Can the Mortensen-Pissarides model match the housing market facts?

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Abstract

This paper examines whether the Mortensen-Pissarides matching model can account for the housing market facts, most of all the empirical anomaly known as 'price dispersion'. Our main finding is that the model can account for the three basic facts of housing market (namely, the existence of price dispersion, the positive correlation between housing price and trading volume, and between housing price and time-on-the market), without any restrictive assumption and in a very simple framework.

Keywords: housing price dispersion, time-on-the-market, bargaining power, search and matching frictions.

JEL Classification: R21, R31, J63

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1. Introduction

Housing markets are characterized by a decentralized framework of exchange with important search and matching frictions. It has, in fact, been acknowledged that housing markets clear not only through price but also through the time and money that a buyer and a seller spend on the market. Consequently, the search and matching approach is widely used even in this type of market (see section 2). Furthermore, three basic facts have been repeatedly reported: (a) the positive correlation between housing price and trading volume (see Leung, Lau and Leong, 2002; Fisher *et al.*, 2003, among others); (b) the positive correlation between housing price and the time-on-the market (see Leung, Leong and Chan, 2002; Anglin et al. 2003; Merlo and Ortalo-Magne, 2004; Leung and Zhang, 2011, among others);[1] and (c) the existence of price dispersion. The latter is probably the most important distinctive feature of housing markets. Price dispersion (or price volatility) refers to the phenomenon of selling two houses with very similar attributes and in near locations at the same time but at very different prices. Although price dispersion research is more commonly found in studies of non-durable consumption goods,[2] price dispersion studies on durable and re-saleable goods such as real estate are also growing rapidly (see e.g. Read, 1991; Gabriel *et al.*, 1992; Baharad and Eden, 2004; Leung, Leong and Wong, 2006; Yiu, Hui, and Wong, 2005; Yiu, Tam, and Lee, 2006; Wong, Yiu, Tse, and Chau, 2006; Wong, Yiu, and Chau, 2007; Yiu, Man, and Wong, 2008). Real estate is in fact the most important durable consumption good and one of the most important assets for most household portfolios (Leung, Leong and Wong, 2006). Since most transactions of real estate come from re-sales between individual buyers and sellers (transactions in the housing markets are in fact dominated by a second-hand market), it should not be surprising that price dispersion exists in the housing market (Leung, Leong and Wong, 2006).

Basically, the variance in house prices cannot be attributed completely to the heterogeneous nature of real estate. In fact, a significant part of house price dispersion is basically due to the *ex-ante* heterogeneity of buyers and sellers (bargaining power, tastes, patience rate, asymmetric information, etc.) and their sustained search costs.

[1] The time it takes to sell a property, the so-called time-on-market (TOM), measures the degree of illiquidity of the real estate asset and is a fundamental characteristic differentiating real estate from financial assets.

[2] A detailed literature review on price dispersion can be found in Baye *et al.* (2006).

Sellers and buyers spend time and money – for advertising vacancies and making the effort to visit the greatest number of houses – before concluding the deal. Moreover, the bargaining power of the parties plays a key role in the formation process of housing prices (Quan and Quigley, 1991; Habito *et al.*, 2010; Harding *et al.*, 2003a; Harding *et al.*, 2003b; Cotteleer and Gardebroek, 2006). These factors affect the selling price and lead to price dispersion, since for different bargaining powers and search costs the selling price will be different.

The main aim of this paper is to develop a search and matching model *à la* Mortensen-Pissarides (see e.g. Pissarides, 2000) that explains the basic facts of housing markets. In particular, we develop a decentralised long-run equilibrium model with *ex-ante* heterogeneous buyers and sellers, based on both the bargaining and the costly search activity that characterises the housing market. The proposed work takes the distinctive features of the considered market into account, where the formal distinction between buyer and seller becomes very subtle. In the model, in fact, a seller can become a buyer and *vice versa*. Indeed, most houses are bought by those who already own one, and most houses are sold by those wanting to buy another house (Janssen *et al.*, 1994); buyers today are in fact potential sellers tomorrow (Leung, Leong and Wong, 2006).

