Flippers in Housing Market Search*

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Abstract
We add arbitraging middlemen–investors who attempt to profit from buying low and selling high–to a canonical housing market search model. Not surprisingly, in a sluggish market in which it is difficult to sell, the opportunities offered to mismatched homeowners to quickly dispose of their old houses by these middlemen are particularly welcome. Less obvious is that the same opportunities are similarly welcome in a tight market in which houses can be sold quickly even without the aid of these intermediaries. To follow is the possibility of multiple equilibria. In one equilibrium, most, if not all, transactions are intermediated, resulting in rapid turnover, a high vacancy rate, and high housing prices. In another equilibrium, few houses are bought and sold by middlemen. Turnover is slow, few houses are vacant, and prices are moderate. The housing market can then be intrinsically unstable even when all flippers are of the liquidity-providing variety in classical finance theory.

Key words: Search and matching, housing market, liquidity, flippers
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1 Introduction

In many housing markets, the purchases of owner-occupied houses by individuals who attempt to profit from buying low and selling high rather than for occupation are commonplace. For a long time, anecdotal evidence abounds as to how the presence of these investors, who are popularly known as flippers in the U.S., in the housing market can be widespread.[1] More recently, empirical studies have began to systematically document the extent to which transactions in the housing market are motivated by buying and selling for short-term gains and how these activities are correlated with the housing price cycle. For example, Haughwout et al. (2011) report that the share of all new purchase mortgages in the U.S. taken out by investors was as high as 25% on average during the early to mid 2000s, where an investor is an individual who holds two or more first-lien mortgages. At the peak of the housing market boom in 2006, the figures reached 35% for the whole of the U.S. and 45% for the"bubble states". Depken et al. (2009) report that for the same period, on average, 13.7% of housing market transactions were for houses sold again within the first two years of purchase in the metropolitan Las Vegas area. At the peak in 2005, it reached a high of 25%. Bayer et al. (2011) report that for five counties in the LA metropolitan area, over 15% of all homes purchased near the peak of the housing market boom in 2003-2005 were re-sold within two years. Even in the cold period in the 1990s, the percentage remained above 5%.

A common theme in the discussion is that housing market flippers can be of two types—the trend-chasing speculators versus the arbitraging middlemen. Whereas the speculators, as noise traders, inevitably destabilize the market, the middlemen, as liquidity providers in classical finance theory, help improve market efficiency. But is such a simple and clear-cut dichotomy warranted? To the extent that the sales and purchases of houses by flippers, arbitraging middlemen or otherwise, add to market demand and supply, it is not inconceivable that the entry and exit of these investors into and out of the housing market can be a source of volatility. Moreover, any efficiency improvement brought by arbitraging middlemen must be weighted against the losses would-be buyers suffer when facing the higher market price and stiffer competition in a more fluid market, a point emphasized in Herbert et al. (2013).

In this paper, we study a housing market search model along the lines of Arnold (1989) and Wheaton (1990) in which houses are demanded by flippers in addition to end-user households. The flippers are of the liquidity-providing variety in classical finance theory. A role for these agents exists because ordinary households are assumed liquidity constrained to the extent that each cannot hold more than one house at a

[1] Out of the five transactions in a large developement in Hong Kong in August 2010, three were reported to involve investors who buy in anticipation of short-term gains (September 10, 2010, *Hong Kong Economic Times*). According to one industry insider, among all buyers of a new development in Hong Kong recently, only about 60% are buying for own occupation (November 20, 2010, *Wenweipo*).

time. In this case, a household which desires to move because the old house is no longer a good match must first sell it before the household can buy up a new house. In a buyer's market—a market in which sellers outnumber buyers by a significant margin—the wait can be lengthy. This opens up a profitable opportunity for a flipper to just buy up the mismatched house at a discount in return for the time spent waiting for the eventual end-user buyer to arrive on behalf of the original owner. This is the usual reason for how flipping can improve market liquidity. The novelty in our analysis is that we find that mismatched homeowners could similarly prefer to sell quickly to flippers in a seller's market if flippers possess a large enough financing and bargaining advantage over ordinary households. In either case, sales, vacancies, and housing prices all increase with the extent of flippers' presence in the market, whereas the average Time-On-the-Market (TOM) declines in the interim.

Because flippers can survive in both sluggish and tight markets, there can be multiple equilibria in our model. With the multiplicity of equilibrium, wide swings in prices and transactions can happen without any underlying changes in housing supply, preference, and interest rate. Moreover, in our model, the entry and exit of flippers can be rather sensitive to small interest rate shocks. A given interest rate shock can then have a not insignificant indirect impact on housing prices through its influence on the activities of flippers, in addition to the usual direct effect of interest rates on asset prices. In all, the presence of these agents in the housing market can be a double-edged sword. On the one hand, the flippers may help improve liquidity. On the other hand, when the extent of their presence can be fickle, the housing market can become more volatile as a result.

It would be foolhardy to suggest that the volatility arising from the activities of liquidity-providing middlemen in our analysis is an important source of the housing market bubble in the U.S. in the early to mid 2000s. Perhaps the trend-chasing speculators have played a significantly more decisive role. In any case, we should emphasize that our model is not meant to be a candidate explanation for any episodes of housing market bubble in the U.S. and beyond. Nevertheless, our quantitative analysis indicates that housing prices can differ by up to 23 percent across steady-state equilibria and vary by 26 percent in response to a seemingly unimportant interest rate shock when the model is calibrated to the several observable characteristics of the U.S. housing market. Amid this substantial price difference, welfare differs much less across the steady-state equilibria. Aggregate welfare in a "fully-intermediated" equilibrium is at most 7 percent higher than in a "no-intermediation" equilibrium. That any welfare increase from intermediation may be modest is because the increase is bounded by the losses would-be buyers suffer in a more active market with higher prices.

Our model has a number of readily testable implications. First, it trivially predicts a positive cross-section relation between housing prices and TOM—mismatched homeowners can either sell quickly to flippers at a discount or to wait for a better offer from an end-user buyer to arrive—which agrees with the evidence reported in

Merlo and Ortalo-Magne (2004), Leung et al. (2002) and Genesove and Mayer (1997), among others.[2]

An important goal of the recent housing market search and matching literature is to understand the positive time-series correlation between housing prices and sales and the negative correlation between the two and the average TOM.[3] In our model, across steady-state equilibria, a positive relation between prices and sales and a negative relation between the two and the average TOM also hold—in an equilibrium in which more houses are sold to flippers, prices and sales both increase, whereas houses on average stay on the market for a shorter period of time. More importantly, our analysis adds a new twist to the time-series empirics of the housing market, which is that vacancies should increase together with prices and sales if the increase in sales is due to more houses sold to flippers, who may then just leave them vacant until they are sold to some end-user households.

Insofar as the flippers in our model act as middlemen between the original homeowners and the eventual end-user buyers, this paper contributes to the literature on middlemen in search and matching pioneered by Rubinstein and Wolinsky (1987). Previously, it was argued that middlemen could survive by developing reputations as sellers of high quality goods (Li, 1998), by holding a large inventory of differentiated products to make shopping less costly for others (Johri and Leach, 2002; Shevchenko, 2004; Smith, 2004), by raising the matching rate in case matching is subject to increasing returns (Masters, 2007), and by lowering distance-related trade costs for others (Tse, 2011). This paper studies the role of middlemen in the provision of market liquidity and the effects of any financing and bargaining advantage that middlemen may possess on the nature of equilibrium.

A simple model of housing market flippers as middlemen is also in Bayer et al. (2011). The model though is partial equilibrium in nature and cannot be used to answer many of the questions we ask in this paper. Intermediaries who buy up mismatched houses from households and then sell them on their behalf are also present in the model of the interaction of the frictional housing and labor markets of Head and Lloyd-Ellis (2012). But there the assumption is merely a simpifying assumption and the presence of these agents in the given setting appears inconsequential. Analyzes of how middlemen may serve to improve liquidity in a search market also include Gavazza (2012) and Lagos et al. (2011). These studies do not allow end-user households a choice of whether to deal with the middlemen and for the multiplicity of equilibrium like we do though. Multiple equilibria in a search and matching model with middlemen can also exist in Watanabe (2010). The multiplicity in that model

[2]Albrecht et al. (2007) emphasize another aspect of the results reported in Merlo and Ortalo-Magne (2004), which is that downward price revisions are increasingly likely when a house spends more and more time on the market.

[3]Stein (1995), who explains how the down-payment requirement plays a crucial role in amplifying shocks, is an early non-search-theoretic explanation for the positive relation between prices and sales. Hort (2000) and Leung et al. (2003), among others, provide recent evidence. Kwok and Tse (2006) show that the same relation holds in the cross section.

is due to the assumption that the intermediation technology is subject to increasing returns to scale—an assumption that we do not need for multiplicity. Moreover, only one of the two steady-state equilibria in that model is stable, whereas there can more than one stable steady-state equilibria in ours.

The next section presents the model. Section 3 contains the detailed analysis. In section 4, we test the time-series implications of our model as pertain to especially the behavior of the vacancy rate. In Section 5, we calibrate the model to several observable characteristics of the U.S. housing market to assess the amount of volatility that the model can generate. Section 6, which draws on results we present in a technical note (Leung and Tse, 2014a) to accompany the paper, discusses several extensions of the model. Section 7 concludes. All proofs are relegated to the Appendix. For brevity, we restrict attention to analyzing steady-state equilibria in this paper. A second companion technical note (Leung and Tse, 2014b) covers the analysis of the dynamics for the special case in which all agents possess the same bargaining power.[4]

2 Model

2.1 Basics

There is a continuum of measure one risk-neutral households, each of whom discounts the future at the rate r. There are two types of housing: owner-occupied, the supply of which is perfectly inelastic at $H < 1$ and rental, which is supplied perfectly elastically for a rental payment of q per time unit. A household staying in a matched owner-occupied house enjoys a flow utility of $\upsilon > 0$, whereas a household either in a mismatched house or in rental housing none. A household-house match breaks up exogenously at a Poisson arrival rate δ, after which the household may continue to stay in the house but it no longer enjoys the flow utility υ. In the meantime, the household may choose to sell the old house and search out a new match. An important assumption is that households are liquidity constrained to the extent that each can hold at most one house at a time. Then, a mismatched homeowner must first sell the old house before she can buy a new one. Our qualitative results should hold as long as there is a limit, not necessarily one, on the number of houses a household can own at a time. In section 6 and in Leung and Tse (2014a), we explain how this is the case when households can hold at most two houses at a time. The one-house-limit assumption simplifies the analysis considerably.

The search market Households buy and sell houses in a search market in which the flow of matches is governed by a concave and CRS matching function $M(B, S)$, with B and S denoting, respectively, the measures of buyers and sellers in the market. Let $\theta = B/S$ denote market tightness. Then, the rate at which a seller finds a buyer

[4]Not for publication, available for download in http://www.sef.hku.hk/~tsechung/index.htm

is

$$\eta = \frac{M(B,S)}{S} = M(\theta, 1),$$

whereas the buyer's matching rate is $\mu = \eta/\theta$. Given that M is increasing and concave in B and S,

$$\frac{\partial \eta}{\partial \theta} > 0, \qquad \frac{\partial \mu}{\partial \theta} < 0.$$

We impose the usual regularity conditions on M to ensure that

$$\lim_{\theta \to 0} \eta = \lim_{\theta \to \infty} \mu = 0, \qquad \lim_{\theta \to \infty} \eta = \lim_{\theta \to 0} \mu = \infty.$$

The Walrasian investment market Instead of waiting out a buyer to arrive in the search market, a recently mismatched household may sell the old house right away in a Walrasian market to specialist investors—agents who do not live in the houses they have bought but rather attempt to profit from buying low and selling high. Because homogeneous flippers do not gain by selling and buying houses to and from one another, the risk-neutral flippers may only sell in the end-user search market and will succeed in doing so at the same rate η that any household seller does in the market. We assume the risk-neutral flippers discount the future at the same rate r that ordinary households do but allow for the possibility that they finance real estate investment at a different rate r_F. In the competitive investment market, prices adjust to eliminate any excess returns on real estate investment.

The assumption of a Walrasian investment market is obviously a simplifying assumption. A more general assumption is to model the market as a search market too, but possibly one in which the frictions are less severe than in the end-user market.[5] If flippers are entirely motivated by arbitrage considerations and do not care if the houses to be purchased are good matches for their own occupation, search should be a much less serious problem. Moreover, if the supply of potential flippers is perfectly elastic and if each can enter the investment market as a buyer at no cost, in equilibrium, there will be a infinite mass of flipper buyers in the market. In this case, any households who wish to sell in the investment market can do so instantaneously. That is, a Walrasian investment market can be thought of as the limit of a search market in which the cost of entry for flippers tends to zero.

