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# Home-seekers in the Housing Market

**Gaetano Lisi**
Creativity and Motivations (CreaM) Economic Research Centre, Department of Economics and Law, University of Cassino and Southern Lazio, via S. Angelo, I-03043 Cassino (FR), Italy; Phone: +39 0776 996150; E-mail: gaetano.lisi@unicas.it

The housing market matching model in this paper considers two types of home-seekers: people who search for a house both in the rental and the homeownership markets, 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 and the selling prices 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 for showing the effects of two different taxes: tax on property sales and tax on rental income.

**Keywords:**

Rental Market; Homeownership market; House Price Dispersion; Taxation

# 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 (TOM) and sales.

The empirical "anomaly" known as 'price dispersion' is probably the most important distinctive feature of housing markets (see for e.g. Leung et al., 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.[1] In Leung and Zhang (2011), in fact, a necessary condition for explaining the housing price dispersion, as well as the relationship among prices, TOM and sales, is the heterogeneity on the side of the seller and/or the buyer, which generates the corresponding submarkets.

Nevertheless, price dispersion may arise from the different states of home-seekers in the search process. The basic idea behind the paper is the following: when a household or person needs to change homes (for business reasons or family needs), the goal is to buy a new or better house. However, the tenant state is often a satisfactory temporary situation, an intermediate step before buying in the homeownership market. In short, in the model, the tenant state is modelled as a staging post for searching in the homeownership market. Nevertheless, some home-seekers can immediately find a home in the homeownership market. As a result, in this model, there are two types of home-seekers: the tenants who are waiting to become owners of a dwelling, thus searching only in the homeownership market, and people who search for a dwelling both in the rental and the homeownership markets (the latter is simply referred to as "seekers"). 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. Indeed, this paper analyses the situation where both the homeownership and the rental markets are subject to search and matching frictions. As far as I am aware, this topic has been overlooked by housing market studies which have adopted search and matching models. Indeed, related papers in the literature omit the rental housing market from their consideration (Diaz and Jerez,

[1] Obviously, house price dispersion may also be due to missing housing characteristics (not observable or difficult to measure), the so-called unobserved good heterogeneity.

2009) or rely on the standard asset-market equilibrium condition (Ngai and Tenreyro, 2009),[2] thus assuming a rental market without frictions (Kashiwagi, 2011).[3]

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, I consider the effects of two different taxes: tax on property sales and tax on rental income. I find that the tax on property sales increases the selling price and reduces the rental price, whereas the tax on rental income increases both the rental and the selling prices, thus also increasing the TOM in both markets. Thus, a property sales tax may be better than a rental income tax. However, in the model, there is the distinction between sellers and landlords, and thus further and potential effects of taxation on house prices are not considered.

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 and describes the equilibrium of the model where the relationship between the selling and the rental prices plays a key role; Section 4 discusses some of the effects of taxation on house prices and TOM; and finally, Section 5 concludes the work.

## 2. The Housing Market Matching Model

The housing market consists of the rental and the homeownership markets. In the latter, the home-seeker who finds a dwelling and pays the selling price becomes the (new) owner of a house, whereas this does not happen in the rental market, where the rental price only ensures the use of the house for a certain period of time. I distinguish these two (sub-) markets with subscript $i=\{R,S\}$, where $R$ = rental market and $S$ = homeownership or sales market. Hence, $p_R$ is the rental price and $p_S$ is the selling price. There are two main categories of home-seekers in this housing market matching model: people who search for a dwelling both in the rental and the homeownership markets,

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[2] By 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 per 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, combined depreciation and maintenance rate, and expected future house price appreciation.

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

and simply named as "seekers" ($h$), and people who pay rent, thus only searching in the homeownership market, and named as "tenants" ($h_S$). It is assumed that the number of households/persons who need to change their homes (for business reasons or family needs) increase over time and all the "new" home-seekers $\lambda$ (where $\lambda$ is a positive and exogenous number) initially search in both markets, i.e. they enter the seekers pool ($h$). With regards to the supply side, i.e. the housing offer, there is free entry into the market. Hence, it is the free entry condition which allows the equilibrium value of vacant houses to be determined. In short, new vacant houses will be posted until the value of a further vacancy becomes equal to zero. In equilibrium, in fact, all the profit opportunities derived from opening new vacancies have been exploited, therefore, the value of an additional vacancy is equal to zero (see Pissarides, 2000).[4] Precisely, in this model, sellers post vacancies in the homeownership market and landlords open vacancies in the rental market.[5] Hence, landlords only meet with the seekers ($h$).

