable in our main regressions the number of years of difference between two adjacent observations within each MSA.

Table 3 MLE estimation of the expected duration

	ln D		
ln(age)	0.22	retire	−0.28
	(0.06)***		(0.09)***
Minority Dummy	0.35	sex	0.03
	(0.05)***		(0.03)
highsch	−0.27	college	−0.10
	(0.04)***		(0.03)***
type dummy (= 1 if house)	−0.50	frstho	−0.06
	(0.28)*		(0.03)**
invest dummy (= 1 if not owner-occupied)	−0.95	builtage	−0.00
	(0.12)***		(0.00)***
builtage	−0.003	ln(unitsf)	0.070
	(0.001)***		(0.033)***
howh	0.04	hown	0.03
	(0.01)***		(0.01)***
ln(unitsf)	0.05	selection dummy(=1 if purchase<1985)	1.04
	(0.04)		(0.04)***
LTV	−0.22	Constant	8.18
	(0.07)***		(1.36)***
Obs.	8,501	Pseudo R2	0.085

This table presents the results from MLE estimation of the expected duration Equation (7) from AHS data. The independent variable duration (D) is taken into log terms before the estimation. Standard errors are clustered at the MSA level. Robust standard errors are in parentheses, with significant at 10 %, ** significant at 5 % and *** significant at 1 % level.

characteristics and the loan-to-value ratio (LTV).[9] We reproduce using this data set the usual findings of the expected duration, which increases in age in a nonlinear fashion and decreases in educational attainment. We also find that the expected duration is increasing in the size and quality of the house or neighborhood. Although a very small fraction of the owners in sample use the property for pure investment purpose, the investment indicator has a significantly negative effect on the expected duration. First-time home buyers have a relatively shorter expected duration at the time of purchase, which is consistent with the property ladder argument.

Stein (1995) and Ortalo-Magne and Rady (2006) argue that borrowing constraints affect mobility. In particular, according to their mechanism, the realized duration is longer in bad market conditions due to borrowing constraints, especially for owners with high leverage. On the other hand, since the mortgage financing becomes more affordable over time, people are more mobile over time. Thus not controlling for owners' financing characteristics leads to a decreasing estimated expected duration over time, which could also mechanically generate a negative correlation with price.

[9] We omit marital status and family size which are potentially important determinants of duration. That is because those two variables are only observed at the time of survey in our data but not at the actual time of purchase.

Thus we include loan-to-value ratio at the time of purchase as a control. The coefficient of LTV suggests that owners borrow more and also move more often, which is consistent with the increasing mortgage affordability argument.

We mainly rely on predictors such as owners' demographic and unit-specific characteristics. In this first stage of the estimation, we are essentially imposing the condition that the expected duration is only a function of time-independent household characteristics. In other words, two households should have the same ex ante holding horizons even if one purchases a home in year 1985 and the other in year 1995, conditional on the same demographic characteristics. Although each household will have its own idiosyncratic mobility and duration preference, the idiosyncratic components cancels out in the aggregate and our estimated expected duration captures the (more relevant) systematic determinants of the expected duration. There are other variables which potentially are important determinants of the expected duration which we leave out. For example, the cohort effect might be an important driver of different ownership duration in addition to the age effect. However, we choose not to incorporate a time fixed effects in this estimation since the purchase year fixed effect may include any other time related factors independent of owners' expected duration, which, in turn, will bias the inference in the subsequent analysis.

Furthermore, we believe the omitted variable bias (due to the cohort effect) is less of a concern for our analysis. As can be seen from Panel B of Table 2, most of the key independent variables do not exhibit a strong time trend, making the coefficient estimates less susceptible to bias induced by the cohort (time) effect. As a result, it is more likely the case that the estimated expected duration is subject to measurement error because of the variable choice restriction rather than a systematic bias, which will bias the result toward zero in our later tests. In a robustness check, we use an alternative measure for short term buyer by creating a dummy variable short term buyer%, based on the estimated expected duration, to alleviate the measurement error problem. On the other hand, there is a sharp increase in the proportion of first time home buyers after year 2000, which may raise the concern over the coefficient estimate of the predictor first home buyer dummy in Table 3. We will also investigate our result robustness in the earlier sample in which the proportion of first time home buyers is relatively stable.

There is a selection bias problem here since only those owners with abnormally long durations enter our sample for purchases prior to 1985, the starting year of the survey. In order to control for that, we first include a dummy variable that takes on a value of one if the purchase is before 1985 in the MLE of the expected duration estimation. Later when we run formal econometric tests, we drop observations before 1985 and focus on the post-1985 period. The other concern is that although we try to be careful not to choose any time varying predictors for the expected duration, we might still pick up some factors that co-vary with macro conditions and house prices. In later tests, we will use more control variables in the regressions.