2.2 Accounting identities and housing market flows

Accounting identities At any one time, a household can either be staying in a matched house, in a mismatched house, or in rental housing. Let n_M, n_U, and n_R

[5] Let's say, for example, the meetings in the investment market are given by another CRS matching function $M_F(B,S)$, whereby $M_F(B,S) > M(B,S)$ for any $\{B,S\}$ pair.

denote the measures of households in the respective states. Given a unit mass of households in the market,

$$n_M + n_U + n_R = 1. \tag{1}$$

Each owner-occupied house must be held either by an ordinary household or by a flipper. Hence,

$$n_M + n_U + n_F = H, \tag{2}$$

where n_F denotes both the measures of active flippers and houses held by these individuals.

If each household can hold at most one house at any moment, the only buyers in the search market are households in rental housing; i.e.,

$$B = n_R. \tag{3}$$

On the other hand, sellers in the search market include mismatched homeowners and flippers, so that

$$S = n_U + n_F. \tag{4}$$

Housing market flows In each unit of time, the inflows into matched owner-occupied housing are comprised of the successful buyers among all households in rental housing (μn_R), whereas the outflows are comprised of those who become mismatched in the interim (δn_M). In the steady state,

$$\mu n_R = \delta n_M. \tag{5}$$

Households' whose matches just break up may choose to sell their old houses right away to flippers in the investment market or to wait out a buyer to arrive in the search market. Let α denote the fraction of mismatched households who choose to sell in the investment market and $1 - \alpha$ the fraction who choose to sell in the search market. In each time unit then, the measure of mismatched homeowners selling in the search market increases by $(1 - \alpha)\, \delta n_M$, whereas the exits are comprised of the successful sellers (ηn_U) in the meantime. In the steady state,

$$(1 - \alpha)\, \delta n_M = \eta n_U. \tag{6}$$

Households moving into rental housing are mismatched households who just sell their old houses to flippers ($\alpha \delta n_M$) and to end users (ηn_U), respectively. The exits are comprised of the successful buyers among all households in rental housing (μn_R). In the steady state,

$$\alpha \delta n_M + \eta n_U = \mu n_R, \tag{7}$$

In each time unit, the measure of houses held by flippers increases by the measure of houses recently mismatched households decide to dispose right away in the investment market ($\alpha\delta n_M$) and declines by the measure of houses flippers manage to sell to end-users (ηn_F). In the steady state,[6]

$$\alpha\delta n_M = \eta n_F. \tag{8}$$

2.3 Market tightness and turnovers

When no houses are sold to flippers ($\alpha = 0$), it seems clear that n_F must be equal to zero in the steady state. On the other hand, when all households sell to flippers immediately after becoming mismatched ($\alpha = 1$), n_U, in the steady state, should just be equal to zero. More generally, as α increases from 0 toward 1, there should be more houses in the hands of flippers and less in the hands of mismatched homeowners. Lemma 1 confirms these intuitions.

Lemma 1

a. *At $\alpha = 0$, $n_F = 0$.*

b. *As α increases from 0 toward 1,*

$$\frac{\partial n_F}{\partial \alpha} > 0, \; \frac{\partial n_R}{\partial \alpha} > 0, \; \frac{\partial n_M}{\partial \alpha} > 0, \text{ whereas } \frac{\partial n_U}{\partial \alpha} < 0.$$

c. *At $\alpha = 1$, $n_U = 0$.*

What is less obvious in the Lemma is that an increase in α also leads to more households staying in rental housing and more households being matched in the steady state. The first relation follows from the fact that fewer households can stay in owner-occupied houses and therefore more must be accommodated in rental housing when flippers hold a greater fraction of the owner-occupied housing stock. For the second relation, when more households sell to flippers immediately after becoming mismatched, fewer households spend any time at all selling their old houses in the search market before initiating search for a new match. Other things equal then, there should be more matched households in the steady state. However, when there are more rental households, there are more buyers and this should lead to a lower buyers' matching rate, which will then lengthen the time a household spends on average in rental housing before a new match can be found. By Lemma 1(b), the first effect dominates to result in an overall greater measure of matched households in the steady state.

[6] Where (1) and (2) are two equations in four unknowns, once any two of the four variables are given, the other two are uniquely determined. In this connection, it is straightforward to verify that only two of the four steady-state flow equations (5)-(8) constitute independent restrictions.

Clearly, there are more buyers in the search market when more mismatched households sell to flippers right away. The mismatched houses, however, are for sale in the search market whether they are held by the mismatched homeowners or flippers. Even so, the measure of sellers in the search market can depend on α. When there are more buyers in the market, houses are sold faster, which can result in a smaller stock of houses for sale in the steady state. Lemma 1(b) confirms these conjectures. Given that $B = n_R$ and $S = n_U + n_F = H - n_M$ by (2) and that $\partial n_R/\partial\alpha > 0$ and $\partial n_M/\partial\alpha > 0$, indeed there will be more buyers and fewer sellers in the steady state as more households sell to flippers. To follow, of course, is a tighter market with a larger

$$\theta = \frac{B}{S} = \frac{n_R}{n_U + n_F}.$$

More formally,

Lemma 2 *Equations* (1)-(8)*, for the turnovers of houses and households, can be combined to yield a single equation,*

$$\delta + \eta\,(1 - H) - (1 - \alpha + \theta)\,H\delta = 0, \tag{9}$$

in α and θ. An implicit function $\theta = \theta_T(\alpha)$, for $\alpha \in [0,1]$, defined by (9)*, is guaranteed single-valued, and that $\partial\theta_T/\partial\alpha > 0$. Both the lower and upper bounds, given by, respectively, $\theta_T(0)$ and $\theta_T(1)$, are strictly positive and finite.*

In the model housing market, the entire stock of vacant house is comprised of houses held by flippers. With a given housing stock, the vacancy rate is simply equal to n_F/H. A direct corollary of Lemma 1(b) is that:

Lemma 3 *In the steady state, the vacancy rate for owner-occupied houses is increasing in α.*

Housing market transactions per time unit in the model are comprised of (i) $\alpha\delta n_M$ houses sold from households to flippers, (ii) ηn_F houses flippers sell to households, and (iii) ηn_U houses sold by one household to another, adding up to an aggregate transaction volume,

$$TV = \alpha\delta n_M + \eta n_F + \eta n_U. \tag{10}$$

Lemma 4 *In the steady state, TV is increasing in α.*

The usual measure of turnover in the housing market is the time it takes for a house to be sold, what is known as Time-On-the-Market (TOM). Given that houses sold in the investment market are on the market for a vanishingly small time interval and houses sold in the search market for a length of time equal to $1/\eta$ on average, we may define the model's average TOM as

$$\frac{\alpha\delta n_M}{TV} \times 0 + \frac{\eta n_F + \eta n_U}{TV} \times \frac{1}{\eta}. \tag{11}$$

Lemma 5 *In the steady state, on average, TOM is decreasing in α.*

TOM is a measure of the turnover of houses for sale, and as such Lemma 5 in itself does not carry any direct welfare implications. A more household-centric measure of turnover is the length of time a household (rather than a house) has to stay unmatched. We define what we call Time-Between-Matches (TBM) as the sum of two spells: (1) the time it takes for a household to sell the old house, and (2) the time it takes to find a new match thereafter. While the first spell (TOM) on average is shorter with an increase in α, the second is longer as the increase in θ to accompany the increase in α causes the buyer's matching rate μ to fall. A priori then it is not clear what happens to the average length of the whole spell. The old house is sold more quickly. But it also takes longer on average to find a new match in a market with more buyers and fewer sellers. To examine which effect dominates, write the model's average TBM as

$$\alpha\frac{1}{\mu}+(1-\alpha)\left(\frac{1}{\eta}+\frac{1}{\mu}\right). \tag{12}$$

where $1/\mu$ is the average TBM for households who sell in the investment market[7] and $1/\eta+1/\mu$ for households who sell in the search market.[8]

Lemma 6 *In the steady state, on average, TBM is decreasing in α.*

Lemma 6 may be taken as the dual of Lemma 1(b) ($\partial n_M/\partial\alpha>0$). When matched households are more numerous in the steady state, on average, they must be spending less time between matches

Up to this point, the model is purely mechanical. Given α, market tightness θ is completely isomorphic to the determination of housing prices in equilibrium. The same conclusion carries over to the determination of vacancies, turnover, and sales. If not for the inclusion of flippers in the model housing market, α is identically equal to 0 and Lemma 1 would have completed the analysis of everything that seems to be of any interest. With the inclusion of flippers and their presence in the housing market measured by α, Lemmas 5 and 6 show how changes in the latter affect the turnovers of houses and households, which can have important consequences on welfare, a question we shall address in the following. But first α obviously should be made endogenous to which we next turn.

[7] The household sells the old house instantaneously. Given a buyer's matching rate μ, the average TBM is then $1/\mu$.

[8] Let t_1 denote the time it takes the household to sell the old house in the search market and t_2-t_1 the time it takes the household to find a new match after the old house is sold. Then the household's TBM is just t_2. On average, $E[t_2]=\int_0^\infty \eta e^{-\eta t_1}\left(\int_{t_1}^\infty t_2\mu e^{-\mu(t_2-t_1)}dt_2\right)dt_1=1/\eta+1/\mu$.

2.4 Asset values and housing prices

Asset values for flippers Let p_{FS} be the price a flipper expects to receive for selling a house in the search market and p_{FB} be the price the flipper has paid for it previously in the investment market. If it takes a length of time equal to T for the house to be sold in the search market, the net present value of the investment is

$$-\frac{\left(1-e^{-rT}\right)}{r} r_F p_{FB} + e^{-rT}\left(p_{FS}-p_{FB}\right),$$

where r is the subjective discount rate and r_F the cost of funds that the flipper faces. Given a seller's matching rate in the search market equal to η, T follows an exponential distribution with density $f(T) = \eta e^{-\eta T}$. Then, the expected NPV is

$$\frac{\eta p_{FS} - \left(\eta + r_F\right) p_{FB}}{\eta + r}.$$

With free entry in the flipping business,

$$p_{FB} = \frac{\eta}{\eta + r_F} p_{FS}. \tag{13}$$

If a flipper is paying p_{FB} for a house in the competitive investment market, the value of a vacant house to the flipper must just be equal to the given amount. We write

$$V_F = p_{FB}. \tag{14}$$

Asset values for households There are three (mutually exclusive) states to which a household can belong at any one time,

1. in a matched house; value V_M,
2. in a mismatched house; value V_U,
3. in rental housing; value V_R.

The flow payoff for a matched owner-occupier begins with the utility she derives from staying in a matched house υ. The match will be broken, however, with probability δ, after which the household may sell the house right away in the investment market at price p_{FB} and switch to rental housing immediately thereafter. Alternatively, the household can continue to stay in the house while trying to sell it in the search market. In all,

$$rV_M = \upsilon + \delta\left(\max\left\{V_R + p_{FB}, V_U\right\} - V_M\right). \tag{15}$$

Let p_H denote the price a mismatched homeowner expects to receive for selling the house in the search market. The agent's flow payoff is thus equal to

$$rV_U = \eta\left(V_R + p_H - V_U\right). \tag{16}$$

Two comments are in order. First, in (16), the mismatched homeowner is entirely preoccupied with disposing the old house while she makes no attempt to search for a new match. This is due to the assumption that a household cannot hold more than one house at a time and the search process is memoryless. Second, under (15) and (16), the household has only one chance to sell the house in the investment market, at the moment the match is broken. Those who forfeit this one-time opportunity must wait out a buyer in the search market to arrive. This restriction is without loss of generality in a steady-state equilibrium, in which the asset values and housing prices stay unchanging over time. No matter, after the old house is eventually sold, the household moves to rental housing to start searching for a new match.

A would-be buyer in the search market may either be buying from a mismatched homeowner at price p_H or from a flipper at price p_{FS}.

Lemma 7 *In the steady state, the fraction of flipper sellers among all sellers in the search market is equal to the fraction of mismatched households selling to flippers in the first place; i.e.,*

$$\frac{n_F}{n_F + n_U} = \alpha.$$

In this case,

$$rV_R = -q + \mu \left(V_M - \left(\alpha p_{FS} + (1-\alpha) p_H \right) - V_R \right), \tag{17}$$

where q is the exogenously given flow rental payment.[9]

Bargaining When a rental household buyer is matched with a flipper seller, the division of surplus in the bargaining satisfies

$$\beta_F \left(V_M - p_{FS} - V_R \right) = (1 - \beta_F) \left(p_{FS} - V_F \right), \tag{18}$$

where β_F denotes the flipper seller's share of the match surplus. When the same buyer is matched with a household seller, the division of surplus in the bargaining satisfies[10]

$$\beta_H \left(V_M - p_H - V_R \right) = (1 - \beta_H) \left(V_R + p_H - V_U \right), \tag{19}$$

where β_H denotes the household seller's share of the match surplus. If flippers are agents specializing in buying and selling, it is most reasonable to assume that $\beta_F \geq \beta_H$.