In order to formalise the housing market, we adopt a standard matching framework per the Mortensen-Pissarides model (see e.g. Pissarides, 2000) with random search and prices determined by Nash bargaining. The housing market is a "matching market" like the labour market, which clears not only through price, but also the time and money that the parties spend in the market. Thus, the search and matching approach is arguably also more appropriate for this type of market. As is common in matching-type models (see Pissarides, 2000; Petrongolo and Pissarides, 2001), the meeting of vacant houses and home-seekers is regulated by an aggregate matching function, $m$:

$$m_R = m(v_R, h);\ m_S = m(v_S, (h + h_S))$$

where $v_R$ and $v_S$ are the number of vacancies in the rental and the homeownership markets, respectively. Precisely, the matching function gives the number of matches (i.e. contracts) formed per unit of time, given the number of vacant houses and the share of home-seekers in the market. Recall that both the seekers ($h$) and the tenants ($h_S$) search in the homeownership market. The matching function is non-negative, increasing and concave in both arguments and performs constant returns to scale. In order to clarify the properties of the matching function, one can consider the functional form commonly used in matching models, i.e. the Cobb-Douglas function:[6]

[4] The zero-profit (or free-entry) condition makes sense in the housing market if houses (in both sub-markets) are supplied by competitive house builders, in addition to being supplied by owners who no longer need them for occupation.

[5] 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.

[6] In this instance, we take into account only the rental market, but the same pattern applies to the homeownership market.

$m_R = m(v_R, h) = v_R^{1-a} h^a$, where $0 < a < 1$ is the (constant) elasticity of the matching function with respect to the share of seekers. The two instantaneous probabilities that characterise the matching process can thus be obtained: $g(\vartheta_R) = \frac{m_R}{h} = \frac{v_R^{1-a} h^a}{h} = v_R^{1-a} h^{a-1} = \left(\frac{v_R}{h}\right)^{1-a} = \vartheta_R^{1-a}$ is the instantaneous probability of finding a home, and $q(\vartheta_R) = \frac{m_R}{v_R} = \frac{v_R^{1-a} h^a}{v_R} = v_R^{-a} h^a = \left(\frac{v_R}{h}\right)^{-a} = \vartheta_R^{-a}$ is the instantaneous probability of filling a vacant house. It follows that the key variable of the model, the so-called market tightness, $\vartheta_i$, with $i = \{R, S\}$, can be introduced:

$$\vartheta_R \equiv \frac{v_R}{h};\ \vartheta_S \equiv \frac{v_S}{(h + h_S)}$$

the ratio between vacancies and home-seekers identifies the market frictions which prevent (or delay) the matching between the parties. Note that $\vartheta_i$, with $i = \{R, S\}$, is the housing market tightness from the standpoint of the sellers and landlords.[7] Hence, an increase in market tightness (vacant houses) causes a positive (negative) effect on the demand (supply) side due to the congestion externality effect on the side of the sellers/landlords. Accordingly, the home-finding rate, i.e. the ratio between the matching function and the share of home-seekers:

$$g(\vartheta_R) = \frac{m(v_R, h)}{h} = m(\vartheta_R, 1);\ g(\vartheta_S) = \frac{m(v_S, (h + h_S))}{(h + h_S)} = m(\vartheta_S, 1)$$

is positive, increasing and concave in market tightness, while the vacancy-filling rate, i.e. the ratio between the matching function and the number of vacancies

$$q(\vartheta_R) = \frac{m(v_R, h)}{v_R} = m(1, \vartheta_R^{-1});\ q(\vartheta_S) = \frac{m(v_S, (h + h_S))}{v_S} = m(1, \vartheta_S^{-1})$$

is a positive, decreasing and convex function in market tightness.[8] Intuitively, this is straightforward to understand since if market tightness increases (decreases), the probability of filling a vacant house is lower (higher), while the probability of finding a home is higher (lower).

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[7] In the matching literature (see Pissarides, 2000), in fact, market tightness is usually calculated from the standpoint of the firm.