We plot the graphs of the average predicted duration against the average observed duration for the entire United States from 1985 to 2005 in the top panel of Fig.. 4. The censoring problem of the observed duration series is quite obvious: the duration is decreasing at a fast pace and it goes to zero as we approach year 2005. For the predicted duration series, for years after 1985, there is a less obvious time trend for the expected duration series. However, there are fluctuations in the expected duration

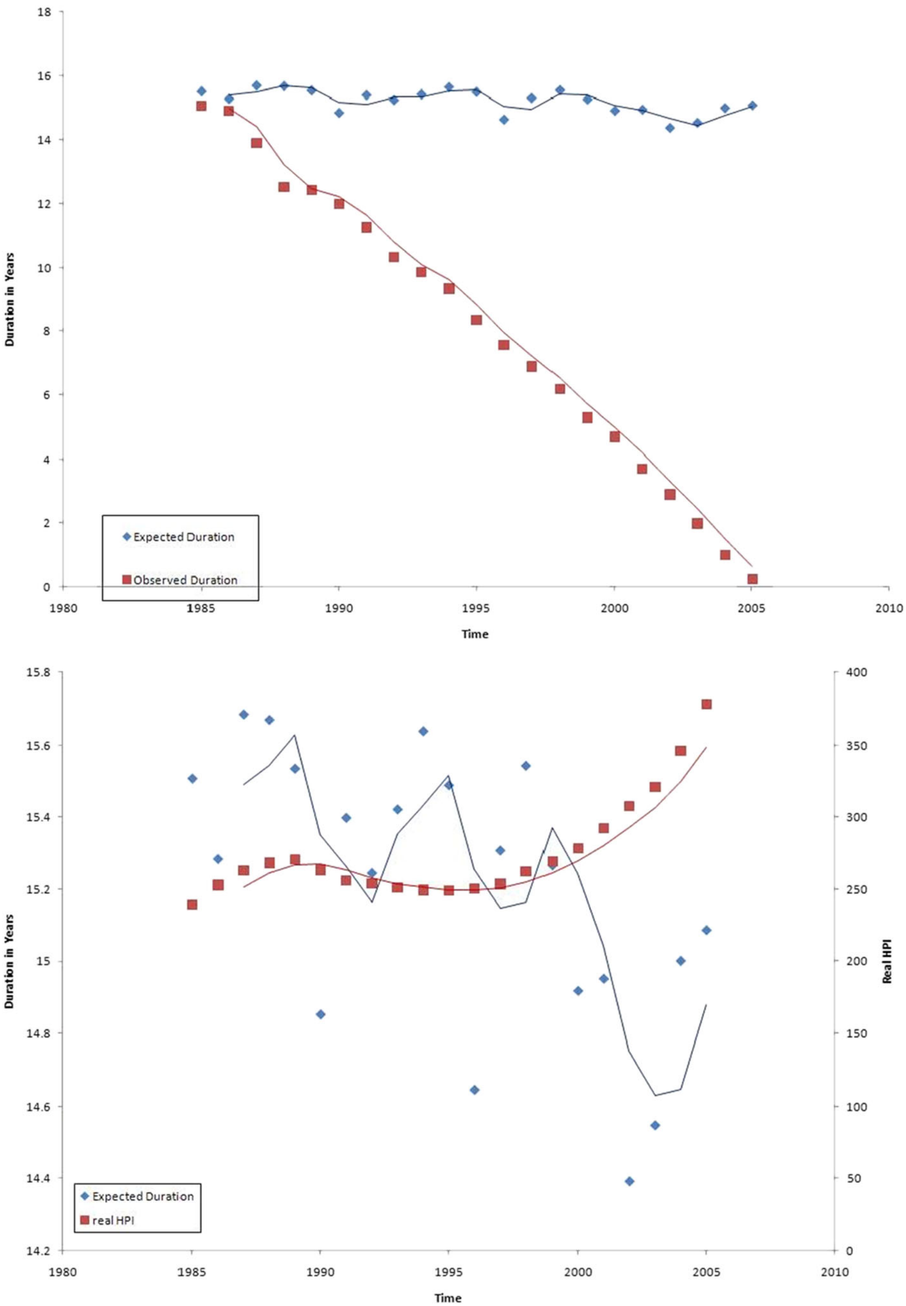


Fig. 4 The average expected duration in the US. We plot the expected duration in the US against the observed duration in the top panel and the expected duration in the US against HPI (in 2006 dollars) in the bottom panel

over time, which corresponds to changing owner characteristics according to the estimation. Even at the national level, there is a bit of evidence of changing owners' characteristics that tracks macroeconomic conditions. For example, the expected

