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# Home-seekers in the Housing Market

Gaetano Lisi [*]

**Abstract**

*This housing market matching model considers two types of home seekers: people who search for a house both in the rental and in the homeownership market, and people who only search in the homeownership market. The house-search process leads to several types of matching and in turn this implies different prices of equilibrium. Also, the house-search process connects the rental market with the homeownership market. This model is thus able to explain both the relationship between the rental price and the selling price and the price dispersion which exists in the housing market. Furthermore, this theoretical model can be used to study the impact of taxation in the two markets. Precisely, it is straightforward to show the effects of two different taxes: the tax on property sale and the tax on rental income.*

*Keywords*: rental market, homeownership market, housing prices

*JEL Classification*: R21, R31, J63

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## 1. Introduction

Although recent, housing market studies that adopt search and matching models are not new in the economic literature (notably, Wheaton, 1990; Krainer, 2001; Albrecht *et al.*, 2007; Caplin and Leahy, 2008; Novy-Marx, 2009; Ngai and Tenreyro, 2009; Diaz and Jerez, 2009; Albrecht *et al.*, 2009; Piazzesi and Schneider, 2009; Genesove and Han, 2010; Leung and Zhang, 2011; Peterson, 2012). Precisely, two goals are usually pursued: analysing the formation process of house price in a decentralised market with search and matching frictions; explaining the behaviour of the housing market, in particular the price dispersion and the relationship among prices, time-on-the-market and sales.

The empirical “anomaly” known as ‘price dispersion’ is probably the most important distinctive feature of housing markets (see Leung, Leong and Wong, 2006). It 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. The literature has mainly responded to the price dispersion puzzle by introducing the heterogeneity of economic agents. In Leung and Zhang (2011), in fact, a necessary condition for explaining the housing price dispersion (as well as the relationship among prices, time-on-the-market and sales) is the heterogeneity on the seller's and/or the buyer's side, which generates corresponding submarkets.

Nevertheless, price dispersion may arise from the very specific nature of the house-search process. In this model there are in fact two types of home seekers: people who search for a dwelling both in the rental and in the homeownership market (named “the homeless”), and people who only search in the homeownership market (named “renters or tenants”). Hence, the search process leads to several types of matching; in turn, this implies different prices of equilibrium. Also, the search process connects the rental market with the homeownership market. As far as we are aware, the latter topic has been overlooked by housing market studies which adopt search and matching models. Indeed, papers in this literature omit the rental housing market from consideration (Diaz and Jerez, 2009) or rely on the standard asset-market equilibrium condition (Ngai and Tenreyro, 2009),[1] thus assuming a rental market without frictions (Kashiwagi, 2011).[2]

[1] Assuming perfectly competitive housing markets, in equilibrium the risk-adjusted returns for homeowners and landlords should be equated across investments. This yields the usual user cost formula *à la* Poterba (1984) where the rental price covers the user cost of housing, which is equal to the house price multiplied by the user cost, i.e. the sum of the real after-tax interest rate, the combined depreciation and maintenance rate, and the expected future house price appreciation.

[2] Well-functioning rental markets can smooth out fluctuations in housing market liquidity (Krainer, 2001).

Therefore, the main aim of this paper is to develop a search and matching model of the housing market which is able to explain both the price dispersion and the relationship between rental and selling prices, relying only on the different states of home seekers in the search process. Furthermore, the proposed theoretical model can be used to study the impact of taxation in the housing market. Precisely, we consider the effects of two different taxes: the tax on property sale and the tax on rental income. We find that the tax on property sale increases the selling price and reduces the rental price; whereas, the tax on rental income increases both the rental price and the selling price, thus also increasing the time-on-the-market in both markets. Thus, a property sale tax may be better than a rental income tax.

The rest of the paper is organised as follows: section 2 presents the housing market matching model; section 3 shows the existence of price dispersion; section 4 describes the relationship between selling price and rental price, while section 5 discusses the effects of taxation on house prices and time-on-the-market; finally, section 6 closes the model and section 7 concludes the work.