In this model, price dispersion comes from two sources: first, the bargaining power of the parties, since different bargaining powers lead to different selling prices for two similar houses; second, the search costs of sellers and buyers, since the *ex-ante* heterogeneity of the parties implies different search costs and thus individuals obtain different values from a conclusive transaction. Furthermore, this simple theoretical model is also able to explain two other well-known empirical regularities, namely the positive correlation between housing price and trading volume, and between housing price and the time-on-the-market. Hence, this paper clearly shows that the behaviour of the housing market (reflected in the above empirical findings) can be addressed adequately by the standard matching framework *à la* Mortensen-Pissarides.

Finally, the model with bargaining and search costs allows to overcome a major drawback of the standard hedonic pricing theory (Rosen, 1974): the assumption of competitive markets (Harding *et al.*, 2003a; Harding *et al.*, 2003b; Cotteleer and Gardebroek, 2006). Indeed, in the standard hedonic pricing theory, markets are assumed to be sufficiently thick (i.e. markets with a large amount of trading) that implicit or hedonic prices, i.e. the shadow prices of the characteristics, are revealed to economic agents through trades that differ only in terms of a single attribute. The house price is then given by the linear or non-linear combination of hedonic prices and housing characteristics. Hence, bargaining has no impact on price because the hedonic prices are well defined and are known to both buyers and sellers. In short, as long as markets are sufficiently thick, market participants can determine the implicit or hedonic prices and the "true" market value of the good is well known. However, this is hardly true: markets become increasingly thin when traded goods are increasingly heterogeneous, and the implicit or hedonic prices as well as the "true" market value of the good are not known. In the limit, each trade becomes unique and market participants may take part only in a single trade.

The rest of the paper is organised as follows: section 2 briefly reviews the literature which makes use of the search and matching models to study the housing market; section 3 presents the housing market matching model; while section 4 concludes.

2. Literature review

This paper belongs to the recent and growing literature that use search and matching models to explain the behaviour of housing markets. The first search model of housing market is Wheaton (1990); since then several papers have developed models to analyze the formation process of prices in housing markets with search/matching/trading frictions (see table 1 for a summary).

========== Table 1 about here now at the end ==========

Usually, papers in this literature assume that search is random, as opposed to directed, and house prices are often determined by Nash bargaining. In some of these papers, an aggregate matching function together with market tightness plays a key role. This is in line with the standard matching framework (see the textbook by Pissarides, 2000).

Among this literature, this model is most related to that of Leung and Zhang (2011), since it aims to explain the basic facts of housing market by using a basic Mortensen-Pissarides matching model. As in Leung and Zhang (2011), a necessary condition for explaining these housing market facts is the heterogeneity on the seller's and/or the buyer's side, which generates corresponding submarkets. In particular, Leung and

Zhang (2011) focus on one-side heterogeneity and assume that sellers are different in terms of their waiting costs for selling the house, where buyers are free to enter either submarket.[3] However, in our model the free-entry or zero-profit condition for sellers *à la* Pissarides, rather than the buyer's free entry assumption used by Leung and Zhang (2011), allows to obtain a solution which characterises the direct relationship between market tightness and house price. In Leung and Zhang (2011), the equilibrium is in fact determined by a system of three equations in three unknowns where the endogenous variables – the value of seller, the value of buyer and the house price – depend on market tightness. Indeed, with a fixed entry value for the buyers and a fixed number of sellers, they first solve the market tightness, and then the (buyer and seller) values and the house price.

3. A Baseline Matching Model of Housing Market

3.1 The hypotheses of the model

We adopt a standard matching framework *à la* Mortensen-Pissarides (see e.g. Pissarides, 2000) with random search and prices determined by Nash bargaining. The random matching assumption is absolutely compatible with a market where the formal distinction between the demand and supply side is very subtle; whereas, bargaining is a natural outcome of thin, local and decentralised markets for heterogeneous goods.

Since we are interested in selling price, the market of reference is the homeownership market rather than the rental market. In this way, if a contract is legally binding (as hypothesised) it is no longer possible to return to the circumstances preceding the bill of sale, unless a new and distinct contractual relationship is set up. In matching model jargon this means that the destruction rate of a specific buyer-seller match does not exist. As a result, the value of an occupied home for a seller is simple given by the selling price.

The economy is populated by N types of sellers (which we indicate with $i = 1,...,N$) and by M types of buyers (which we indicate with $j = 1,...,M$). "Type" refers to the economic rather than social or personal characteristics of the individual. We indicate with s^i a measure of sellers of type i and with b^j a measure of buyers of type j.