Table 4 Correlation between the expected duration and macro variables: MSA level

	(1) $\Delta_{t,t-1}\overline{\overline{d}}$ [1970,2005]	(2) $\Delta_{t,t-1}\overline{\overline{d}}$	(3) $\Delta_{t,t-1}\overline{\overline{d}}$	(4) $\Delta_{t,t-1}\overline{\overline{d}}$ [1985,2005]	(5) $\Delta_{t,t-1}\overline{\overline{d}}$	(6) $\Delta_{t,t-1}\overline{\overline{d}}$	(7) $\Delta_{t,t-1}\overline{\overline{d}}$	(8) $\Delta_{t,t-1}\overline{\overline{d}}$
$\Delta_{t,t-1}$ **inc**	−0.04			−0.1				
	(0.10)			(0.16)				
$\Delta_{t,t-1}$ **unemploy**	0.00			0.00				
	(0.01)			(0.01)				
$\Delta_{t,t-1}$ **rates**	0.23			0.21				
	(0.18)			(0.20)				
$\Delta_{t,t-1}$ **cpi**	−0.64			−1.62				
	(0.30)**			(1.05)				
$\Delta_{t,t-1}\overline{p}$		−0.06	−0.06		−0.09	−0.08	−0.08	
		(0.02)***	(0.02)***		(0.03)***	(0.02)***	(0.02)***	
$\Delta_{t,t-1}\overline{\overline{p}}$								−0.07
								(0.03)*
$\Delta_{t,t-1}$ **owner%**							0.21	0.22
							(0.14)	(0.16)
$\Delta_{t,t-1}$ **middle%**							0.02	0.02
							(0.17)	(0.18)
$\Delta_{t,t-1}$ **old%**							−0.03	−0.04
							(0.19)	(0.21)
$\Delta_{t,t-1}$ **college%**							0.13	0.13
							(0.17)	(0.19)
$\Delta_{t,t-1}$ **married%**							0.24	0.2

Table 4 (continued)

	(1) $\Delta_{t,t-1}\tilde{\bar{\bar{d}}}$ [1970,2005]	(2) $\Delta_{t,t-1}\tilde{\bar{\bar{d}}}$	(3) $\Delta_{t,t-1}\tilde{\bar{\bar{d}}}$	(4) $\Delta_{t,t-1}\tilde{\bar{\bar{d}}}$ [1985,2005]	(5) $\Delta_{t,t-1}\tilde{\bar{\bar{d}}}$	(6) $\Delta_{t,t-1}\tilde{\bar{\bar{d}}}$	(7) $\Delta_{t,t-1}\tilde{\bar{\bar{d}}}$	(8) $\Delta_{t,t-1}\tilde{\bar{\bar{d}}}$
							(0.13)*	(0.15)
$\Delta_{t,t-1}$ **invest**	−1.12	−1.05	−1.02	−1.09	−1.01	−0.97	−1.03	−1.03
	(0.07)***	(0.05)***	(0.06)***	(0.07)***	(0.05)***	(0.06)***	(0.09)***	(0.08)***
Other Controls				yes				
Time FE	No	No	Yes	No	No	Yes	Yes	Yes
Observations	1324	1985	1985	1112	1521	1521	1096	1068
R-squared	0.13	0.16	0.42	0.15	0.21	0.50	0.44	0.45

This table presents the results of OLS regressions taking the specification in Equation (8). The expected duration and all macro variables that are in levels are in log terms. The first three columns show the regression that includes purchases prior to 1985. In order to control for selection problem, we restrict the observations to purchases after 1985 in columns (4)–(8). The independent variable is the change from time t−1 to t in MSA average expected duration of home buyers (in log terms) estimated in Table 3. The dependent variables also denote change from t−1 to t in MSA averages. Please refer to Table 2 Panel A for variable descriptions. For the price variable, we first scale it by the unit size. In column (10), we use the predicted price change from t−1 to t for each MSA using observed macro variables such as MSA average income, unemployment rate, interest rate, inflation rate and lagged price level. MSA fixed effects are included in all three specifications. Other controls include the average and change in average housing unit size for each MSA in our sample. Since it is possible that within an MSA area there are no observations for one purchase year, we also control for the number of years between purchase observations in the area. Standard errors are clustered at the year level. Robust standard errors are in parentheses, with * significant at 10 %, ** significant at 5 % and *** significant at 1 %.

duration decreases until 1990 and slowly climbs up until 1995 and this period happens to coincide with the real estate bust period.

As another illustration, we plot in the bottom panel of Fig. 4 the expected duration series against the real House Price Index (HPI) obtained from the Office of Federal Housing Enterprise Oversight (OFHEO) over the same time. As the model predicts, the two series are negatively correlated especially after year 1990 (although the expected duration series is quite noisy compared to the price index series). Given the fact that the key predictors of the expected duration do not have a clear time trend, it is quite unlikely that the downward trending expected duration merely reflects the aggregate demographic trend.

Relationship between the Expected Duration and House Prices

The first econometric test examines the correlation between the MSA average expected duration and the macro variables. Table 4 presents the results. The first three columns show the findings for the whole sample (1970–2005). The first column tests the correlation with macro variables and the next two columns use the price (per square foot) variable. We find some relationship between the expected duration changes and macro variables' changes (column (1)), but the effect is statistically indistinguishable from zero. Then, when we test the correlation using average house prices as the independent variable,[10] there is a strong and significant negative relationship between price changes and the expected duration changes in the full sample, which is consistent with our model predictions.