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

In order to study the matching between the parties in the two markets, it is necessary to introduce the value functions of the model. The value functions describe the expected marginal values (from which the positive and exogenous interest rate $r$ has been deducted) associated with the differing conditions of housing market participants, basically comparing them on financial security: [9]

$$rH = -e + g(\vartheta_R)\cdot[T - H] + g(\vartheta_S)\cdot[x - p_S - H] \quad (1)$$

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

$$rV_R = -c + q(\vartheta_R)\cdot[D - V_R] \quad (3)$$

$$rD = p_R + \delta\cdot[V_R - D] \quad (4)$$

$$rV_S = -c + q(\vartheta_S)\cdot\beta\cdot\left[p_S^{h_S} - V_S\right] + q(\vartheta_S)\cdot(1-\beta)\cdot\left[p_S^{h} - V_S\right] \quad (5)$$

where $H$ is the discounted present value of the infinite life of a seeker ($h$); $T$ is the discounted present value of the infinite life of a tenant ($h_S$); $V_R$ is the discounted present value of a vacant house in the rental market; $D$ is the discounted present value of the infinite life of a landlord, and $V_S$ is the discounted present value of a vacant house in the homeownership market. In the rental market, existing leases are cancelled at an exogenous rate $\delta$, and thus at rate $\delta$, a tenant ($h_S$) becomes a seeker ($h$). Instead, in the homeownership market, if a contract is legally binding (as hypothesised) it is no longer possible to return to the circumstances that preceded the bill of sale (unless a new and distinct contractual relationship is set up); hence, the discounted present value of an infinite life of a seller is simply given by the selling price ($p_S$). In short, the destruction rate in the rental market is $\delta > 0$ (lease destruction rate), while it is zero for the sales market. The terms on the right hand side of the value functions are, respectively, the "dividends" associated with the different conditions and the "capital gains". With regards to the "dividends", $e$ is the effort (in monetary terms) made by the home-seekers to find and visit the greatest possible number of houses: obviously, $e > e_S$, since the seeker ($h$) searches in both markets; $c$ is the cost of opening a vacant house and in this case, also includes the cost of building new homes; and finally, $x$ is the buyer's benefit which coincides with the value of the house and depends on the housing characteristics.[10] As will become clear later, $x$ can differ from the market price because of the matching frictions and

[9]Time is continuous and individuals are risk neutral, live infinitely and discount the future at an exogenous interest rate $r$. It is common practice in the literature to make use of linear utility functions. In assuming that individuals are risk neutral not only simplifies the analysis, but also allows the focus to be on the consequences of the search and matching process rather than the deficiencies of the insurance markets.

[10] According to the hedonic price theory, the value of the house, and thus the buyer's benefit, can be higher or lower according to the mix of desired and undesirable housing characteristics.

bargaining power. The "capital gain", instead, is the transition from one condition to the other, influenced by the probability of finding a home $g(\vartheta_i)$, filling a vacancy $q(\vartheta_i)$, with $i=\{R,S\}$, and the lease destruction rate $\delta$. Consider Equation (1), for example (the same reasoning applies to the other value functions): a seeker (*h*) bears the cost flows ( $e$ ) during the search (*negative dividends*); whereas, s/he becomes a tenant at rate $g(\vartheta_R)$, thus obtaining the value $T$, and gets the house and pays the selling price at rate $g(\vartheta_S)$. Hence, at rates $g(\vartheta_R)$ and $g(\vartheta_S)$, s/he finds a home as tenant or homeowner (capital gains).

Since potential buyers are different, the selling prices are also different: in fact, the seller may be matched with either a tenant ($h_S$) or a seeker (*h*). Hence, $\beta = h_S / (h_S + h)$ and $(1-\beta) = h / (h_S + h)$ in Equation (5) are, respectively, the share of tenants ($h_S$) and seekers (*h*).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 seeker (*h*) can become a tenant ($h_S$) and vice versa. Therefore, we assume that sellers are not able to distinguish between the different states of buyers in the search process, i.e. the buyers always appear identical to sellers ex ante. Hence, the selling prices also appear to be identical to the sellers ex ante, namely, $p_S^{h_S} = p_S^h = p_S$, and thus Equation (5) collapses to:

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

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. Hence, sellers accept offers as long as the selling price is higher than the value of the vacant house.

Finally, the value of being a tenant $T$ is modelled as a staging post for searching in the homeownership market. Hence, a necessary condition for a non-trivial equilibrium requires that:

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

which is true if $(e-e_S) > p_R$, namely, if the cost of being a seeker (*h*) in both markets is higher than that of being a tenant ($h_S$). In this case, the tenant state is a satisfactory temporary situation.