[3] Sellers with higher waiting costs (the so-called impatient or "fire-sale" sellers) are willing to accept lower prices, which attract a larger number of potential buyers so that the house would be sold faster.

Hence, we can think of $\sum s^i = S$ and $\sum b^i = B$ as measures of the stock of sellers and buyers in the economy, respectively. Sellers hold $h \geq 2$ houses of which $h-1$ are on the market, i.e. vacancies (v) are simply given by $v = (h-1) \cdot S > 0$, thus assuming a vacancy rate permanently positive (as in Wheaton, 1990). It is therefore possible that a buyer of type j can become a seller of type i, and that a seller of type i can become a buyer of type j.[4]

The expected values of a vacant house (V) and of buying a house (H) are given by: [5]

$$rV = -a^i + q(\theta) \cdot [P - V] \quad [1]$$

$$rH = -e^j + g(\theta) \cdot [x - H - P] \quad [2]$$

where $\theta \equiv \frac{v}{B}$ is the housing market tightness from the sellers' standpoint,[6] while $q(\theta)$ and $g(\theta)$ are, respectively, the (instantaneous) probability of filling a vacant house and of finding/buying a home. The popular hypothesis of constant returns to scale in the matching function, $m = m\{v, B\}$, is adopted (see Pissarides, 2000; Petrongolo and Pissarides, 2001). Hence, the properties of these functions are straightforward: $q'(\theta) < 0$ and $g'(\theta) > 0$.[7] The terms a^i and e^j represent, respectively, the costs sustained by sellers of type i for the advertisement of vacancies and the effort (in monetary terms) made by buyers of type j to find and visit the largest possible number of houses. If a contract is stipulated, the buyer of type j gets a benefit x from the property (abandoning the home searching value) and pays the sale price P to the seller of type i (who abandons the value of finding another buyer). As usual, the buyer's benefit x, i.e. the value of the house, is a positive function of housing characteristics; hence, x does not depend on the buyer's type.[8]

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[4] Alternatively, one could assume that the sellers hold $h \geq 1$ houses of which h are on the market, and the buyers are the homeless. This case would not change the results of the analysis.

[5] Time is continuous and individuals are risk neutral, live infinitely and discount the future at the exogenous rate r. As usual in matching-type models, the analysis is restricted to the stationary state.

[6] Leung and Zhang (2011) define the market tightness from a buyer perspective and the number of sellers is fixed.

[7] Standard technical assumptions are assumed: $lim_{\theta \to 0} q(\theta) = lim_{\theta \to \infty} g(\theta) = \infty$, and $lim_{\theta \to 0} g(\theta) = lim_{\theta \to \infty} q(\theta) = 0$. By definition, markets with frictions require positive and finite tightness, i.e. $0 < \theta < \infty$, since for $\theta = 0$ the vacancies are always filled, whereas for $\theta = \infty$ the home-seekers immediately find a vacant house.

[8] As in Albrecht et al. (2007) and Leung and Zhang (2011), the value of the house is independent of agents' types.

3.2 Equilibrium

In a housing market with frictions, the endogenous variables that are determined simultaneously at equilibrium are market tightness (θ) and sale price (P).

The customary long-term equilibrium condition, namely the "zero-profit" or "free-entry" condition, normally used in the matching models (see Pissarides, 2000) yields the first key relationship of the model, in which market tensions are a positive function of price. In fact, using the condition $V = 0$ in [1], we obtain:

$$\frac{a^i}{P} = q(\theta) \Rightarrow \frac{1}{q(\theta)} \cdot a^i = P \qquad [3]$$

with $\frac{\partial\theta}{\partial P} > 0$, since $q'(\theta) < 0$. This positive relationship is very intuitive: in fact, if the price increases, more vacancies will be on the market. Note that there are several sub-markets and each submarket has its tightness. As in Leung and Zhang (2011), the "sub-markets" simply represent the trading which involves different type of agents. Thus, with ex-ante heterogeneity of agents and assuming complete and perfect information, we don't worry on the cross-market effects.