In columns (4)–(8), we use a post 1985 sample to reduce the effects of selection bias. We include the percentage of home ownership as a control for the tenure choice effect, which is reflected in a higher home ownership rate as well as an increased proportion of short-horizon owners when a higher price reduces user cost, particularly for short-horizon buyers. We include proxies for labor market characteristics such as the MSA level education level (percentage of college graduates), and the MSA level percentage of middle-aged (i.e., labor force) population. We also include in our specifications MSA (as well as year) fixed effects to control for other unobservable but persistent factors (e.g., industry or occupation effects). We find similar results as in the full sample. Macro variables do not bear a strong relationship with the expected duration of home buyers, but there is strong evidence that the average expected duration is short when prices are high. A 10 % increase in the average MSA house price is associated with a 0.8 % decrease in the average expected duration of home buyers (column (6)). This effect is economically and statistically significant.

We believe that the house price is a better variable to test the correlation implication of our model because price, in essence, "aggregates" all macro fundamentals that are relevant for the house asset. This notion is consistent with our empirical findings. Comparing the R^2 between specifications, we observe that the house price has a higher explanatory power (21 %, column (5)) for the expected duration of home buyers than the set of macro variables (15 %, column (4)). Furthermore, we test the correlation using the predicted price change, which is estimated based on the

[10] The average price variable is defined as the average transaction price per square foot for all observed sales for a given purchase year in an MSA from the American Housing Survey.

Table 5 MSA level return forecasting regressions

Panel A				
	(1)	(2)	(3)	(4)
	$\Delta_{t,t-1}\overline{p}$	$\Delta_{t,t-1}\overline{p}$	$\Delta_{t,t-1}\overline{p}$	$\Delta_{t,t-1}\overline{p}$
$\overline{\widetilde{d_{t-1}}}$		0.01	0.02	0.00
		(0.06)	(0.06)	(0.05)
		[0.04, 0.09]	[0.03, 0.09]	[0.01, 0.08]
$\overline{\widetilde{d_{t-1}}} \times$ *inelastic dummy*			−0.17	−0.14
			(0.07)**	(0.11)
			[0.018, 0.25]	[0.026, 0.27]
$\overline{p_{t-1}}$	−0.75	−0.92	−0.92	−0.81
	(0.06)***	(0.05)***	(0.05)***	(0.05)***
$ownership\%_{t-1}$				0.30
				(0.21)
$middle\%_{t-1}$				0.76
				(0.29)**
$old\%_{t-1}$				−0.01
				(0.45)
$college\%_{t-1}$				0.55
				(0.29)*
$married\%_{t-1}$				−0.74
				(0.29)*
$\Delta_{t-1,t-2}\overline{p}$				−0.08
				(0.03)**
Observations	1,448	1,352	1,352	1,026
R-squared	0.45	0.55	0.56	0.55
Panel B				
	(1)	(2)	(3)	(4)
	$\Delta_{t,t-1}\overline{\overline{p}}$	$\Delta_{t,t-1}\overline{\overline{p}}$	$\Delta_{t,t-1}\overline{\overline{p}}$	$\Delta_{t,t-1}\overline{\overline{p}}$
$\overline{\widetilde{d_{t-1}}}$		−0.10	−0.09	−0.05
		(0.02)***	(0.03)***	(0.02)**
		[0.02, 0.03]	[0.02, 0.04]	[0.1, 0.03]
$\overline{\widetilde{d_{t-1}}} \times$ *inelastic dummy*			−0.05	−0.02
			(0.04)	(0.02)
			[0.01, 0.06]	[0.00, 0.04]
$\overline{p_{t-1}}$	−0.71	−0.72	−0.72	−0.73
	(0.02)***	(0.02)***	(0.02)***	(0.01)***
$ownership\%_{t-1}$				0.25
				(0.03)***
$middle\%_{t-1}$				0.42
				(0.06)***
$old\%_{t-1}$				0.19
				(0.06)***
$college\%_{t-1}$				0.49

Table 5 (continued)

				(0.04)***
$married\%_{t-1}$				−0.39
				(0.05)***
$\Delta_{t-1,t-2}\overline{p}$				−0.01
				(0.01)
Observations	1,100	1,030	1,030	1,026
R-squared	0.97	0.97	0.97	0.99

This table presents the results of OLS regressions taking the specification of Equation (9) (panel A) and (10) (panel B). We restrict the observations to be after year 1985 in order to control for sample selection. The independent variable is the return from *t−1* to *t* of housing prices in the AHS sample. MSA average expected duration and all macro variables that are in levels are in log terms. Inelastic dummy takes on one for Los Angeles-Long Beach, Miami, San Francisco, New York City, and Boston-Worcester-Lawrence areas (Saiz 2010). Please refer to Table 2 for other variables' description. Since it is possible that within an MSA area there are no observations for one purchase year, we also control for the number of years between purchase observations in the area. Other control variables that are not reported here include the average size of the houses traded in a given MSA and MSA fixed effects. Standard errors are clustered at the year level. Robust standard errors are in parentheses, with * significant at 10 %, ** significant at 5 % and *** significant at 1 %.. In Panel B where we test (10), we first project MSA level observed price changes on a vector of macro variables, including (lagged) MSA level mean income, unemployment rate, interest rates, inflation rates (CPI) as well as lagged price. The resulting regression has an adjusted R square of 0.41. As a robustness check, we compute the 95 % confidence interval for standard errors for the key variables of interest $\left(c \text{ and } \widetilde{d_{t-1}} \times \text{inelastic dummy}\right)$ using bootstrapping methods. The results are presented under the OLS standard errors for these two variables in square brackets. The number of replications used is 5000.

observed macro variables (column (8)). There is a significant negative relationship (with a similar magnitude) between the predicted price change and the change in the expected duration. This implies that macro variables are related to the home buyer's expected duration via their impact on the house price.