To summarise, in value functions (1) – (6), four endogenous variables ( $p_S$ , $p_R$ , $\vartheta_S$ and $\vartheta_R$ ) are introduced, while all the other variables are exogenous. In other words, as is common in matching-type models, the variables that characterise the model are market prices and matching frictions. Hence, once the equilibrium values of $p_S$ , $p_R$ , $\vartheta_S$ and $\vartheta_R$ are obtained, the value functions are determined. Precisely, the "zero profit" equilibrium condition or free-entry equilibrium condition, normally used by matching models (see Pissarides, 2000), gives the key relationship of the model between price and market tightness. Indeed, by using the condition $V_i = 0$ , with $i = \{R, S\}$ , in Equations (3) – (4) and (6), we get:

$$\frac{1}{q(\vartheta_R)} = D \Rightarrow \frac{1}{q(\vartheta_R)} = \frac{p_R}{c \cdot (r+\delta)} \Rightarrow \underbrace{q(\vartheta_R)^{-1}}_{l.h.s.} = \underbrace{\frac{p_R}{c \cdot (r+\delta)}}_{r.h.s.} \tag{7}$$

$$\frac{1}{q(\vartheta_S)} = \frac{p_S}{c} \Rightarrow q(\vartheta_S)^{-1} = \frac{p_S}{c} \tag{8}$$

unlike the labour market matching model (which describes a negative relationship between market tightness and wages), in this case, the free-entry condition yields a positive relationship between market tightness and price. In fact, $q(\vartheta_i)^{-1}$ is increasing in $\vartheta_i$ , with $i = \{R, S\}$ . This positive relationship is very intuitive: in fact, if the price increases, more vacancies will be on the market. However, Equations (7) and (8) define a system of two equations in four unknowns. Thus, we need to introduce the two price equations.

## 3. Price Equation and Housing Market Equilibrium

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.

The generalised Nash bargaining solution, usually used for decentralised markets, allows the price to be obtained through the optimal subdivision of surplus that is derived from a successful match. The surplus is defined as the sum of the value of the seller/landlord and the home-seeker 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:

$$price = argmax\left\{(net\,gain\,of\,seller\,/\,landlord)^{\gamma} \cdot (net\,gain\,of\,homeseeker)^{1-\gamma}\right\} \tag{9}$$

where $\gamma \in (0,1)$ is the bargaining power of the seller/landlord. The bargained price crucially depends on the surplus that is derived from the matching. Precisely, in this model, three kinds of matching can occur, thus leading to different surpluses.

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

Therefore, the existence of price dispersion can be shown in a straightforward manner. In fact, in the homeownership market, the net gain of seekers (*h*) is different from that of tenants ($h_S$), and this produces two different surpluses. Eventually, from Equation (9), two different selling prices ($p_S^1$ and $p_S^2$) are obtained. It follows that the origin of the price dispersion is due to the different states of the home-seekers in the search process. Indeed, this result holds true even in the presence of identical bargaining power, identical search costs and also when the same house (namely, the same as the buyer's benefit, *x*) is considered.

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

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

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

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:[11]

$$p_S = p_S(p_R) \tag{10}$$

[11] 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.

with $\partial p_S / \partial p_R > 0$. Furthermore, if the rental price tends towards zero, no one will bother 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 towards zero, since it cannot be negative or null (since the surplus is positive).

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

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

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

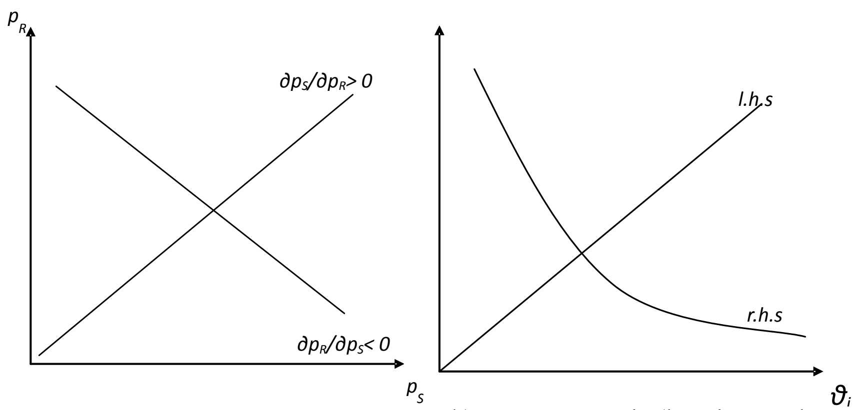
We know that an increase in selling price reduces both $T$ and $H$, since both types of home-seekers search in the homeownership market. Nevertheless, as long as the tenant state is an appealing prospect, i.e. as long as $g(\vartheta_R)>\delta$, the decrease in $T$ is stronger than the decrease in $H$, i.e. $\left|\frac{\partial T}{\partial p_S}\right|>\left|\frac{\partial H}{\partial p_S}\right|$. Indeed, buying a home is the only future prospect for a tenant. Hence, in this case, a negative relationship is obtained between the rental and the selling prices:

$$p_R = p_R(p_S) \tag{11}$$

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

Therefore, the relationship between the selling and the 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).