[9] Equation (17) assumes that the rental household is better off buying a house either from a mismatched homeower or a flipper rather than continuing to stay in rental housing. Equation (15) and (16) assume that the mismatched household is better off selling the old house either in the investment or search market rather than just staying in the mismatched house. Lemma 11 in the Appendix verifies that all this holds in equilibrium.

[10] With multiple types, the assumption of perfect information in bargaining is perhaps stretching a bit. We could have specified a bargaining game with imperfect information as in Harsanyi and Selten (1972), Chatterjee and Samuelson (1983), or Riddell (1981), for instance. It is not clear what may be the payoffs for the added complications.

2.5 Which market to sell?

Write

$$D(\theta, \alpha) \equiv V_R + p_{FB} - V_U, \tag{20}$$

as the difference in payoff for a mismatched household between selling in the investment market ($V_R + p_{FB}$) and in the search market (V_U). Clearly, if $D(\theta, \alpha) > 0$ (< 0), for all $\alpha \in [0, 1]$, the household prefers to sell in the investment (search) market at the given θ no matter what others choose to do. For certain θ, however, there may exist some $\alpha_D(\theta) \in [0, 1]$ such that $D(\theta, \alpha_D(\theta)) = 0$. In this case, equilibrium requires a certain fraction $\alpha_D(\theta)$ of mismatched households selling in the investment market and the rest selling in the search market. In all, we can define a relation

$$\alpha_O(\theta) = \begin{cases} 1 & D(\theta, 1) \geq 0 \\ \alpha_D(\theta) & D(\theta, \alpha_D(\theta)) = 0 \\ 0 & D(\theta, 0) \leq 0 \end{cases},$$

between market tightness θ and the fraction α of mismatched households selling in the investment market from the households' optimization.

2.6 Equilibrium

We now have two steady-state relations between α and θ: the $\theta_T(\alpha)$ function in Lemma 2 from the turnover equations and the $\alpha_O(\theta)$ relation from mismatched households' optimization. A steady-state equilibrium is any $\{\alpha, \theta\}$ pair that simultaneously satisfies the two relations.[11]

3 Analysis

3.1 Flippers' advantages and the nature of equilibrium

To proceed with the analysis of equilibrium, we begin with the characterization of the $D(\theta, \alpha)$ function that underlies the $\alpha_O(\theta)$ relation. By (13), (14), (18), and (19),

$$D(\theta, \alpha) = (1 - \beta_H)^{-1} \left(\frac{\beta_H r_F + \beta_F \eta}{\beta_F \eta} p_{FB} - p_H \right). \tag{21}$$

For $\beta_H \neq 1$, (21) has the same sign as

$$p_{FB} - p_H \frac{\eta \beta_F}{\eta \beta_F + r_F \beta_H}. \tag{22}$$

Recall that a mismatched household receives p_{FB} right away if it sells in the investment market, whereas it will receive p_H at some uncertain future date if it offers the

[11]Proposition 6 in the Appendix establishes the existence of equilibrium.

house for sale in the search market. By (22), the comparison in (20) is likened to a comparison between the instantaneous reward p_{FB} and an appropriately discounted future reward p_H of selling the mismatched house.

In a tighter search market with a larger θ, houses, on average, are sold faster in the market. Then, p_H should be discounted less heavily in the comparison of the payoffs between selling in the two markets. Indeed, holding constant p_{FB} and p_H, the expression in (22) is decreasing in θ, whereby households should find selling in the investment market less attractive when there is faster turnover in the search market.

Of course, both p_{FB} and p_H can also depend on θ and the question of how $D(\theta, \alpha)$ depends on θ can only be resolved by substituting the solutions of the two prices into (21) and then checking how the resulting expression behaves as a function of θ. In Lemma 10 in the Appendix, we present the solutions of p_{FB} and p_H, together with those of the various asset values, from (13)-(19). Substituting in the solutions to (21), $D(\theta, \alpha)$ is seen to have the same sign as

$$D_S(\theta, \alpha) \equiv \left(\beta_F \frac{r}{r_F} - \beta_H - z\beta_H\right)\eta + (1 - \beta_H - \alpha(\beta_F - \beta_H))\mu - (\delta + r)z, \quad (23)$$

where $z = q/v$.[12]

Given that η is increasing and μ is decreasing in θ, $D_S(\theta, \alpha)$ is indeed everywhere decreasing in θ if

$$r_F \geq \frac{\beta_F}{\beta_H}\frac{r}{1+z} \equiv \bar{r}. \quad (24)$$

Lemma 8 *If $r_F \geq \bar{r}$, $\alpha_O(\theta)$ is everywhere non-increasing, given by*

$$\alpha_O(\theta) = \begin{cases} 1 & \theta \leq \theta_1^d \\ \alpha_D(\theta) & \theta \in (\theta_1^d, \theta_0^d) \\ 0 & \theta \geq \theta_0^d \end{cases},$$

where $\theta_1^d < \theta_0^d$ are defined by, respectively, $D_S(\theta_1^d, 1) = 0$ and $D_S(\theta_0^d, 0) = 0$, and that $\partial\alpha_D(\theta)/\partial\theta < 0$.[13]

Panel A of Figure 1 illustrates an example of the $\alpha_O(\theta)$ function in the Lemma. Here, as expected, mismatched households only prefer selling in the investment market for smaller θ in which case there can be a lengthy wait in selling in a sluggish search market. Notice that the condition in (24) is met for $r_F = r$ and $\beta_F = \beta_H$. Hence, in the absence of any financing or bargaining advantage over ordinary households,

[12] Lemma 10 in the Appendix presents two sets of prices and asset values, one derived under the assumption that $D \leq 0$ and the other $D \geq 0$. In either case, D is seen to have the same sign as D_S in (23).

[13] The superscript "d" denotes the θ is at where D_S is decreasing in θ. Likewise, the superscript "u" is used later on to denote the θ is at where D_S is increasing in θ.

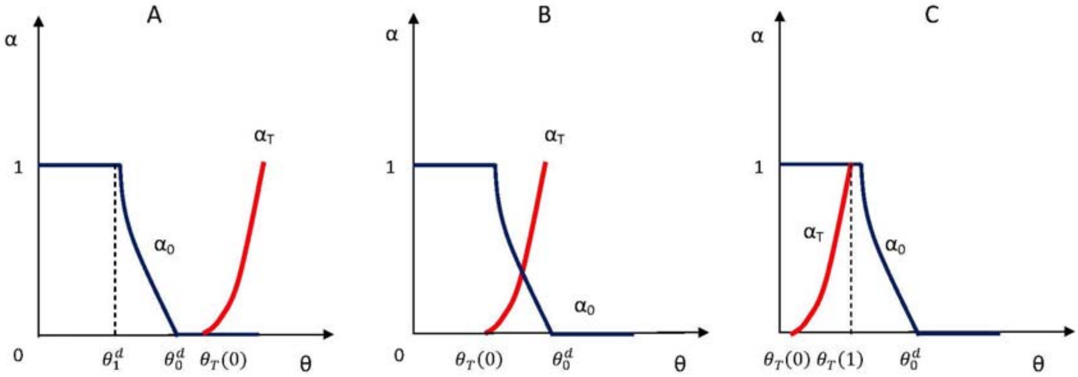

Figure 1: Equilibrium : $r_F \geq \overline{r}$

flippers survive only when the search market is relatively illiquid due to a small θ and on the basis of helping mismatched households overcome the liquidity problems that they face in the market.

To pin down the equilibrium α and θ, we invert $\theta_T(\alpha)$ in Lemma 2 to define $\alpha_T \equiv \theta_T^{-1}$, whereby $\alpha_T : [\theta_T(0), \theta_T(1)] \rightarrow [0,1]$.[14] Given that $\partial\theta_T/\partial\alpha > 0$, likewise, $\partial\alpha_T/\partial\theta > 0$. That is, $\alpha_T(\theta)$ increases continuously from 0 at $\theta = \theta_T(0)$ to 1 at $\theta = \theta_T(1)$. In the three panels of Figure 1, we superimpose a different $\alpha_T(\theta)$ onto the same $\alpha_O(\theta)$. Given a strictly increasing $\alpha_T(\theta)$ and a non-increasing $\alpha_O(\theta)$, clearly, equilibrium is unique. In Panel A, at $\theta = \theta_T(0)$, $\alpha_O(\theta) = 0$; then $\{\alpha, \theta\} = \{0, \theta_T(0)\}$ is the unique steady-state equilibrium. In this equilibrium, all sales and purchases are between two end-users while turnover is slowest. In the following, we refer this as the no-intermediation equilibrium. In Panel C, at $\theta = \theta_T(1)$, $\alpha_O(\theta) = 1$; then $\{\alpha, \theta\} = \{1, \theta_T(1)\}$ is the unique steady-state equilibrium. In this equilibrium, which we refer to as the fully-intermediated equilibrium, all transactions are intermediated and turnover is fastest. In between, there can be equilibria at where $D_S(\theta_T(\alpha), \alpha) = 0$, as illustrated in Panel B. In such partially-intermediated equilibria, with mismatched households indifferent between selling in the investment and search markets, a fraction, but only a fraction, of all transactions are intermediated.

What distinguishes between the situations depicted in Panels B and C, on the one hand, with $\alpha > 0$ in equilibrium, and Panel A, on the other hand, with $\alpha = 0$ in equilibrium is whether or not $\theta_T(0) < \theta_0^d$. It turns out that market tightness θ_T at any α is decreasing in the housing stock H, and that $\lim_{H\rightarrow 0} \theta_T(0) = \infty$ and $\lim_{H\rightarrow 1} \theta_T(0) = 0$. Intuitively, with a larger housing stock, more houses are for sale and then as houses are sold more slowly as a result, there can only be fewer mismatched households moving to rental housing to enter the search market as buyers. Besides, in case no one is selling to flippers ($\alpha = 0$), in the limit as $H \rightarrow 1$, no

[14] The closed-form solution for $\alpha_T(\theta)$ is given by (66) in the Appendix.

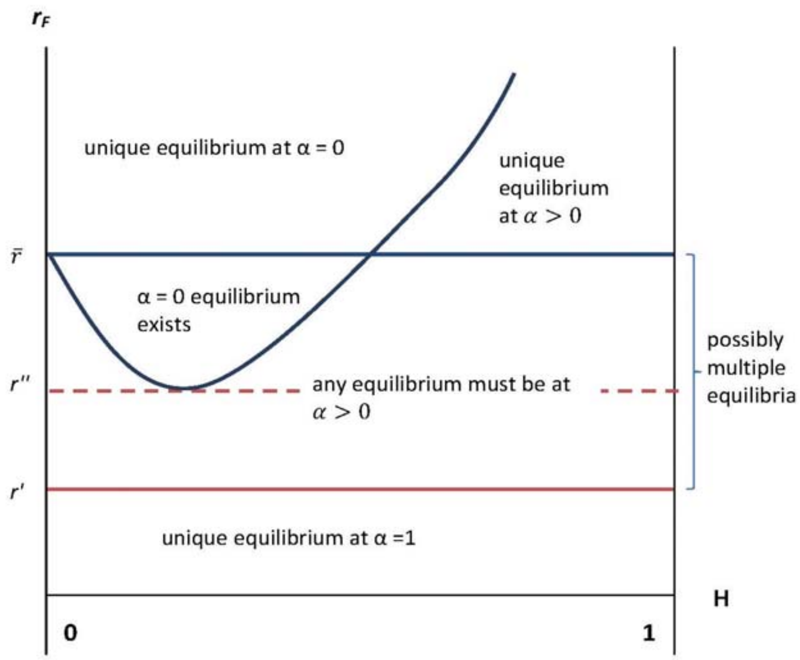

Figure 2: The nature of equilibrium

mismatched households can rid themselves of their old houses to start searching for a new match, from which $\theta_T(0) = 0$ follows. On the other hand, θ_0^d is decreasing in r_F, where $\lim_{r_F \to \infty} \theta_0^d = \overleftarrow{\theta}_0^d$ is strictly positive. All this means that in Figure 2 and for $r_F \geq \bar{r}$, we can draw an upward-sloping border in the H-r_F space, to the right (left) of which are combinations of $\{H, r_F\}$ that result in a unique equilibrium in which $\alpha > 0$ ($\alpha = 0$).[15] Of particular interest here is that given that $\lim_{H \to 1} \theta_T(0) = 0$ and a strictly positive $\overleftarrow{\theta}_0^d$, there can be a liquidity provision role for flippers even when they are handicapped by an arbitrarily large r_F if in the meantime, there is a large enough housing stock to make selling in the search market very difficult.