Return Predictability of the Expected Duration

The statistical results for the stronger prediction, delineated by Equation (9) and Equation (10), are presented in Table 5. In this set of regressions, we focus on the sub sample after 1985. The model predicts that the current expected duration should have forecasting power on future returns. Regressing the realized 1-year-ahead price change on the lagged expected duration (panel A) produces insignificant coefficients. This is possible if a large portion of the return is pure unexpected shock and thus unforeseeable. Then in panel B we use the predicted price change as the dependent variable and test whether the expected duration has explanatory power for the predicted return component. We obtain the predicted price change by projecting the observed 1-year-ahead return on a set of macro variables.[11] The forecasting power of the lagged duration becomes statistically significant at the 1 % level. To interpret, conditional on the price level, a 10 % increase in the expected duration explains 90 basis points' decrease in the predicted annual returns, controlling for aggregate

[11] We use the lagged MSA level income, the lagged unemployment, a set of lagged demographics, lagged price, lagged interest rates and inflation measures (CPI) as the explanatory variables. The R^2 in the regression is 41 %.

demographics and MSA fixed effects (column (3) of panel B). In column (4), we incorporate more control variables. The concern is that the expected duration measure obtained in the MLE potentially picks up some time-varying component. Then we cannot credibly attribute the forecasting power to the true intrinsic duration. In particular, we find that owners' socioeconomic variables are important determinants of the expected duration. Therefore, we specifically control for the aggregate demographic and socioeconomic trend for all households at the MSA level. The explanatory power of the lagged expected duration remains statistically and economically significant.[12]

The predicted price change regressions in panel B of Table 5 help differentiate our duration mechanism from a speculative channel. In the presence of speculation, the expected duration can also predict future price changes. Speculators bet on continued price increases by flipping the properties quickly which simultaneously drive up the price in the short run. However, this is unlikely for two reasons. First, most of the home purchases in the sample are owner-occupied (see Table 2). Second, since speculators are by definition chasing price trends that are unrelated to economic fundamentals, we do not expect duration to be predictive for the price changes that are caused by macroeconomic variations. Results in panel B of Table 5 suggest the forecasting power of the expected duration is consistent with our model.

We also investigate the implication of the cross-sectional variation in supply constraints. Our model implies that the return predictive power should be stronger in areas with a more inelastic housing supply. We add an interactive term of the expected duration with an area dummy that takes on a value of one for the metropolitan areas with the highest supply inelasticity, i.e. Los Angeles-Long Beach, Miami, San Francisco, New York city, and Boston-Worcester-Lawrence areas (Saiz 2010). In general, the interactive term has a negative coefficient and a particularly strong effect in the regression for the observed future returns. Overall, the evidence is consistent with the conjecture on the supply effects discussed in our model.

The tests are subject to errors-in-variables problems because of the use of the estimated regressors. Performing the regression on the average value in an MSA can only mitigate the problem, since there might be only a few observations for a given MSA in any year. Therefore, we adopt bootstrapping methods for the forecasting regressions in order to obtain a confidence interval for the standard errors of key variables. The confidence intervals are in square brackets under robust standard errors in Table 5. For the key variable, $\overline{\widetilde{d_{j,t-1}}}$, the confidence interval is in general relatively tight. Especially for panel B, the highest standard error in this confidence interval decreases the t-statistics; but in the worst case the statistical significance remains at the 10 % level.

Robustness Checks

We investigate the robustness of our main findings with respect to an alternative duration measure. Instead of the continuous measure of the estimated duration, we create a dummy variable for short-term buyer if the estimated duration of a home

[12] One might notice that the R^2s in panel B are astonishingly high. Recall these are regressions of the predicted price changes based on observable macro variables. Specifically, the R^2 in the first stage regression where we predict the price is 41 %. One way to interpret is that the given independent variables in panel B explain nearly 41 % of the total price changes, conditional on the current price level.

buyer is in the bottom tercile distribution in our sample. Then we use the proportion of home buyers who are classified as short-term buyers within a given MSA in each year in the main regressions. This alternative (categorical) measure alleviates the measurement error problem in the first stage estimation. We repeat the return predictability regressions and obtain similar results (see Table 6).

Next, we explore an alternative interpretation based on the unobservable factors associated with the estimated long-horizon buyers, who are more likely to be minority home buyers with less educational background (Table 3). For example, our short-term buyers in general have a higher level of financial literacy, are more informed and less subject to behaviorial limitations, leading to an information-based interpretation for the positive return predictability for the concentration of short-term buyers. We observe from Panel B of Table 2 that key buyer characteristics, such as the proportion of home buyers with a college degree as well as the average loan-to-value ratio at the time of purchase, do not exhibit a strong time trend.