## 2. The model

The housing market consists of the rental market and the homeownership market. In the homeownership market, the home-seeker who finds a dwelling and pays the selling price ($p_S$) becomes the (new) owner of the house; whereas, this does not happen in the rental market, where the rental price ($p_R$) only ensures the use of the house for a certain period of time. We distinguish these two markets by the subscript $i=\{R,S\}$, where $R$ = rental market and $S$ = homeownership market.

We adopt a standard matching framework *à la* Mortensen-Pissarides (see e.g. Pissarides, 2000) with random search and prices determined by Nash bargaining. As regards the demand side, there are two types of home-seekers in this model: i) the homeless ($h$) who search for a house in both markets simultaneously; ii) the renters or tenants ($t$) who only search in the homeownership market. The value function of the homeless ($H$) is the following:[3]

$$rH=-e_H-a+g(\vartheta_R)\cdot[T-H]+g(\vartheta_S)\cdot[x-p_S-H] \qquad [1]$$

[3] Time is continuous and individuals are risk neutral, live infinitely and discount the future at the exogenous interest rate $r>0$. As usual in matching-type models, the analysis is restricted to the stationary state.

where $\vartheta_i$ is the housing market tightness (see later), with $i = \{R, S\}$; $T$ is the value of being a tenant; $e_H$ is the effort (in monetary terms) made by the homeless to find and visit the largest possible number of houses; $a$ is the cost of accommodation; $g(\vartheta_i)$ is the (instantaneous) probability of finding a vacant house, which depends on $\vartheta_i$, with $i = \{R, S\}$; and $x$ is the buyer's benefit (i.e. the value of the house). Instead, $T$ is modelled as a staging post for searching in the homeownership market:

$$rT = -e_T - p_R + g(\vartheta_S) \cdot [x - p_S - T] + \delta \cdot [H - T] \qquad [2]$$

where $e_H > e_T$, since the homeless search in both markets, and $\delta$ is the lease destruction rate. A necessary condition for a non trivial equilibrium requires that:

$$(T - H) = \frac{(e_H - e_T) + a - p_R}{r + \delta + g(\vartheta_R) + g(\vartheta_S)} > 0$$

which is true if $(e_H - e_T) + a > p_R$, namely if the cost of being homeless is higher than the cost of being a tenant.

As regards the supply side, the expected values of posting a vacant house ($V_i$) and of an occupied dwelling ($D_i$), with $i = \{R, S\}$, are the following:[4]

$$rV_R = -c_R + q(\vartheta_R) \cdot [D_R - V_R] \qquad [3]$$

$$rD_R = p_R + \delta \cdot [V_R - D_R] \qquad [4]$$

$$rV_S = -c_S + q(\vartheta_S) \cdot \beta \cdot [p_S^t - V_S] + q(\vartheta_S) \cdot (1 - \beta) \cdot [p_S^h - V_S] \qquad [5]$$

where $c_R$ and $c_S$ are, respectively, the cost of posting rental and ownership housing vacancies; $q(\vartheta_i)$ is the (instantaneous) probability of filling a vacant house, which depends on $\vartheta_i$, with $i = \{R, S\}$. In the homeownership market 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. Hence, there is no destruction rate and the value of an occupied home is simply given by the selling price. Furthermore, because potential buyers are different, the selling prices are also different: in fact, the seller may be matched with either a renter or a homeless person. Hence, $\beta = t / (t + h)$ and $(1 - \beta) = h / (t + h)$ are, respectively, the share of renters and homeless persons. In this model, however, the home-seekers differ only with respect to their state in the search process. Furthermore, they can change their condition in the house-search process: in fact, a

[4] The distinction between sellers and landlords is obviously a simplification of the model, since the sellers can rent their house and landlords can sell their house. Matters thus become simpler without loss of generality.

homeless person can become a renter and vice versa. Hence, we assume that sellers are not able to distinguish between different states of buyers, i.e. the buyers always appear identical to sellers ex ante.[5] It also follows that the selling prices appear identical to sellers ex ante, i.e. $p_S^t = p_S^h = p_S$, and then the equation [5] collapses to:

$$rV_S = -c_S + q(\vartheta_S)\cdot[p_s - V_S] \qquad [6]$$

However, when the parties meet each other, the seller will observe the state of buyer ex post. Nevertheless, s/he always decides to sell since the search is costly in terms of time and money. In a nutshell, if the search is costly and random, it is not convenient for the seller to wait for a new match.