But then what appears to be somewhat puzzling is that the liquidity advantage alone does not always guarantee the survival of flippers. Notice that even if $r_F < r$ and $\beta_F > \beta_H$, whereby flippers are not handicapped by any financing and bargaining disadvantage, $r_F \geq \bar{r}$ can still hold, in which case flipping does not always take place in equilibrium. By selling to flippers right away, mismatched households can begin searching for a new house sooner. As such, it seems that they should always find selling in the investment market beneficial unless flippers's ability to offer a good enough price in the market is hindered by a high financing cost and/or by their weak bargaining strength in the search market. To understand the apparent puzzle, notice

[15] The construction of the diagram is explained in more details in the Appendix.

that for $\beta_F = \beta_H = \beta$, by (13) and (21),

$$V_R + V_F - V_U = \frac{p_{FS} - p_H}{1-\beta}; \tag{25}$$

That is, for the same bargaining strength, flippers can offer a price (p_{FB}) in the investment market that mismatched households find attractive only if they can later on sell houses to end-user households at a price (p_{FS}) not lower than the price (p_H) at which mismatched households sell to the same end-user households themselves. In the model housing market, the two prices can differ even if flipper sellers finance investment at the same rate and bargain at the same β that household sellers do because the surpluses to be bargained for in the two kinds of match are not the same. Specifically, for small θ, a sale is difficult for both the flipper seller and the household seller. There will be a small V_F and V_U. But the negative effect of the small θ on V_U should be more significant than the similar effect on V_F as the small θ can severely hinder the household's transition to becoming a would-be buyer, whereas no such considerations apply to the flipper. With her comparatively more favorable outside option, the flipper can bargain for a p_{FS} that exceeds the p_H that the household seller is able to bargain for in a sale to the same end-user household. Conversely, at a large θ, it is easy for anyone to sell but the positive effect of the fast turnover should be felt more significantly on V_U than on V_F. If the improvement in the household sellers' outside option is large enough relative to that of flipper sellers, households can sell the mismatched houses themselves at a higher price.

For $r_F < \overline{r}$, $D_S(\theta, \alpha)$ in (23) as a function of θ, is U-shaped, first decreasing but eventually increasing under a fairly weak condition on η,[16] which we assume holds in the following. As it turns out, both p_{FB} and p_H are increasing in θ and if flippers can finance investment at a low enough rate relative to that of ordinary households or if they are relatively adept at bargaining in the search market, for large θ, p_{FB} will rise faster than discounted p_H as θ goes up further. Apparently, any financing or bargaining advantage that flippers may possess is most effective when there is a tight search market. In this case, when the search market is particularly tight, just as when it is particularly sluggish, there will be greatest incentives for mismatched households to sell right away in the investment market for the high price in the market.

Lemma 9 *There exist some r' and r'', with $0 < r' < r'' \leq \overline{r}$, such that*

a. *For $r_F \in (0, r']$,*

$$\alpha_O(\theta) = 1 \text{ for } \theta \geq 0.$$

b. *For $r_F \in (r', r'')$,*

$$\alpha_O(\theta) = \begin{cases} 1 & \theta \leq \theta_1^d \\ \alpha_D(\theta) & \theta \in \left(\theta_1^d, \theta_1^u\right) \\ 1 & \theta \geq \theta_1^u \end{cases},$$

[16] The condition is $2\frac{\partial \eta}{\partial \theta}\left(\eta - \theta\frac{\partial \eta}{\partial \theta}\right) + \theta\frac{\partial^2 \eta}{\partial \theta^2}\eta \leq 0$, which is guaranteed to hold if η is isoelastic.

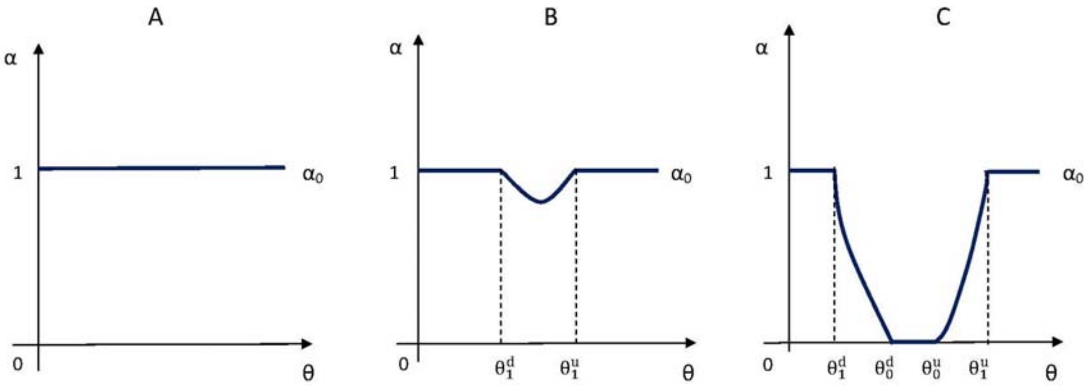

Figure 3: The $\alpha_O(\theta)$ function : $r_F < \overline{r}$

where $\theta_1^d < \theta_1^u$ *are defined by* $D_S\left(\theta_1^d, 1\right) = 0$ *and* $D_S\left(\theta_1^u, 1\right) = 0$ *over where* $D_S(\theta, \alpha)$ *is decreasing and increasing in* θ*, respectively. Here,* $\alpha_D(\theta)$ *is first decreasing, reaching a minimum above zero, and then increasing toward 1.*

c. *For* $r_F \in [r'', \overline{r})$,

$$(c) \qquad \alpha_O(\theta) = \begin{cases} 1 & \theta \leq \theta_1^d \\ \alpha_D(\theta) & \theta \in \left(\theta_1^d, \theta_0^d\right) \\ 0 & \theta \in \left[\theta_0^d, \theta_0^u\right] \\ \alpha_D(\theta) & \theta \in \left(\theta_0^u, \theta_1^u\right) \\ 1 & \theta \geq \theta_1^u \end{cases},$$

where $\theta_1^d < \theta_0^d < \theta_0^u < \theta_1^u$ *are defined by, respectively,* $D_S\left(\theta_1^d, 1\right) = 0$ *and* $D_S\left(\theta_0^d, 0\right) = 0$*, over where* $D_S(\theta, \alpha)$ *is decreasing in* θ*, and* $D_S\left(\theta_0^u, 0\right) = 0$ *and* $D_S\left(\theta_1^u, 1\right) = 0$ *over where* $D_S(\theta, \alpha)$ *is increasing in* θ*. For* $\theta \in \left(\theta_1^d, \theta_0^d\right)$*,* $\partial\alpha_D(\theta)/\partial\theta < 0$*, whereas for* $\theta \in \left(\theta_0^u, \theta_1^u\right)$*,* $\partial\alpha_D(\theta)/\partial\theta > 0$*.*

Part (a) of the Lemma covers the situation in which the U-shaped $D_S(\theta, \alpha)$ function stays above zero for all α and θ, meaning that the payoff of selling in the investment market exceeds that of in the search market at any market tightness. This results in $\alpha_O(\theta) = 1$ for all θ, as illustrated in Panel A of Figure 3. Here, of course, the unique equilibrium is at $\alpha = 1$ for any values of H, as shown in Figure 2. In this case, flippers' financing advantage is so overwhelming that the unique equilibrium must be a full-intermediation equilibrium.

For r_F larger than some threshold, which we denote as r', flippers' financing advantage, though remains operative, only suffices to allow them to offer a price in the investment market attractive enough to lure all mismatched households to sell in the market when the search market is particlarly sluggish or particularly tight. This suggests that $\alpha_O(\theta)$ can become strictly increasing over a given range of θ. In the meantime, given a strictly increasing $\alpha_T(\theta)$, the multiplicity of equilibrium becomes a distinct possibility.

Lemma 9(b) covers the situation where r_F remains below a second threshold, which we denote as r'', in which case $\alpha_O(\theta)$ remains above zero for all θ, as illustrated in Panel B of Figure 3. In this case, any equilibria must be at where $\alpha > 0$, as shown in Figure 2.

As r_F reaches and rises above the r'' threshold, Lemma 9(c) says that $\alpha_O(\theta)$ now does fall to zero over a given interval $\left[\theta_0^d, \theta_0^u\right]$ of market tightness, as illustrated in Panel C of Figure 3. If

$$\theta_0^d \leq \theta_T(0) \leq \theta_0^u, \tag{26}$$

there indeed exists a no-intermediation equilibrium with $\alpha = 0$. Otherwise, any equilibria must still be at where $\alpha > 0$.

As r_F goes up further, flippers' financing advantage weakens. Formally, the interval $\left[\theta_0^u, \theta_0^d\right]$ widens with $\partial\theta_0^u/\partial r_F < 0$ and $\partial\theta_0^d/\partial r_F > 0$. Given that $\partial\theta_T(0)/\partial H < 0$, we can divide the H-r_F space for $r_F \in [r'', \overline{r})$ in Figure 2 into three subsets with a downward-sloping border between the first and the second subsets and an upward-sloping border between the second and third subsets. Within the middle subset, there exists a no-intermediation equilibrium with $\alpha = 0$. In the other two subsets, any equilibria must be at where $\alpha > 0$. That the second border is upward-sloping has the same interpretation as to why the border in the Figure for $r_F \geq \overline{r}$ is upward-sloping: an increase in r_F hinders flippers' ability to offer a price attractive enough to allow them to carry out their liquidity-provision role so that flipping can continue to take place only when the search market is more illiquid due to a larger housing stock. For $\{H, r_F\}$ in the first subset, the second inequality in (26) fails to hold; i.e., $\theta_T(0) > \theta_0^u$. The condition says that the smallest feasible market tightness $\theta_T(0)$ is above the lower bound θ_0^u of market tightness above which the financing advantage of flippers would allow them to lure at least a fraction of mismatched households to sell in the investment market. Then, no equilibrium can be at $\alpha = 0$. As r_F increases, the advantage weakens and such a lower bound increases in value. A corresponding increase in $\theta_T(0)$ due to a smaller housing stock is needed for the condition to continue to hold.

To summarize, in the model housing market, flippers possess two advantages over ordinary households: (1) liquidity advantage and (2) financing/bargaining advantage. For the smallest r_F and largest β_F, the financing/bargaining advantage suffices to enable flippers to offer a good enough price to lure all mismatched households to sell in the investment market at any level of market tightness in the search market resulting from any level of housing supply. As the advantage weakens, flippers may only survive in particularly sluggish search markets on the basis of helping mismatched households overcome the liquidity problems and in particularly tight search markets on the basis of offering a very attractive price. The possibility of multiple equilibria arises. Finally,

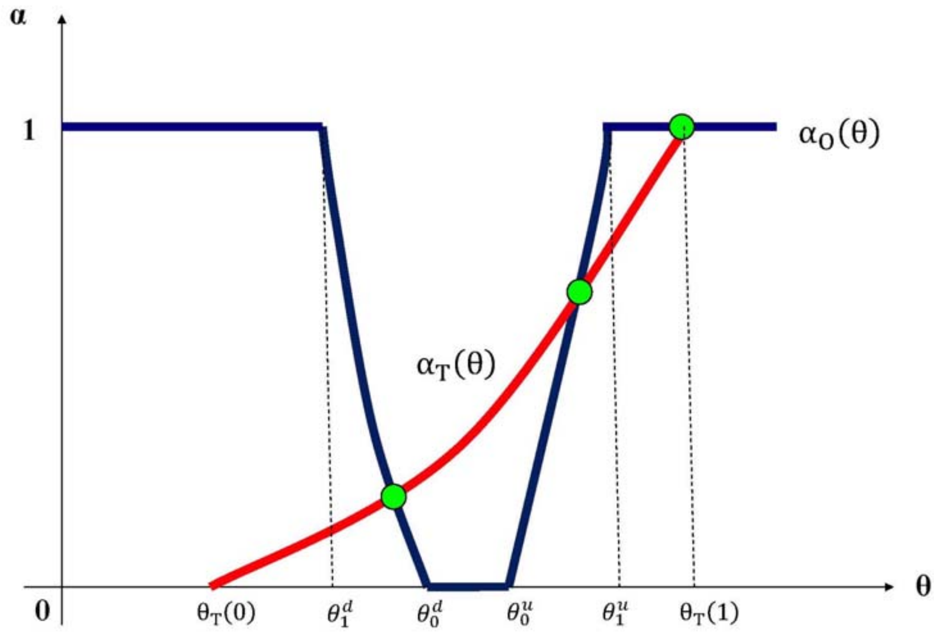

Figure 4: Multiple Equilibria: $\theta_0^d > \theta_T(0)$

when the financing/bargaining advantage weakens further and disappears altogether, flippers may only survive on the basis of providing liquidity services. In this case, equilibrium is guaranteed unique and may involve flipping only for relatively sluggish markets resulting from a large housing supply.