To further address this concern, we analyze a sub-sample restructured for only home buyers in the survey who have a college degree to construct the average expected duration in a given MSA in the main regressions. The cross-sectional as well as the time-series variation in the average expected duration, conditional on a more homogeneous buyer group in terms of education, is less likely driven by information. Results in Table 7 suggest that our findings are unlikely to be explained by the alternative information-based interpretation.

We perform other robustness tests. From Panel B of Table 2, we observe that there is a sharp difference in buyer characteristics (i.e., the proportion of first time home buyers) after 2000. This is likely to be caused by improved access to the credit market and increased home affordability given a structural change in the mortgage market. To address the concern that there might be systematic macroeconomic factors influencing both the expected duration and housing price after 2000, we restrict our analysis to the more homogeneous earlier sample (1985–2000), and find that our results are unaffected.

The final robustness test investigates the use of a different return horizon in the forecasting regressions. In Table 5, we perform the forecasting exercise for 1-year-ahead returns. We redo the analysis by extending the return horizons to 2 and 3 years respectively, and the results are very similar and thus are not reported.

Concluding Remarks

This paper models agent heterogeneity–in particular home buyer investment horizon differences–and shows its implications for house price and trading dynamics. In summary, given different liquidity needs, agents with heterogeneous investment horizons tend to have different demand sensitivities to economic fundamentals. Thus, the owner-occupied market is composed of a different mix of owner populations at different market states, which is informative about future price and trading patterns. We show theoretically and empirically that the ownership composition is more likely to be short-term oriented in a rising market versus long-term oriented in a declining market. Our empirical evidence suggests that investment horizon heterogeneity is an important mechanism for explaining and understanding aggregate housing market return predictability, as well as trading dynamics.

Appendix

A Proof of Lemma 1

In the presence of private consumption benefits associated with home ownership, consumers will be indifferent between paying the market rent and live in the rental market and owning by paying the rental cost adjusted for the idiosyncratic private value. The indifference reservation price for each type of consumers then consists of a component that equals the rental cost given the consumer's horizon. In addition, since owners are entitled to capital gains/losses associated with asset ownership, their reservation price also incorporates the expected price at time of sale given their different horizons. Therefore each short horizon buyer i and every long horizon buyer j have the following valuations,

$$P_{s,i,t} = \eta_i r_{s,t} + g_{s,t},$$

$$P_{l,j,t} = \eta_j r_{l,t} + g_{l,t}, \tag{A1}$$

where $r_{s,t}, g_{s,t}$, $r_{l,t}$ and $g_{l,t}$ are defined as in equation (1). Essentially the first term on both equations in (A1) refers to the buyer's willingness to pay for housing consumption, after adjusting for buyer-specific private values associated with ownership. The second term in both equations of (A1) is the capital gains component that is specific to the buyer's holding horizon, net of transaction cost.

Any potential buyer will only become owner if his/her valuation is greater than or equal to the market price P_t. That implies the individual demand for owner-occupied housing is $I_{P_{s,i,t}\geq P_t}$ for a short horizon buyer i, and is $I_{P_{l,j,t}\geq P_t}$ for a long horizon buyer j. Aggregating the individual demand leads to the following,

$$D_{s,t}(P_t) = \int_{1-\psi}^{1+\psi} I_{P_{s,i,t}\geq P_t} dF_{\eta_i},$$

$$D_{l,t}(P_t) = \int_{1-\psi}^{1+\psi} I_{P_{l,j,t}\geq P_t} dF_{\eta_j}, \tag{A2}$$

Direct calculation of the conditional expectation of a uniform distribution will give the result in Equation (2). **Q.E.D**.

B Proof of Proposition 1

First we normalize the equilibrium price by the market rent level, i.e., define $p_t \equiv \frac{P_t}{R_t}$. Since $R_{t+1} = R_t Y_t$, we can eliminate the rent levels in the valuation equations, in which the rent growth rate will be the only state variable. With the equilibrium concept defined to be a steady-state stationary equilibrium, the equilibrium price-to-rent ratio to be solved involves two unknown values and we define them as p^L and p^H. Using the transition matrix of the rent growth rate, one can easily write-out the normalized valuation equations (by dividing (1) and (A1) by the rent level) as functions of λ,Y^L, Y^H along with other model primitives, as in (5). Scaling the price by the rent level does not change the distribution properties of the private values as well as buyers' valuations, so the aggregate demand for each type of buyers is obtained again by calculating the conditional expectation of a uniform random variable (similar to equation (A2)), and one can easily verify the formula in (4).