Market frictions in the rental and homeownership market are the following:

$$\vartheta_R = \frac{v_R}{h} \qquad [7]$$

$$\vartheta_S = \frac{v_S}{h+t} \qquad [8]$$

with $q'(\vartheta_i) < 0$, and $g'(\vartheta_i) > 0$, $\forall i$, since $v_i$ are the vacancies.[6] The "zero profit" equilibrium condition (i.e. $V_i = 0, \forall i$) normally used by matching models gives the market equilibrium tensions (see Pissarides, 2000).[7] However, unlike the labour market matching model (which describes a negative relationship between market tightness and wage), in this case the free-entry condition yields a positive relationship between market tightness and price:

$$V_R = 0 \Rightarrow \frac{1}{q(\vartheta_R)} = \frac{p_R}{c_R\cdot(r+\delta)} \qquad [9]$$

$$V_S = 0 \Rightarrow \frac{1}{q(\vartheta_S)} = \frac{p_S}{c_S} \qquad [10]$$

This positive relationship is very intuitive: in fact, if the price increases, more vacancies will be on the market.

We assume that market tensions are exogenous at the microeconomic level, in the sense that each individual takes $\vartheta_R$ and $\vartheta_S$ as given in the price bargaining.

[5] Alternatively, one can assume that the homeless are ashamed to reveal their status.

[6] Standard technical assumptions are assumed:
$lim_{\vartheta_i\to 0} q(\vartheta_i) = lim_{\vartheta_i\to\infty} g(\vartheta_i) = \infty$, and $lim_{\vartheta_i\to 0} g(\vartheta_i) = lim_{\vartheta_i\to\infty} q(\vartheta_i) = 0$, $\forall i$.

[7] By definition, markets with frictions require positive and finite tightness, i.e. $0 < \vartheta < \infty$, since for $\vartheta = 0$ the vacancies are always filled, whereas for $\vartheta = \infty$ the home-seekers immediately find a vacant house.

## 3. Surplus, price bargaining and price dispersion

The generalised Nash bargaining solution, usually used for decentralised markets, allows the price to be obtained through the optimal subdivision of surplus deriving from a successful match. The surplus is defined as the sum of the seller/landlord's and home-seeker's value when the trade takes place, net of the respective external options (the value of continuing to search). Hence, a trade takes place between the parties at a price determined by Nash bargaining if the surplus is positive. Precisely, the price (both rental and selling) solves the following optimisation condition:

$$price = argmax\{(net\ gain\ of\ seller/landlord)^{\gamma} \cdot (net\ gain\ of\ homeseeker)^{1-\gamma}\} \quad [11]$$

where $\gamma \in (0,1)$ is the bargaining power of the seller/landlord.

Hence, the bargained price crucially depends on the surplus deriving from the matching. Precisely, in this model three kinds of matching can occur, thus leading to different surpluses:

1) The homeless person finds a home in the homeownership market. This matching produces an equilibrium selling price of $p_S^1 = argmax\{(p_S - V_S)^{\gamma} \cdot (x - p_S - H)^{1-\gamma}\}$;
2) The renter (tenant) finds a home in the homeownership market. Hence, the equilibrium selling price is $p_S^2 = argmax\{(p_S - V_S)^{\gamma} \cdot (x - p_S - T)^{1-\gamma}\}$;
3) The homeless person finds a home in the rental market. This matching produces an equilibrium rental price of $p_R = argmax\{(D_R - V_R)^{\gamma} \cdot (T - H)^{1-\gamma}\}$.