3.2 Multiplicity

Figures 4 and 5 illustrate two examples of multiplicity. In both examples, there are three equilibria. Consider first the $\alpha = 1$ equilibrium. At $\theta = \theta_T(1)$, there is a tight search market, under which flippers can offer a price attractive enough to lure all mismatched households to sell in the investment market. In the meantime, if all mismatched houses are sold in the investment market right away, the rapid turnover will indeed give rise to a tight market. In this way, $\alpha = 1$ is equilibrium in Figures 4 and 5. For smaller θ, flippers can no longer offer prices good enough to attract all mismatched households to sell in the investment market. But precisely because fewer or none at all mismatched houses are sold in the investment market, a relatively sluggish search market will emerge from the slower turnover. As a result, a smaller α and a smaller θ is also equilibrium in Figures 4 and 5.

Consider a small perturbation from the middle equilibrium in Figures 4 and 5 that knocks the $\{\alpha, \theta\}$ pair off to the right of the $\alpha_O(\theta)$ function. Then, $D_S(\theta, \alpha) > 0$ since $\partial D_S / \partial \theta > 0$ for $\theta \geq \theta_0^u$ after which all mismatched households will find it better to sell

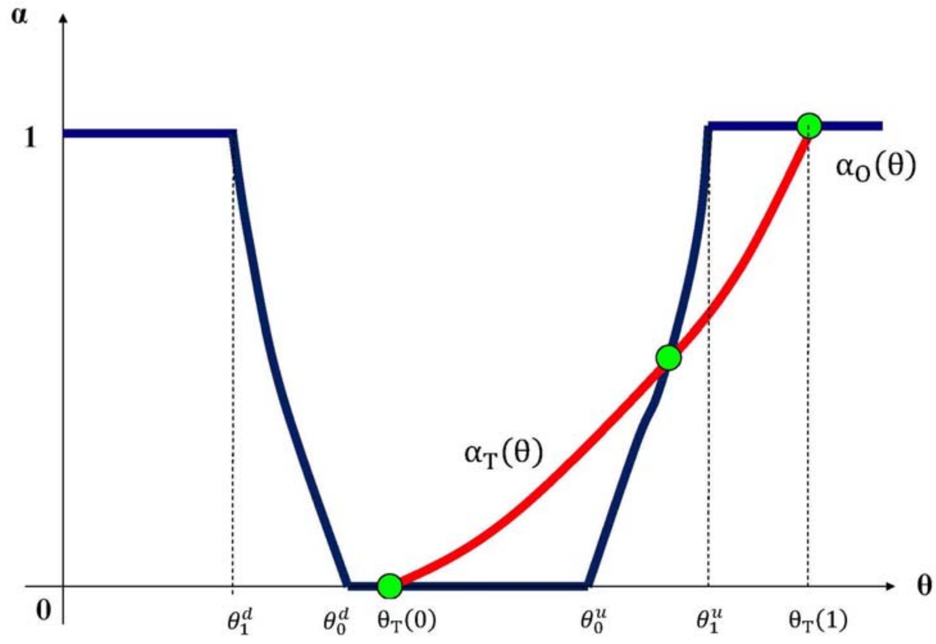

Figure 5: Mutliple Equilibria: $\theta_T(0) > \theta_0^d$

in the investment market. The increase in turnover will raise θ further. Eventually the market should settle at the $\alpha = 1$ equilibrium. Conversely, a perturbation that knocks the $\{\alpha, \theta\}$ pair off to the left of $\alpha_O(\theta)$ function from the middle equilibrium in Figures 4 and 5 should send the market to a smaller α equilibrium. In general, an equilibrium that occurs at where $\alpha_O(\theta)$ is increasing should be unstable. By analogous arguments, the other equilibria in the two examples should be locally stable.[17] Hence, there are not just multiple steady-state equilibria but also multiple locally *stable* steady-state equilibria.

With multiple steady-state equilibria, the presence of flippers in the market can be fickle, especially when the equilibrium the market happens to be in is unstable. In general, where there are multiple equilibria, any seemingly unimportant shock can dislocate the market from one equilibrium and move it to another, causing catastrophic changes in flippers' market share, turnover, and sales. To follow such discrete changes in the activities of flippers can be significant fluctuations in housing price, a subject we shall address in the next Section. And then in Section 5, we will calibrate the model to several observable characteristics of the U.S. housing market to assess quantitatively the importance of such a channel of volatility.

[17] A more rigorous local stability analysis is in Leung and Tse (2014b).

3.3 Housing prices

Housing prices in no-intermediation equilibrium Absent flippers, all housing market transactions are between pairs of end-user households at price[18]

$$p_H = \frac{\beta_H (\eta + r) - (1 - \beta_H) \mu}{(r + \delta + \beta_H \eta) r} \upsilon + \frac{q}{r}, \tag{27}$$

evaluated at $\theta = \theta_T (0)$.

Housing prices in fully-intermediated equilibrium In a fully-intermediated equilibrium, all houses are first sold from mismatched households to flippers at price

$$p_{FB} = \frac{\beta_F \eta (\upsilon + q)}{(r_F + \beta_F \eta) r + (\delta + (1 - \beta_F) \mu) r_F}, \tag{28}$$

in the investment market and then at price

$$p_{FS} = \frac{\beta_F (\eta + r_F) (\upsilon + q)}{(r_F + \beta_F \eta) r + (\delta + (1 - \beta_F) \mu) r_F}, \tag{29}$$

from flippers to end-user households in the search market, both evaluated at $\theta = \theta_T (1)$. Clearly, $p_{FB} < p_{FS}$. Now, houses sold from households to flippers stay on the market for a vanishingly small time interval, whereas houses sold from flippers to households in the search market stay on the market for, on average, $1/\eta > 0$ units of time. There should then be a positive cross-section relation between prices and TOM in the model housing market, as in the real-world housing market. Besides, with $p_{FB} < p_{FS}$, the model trivially predicts that houses bought by flippers are at lower prices than are houses bought by non-flippers. Both Depken et al. (2009) and Bayer et al. (2011) find such flipper-buy discounts exist in their respective hedonic price regressions.

Housing prices in partially-intermediated equilibrium In a steady-state equilibrium in which mismatched households sell in both the investment and search markets, in addition to the two prices

$$p_{FB} = \frac{\beta_F \eta}{r_F (r + \delta + \beta_H \eta)} \upsilon, \tag{30}$$

$$p_{FS} = \frac{\beta_F \eta + \beta_F r_F}{r_F (r + \delta + \beta_H \eta)} \upsilon, \tag{31}$$

[18] The equations for the housing prices and asset values referred to hereinafter are special cases of those presented in Lemma 10 in the Appendix. In particular, (27) is from (48) evaluated at $\alpha = 0$; (28) and (29) are from (56) and (55), respectively, evaluated at $\alpha = 1$; (30), (31), and (32) are from (50), (49), and (48), respectively, all evaluated at $D_S (\theta, \alpha) = 0$.

for transactions between a flipper and an end-user household, there will also be transactions between two end-user households, carried out at price

$$p_H = \frac{\beta_F \eta + \beta_H r_F}{r_F \left(r + \delta + \beta_H \eta\right)} \upsilon. \tag{32}$$

Here, we have $p_{FB} < p_H < p_{FS}$ for $\beta_F > \beta_H$. Just as in the fully-intermediated equilibrium, a positive relation between prices and TOM holds in the cross section and houses bought by flippers are at lower prices. Moreover, here houses sold by flippers are sold at a premium over houses sold by one end-user household to another. Such flipper-sell premiums are also found to exist in Depken et al. (2009) and Bayer et al. (2011).

Prices across equilibria Across steady-state equilibria, $\theta = B/S$ is largest in the equilibrium where flippers are most numerous. Then, prices should be highest in such an equilibrium where the competition among buyers is most intense.

Proposition 1 *Across steady-state equilibria in case there exist multiple equilibria, housing prices in both the search and investment markets are highest in the equilibrium with the tightest market and lowest in the equilibrium with the most sluggish market.*

Now, a direct corollary of the Proposition and Lemmas 3-6 is that:

Proposition 2 *Across steady-state equilibria in case there exist multiple equilibria, prices, sales, and vacancies increase or decrease together from one to another equilibrium, whereas the average TOM and TBM move with the former set of variables in the opposite direction.*

Interest rate shocks In a typical asset pricing model, the price of an asset falls when interest rates go up. The same tends to hold in the present model. Specifically, in a no-intermediation equilibrium, a decline in r can lead to a higher p_H for sufficiently large $\theta_T(0)$ and/or q, as can be seen from (27), but market tightness, vacancies, turnover, and sales are invariant to an interest rate shock that has no effects on α.

In a fully-intermediated equilibrium, by (28) and (29), respectively, both p_{FB} and p_{FS} are decreasing in r_F. Just as in the no-intermediation equilibrium, such interest rate shocks will leave no impact on market tightness, vacancies, turnover, and sales, if all transactions were already intermediated to begin with.

In a partially-intermediated equilibrium, prices in the search market, p_{FS} and p_H, as well as in the investment market p_{FB}, are decreasing in r_F, just as they are in a fully-intermediated equilibrium. But where θ was not already fixed at the boundary of $\theta_T(1)$, housing prices can also vary to follow any movements in θ triggered by the given interest rate shock. As expected, the prices given in (30)-(32) are higher when the search market is tighter. Hence, if a given positive (negative) interest rate shock should cause α and therefore θ to decrease (increase), there will be lower (higher) housing prices to follow because of a direct negative (positive) effect and of an indirect effect due to the exit (entry) of flippers. When the two effects work in the same direction, a given interest rate shock can cause significantly more housing price volatility than in a model that only allows for the usual effect of interest rates on asset prices.

However, a positive interest rate shock need not cause α and θ to fall. In case there exist multiple equilibria, the shock can possibly dislocate the market from a given equilibrium and send it to another equilibrium. In what direction housing prices will move then cannot be unambiguously read off from (30)-(32) as the direct effect of any interest rate shock and the indirect effect via the movements in θ can affect housing prices differently. To proceed, we solve $D_S(\theta, \alpha) = 0$ for r_F and substitute the result into (30)-(32), respectively,

$$p_{FB} = \frac{\beta_H \eta + ((\beta_F - \beta_H)\alpha_T - (1 - \beta_H))\mu}{r(r + \delta + \beta_H \eta)} \upsilon + \frac{q}{r}, \tag{33}$$

$$p_{FS} = \frac{\beta_H \eta + \beta_F r + ((\beta_F - \beta_H)\alpha_T - (1 - \beta_H))\mu}{r(r + \delta + \beta_H \eta)} \upsilon + \frac{q}{r}, \tag{34}$$

$$p_H = \frac{\beta_H \eta + \beta_H r + ((\beta_F - \beta_H)\alpha_T - (1 - \beta_H))\mu}{r(r + \delta + \beta_H \eta)} \upsilon + \frac{q}{r}. \tag{35}$$

The three equations are independent of r_F – whatever effects a given change in r_F will have on housing prices are subsumed through the effects of the change in θ that follows the change in r_F obtained from holding $D_S(\theta, \alpha) = 0$. To evaluate the effects of r_F on housing prices is to simply check how these three expressions behave as functions of θ.

Proposition 3 *Across steady-state equilibria and holding $D_S(\theta, \alpha) = 0$, a shock to r_F, whether positive or negative, will cause housing prices to increase (decrease), as long as to follow the interest rate shock are increases (decreases) in α and θ.*

By Proposition 3, the indirect effect of an interest rate shock on housing prices through the entry and exit of flippers and then in market tightness always dominates the direct effect shall the two be of opposite directions. A surprising implication is that housing prices can actually go up in response to an increase in flippers' cost of financing, if to follow the higher interest rate is also a heightened presence of flippers in the market. In any case, a direct corollary of Lemmas 3-6 and Proposition 3 is that:

Proposition 4 *Across steady-state equilibria and holding $D_S(\theta, \alpha) = 0$, a shock to r_F will cause housing prices, sales, and vacancies to move in the same direction, whereas the average TOM and TBM will move in the opposite direction.*

In the above, we have restricted attention to analyzing how changes in r_F alone may affect housing prices. It turns out that many of the implications continue to hold for equiproportionate increases or decreases in r and r_F. Proposition 6 in the Appendix contains the details.

3.4 Efficiency

In this section, we study the problem of optimal flipping in the model housing market. The planner, who is subject to the same trading and financing frictions that agents in the model housing market face, chooses the fraction of mismatched households using the service of flippers to maximize the utility flows over time that households derive from matched owner-occupied housing net of the rental payments incurred; i.e.,

$$\max_{\alpha}\left\{\int_0^{\infty} e^{-rt}\left(n_M \upsilon - n_R q\right) dt\right\} dt, \tag{36}$$

subject to (1)-(4) and the equations of motions for n_M, n_U, n_F, and n_R, given by the differences between the LHS and RHS of (5)-(8), respectively.