The free-entry condition also implies a trade-off between the housing price and the speed of sales for the sellers. In fact, with an arrival rate of $q(\theta)$, the expected time-on-the-market (TOM) is the inverse function $q(\theta)^{-1}$. As a result, from [3] there is a positive correlation between housing prices and the time on the market, since a higher price takes a longer time to sell a house (as pointed by Leung, Leong and Chan, 2002; Anglin et al. 2003; Merlo and Ortalo-Magne, 2004; Leung and Zhang, 2011).

The (generalised) Nash bargaining solution, usually used for decentralised markets, allows the sale price P to be obtained through the optimal subdivision of surplus (S) deriving from a successful match. The surplus is defined as the sum of the seller's and buyer's value when the trade takes place, net of the respective external options, i.e. the value of continuing to search: [9]

$$S = \underbrace{(P - V)}_{capital\ gain\ of\ seller} + \underbrace{(x - H - P)}_{capital\ gain\ of\ buyer}$$

$$\Rightarrow S = x - H \qquad [4]$$

[9] Entering into a contractual agreement obviously implies that $S > 0$, i.e. $x > H$, $\forall\theta$. This realistic condition ensures that the price is positive.

The price is obtained by solving the following optimisation condition (recall that in equilibrium $V = 0$, $\forall i$):

$$P = argmax\left\{(P-V)^{\gamma^i} \cdot (x-H-P)^{1-\gamma^i}\right\}$$

$$P = \frac{\gamma^i}{(1-\gamma^i)} \cdot (x-H-P) \Rightarrow P = \gamma^i \cdot (x-H)$$

where γ^i is the bargaining power of sellers of type i.

By using the previous result $(x-H-P) = \frac{(1-\gamma^i)}{\gamma^i} \cdot P$ in equation [2], eventually we get:

$$P = \frac{\gamma^i \cdot (rx + e^j)}{r + g(\theta) \cdot (1-\gamma^i)} \qquad [5]$$

Equation [5] is none other than the *hedonic price function* of the model: in fact, the selling price depends positively on the buyer's benefit x, which in turn depends positively on the housing characteristics. Hence, as suggested by the hedonic price theory, the selling price is a positive function of housing characteristics.

Furthermore, since $g'(\theta) > 0$, as market tensions increase, the sale price decreases; hence, we obtain the second key relationship of the model: $\frac{\partial P}{\partial \theta} < 0$. In short, if the market tightness increases, the effect of the well-known *congestion externalities* on the demand side (see Pissarides, 2000) will lower the price.

By combining the equations [3] and [5], this model is able to reproduce the observed joint behaviour of prices and time on the market: in fact, the house with a higher selling price has a longer time on the market (see equation (3)), but, *ceteris paribus*, the longer the time on the market the lower the sale price, since the expected time-on-the-market $q(\theta)^{-1}$ is increasing in θ (Krainer, 2001; Merlo and Ortalo-Magne, 2004; Leung and Zhang, 2011; Diaz and Jerez, 2009).

Finally, it is straightforward to obtain from [3] that when P tends to zero (infinity), θ tends to zero (infinity), as $q(\theta)$ tends to infinity (zero). Consequently, given the negative slope of [5] and the fact that price is always positive, with intercept $\lim_{\theta \to 0} P = \frac{\gamma^i \cdot (rx + e^j)}{r + (1-\gamma^i)}$, only one long term equilibrium deriving from the intersection of the two curves exists in the model (see point A in *Figure* 1).

========== *Figure 1 about here (now at the end)* ==========

3.3 Comparative statics and price dispersion

From [5], the selling price crucially depends on the bargaining power of the seller. In fact, $\gamma^i \to 0 \Rightarrow P = 0$, and $\gamma^i \to 1 \Rightarrow P = x + \frac{e^j}{r}$. Since the price can never be negative or null, we assume that $0 < \gamma^i \leq 1$.

Furthermore, the selling price also depends on the search costs of buyers and sellers. In particular, from [5] it is straightforward to obtain that an increase in the search effort of buyers (e^j) increases the selling price. This is an intuitive result. However, a partially counter-intuitive result regards the effect of advertising vacancies on the selling price. In fact, an increase in a^i decreases market tightness, which in turn increases the selling price (see point A' in *Figure 2*). In short, an increase in the seller's search cost also leads to an increase in the selling price.