**Figure 1 Equilibrium**




a) microeconomic (house prices) b) macroeconomic (housing market tightness)

Eventually, given $p_R^*$ and $p_S^*$ , a unique tightness value is obtained for each market ( $\vartheta_R^*$ and $\vartheta_S^*$ ) at the macroeconomic level. This testable proposition is made possible by a downward sloping price function which forms the right hand side (r.h.s.) of the free-entry conditions (see Equations (7)-(8) and Figure 1b). In fact, ceteris paribus, $\partial p_R / \partial \vartheta_R < 0$ and $\partial p_S / \partial \vartheta_S < 0$ , since an increase in market tightness increases *T* and *H* and reduces $q(\vartheta_R)$.

Finally, the model is closed by describing the evolution of $h$ and $h_S$ in the course of time $t$ :[12]

$$\dot{h} \equiv \frac{\partial h}{\partial t} = \delta \cdot h_S + \lambda - \left[ g(\vartheta_R) + g(\vartheta_S) \right] \cdot h \tag{12}$$

$$\dot{h}_S \equiv \frac{\partial h_S}{\partial t} = g(\vartheta_R) \cdot h - g(\vartheta_S) \cdot h_S \tag{13}$$

where $\delta \cdot h_S$ represents seeker inflows, i.e. existing leases cancelled at rate $\delta$ ; $h \cdot \left[ g(\vartheta_R) + g(\vartheta_S) \right]$ describes the seeker outflows, i.e. the seekers (*h*) who find a home as a tenant or as a homeowner, and $\lambda$ are the "new" home-seekers. Likewise, $g(\vartheta_R) \cdot h$ and $g(\vartheta_S) \cdot h_S$ describe, respectively, the inflows and outflows in/from the tenant state.

In steady state equilibrium, where $h$ and $h_S$ are constant over time, it follows that:

$$\dot{h} = 0 \Rightarrow \delta \cdot h_S + \lambda = \left[ g(\vartheta_R) + g(\vartheta_S) \right] \cdot h$$
$$\dot{h}_S = 0 \Rightarrow g(\vartheta_R) \cdot h = g(\vartheta_S) \cdot h_S$$

therefore, given the value of search frictions in both markets, a system of two equations in two unknowns is obtained: $h$ and $h_S$ . A sufficient condition for the existence of an interior equilibrium is that $g(\vartheta_S) \cdot \frac{\left( g(\vartheta_R) + g(\vartheta_S) \right)}{g(\vartheta_R)} > \delta$, namely $g(\vartheta_S)$ is sufficiently high or $\delta$ is sufficiently low:

$$\lambda = \left\{ \left[ g(\vartheta_R) + g(\vartheta_S) \right] \cdot \frac{g(\vartheta_S)}{g(\vartheta_R)} - \delta \right\} \cdot h_S \tag{14}$$

[12] The equilibrium usually characterised by these models is in fact the stationary state, in which the values of the variables are not subject to further changes over time.

$$h = \frac{g(\vartheta_S)}{g(\vartheta_R)} \cdot h_S \qquad (15)$$

In other words, if the probability of finding a home in the sales market is sufficiently high and/or the lease destruction rate is sufficiently low, the prospect of finding a home in both markets is very attractive. This is consistent with the story told in this model, where the goal of each home-seeker is to buy a house and the tenant state is a satisfactory temporary situation.

## 4. Effects of Taxation on House Prices

By considering the rental and the homeownership markets 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 sales and rental income taxes.