Therefore, the existence of price dispersion can be straightforwardly shown. In fact, in the homeownership market the net gain of home-seekers is different and this produces two different surpluses. Eventually, from equation [11] two different selling prices ($p_S^1$ and $p_S^2$) are obtained. It follows that the origin of price dispersion is due to the specific nature of the search and matching process. Indeed, this result holds true even in the presence of an identical bargaining power, identical search costs and also when the same house is considered.

## 4. The relation between selling price and rental price

As regards the selling prices, i.e. the matching 1) and 2) in the homeownership market, solving the optimisation conditions yields (recall that in equilibrium $V_i = 0,\ \forall i$):

$$\left(x-p_S^1-H\right)=\frac{1-\gamma}{\gamma}\cdot p_S^1 \Rightarrow p_S^1=\gamma\cdot\left(x-H\right)$$

$$\left(x-p_S^2-T\right)=\frac{1-\gamma}{\gamma}\cdot p_S^2 \Rightarrow p_S^2=\gamma\cdot\left(x-T\right)$$

Given the properties of equations [1] and [2], both $p_S^1$ and $p_S^2$ depend positively on $p_R$ (yet remaining different since $T \neq H$): in fact, an increase in the rental price reduces both $T$ (directly) and $H$ (indirectly through $T$). Therefore, without loss of generality, we can express this relationship in a broader form as follows: [8]

$$p_S=p_S\left(p_R\right) \tag{12}$$

with $\partial p_S/\partial p_R>0$. Furthermore, if the rental price tends to zero, no one will have convenience to buy a house and the value of being a tenant will be at the maximum. As a result, the selling price will also tend to zero, since it cannot be negative or null.

Instead, as regards the matching 3) in the rental market, we obtain:

$$\left(T-H\right)=\left[\left(1-\gamma\right)/\gamma\right]\cdot\left(D_R-V_R\right)$$

$$\Rightarrow\left(T-H\right)=\frac{1-\gamma}{\gamma}\cdot\frac{p_R+c_R}{r+\delta+q\left(\vartheta_R\right)}\Rightarrow\frac{\gamma\cdot\left(r+\delta+q\left(\vartheta_R\right)\right)}{1-\gamma}\cdot\left(T-H\right)-c_R=p_R$$

We know that an increase in selling price reduces both $T$ and $H$, since both home-seekers search in the homeownership market. Nevertheless, as long as the renter state is an appealing perspective, i.e. as long as $g\left(\vartheta_R\right)>\delta$, the decrease in $T$ is stronger than the decrease in $H$. Indeed, buying a home is the only future perspective for a tenant. Hence, in this case we obtain a negative relationship between rental price and selling price:

$$p_R=p_R\left(p_S\right) \tag{13}$$

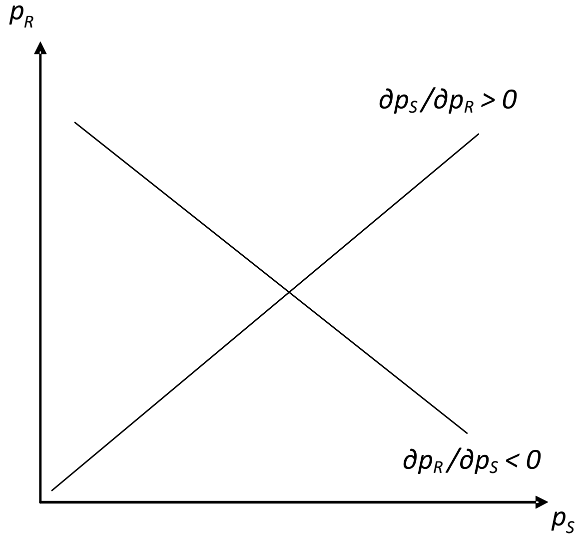
with $\partial p_R/\partial p_S<0$.