========== *Figure 2 about here (now at the end)* ==========

Intuitively, the trading volume for a given period is given by the matching rate (see Leung and Zhang, 2011). Although in this simple model the search costs of buyers and sellers are exogenous, it is straightforward to include them in the matching function, i.e. $m = m\{a^i \cdot v, e^j \cdot B\}$. An increase in the search effort or advertising vacancies will increase the matching rate m. As a result, the model could also explain the positive relationship between housing price and trading volume, since an increase in the search costs of buyers and sellers increases both the selling price and the matching rate. This is in line with the empirical works of Fisher *et al.* (2003) and Leung, Lau and Leong (2002).

Finally, we consider two similar houses, *Y* and *Z*, which give the same benefit: $x^Y = x^Z$. In this case, price dispersion in the model comes from:

a) The bargaining power of sellers (γ^i): different bargaining powers lead to different selling price;
b) The search costs of sellers (a^i) and buyers (e^j): in fact, since matching occurs between a seller of type i and a buyer of type j, different pairs lead to different search costs, which in turn imply different selling prices.

The key determinant of price dispersion is in fact the heterogeneity in buyers and sellers incorporated in the formula of selling price. The housing price dispersion exists as long as the heterogeneity enters the pricing formula, no matter how the prices are determined (Leung and Zhang, 2011). Vukina and Zheng (2010) find a very strong empirical support for the theoretical prediction that bargaining with search costs explains price dispersion in the agricultural market.

3.4 Closing the model with the natural vacancy rate

In order to find the "natural" vacancy rate – i.e. the optimal share of houses for sale on the market that prevails in long term equilibrium at which sellers make no economic profits (see Arnott and Igarashi, 2000; McDonald, 2000) – we normalise the population in the housing market to the unit, i.e. $1 = S + B$. As a result, using the definitions of equilibrium tightness, $\theta = \theta^* \equiv \frac{v}{B}$, and vacancies, $v = (h-1) \cdot S$, it straightforward to obtain the stock of sellers, buyers, and the "natural" vacancy rate:

$$S = \frac{\theta^*}{h-1+\theta^*} \quad [6]$$

$$B = \frac{h-1}{h-1+\theta^*} \quad [7]$$

$$v = \frac{(h-1) \cdot \theta^*}{h-1+\theta^*} \quad [8]$$

which have very intuitive properties: $\frac{\partial S}{\partial \theta^*} > 0$, $\frac{\partial B}{\partial \theta^*} < 0$, and $\frac{\partial v}{\partial \theta^*} > 0$.

3. Conclusions

Housing markets are characterized by a decentralized framework of exchange with important search and matching frictions. Furthermore, three basic facts have been repeatedly reported by empirical studies: 1) the variance in house prices cannot be completely attributed to the heterogeneous nature of real estate and the residual volatility is empirically non negligible; 2) the (partially counter-intuitive) positive relationship between housing price and the number of contracts traded during a given period; 3) the trade-off between the housing price and the speed of sales for the sellers. This theoretical paper clearly shows that the behaviour of housing markets, reflected in the above empirical findings, can be addressed adequately by the standard matching framework *à la* Mortensen-Pissarides.