Basically, from a microeconomic point of view, taxation ( $\tau$ ) increases house prices, since sellers/landlords with sufficient bargaining power react by increasing the price charged to home-seekers. This can be shown in a straightforward manner by introducing the term $-\tau_i$, with $i = \{R, S\}$, in the value of an occupied home, viz.:[13]

$$rD = p_R - \tau_R + \delta \cdot [V_R - D] \qquad (16)$$

$$rV_S = -c + q(\vartheta_S) \cdot [p_s - \tau_S - V_S] \qquad (17)$$

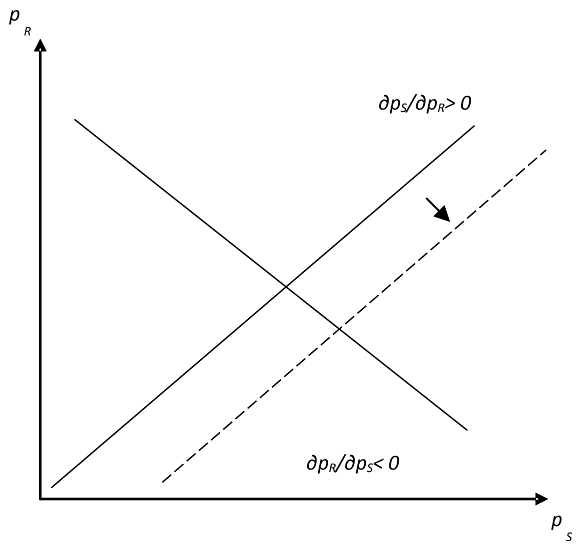
Precisely, by using Equations (10) and (11) together, it is possible to show that a tax on a property sale ( $\tau_S$ ) leads to an increase in selling price and a decrease in rental price (see also Figure 2a); whereas a tax on rental income ( $\tau_R$ ) leads to an increase in both selling and rental prices (see also Figure 2b).

The change in house prices, in turn, affects the time that it takes to sell (rent) a property, the so-called TOM, which measures the degree of illiquidity of the real estate market. By using free-entry conditions, it is straightforward to show that a house with a higher price has a longer TOM. In fact, with the probability of filling a vacant house of $q(\vartheta_i)$, the (expected) TOM 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 TOM increases for both markets (since both prices are higher), whereas with a tax on property sales, the TOM increases in the

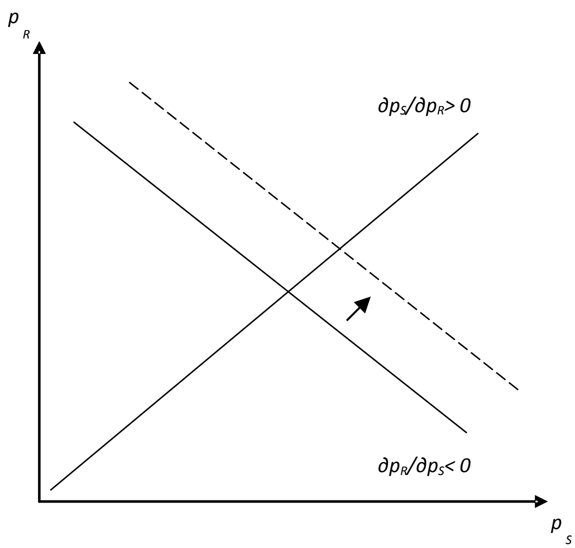
[13] Recall that the value of an occupied home for a seller is simply given by the selling price.

homeownership market, but decreases in the rental market. Thus, a property sales tax may be better than a rental income tax. The explanation is that the tax on property sales is a lump-sum cost for sellers, while the tax on rental income is a cost flow for landlords.

**Figure 2 Effects of Taxation**




a) tax on property sales




b) tax on rental income

Nevertheless, the prediction by the model that levying rental income tax will increase house price might seem very counterintuitive. In particular, it is inconsistent with the classical four-quadrant model (see DiPasquale and Wheaton, 1992, 1996). However, in this simple model, there is the distinction between sellers and landlords. By introducing the possibility that the sellers can rent their house and landlords can sell their house, the rental income tax $\tau_R$ introduces a further effect into the model developed here. Precisely, an increase in $\tau_R$ reduces the value of being a landlord ( $D$ ). Hence, many landlords may choose to sell their houses rather than offer rental units, thus increasing vacant houses and market frictions in the sales market. This, in turn, has a negative effect on the house price, since $p_S$ depends negatively on $\vartheta_S$ (due to the congestion externality effect on the side of the sellers). An analogous reasoning is applied to the tax on property sales ( $\tau_S$ ). Therefore, it can be useful to develop in the future an extended version of the model in order to investigate the net effect of taxation on house prices.

## 5. Conclusions

In this paper, I have developed a matching theoretic-model that is able to capture the main characteristic of the housing market, namely, the house price dispersion, and considers the rental and the homeownership markets together. Precisely, this housing market matching model considers two types of home-seekers: people who search for a house both in the rental and the homeownership markets, 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 paper is thus 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 for studying the effects of taxation in the housing market.

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