Therefore, the relationship between selling and rental prices can be represented in the diagram with axes [$p_S$, $p_R$], where only a steady-state equilibrium exists in the housing market with positive prices (see *Figure* 1a).

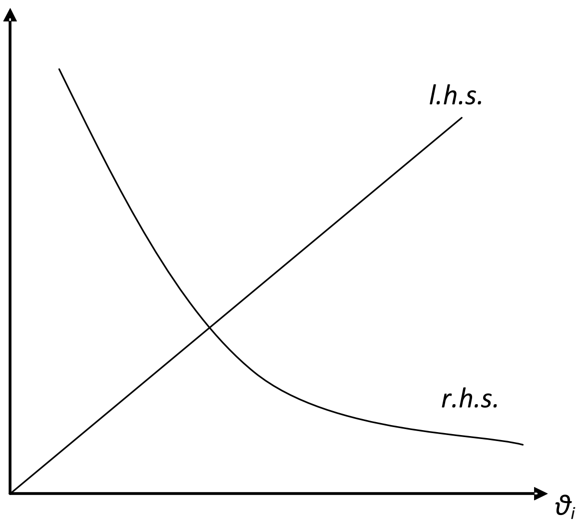
Eventually, given $p_R^*$ and $p_S^*$, we obtain a unique value of tightness for each market ($\vartheta_R^*$ and $\vartheta_S^*$) at the macroeconomic level. This testable proposition is made possible by a downward sloping price function (in fact, *ceteris paribus*, $\partial p_R/\partial\vartheta_R<0$ and $\partial p_S/\partial\vartheta_S<0$),

[8] Alternatively, one could see $p_S$ as a function of the two selling prices ($p_S^1$, $p_S^2$) and set up a system of four equations in four unknowns ($p_S$, $p_S^1$, $p_S^2$, $p_R$). However, this solution would add complexity but no further insight.

which forms the right hand side (*r.h.s.*) of the free-entry conditions (see equations [9]-[10] and *Figure* 1b).




a) microeconomic (house prices)




b) macroeconomic (housing market tightness)

**Figure 1. Equilibrium**

## 5. Effects of taxation on house prices and time-on-the-market

By considering rental and homeownership market together in a matching framework, one can study how changes in the relative tax treatment of owner and rental housing influence the two markets.

Indeed, the proposed theoretical model can be used to show the effects of both property sale tax and rental income tax. Basically, the taxation ($\tau$) increases the house price, since the sellers/landlords react by increasing the price charged to the home-seekers. This can be straightforwardly shown by introducing the term $-\tau_i$, with $i = \{R, S\}$, in the value of an occupied home. Precisely, a tax on property sale leads to an increase in selling price and a decrease in rental price (see figure 2a); whereas, a tax on rental income leads to an increase in both selling and rental prices (see figure 2b).

The change in house prices, in turn, affects the time it takes to sell (to rent) a property, the so-called time-on-the-market (TOM), which measures the degree of illiquidity of the real estate market. By using the free-entry conditions, it is straightforward to show that the house with a higher price has a longer time-on-the-market. In fact, with a probability of filling a vacant house of $q(\vartheta_i)$, the (expected) time-on-the-market is $q(\vartheta_i)^{-1}$ which is increasing in $\vartheta_i$, with $i = \{R, S\}$. As a result, with a tax on rental income the time-on-the-market increases for both markets (since both prices are higher); whereas, with a tax on property sale the time-on-the-market increases in the homeownership market but decreases in the rental market. Therefore, a property sale tax may be better than a rental income tax. The tax on property sale is in fact a lump-sum cost for sellers, while the tax on rental income is a cost flow for landlords.