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Figures

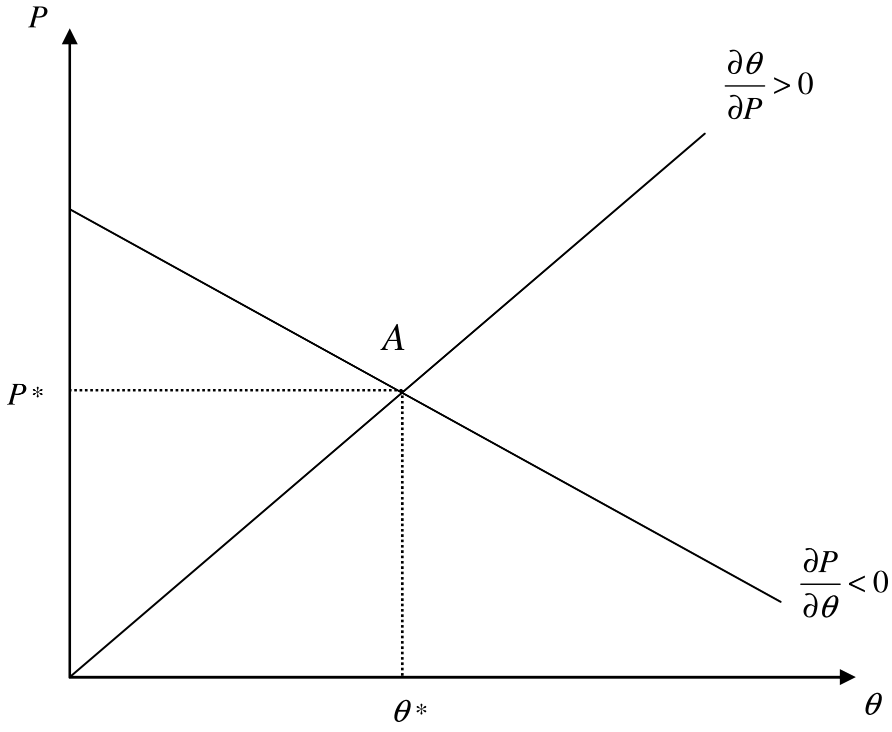

Figure 1. Equilibrium

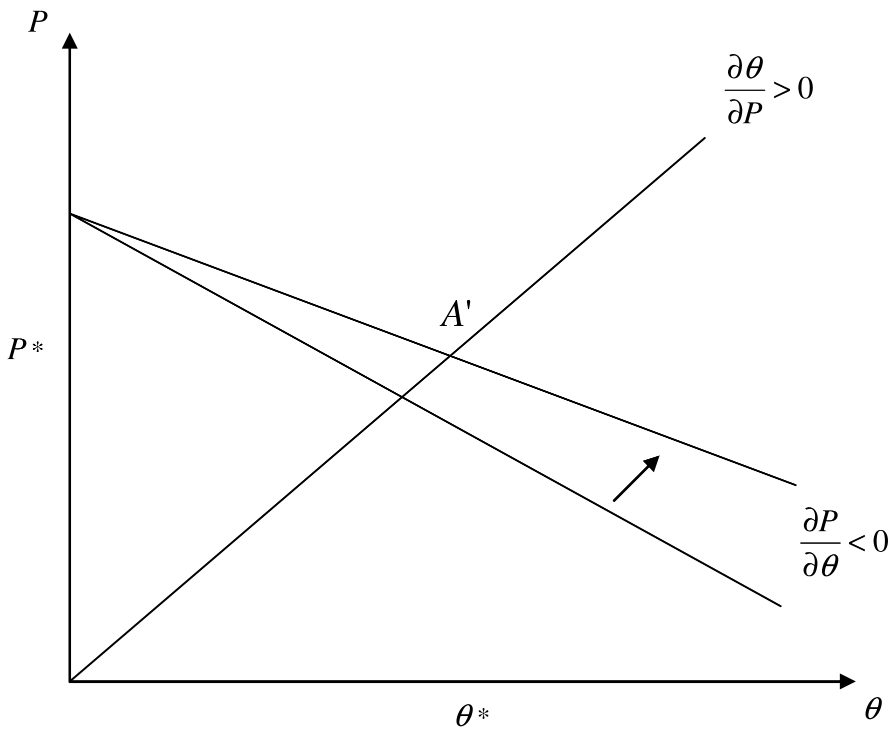

Figure 2. Increase in the search costs of sellers (advertising vacancies)

Table

Table 1. Literature on search and matching in housing market: a summary

Author/s	**Main aim**	**Key mechanism or insight behind the model**	**Price determination**	**Matching function /search**	**Main result**
Wheaton (1990)	to deal with housing turnover, search, and pricing in the homeownership market	households (both buyers and sellers) move when a stochastic process leaves them dissatisfied with their current unit, and moving or changing houses involves transactions costs	bargaining with symmetric bargaining power	Yes /random	the model yields a strong theoretical relationship (in-verse) between vacancy and prices, which with competitive supply explains the existence of longer-run "structural" vacancy.
Krainer (2001)	to provide a theory of ‘‘hot’’ and “cold” real estate market	as in Wheaton (1990), trade in housing market takes place because individuals are vulnerable to idiosyncratic shocks that break the match with their house	Sellers makes a take-it-or-leave-it offer	No /random	the frictions which lead to hot and cold markets can be overcome by the creation of (well-functioning) rental markets for vacant houses
Albrecht et al., (2007)	to analyze the joint distribution of price and time to sale (for sellers).	buyers and sellers move from one state (relaxed) into another (desperate) if they remain unmatched	symmetric Nash bargaining	No /random	The expected price conditional on time to sale falls with time spent on the market, whereas the conditional variance of price first rises and then falls with time on the market
Caplin and Leahy (2008)	to analyze the dynamics of equilibrium prices and the joint process of prices, sales and inventory	the mismatch between workers and firms: whenever there is excess demand, sellers extract the maximal price; whenever there is excess supply, sellers must be indifferent between sales today and sales tomorrow	Bertrand competition among sellers	No /Search is a “black box” (however, search is not directed)	the model generates the positive correlation between price changes and the volume of transactions displayed by the data
↓					