The next step in solving the equilibrium is to employ the market clearing condition. Note that although the owner-occupied housing market has a fixed size Q, not all housing units are available for sale at any point in time. This is due to the fact that long horizon owners will hold the houses for two periods until the end of their life cycle. As a result, the portion of the owner-occupied housing stock that is absorbed by the long horizon buyers in the previous period will not be for sale during this period, which effectively reduces the housing supply. In the stationary equilibrium, the expected reduction in housing supply equals the probability weighted average of the long horizon's demand during the previous period. Then the market clearing conditions as in (3) obtain and the equilibrium price (pair) is the solution to that system. **Q.E.D.**

Table 6 MSA level return forecasting regressions: alternative duration measure

Panel A	(1)	(2)	(3)	(4)
	$\Delta_{t,t-1}\overline{p}$	$\Delta_{t,t-1}\overline{p}$	$\Delta_{t,t-1}\overline{p}$	$\Delta_{t,t-1}\overline{p}$
$\widetilde{\overline{short}}_{t-1}$		0.03	0.02	0.02
		(0.03)	(0.03)	(0.03)
$\widetilde{\overline{short}}_{t-1} \times inelastic\ dummy$			0.16	0.12
			(0.09)*	(0.11)
$\overline{p_{t-1}}$	−0.75	−0.92	−0.92	−0.86
	(0.06)***	(0.05)***	(0.05)***	(0.06)***
$ownership\%_{t-1}$				0.25
				(0.22)
$middle\%_{t-1}$				0.57
				(0.25)**
$old\%_{t-1}$				−0.05
				(0.44)
$college\%_{t-1}$				0.49
				(0.29)
$married\%_{t-1}$				−0.58
				(0.27)**
$\Delta_{t-1,t-2}\overline{p}$				−0.09
				(0.03)***
Observations	1,448	1,352	1,352	1,026
R-squared	0.45	0.55	0.56	0.58
Panel B	$\Delta_{t,t-1}\overline{\overline{p}}$	$\Delta_{t,t-1}\overline{\overline{p}}$	$\Delta_{t,t-1}\overline{\overline{p}}$	$\Delta_{t,t-1}\overline{\overline{p}}$
$\widetilde{\overline{short}}_{t-1}$		0.04	0.03	0.01
		(0.01)**	(0.01)**	(0.01)*
$\widetilde{\overline{short}}_{t-1} \times inelastic\ dummy$			0.04	0.02

Table 6 (continued)

			(0.02)*	(0.02)*
$\overline{p_{t-1}}$	−0.71	−0.71	−0.71	−0.73
	(0.02)***	(0.02)***	(0.02)***	(0.01)***
$ownership\%_{t-1}$				0.24
				(0.04)***
$middle\%_{t-1}$				0.44
				(0.05)***
$old\%_{t-1}$				0.22
				(0.06)***
$college\%_{t-1}$				0.53
				(0.07)***
$married\%_{t-1}$				−0.43
				(0.05)***
$\Delta_{t-1,t-2}\overline{p}$				−0.01
				(0.01)
Observations	1,100	1,030	1,030	1,026
R-squared	0.97	0.97	0.97	0.99

This table repeats the forecasting regressions in Table 5 by using an alternative expected duration measure. Instead of the continuous variable, we classify a purchase to be made by short-term buyers if the estimated expected duration is in the bottom tercile distribution in the pooled sample. $\widetilde{short_{t-1}}$ is the average proportion of short term buyers in an MSA at time t−1. Please refer to Table 5 for the. rest of the variables and specification.

Table 7 MSA level return forecasting regressions by using expected duration of buyers with a college degree

Panel A	(1)	(2)	(3)	(4)
	$\Delta_{t,t-1}\overline{p}$	$\Delta_{t,t-1}\overline{p}$	$\Delta_{t,t-1}\overline{p}$	$\Delta_{t,t-1}\overline{p}$
$\overline{\widetilde{d_{t-1}}}$		−0.05	−0.05	−0.09
		(0.06)	(0.06)	(0.04)*
$\overline{\widetilde{d_{t-1}}} \times inelastic\ dummy$			−0.09	−0.01
			(0.07)	(0.17)
$\overline{p_{t-1}}$	−0.77	−0.88	−0.88	−0.86
	(0.05)***	(0.05)***	(0.05)***	(0.06)***
$ownership\%_{t-1}$				0.30
				(0.41)
$middle\%_{t-1}$				0.17
				(0.34)
$old\%_{t-1}$				−0.42
				(0.57)
$college\%_{t-1}$				1.33
				(0.54)**
$married\%_{t-1}$				−0.91
				(0.35)**
$\Delta_{t-1,t-2}\overline{p}$				−0.07
				(0.06)

Table 7 (continued)

Observations	900	845	845	615
R-squared	0.47	0.54	0.54	0.54
Panel B	$\Delta_{t,t-1}\overline{\overline{p}}$	$\Delta_{t,t-1}\overline{\overline{p}}$	$\Delta_{t,t-1}\overline{\overline{p}}$	$\Delta_{t,t-1}\overline{\overline{p}}$
$\widetilde{\overline{d_{t-1}}}$		−0.12	−0.12	−0.06
		(0.01)***	(0.02)***	(0.01)***
$\widetilde{\overline{d_{t-1}}} \times$ *inelastic dummy*			−0.03	−0.02
			(0.02)	(0.02)
$\overline{p_{t-1}}$	−0.73	−0.73	−0.73	−0.74
	(0.02)***	(0.02)***	(0.02)***	(0.01)***
$ownership\%_{t-1}$				0.22
				(0.05)***
$middle\%_{t-1}$				0.57
				(0.09)***
$old\%_{t-1}$				0.22
				(0.06)***
$college\%_{t-1}$				0.57
				(0.06)***
$married\%_{t-1}$				−0.29
				(0.05)***
$\Delta_{t-1,t-2}\overline{p}$				−0.02
				(0.01)**
Observations	675	628	628	615
R-squared	0.97	0.97	0.97	0.99

This table repeat the forecasting regressions in Table 5 based on the estimated expected duration of buyers with a college degree. $\widetilde{\overline{d_{t-1}}}$ is the average expected duration among home buyers with a college degree in an MSA at time t−1. Please refer to Table 5 for the rest of the variables and specification.