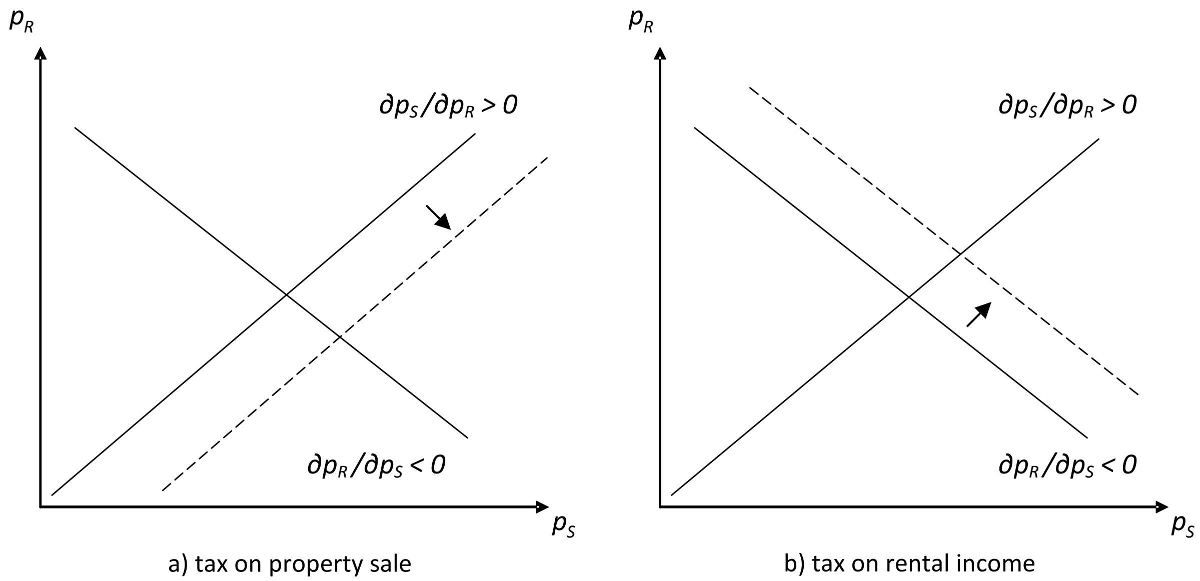



**Figure 2. Effects of taxation**

## 6. Closing the model with the homelessness equation

In order to close the model, we normalise the mass of home-seekers in the housing market to the unit:

$$1 = t + h \quad [14]$$

The evolution of homelessness in the course of time ( $\dot{h}$ ) is the following:

$$\dot{h} = \delta \cdot (1-h) - h \cdot [g(\vartheta_R) + g(\vartheta_S)] \quad [15]$$

$\delta \cdot (1-h)$ represents homelessness inflows, i.e. existing leases cancelled at rate $\delta$, whereas $h \cdot [g(\vartheta_R) + g(\vartheta_S)]$ describes the homelessness outflows, i.e. the homeless that find a home (as renter or as homeowner). Obviously, the homelessness equation is independent of the transition rate which connects the renter (tenant) state to the homeowner state.

In steady state equilibrium, where homelessness is constant over time ( $\dot{h} = 0$ ), it follows that:

$$h = \frac{\delta}{\delta + g(\vartheta_R) + g(\vartheta_S)} \quad [16]$$

which has very intuitive properties: *$\partial h/\delta > 0$, $\partial h/\partial g(\vartheta_R) < 0$, and $\partial h/\partial g(\vartheta_S) < 0$.*

Eventually, knowing the share of homeless persons, it is straightforward to get the share of renters:

$$t = 1 - h \quad [17]$$

since $0 < \dfrac{\delta}{\delta + g(\vartheta_R) + g(\vartheta_S)} < 1$, also the share of renters is positive. Thus, the mass of potential home-seekers can never go to zero.

## 7. Conclusions

The literature has mainly responded to the price dispersion puzzle by introducing the heterogeneity of economic agents. Furthermore, the link between rental and homeownership markets has been overlooked by housing market studies which adopt search and matching models. This paper develops a search and matching model of the housing market which is able to explain both the price dispersion and the relationship between rental and selling prices, relying only on the different states of home-seekers in the search and matching process. Also, this theoretical model can be useful to study the effects of taxation in the housing market.

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