Lemma 10 *In the steady state, the planner's incentives to have mismatched households selling to flippers are governed by*[19]

$$E_S(\theta) = \frac{\partial \eta}{\partial \theta} - \left(r + \delta + \eta - \theta \frac{\partial \eta}{\partial \theta}\right) z, \tag{37}$$

whereby

$$\alpha = \begin{cases} 1 & E_S(\theta_T(1)) \geq 0 \\ \alpha_E & E_S(\theta_T(\alpha_E)) = 0 \\ 0 & E_S(\theta_T(0)) \leq 0 \end{cases}. \tag{38}$$

Notice that $E_S(\theta)$ starts off equal to positive infinity at $\theta = 0$, is everywhere decreasing in θ, and ends up equal to some negative value as $\theta \to \infty$. Then, one and only one of the three cases in (38) applies given that $\partial \theta_T(\alpha) / \partial \alpha > 0$. In particular, if $E_S(\theta_T(1)) \geq 0$, $E_S(\theta) > 0$ for all $\theta \in [\theta_T(0), \theta_T(1))$, and hence for efficiency, $\alpha = 1$. On the other hand, if $E_S(\theta_T(\alpha_E)) = 0$ holds at some $\theta_T(\alpha_E) \in (\theta_T(0), \theta_T(1))$, for efficiency, $\alpha = \alpha_E$. Finally, if $E_S(\theta_T(0)) \leq 0$, $E_S(\theta) < 0$ for all $\theta \in (\theta_T(0), \theta_T(1)]$, and for efficiency, $\alpha = 0$.

Apparently, efficient flipping does not depend on flippers' cost of financing r_F or their bargaining strength β_F in particular and their payoffs in general. Intuitively, flippers earn a zero expected payoff no matter what. This then suggests that for

[19] Fornally, $E_S(\theta)$ denotes the sign of the steady-state shallow value of n_R in (36). When such a shallow value is positive, the objective function in (36) increases in value if the planner sends one more mismatched household to rental housing by making the household sell to a flipper.

efficiency, flippers' survival should only be on the basis of providing liquidity services to the households. Such liquidity services are valued only if $E_S(\theta_T(0)) > 0$ as implied by the third line of (38). The condition holds for small but not large $\theta_T(0)$ with $\partial E_S(\theta)/\partial\theta < 0$. In turn, a small $\theta_T(0)$ follows from a large housing stock H, with which a sale in the search market can take a long time. Conversely, in a market with a sufficiently small housing stock, the resources used up in rental payments resulting from any flipping is wasteful.

Flipping in equilibrium is efficient if households' private incentives to sell to flippers as given by D_S in (23) coincide with the planner's incentives E_S as given in (37). This happens under the conditions in the following proposition.

Proposition 5 *Equilibrium is efficient if*

$$\beta_H = 1 - \frac{\theta}{\eta}\frac{\partial\eta}{\partial\theta} \equiv \beta^e, \tag{39}$$

$$\beta_F = \left(1 - \frac{\theta}{\eta}\frac{\partial\eta}{\partial\theta}\right)\frac{\theta - \alpha}{\frac{r}{r_F}\theta - \alpha} \equiv \beta_F^e \tag{40}$$

at the optimum $\{\alpha, \theta\}$ *pair.*

The usual congestion externalities and appropriability problem in models of search and matching apply to the present model. When more mismatched households are selling to flippers, there are more buyers and fewer sellers in the search market. As a result, the buyers' side of the market is more congested and the sellers' side is less so. Moreover, when a mismatched household sells to a flipper, the household begins paying the flow rental sooner in return for spending less time in between matches. Later on, the household, however, only appropriates a fraction of the surplus of the prospective match in the search market.

In case $r_F = r$, Proposition 5 says that $\beta_F^e = \beta^e$ and the Hosios (1990) condition holds exactly. The congestion externalities and the effects of imperfect appropriability just cancel out and efficiency is obtained when the buyer's share of the match surplus, whoever the buyer is matched with, is just equal to the elasticity of the matching function with respect to the measure of buyers. For $r_F < r$, $\beta_F^e < \beta^e$ though. That is, if $r_F < r$ but $\beta_F = \beta^e$, the price that flippers can offer will be too attractive to give rise to excessive incentives for mismatched households to sell in the investment market.

Given that efficiency does not always increase with α and θ and that the market incentives to sell to flippers can be suboptimal or excessive, there is no reason to expect that when there exist multiple equilibria, the more active equilibria are necessarily more efficient. Most of all, the equilibria cannot be pareto ranked under all circumstances. Specifically, in a steady-state equilibrium where $D_S(\theta, \alpha) = 0$, asset values for matched and mismatched homeowners, renters, and flippers are given by, respectively,[20]

$$V_M = \frac{(r + \beta_H \eta)\, \upsilon}{r\,(r + \delta + \beta_H \eta)}, \tag{41}$$

$$V_U = \frac{\beta_H \eta \upsilon}{r\,(r + \delta + \beta_H \eta)}, \tag{42}$$

$$V_R = \frac{(\beta_H r_F - \beta_F r)\, \eta \upsilon}{r_F r\,(r + \delta + \beta_H \eta)}, \tag{43}$$

$$V_F = \frac{\beta_F \eta \upsilon}{r_F\,(r + \delta + \beta_H \eta)}. \tag{44}$$

It is straightforward to verify that V_M, V_U, and V_F are all increasing in θ. Any homeowners—matched or mismatched, end-users or flippers—benefit from the higher housing prices in a tighter market. But the asset value for households in rental housing V_R is decreasing in θ if $\beta_H r_F < \beta_F r$, which is a necessary condition for the multiplicity of equilibrium (equation (24) and Figure 2). In this case, would-be buyers are made worse off by the higher housing prices in the tighter market. In a comparison between two steady-state equilibria both at where $D_S(\theta, \alpha) = 0$, homeowners are better off whereas renters are worse off in the larger θ equilibrium than in the smaller θ equilibrium. Thus, any two such equilibria cannot be pareto ranked. The same conclusion carries over to comparisons between a $D_S(\theta, \alpha) > 0$ equilibrium and a $D_S(\theta, \alpha) = 0$ equilibrium and between a $D_S(\theta, \alpha) = 0$ equilibrium and a $D_S(\theta, \alpha) < 0$ equilibrium.

4 Time-series relations among housing prices, sales, and vacancies

By Propositions 4, 5, and 7 in the Appendix, any movement from one to another steady-state equilibrium would involve housing prices, sales, and vacancies all moving in the same direction. The positive time-series relation between housing prices and sales is well known and numerous models have been constructed to account for it. In Kranier (2001), for instance, a positive but temporary preference shock can give rise to higher prices and a greater volume of transaction, whereas Diaz and Jerez's (2013) analysis implies that an adverse shock to construction will shorten TOM, and may possibly lead to higher prices and a greater volume of transaction. The paper by Ngai and Tenreyro (2014) studies the comovement in prices and sales over the seasonal cycle and they argue that increasing returns in the matching technology play a key role in generating such cycles. Unique to our analysis is that vacancies should also move in the same direction with prices and sales. In contrast, in both the Kranier

[20] The first two equations are from (52) and (53), respectively. The last two are from (51) and (50), respectively, both evaluated at $D_S(\theta, \alpha) = 0$.

and the Diaz and Jerez's models, the increase in sales should be accompanied by a decline in vacancy—given that when a house is sold, it is sold to an end-user, who will immediately occupy it, vacancies must decline, or at least remain unchanged. In Ngai and Tenreyro's model, households are assumed to move out of their old houses and into rental housing immediately when they become mismatched. Then, any and all houses on the market are vacant houses and given the assumed increasing-returns-to-scale matching technology, vacancies rise and fall with prices and sales in the seasonal cycle. A mismatched household in their model, however, could well have stayed in the old house and avoided rental housing and the payment thereof until it has successfully sold the old house. In this alternative setup, the stock of vacant houses only includes houses held by people who have bought new houses before they manage to sell their old ones. Then, it is no longer clear that vacancies must rise and fall with prices and sales in the seasonal cycle of Ngai and Tenreyro.

Figure 6 depicts the familiar positive housing price-transaction volume correlation for the U.S. for the 1981Q1 to 2011Q3 time period.[21] The usual housing market search model predicts that vacancies should decline in the housing market boom in the late 1990s to the mid 2000s and rise thereafter when the market collapses around 2007. Figures 7 and 8 show that any decline in vacancy is not apparent in the boom.[22] In fact, if there is any comovement between vacancies on the one hand and prices and sales on the other hand in the run-up to the peak of the housing market boom in 2006, vacancies appear to have risen along with prices and sales. In a literal interpretation of our model, vacancies should fall very significantly to follow the market collapse since 2007. Apparently, the decline in vacancy in Figures 7 and 8 since the market collapse appears modest, compared to the increase in the boom years. Two forces absent in our analysis–the massive amount of bank foreclosures and unsold new constructions in the market bust–may have accounted for the slow decline in vacancy since 2007.

In a more systematic analysis, we first verify that in the 1981Q1 to 2011Q3 sample period, the three variables are all $I(1)$ at conventional significance levels. Next, we test for cointegration. Assuming the absence of any time trends and intercepts in the cointegrating equations, both the Trace test and the Max-eigenvalue test indicate two such equations, whose normalized forms read

$$\text{Price} - 6045.51 \times \text{Vacancy} = 0,$$

[21] Housing Price is defined as the nominal house price, which is the transaction-based house price index from OFHEO (http://www.fhfa.gov), divided by the CPI, from the Federal Reserve Bank at St. Louis. We set Housing Price at 1981Q1 equal to 100. Transaction is measured by the *quarterly* sales in single-family homes, apartment condos, and co-ops, normed by the stock of such units. The sales data are from the *Real Estate Outlook* by the National Assoication of Realtors, complied by Moody's Analytics. The housing stock is defined as the sum of owner-occupied units and vacant and for-sale-only units. The data are from the Bureau of Census's CPS/HVS Series H-111 available at http://www.census.gov/housing/hvs/data/histtabs.html.

[22] Vacancy rate is obtained by dividing the number of vacant and for-sale-only housing units by the housing stock as defined in the prevous note.