References

Amihud, Y., & Mendelson, H. (1986). Asset pricing and the bid-ask spread. *Journal of Financial Economics, 17*, 223–249.

Boehm, T. P. (1981). Tenure choice and expected mobility: A synthesis. *Journal of Urban Economics, 10*, 375–389.

Case, K. E., & Shiller, R. J. (1988). The behavior of home buyers in boom and post boom markets, Working paper NBER Working Paper Series, NO. 2748.

Case, K. E., & Shiller, R. J. (1989). The efficiency of the market for single-family homes. *American Economic Review, 79*, 125–137.

Case, K. E., Quigley, J. M., & Shiller, R. J. (2003). *Home-buyers, housing and the macroeconomy, Asset Prices and Monetary Policy* (pp. 149–188). Canberra: Reserve Bank of Australia.

Cauley, S. D., & Pavlov, A. D. (2002). Rational delays: the case of real estate. *Journal of Real Estate Finance and Economics, 24*, 143–165.

Cutler, D. M., Poterba, J. M., & Summers, L. H. (1990). Speculative dynamics and the role of feedback traders. *American Economic Review, 80*, 63–68.

Engelhardt, G. V. (2003). Nominal loss aversion, housing equity constraints, and household mobility: evidence from the United States. *Journal of Urban Economics, 53*, 171–195.

Genesove, D., & Mayer, C. J. (1997). Equity and time to sale in the real estate markets. *American Economic Review, 87*, 255–269.

Genesove, D., & Mayer, C. J. (2001). Loss aversion and seller behavior: evidence from the housing market. *The Quarterly Journal of Economics, 116*, 1233–1260.
Harrison, J. M., & Kreps, D. M. (1978). Speculative investor behavior in a stock market with heterogeneous expectations. *The Quarterly Journal of Economics, 92*, 323–336.
Haurin, D., & Gill, H. L. (2002). The impact of transaction costs and the expected length of stay on homeownership. *Journal of Urban Economics, 51*, 563–584.
Hong, H., & Stein, J. C. (2007). Disagreement and the stock market. *Journal of Economic Perspectives, 21*, 109–128.
Hong, H., Scheinkman, J. A., & Xiong, W. (2006). Asset float and speculative bubbles. *Journal of Finance, 61*, 1073–1117.
Ioannides, Y. M., & Kan, K. (1996). Structural estimation of residential mobility and housing tenure choice. *Journal of Regional Science, 36*, 335–363.
Kahneman, D., & Tversky, A. (1979). Prospect theory: an analysis of decision under risk. *Econometrica, 47*, 236–291.
Kan, K. (1999). Expected and unexpected residential mobility. *Journal of Urban Economics, 45*, 72–96.
Krainer, J. (2001). A theory of liquidity in residential real estate markets. *Journal of Urban Economics, 49*, 32–53.
Lamont, O. A., & Stein, J. C. (1999). Leverage and house-price dynamics in U.S. cities. *Rand Journal of Economics, 30*, 498–514.
Meese, R. A., & Wallace, N. (1994). Testing the present value relation for housing prices: should i leave my house in San Francisco? *Journal of Urban Economics, 35*, 245–266.
Novy Marx, R. (2009). Hot and cold markets. *Real Estate Economics, 37*, 1–22.
Ortalo-Magne, F., & Rady, S. (2006). Housing market dynamics: on the contribution of income shocks and credit constraints. *Review of Economic Studies, 73*, 459–485.
Qian, W. (2012). Why do sellers hold-out in the down market? An option-based explanation, *Real Estate Economics*, forthcoming.
Saiz, A. (2010). The geographic determinants of housing supply. *Quarterly Journal of Economics, 125*, 1253–1296.
Scheinkman, J. A., & Xiong, W. (2003). Overconfidence and speculative bubbles. *Journal of Political Economy, 111*, 1183–1219.
Shelton, J. P. (1968). The cost of renting versus owning a home. *Land Economics, 44*, 59–72.
Sinai, T., & Souleles, N. S. (2005). Owner occupied housing as a hedge against rent risk. *The Quarterly Journal of Economics, 120*, 763–789.
Stein, J. C. (1995). Prices and trading volume in the housing market: a model with down-payment effects. *The Quarterly Journal of Economics, 110*, 379–406.
Wheaton, W. C. (1990). Vacancy, search and prices in a housing market matching model. *Journal of Political Economy, 98*, 1270–1292.
Williams, J. T. (1995). Pricing real assets with costly search. *Review of Financial Studies, 8*, 55–90.