Novy-Marx (2009)	to provide a theory of ‘‘hot’’ and “cold” real estate market	Key role of market tightness: if for any reason the market tightness unexpectedly increases, houses can sell more quickly, decreasing the stock of sellers in the market. This in turn increases the relative number of buyers to sellers even more, amplifying the initial shock	Asymmetric Bargaining	Yes /random	the model generates a positive correlation between prices and tightness, but not necessarily a positive correlation between prices and the volume of transactions
Ngai and Tenreyro (2009)	to provide a theory of ‘‘hot’’ and “cold” real estate market	Amplification mechanism due to the “thick-market effect” on “match-specific quality”: in a market with more houses for sale, a buyer is more likely to find a better match; this makes appealing to all agents to transact in that season (“hot”); also, better matches imply higher surpluses to be shared between buyers and sellers: to the extent that sellers have some bargaining power, this leads to higher house prices	Nash bargaining (however, seasonality in vacancies and transactions are independent of the exact price-setting mechanism, i.e. how the surplus is shared across buyers and sellers)	No /random match-quality	The calibrated model can quantitatively account for the seasonal fluctuations in prices and transactions observed in U.S. and countries U.K.
Diaz and Jerez (2009)	to build a simple framework where prices and sales are positively correlated, and both variables are negatively related with time to sell as in the data	idiosyncratic shocks: when hit by a shock, agents become mismatched and seek to move, but they take time to locate an appropriate unit	sellers post prices to attract buyers (as in Albrecht *et al.* (2009))	Yes /directed	The model is able to generate a positive co-movement in prices, sales and liquidity
Albrecht et al. (2009)	to analyze the way houses are bought and sold in the United States	houses are sold by auction and are sometimes sold above, sometimes below and sometimes at the asking price. Hence, the final selling price need not be the same as the posted price	“asking price”: the price posted by seller is used to attract buyers (i.e. sellers post asking prices, and buyers direct their search based on these prices)	No /directed	it captures the main features of the house-selling process in the U.S. and explains the role of asking price and its relationship to the sales price
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Piazzesi and Schneider (2009)	to study household beliefs during the recent US housing boom	preference shocks (a household is initially a "happy owner" who obtains housing services; however, s/he may be hit by a shock that makes him an "unhappy" owner who no longer obtains any services from the house. S/he can then sell the house and purchase a new one to again begin obtaining housing services)	seller makes a take-it-or-leave it offer, and the buyer accepts or rejects the offer.	Yes /random	optimists (investors) can drive up the average transaction price without a large increase in trading volume or in their market share
Genesove and Han (2010)	to study how demand shocks affect market liquidity (time on the market for sellers and buyer) and the number of home visits by buyers	demand shocks (average income and population are used as demand proxies, given the difficulties of measuring yearly consumption and production amenities)	Nash bargaining (with an extension to the case in which seller makes a take-it-or-leave it offer)	Yes /random	a positive demand shock leads to shorter seller time on the market and fewer home visits, while buyer time on the market is much less sensitive
Leung and Zhang (2011)	to explain the three basic facts of housing market (price dispersion, positive correlation between time-on-the-market and prices, and between prices and trading volume)	one-side heterogeneity which generates corresponding submarkets: sellers are different in terms of their waiting costs for selling the house, where buyers are free to enter either submarket	Nash bargaining	Yes /random	the model is able to reproduce the three basic facts of housing market
Peterson (2012)	to explain the behaviour of house prices in the United States	The model combines search frictions with a behavioural assumption where market participants incorrectly believe that the efficient market theory holds (the so-called "Fooled by search")	Nash bargaining	Yes /random	The model can replicate the observation that real price growth and turnover are highly correlated, and it explaining over 70% of the housing bubble in the United States