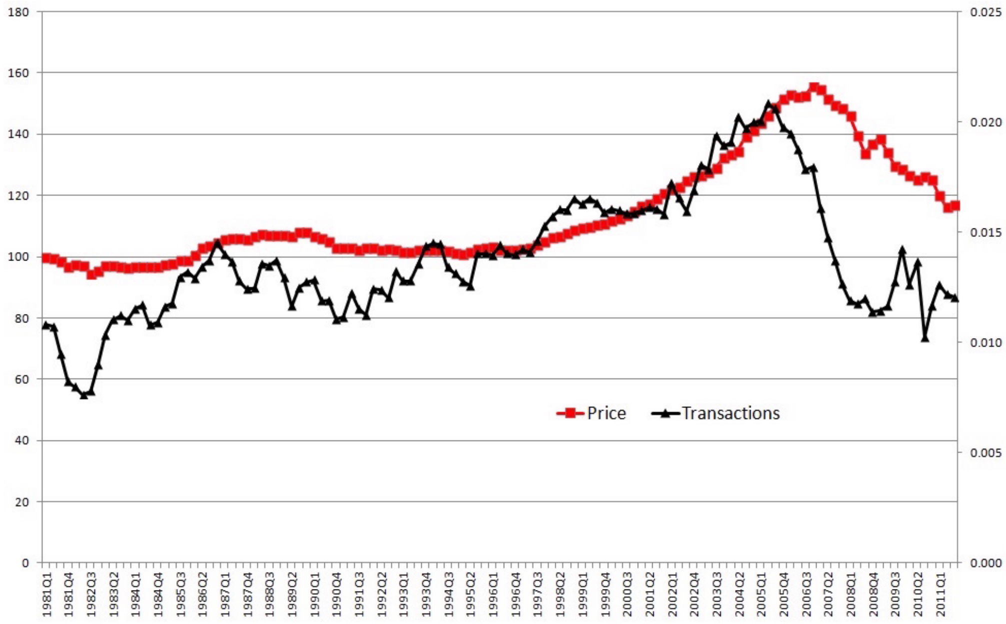

Figure 6: Price and Transactions

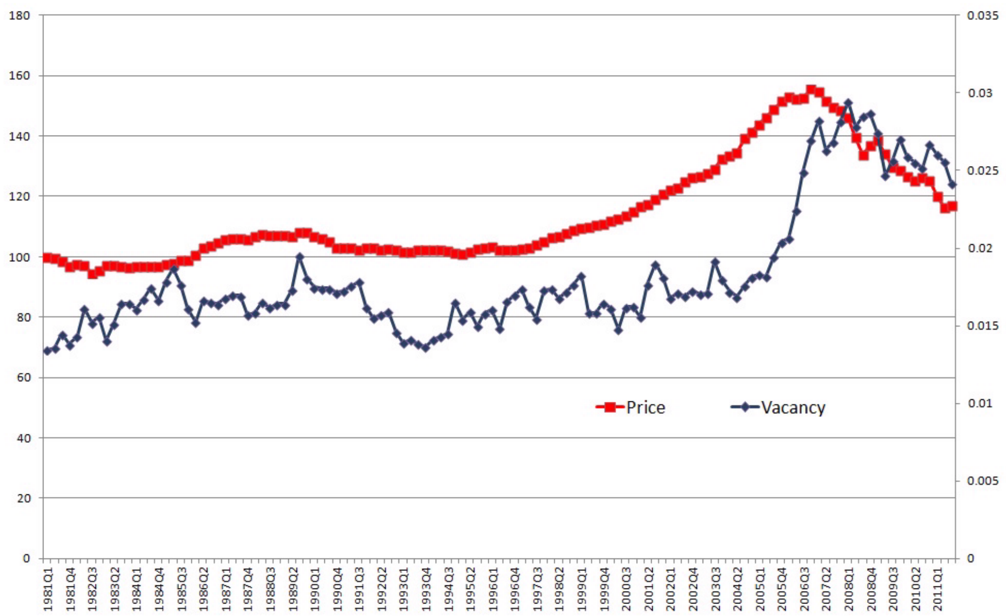

Figure 7: Price and Vacancy

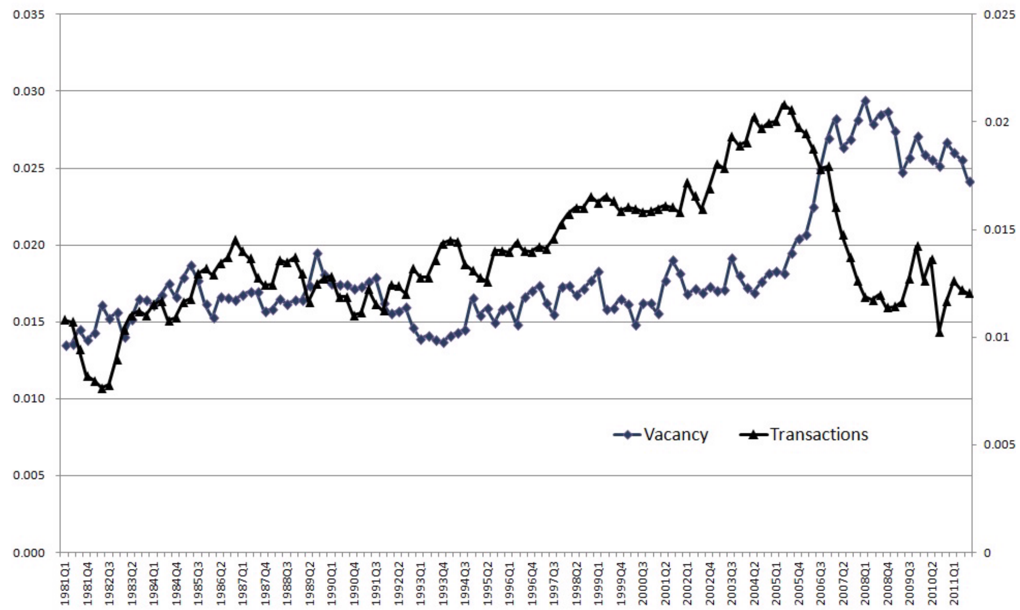

Figure 8: Transactions and Vacancy

$$\text{Transaction} - 0.74 \times \text{Vacancy} = 0,$$

which together imply that the three variables tend to move in the same direction from one to another long-run equilibrium over time. With other time trend and intercept assumptions, either one or both of the tests suggest that there exist only one or as many as three cointegrating equations. In a single cointegrating equation with non-zero coefficients for all three variables, at least two of the three coefficients must be of the same sign. Then, the two variables concerned must move in opposite directions across long-run equilibria. With as many cointegrating equations as the number of variables, there exist definite long-run values for the three variables, which rules out the possibility of the system moving from one to another long-run equilibrium altogether. Restricting a priori to two cointegrating equations in the estimation, however, we always obtain two equations whose coefficients have the same signs as those in the system above whatever the trend and intercept assumptions are. Then, any long-run movements for the three variables must be in the same direction.

5 Quantitative predictions on volatility

Given the possible multiplicity of equilibrium and that an interest rate shock may have important effects on the extent of intermediation, the model can be consistent with a volatile housing market. The question remains as to how important quantitatively such channels of volatility can be. In this section, we calibrate the model to several observable characteristics of the U.S. housing market and study by how much housing prices can fluctuate across steady-state equilibria and in response to interest rate shocks.

To begin, we take a time unit in the model to be a quarter of a year and assume a Cobb-Douglas matching function with which $\eta(\theta) = a\theta^b$. We set a priori the mismatch rate $\delta = 0.014$ to calibrate a two-year mobility rate of 11.4% for owner-occupiers reported in Ferreira et al. (2010) and $b = 0.84$, which is the elasticity of the seller's matching hazard with respect to the buyer-seller ratio reported in Genesove and Han (2012). Next, the parameters a and H and the share of mismatched households selling to flippers α are chosen to calibrate:

1. a quarterly transaction rate of owner-occupied houses of 1.78%
2. a vacancy rate of owner-occupied houses of 1.84%
3. the share of houses bought by flippers among all transactions of owner-occupied houses equal to 19%

The first two targets are, respectively, the average quarterly transaction rate and the average vacancy rate for the period 2000Q1-2006Q4, calculated from our dataset for the plots in Figures 6-8 and the estimations in Section 4. Estimates of the share of houses bought by flippers come from two sources: the 25% investors' share of all new purchase mortgages in the whole of the U.S. in Haughwout et al. (2011) in the 2000Q1-2006Q4 time period and the 13.7% housing market transactions share for houses sold again within the first two years of purchase in the metropolitan Las Vegas area in Depken et al. (2009) in the same time period. Because an investor in Haughwout et al. (2011) may intend to hold the house as a long-term investment, the 25% share is probably an overestimate of the true flippers' share. Because not all houses bought for short-term flips can actually be sold within two years, the 13.7% share in Depken et al. (2009) is probably an underestimate of the true flippers's share. Our 19% target is obtained by taking a simple average of the two estimates.

Given the targets, denoted as x_i, $i = 1, 2, 3$, respectively, we choose a, H, and α to

$$\min \left\{ \sum_{i=1}^{3} \left(\frac{x_i - \widehat{x}_i}{x_i} \right)^2 \right\},$$

subject to

$$a \leq 1.2,$$
$$0.6 \leq H < 1,$$
$$0 \leq \alpha \leq 1,$$

where the $\widehat{x}_i$'s are the model's calibrated values of the corresponding targets.[23] The first constraint is for expediency and is not binding. Given that H in the model is the stock of owner-occupied houses relative to the population of households demanding such housing, anything near the lower bound of the second constraint is probably unreasonable, whereas the model is not well-behaved if H exceeds the upper bound of the constraint. The minimization is carried out via a grid search with a grid size of 0.005 for each of a, H, and α, yielding $a = 0.085$, $H = 0.865$, and $\alpha = 0.25$ at which the calibrated values of the three targets are reported in the second column of Table 1.

Table 1: Calibration Targets and Calibrated Model Values

	Targeted value	Calibrated value
Transaction rate (quarterly)	0.0178	0.016
Vacancy rate	0.0184	0.018
Flippers' share in transactions	0.19	0.19

Thus far in the calibration, we have effectively identified $\alpha_T = 0.25$ as equilibrium. For equilibrium to be indeed at $\alpha = 25$, we need to pick the values for $\{q, \upsilon, \beta_H, \beta_F, r, r_F\}$ to force $\alpha_O = 0.25$ as well. Since only the ratio $z = q/\upsilon$, but not the levels of the two parameters, matters for the value of α_O and the comparison of prices and welfare, we first normalize $\upsilon = 1$. We then obtain an estimate of z (or equivalently q) equal to 1.43 from the results in Anenberg and Bayer (2013). The details are in Appendix 8.2. Next, we set $r = 0.02$ for an annual rate of 8% to match the usual 30-year fixed-rate mortgage rate. Lastly, for the lack of any obvious empirical counterpart, we set the household seller's bargaining strength $\beta_H = 0.5$. Then for each of $\beta_F = 0.5$, 0.6, 0.65, 0.7, and 0.8, we look for the value of r_F at which $\alpha_O = 0.25$. The results are shown in Table 2.[24,25]

[23] The $\widehat{x}$s are equal to TV/H, n_F/H, and $\alpha\delta n_M/TV$ for the model's transaction rate, vacancy rate, and the flippers' transaction share, respectively.

[24] A r_F below r by a few percentage points can make sense if flippers, but not end-user households, tend to be all-cash investors. Herbert et al. (2013) report that the majority of investors acquiring foreclosures are indeed all-cash buyers. Even though no comparable evidence is available for other properties, it would not be surprising that cash is often used too. Moreover, investors may also make use of mortgages with zero initial or negative amortization, short interest rate reset periods, or low introductory teaser interest rates. Such mortgages obviously are ideal for flippers who plan to sell quickly for short-term gains. Amromin et al. (2012) find that borrowers who take out such "complex" mortages are usually high income individuals with good credit scores. Foote et al. (2012) find that periods of interest rate resets do not tend to trigger significant increases in defaults, consistent with the finding of Amromin et al. that the borrowers of such mortgages are sophisticated investors. Barlevy and Fisher (2010) find that interest-only mortgages are used much more heavily in cities with the most rapid increase in housing prices. And then Haughwout et al. (2011) find that states that have undergone the most rapid price increase are states where the share of transaction involving flippers is highest.

[25] Notice that the model does not require $r_F < r$ for flippers to survive or for the multiplicity of

Table 2: Calibrated β_F and r_F for $\alpha_O = 0.25$

β_F	0.5	0.6	0.65	0.7	0.8
r_F	0.0077	0.0091	0.0099	0.0106	0.012
r_F (annual basis)	3.1%	3.7%	4%	4.23%	4.8%

For the last two pairs of β_F and r_F in Table 2, the $\alpha = 0.25$ equilibrium is the unique equilibrium. For the first three pairs, there are two other equilibria each beside the $\alpha = 0.25$ equilibrium. Table 3 reports the prices and aggregate asset values

$$W = n_M V_M + n_U V_U + n_R V_R + n_F V_F$$

in these equilibria. For instance, for $\beta_F = 0.5$ and $r_F = 3.1\%$ per annum, the three equilibria are at $\alpha = 0$, 0.25, and 1, respectively.[26] The price $\overline{p}$, on the next row, is the average of p_H, p_{FB}, and p_{FS}, weighted by the shares of transactions taking place at the respective prices, with $\overline{p}$ in the smallest-α equilibrium set equal to 1. Evidently, the volatility arising from the multiplicity is non-trivial, with average prices differing by up to 23% across the equilibria. Meanwhile, welfare, as measured by the aggregate asset value W, shown on the last row, differs by at most 7%. This is not surprising in light of the analysis in Section 3.4. Whereas homeowners benefit from the higher prices and faster turnover, would-be buyers in rental housing are made worse off by the same higher prices and longer wait for owner-occupied housing. Any efficiency gains from intermediation must be weighted against the losses buyers suffer amid a tighter market.

Table 3: Multiple Equilibria

β_F r_F (annual basis)	0.5 3.1%			0.6 3.7%			0.65 4%		
α	0	0.25	1	0	0.25	1	0.25	0.71	1
$\overline{p}$	1	1.1	1.2	1	1.11	1.23	1	1.08	1.11
W	1	1.04	1.07	1	1.04	1.07	1	1.025	1.03

Table 4: Housing Prices and Interest Rates, $\beta_F = 0.7$

r_F (annual basis)	3.5%	4.21%	4.22%	4.23%	4.27%	6%
$\alpha = 0$					0.89	0.89
$\alpha = 0.25$				1		
$\alpha = 0.63$			1.07			
$\alpha = 1$	1.13	1.12				

equilibria. For smaller values for z, we can force α_O to be equal to 0.25 for much larger r_F.

[26] At $\alpha = 1$, in the steady state, one half of all houses bought are purchases made by flippers. This is just about equal to the peak investor share in the "bubble states" reported in Haughwout et al. (2011).

To study the response of housing prices to interest rate shocks, we report in Table 4 average housing prices $\overline{p}$ for various small deviations of r_F from a benchmark of $r_F = 4.23\%$ and $\beta_F = 0.7$ at which equilibrium is unique at the calibrated value of $\alpha = 0.25$. Fixing $\beta_F = 0.7$, for all values of r_F under consideration, equilibrium remains unique. The entries in the table are normed by the average equilibrium price at the benchmark r_F. Here, housing prices hardly move to follow a given interest rate shock if the shock has not caused any changes in equilibrium α. But when the given interest rate shock does cause α to change significantly, it also leads to significant changes in housing prices. Specifically, a decline in r_F from 6% per annum to 4.27% per annum causes no noticeable change in $\overline{p}$ when the given movement in r_F has no effect on α. On the other hand, a further decline in r_F from 4.27% per annum to 4.21% per annum now causes $\overline{p}$ to increase by 26% as α rises from 0 to 1 in the meantime. Thereafter, $\overline{p}$ remains essentially unchanged from any additional decline in r_F as α has already reached the upper bound of 1. All this suggests that the response of housing prices to interest rate shocks can appear erratic and unpredictable. Before a given threshold r_F is reached, the response is at most moderate. When r_F crosses the threshold to trigger the entry of flippers, the housing market can become significantly tighter and housing prices significantly higher as a result.

6 Extensions

The model we studied in this paper is clearly a very special model. In Leung and Tse (2014a), we study how the major results of the paper may be affected under competitive search, a two-house-limit liquidity constraint for households, and allowing for investors choosing between short-term flips and long-term investments and mismatched households selling to housing market intermediaries right before buying a new house. Below are the summaries of the findings.

6.1 Competitive search

The multiplicity of equilibrium arises from flippers being able to offer especially attractive prices in the investment market under certain situations. A natural question to ask is whether the multiplicity is special to price determination under bargaining as we have assumed or whether similar conclusions hold under the alternative assumption of price determination under competitive search as in for example Mortensen and Wright (2002).

In the competitive search version of our model, the search market is segmented into submarkets, each of which is controlled by a market maker. A market maker charges entry fees $\phi_b(\theta, p)$ for buyers and $\phi_s(\theta, p)$ for sellers for buying and selling in his submarket in return for promising a tightness equal to θ and regulating the transaction price to be equal to the given p. There is free entry into market making and therefore in equilibrium, the market makers earn zero profit and end up charging zero entry fees. Each household buyer, household seller and flipper seller chooses which submarket, taking as given the fee schedule, to enter into to maximize the respective expected returns of buying and selling. In this setting, we find that in equilibrium,

$$\alpha = \begin{cases} 1 & C_S(\theta_T(1)) \geq 0 \\ \alpha_C & C_S(\theta_T(\alpha_C)) = 0 \\ 0 & C_S(\theta_T(0)) \leq 0 \end{cases}, \tag{45}$$

where

$$C_S(\theta) = \frac{\partial \eta}{\partial \theta} + \left(\eta - \theta \frac{\partial \eta}{\partial \theta}\right)\left(\frac{r}{r_F} - (1+z)\right) - z(\delta + r), \tag{46}$$

can be thought of as the incentives of mismatched households to sell in the investment market under competitive search – the counterpart to $D_S(\theta, \alpha)$ in (23) under bargaining and $E_S(\theta)$ in (37) for efficiency.

First notice that if $r_F = r$, $C_S(\theta) = E_S(\theta)$ and hence, as expected, competitive search is efficient. For $r_F \neq r$, however, $C_S(\theta) \neq E_S(\theta)$. Most importantly for our purpose, for

$$r_F < \frac{r}{1+z}, \tag{47}$$

$C_S(\theta)$, like $D_S(\theta, \alpha)$ for $r_F < \overline{r}$, is U-shaped, first decreasing but eventually increasing. This of course opens up the possibility of multiplicity. Indeed, this necessary condition for multiplicity is the same necessary condition for multiplicity in Lemma 9 and Figure 2 if $\beta_F = \beta_H$. Thus, as long as flippers possess a sufficiently large financing advantage, they can attract mismatched households to sell in the investment market when the search market is particularly tight, in addition to when the search market is particularly sluggish, whether prices in the search market are determined by bargaining or by competitive search.

6.2 Two-house-limit liquidity constraint

In some version of the housing market search model, most notably in Wheaton (1990), there is not any rental housing at all but rather a mismatched household must stay in its old house while searching for a new match, and then the old house will be put up for sale only after the household has found a new house to move into. In this environment, a household will be holding as many as two mismatched houses if the household is hit by a moving shock again before it is able to sell the previously mismatched house. If there is a two-house-limit liquidity constraint, the household will then be prevented from entering the search market as a buyer until it is able to sell one of the two mismatched houses. A liquidity provision role for flippers arises then. Indeed, a household may wish to sell to flippers right after it is moving to a new house from the old mismatched house. By doing so, the household will never be holding two houses at any moment in time. In all, we find that either when more households sell to flippers right after they find new houses to move into or when more households sell to flippers when they are hit by moving shocks again before the previously mismatched houses are sold, there will be a tighter search market.

In this setup, it is not implausible that flippers, like in the present model, may be able to lure households to sell in the investment market not just when the search market is sluggish but also when it is tight if they possess a large enough financing/bargaining advantage. In this model though, there is not any relationship between the activities of flippers and the vacancy rate since the latter is simply equal to the difference between the housing stock and the population of households, in the entire absence of rental housing. Furthermore, unlike the present model, for efficiency, all households should use the services of flippers since there would not be any additional rental expenditures to be incurred by any household during which flipping in the housing market takes place. Furthermore, in case there exist multiple equilibria, a more active equilibrium should pareto dominate a less active one, with any household owning at least one house at any moment.

6.3 Short-term flips versus long-term investment

In reality, there can be two strategies for housing market investments – short-term flip versus long-term investment in which an investor holds the house for an extended period of time, earning the rental revenue in the interim and in anticipation for a certain capital gain in the medium to long term. In a summary of case studies of four metropolitan areas in the U.S., Herbert et al. (2013) report that both investment strategies were commonly adopted by housing market investors in the wake of the collapse of the housing market in the U.S. in 2007. In the early phase when prices appeared to have reached the lowest levels, most investments were found to be short-term flips, whereas in the latter phase when the market appeared to have stabilized, most investments were found to be medium- to long-term investments.

In the present model, the supply of rental housing is taken as perfectly elastic at some exogenously given rental. We could have chosen to assume the opposite extreme in which the stock is exogenously given while the market rental is determined in equilibrium. All the same, underlying either setting is the presumption that the rental and owner-occupied housing stocks are completely separate. In light of the above discussions, a richer analysis would allow for the same housing stock to serve as both rental and owner-occupied housing. In this revised model, just as in the present model, mismatched households choose between selling in the investment market or offering their houses for sale in the end-user search market. Unlike the present model, the specialist investors in the revised model may choose to offer their properties for sale and/or for rent. It turns out that in this setup, the only kind of steady state is one in which at least a fraction of mismatched households choose to sell to investors while investors choose to offer their properties both for sale and for rent. But any such steady state can be equilibrium only under selected values of the housing stock and investors' cost of financing, just as a full or partially-intermediated equilibrium exists only under some specific circumstances in the present model. When the conditions are not met, no steady-state equilibrium can exist in the revised model. This result is perhaps highly suggestive for in reality, housing market investors do predominantly choose whether to flip or to invest long term during different phases of the housing price cycle as reported in Herbert et al. (2013). No matter, to analyze a model that allows for investors choosing between the two investment strategies, it becomes imperative to study the full dynamics. Undoubtedly, this can be a very fruitful exercise towards a fuller understanding of the dynamics of housing market investment but is best to be left for future research.[27]

6.4 Selling to housing market intermediaries right before buying a new house

We have in the above assumed that a mismatched household must either sell to a flipper or to an end-user household before it can start looking for a new house. Strictly speaking, given the assumption of instantaneous sale in the investment market, the household can choose to stay in the old house while searching for a new one and then sell the old house to a flipper only right before the household buys the new house.[28] This means that, a one-house-limit liquidity constraint notwithstanding, mismatched households should be able to enter the search market as buyers before selling the old houses.

As in our original model, the mismatched house is put up for sale in the search market whoever its owner is. But now, a mismatched household is a buyer in the search market no matter what. Then, the tightness in the search market will not depend in any way on how many mismatched households choose to sell to flippers in the first instance, if any mismatched households choose to do that at all. Instead, market tightness depends solely on the housing stock, among other factors, and is completely isomorphic to price determination in equilibrium. Moreover, flippers' liquidity provision role is entirely fulfilled so long as they are in the market ready to buy up any houses would-be buyers need to sell just before buying. That is, unless flippers possess some large enough financing/bargaining advantage, α must be equal to zero in equilibrium. In sum, equilibrium is guaranteed unique and any sale to flippers that takes place at the moment households first becoming mismatched must be on the basis of flippers' financing/bargaining advantage.

True, with a frictionless investment market in place, our assumption that mismatched households must rid themselves of their old houses first before entering the

[27] Indeed, Head et al. (2014) have explored a number of interesting implications of a model that allows households and real estate developers a choice between the two strategies. They do not allow for specialist investors in their model like we do though.

[28] The households who move within a given city in Head and Lloyd-Ellis (2012) can do just that. There, households do not face any liquidity constraints and the assumption of having housing market intermediaries is merely a simplifying assumption to facilitate analysis.

search market as buyers is ad hoc. We could have included some additional technical details to better justify the assumption.[29] But we think it is more constructive to simply note that the assumption is a well-motivated assumption. In reality, the investment market for the housing asset is by no means completely free of frictions. Sales in the market are certainly not instantaneous. If a household is not able to sell the old house quickly enough to pay off the mortgage for the house, it can face considerable difficulties in getting a mortgage for the new house. A more realistic and arguably more rigorous analysis obviously is to model the investment market as a search market too. A frictionless investment market is best thought of as a simplifying assumption or, as we remarked in Section 2, as the limit of a frictional market when the cost of entry for investors tends to zero.

7 Concluding remarks

Housing market flippers can be the arbitraging middlemen in classical finance theory as we model in this paper, intermediaries who survive on the basis of superior information, or momentum traders blindly chasing the market trend. Our analysis suggests a number of empirical implications to distinguish between the these theories of flipping. First and foremost, if flippers are predominantly momentum traders instead of specialist middlemen, there should not be any significant flipper-buy discounts and flipper-sell premiums. But such discounts and premiums do exist and they are sizeable, as reported in Depken et al. (2009) and Bayer et al. (2011). Second, in a housing market boom fed by the entry of momentum traders, there can and usually will be sales and purchases among flippers. While in a more elaborate theory of intermediation as in Wright and Wong (2014), this can also happen. But this does not seem like a robust implication of a theory of middlemen in the housing market. Third, a theory of housing price speculation should imply that prices should stay at the peak for at most a short while and then fall right afterwards. In our model, the market can conceivably move from a low-price to a high-price steady-state equilibrium and then just stays at the new equilibrium for any length of time. Relatedly, speculators should only buy in an up market, whereas in our model, there can be multiple locally stable steady-state equilibria involving flipping. Indeed, in our model, the gross returns to flipping, p_{FS}/p_{FB}, by (13), is actually higher in a lower-price less active equilibrium than in a higher-price more active equilibrium. Lastly, if housing market middlemen are mostly "market edge" investors who survive on the basis of informational advantage rather than investors who have more flexible financing, as we model in this paper, they should use ordinary mortgages as much as end-user households do. Herbert et al. (2013) report that there was little evidence of bank

[29] For example, consider a discrete time version of the model. Say a period is divided into two subperiods where the investment market is open in the first subperiod only and the search market is open next in the second subperiod. In Leung and Tse (2014a), we propose three other alternative justifications.

lending to investors acquiring foreclosed properties in the wake of the 2007 housing market meltdown in the U.S. Instead, the great majority of acquisitions were bought with cash. In addition, in the housing market boom in the U.S. before 2007, there is ample evidence, as we remarked in note 24, that investors took advantage of "complex mortgages" more than ordinary households did. Other than observations on the choices of financing, the two theories may also be distinguished by what market conditions under which flipping takes place. In our model, flipping tends to occur in particularly tight as well as particularly sluggish markets—a prediction that is hard to envisage to come from a theory of housing market intermediaries who survive on the basis of superior information.

In the U.S., house flipping is thought to often involve renovating before selling rather than simply buying and then putting up the house for sale right after. In this line of thinking, the returns to flipping are more about the returns to the renovations investment than the returns to holding the house on behalf of the liquidity-constrained owner. The question then is what prevents the original owners themselves from earning the returns on the investment. A not implausible explanation is that many original owners lack the access to capital to undertake the investment, just as the original owners in our model lack the access to capital to hold more than one house at a time. Thus, at a deeper level, our model is not just a model of buy-and-sell flips but should also encompass, with suitable modifications, buy-renovate-sell flips.

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