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# Housing market discrimination, housing regulations and intermediaries\*

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## Abstract

Housing and labor markets exhibit many similarities. First, information is imperfect. Tenant quality, like worker quality, is unobserved. Second, separation is costly and time consuming. The laws and regulation typically complicate or slow down the termination process of the contractual relationship and make it more costly for firms and landlords to fire an employee /evict a tenant. And finally, there are rigidities in nominal wages and rents. Adapting tools from labor theory, we attempt to understand how landlords wish to screen and possibly statistically discriminate against potential tenants. They do so when housing regulations are more stringent. If they have a “taste against discrimination” (the opposite of Becker’s “taste for discrimination”), they are more likely to have recourse to agencies in order to outsource screening. Preliminary descriptive evidence of cross-country differences in housing regulations and housing market functioning is provided.

- Keywords: search frictions, housing, discrimination, moral hazard, intermediation
- JEL: R1, R21, R31, J61, J63

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i) *"Le droit au logement est un droit fondamental; il s'exerce dans le cadre des lois qui le régissent"*.<sup>1</sup> Préambule de la Loi du 22 juin 1982, France.

ii) In Paris, 136 000 dwellings (10% of the stock) are vacant, while unsatisfied demands amount to 100 000. French Institute of Statistics (INSEE) and Droit au Logement (DAL).

iii) *"In France, expect to spend four months of rent when moving in. You will also need to find a guarantor."*, Association des Québécois en France.

iv) *"In Montreal, the vacancy rate is 1.4%. Landlords cannot ask more than a month of rent in advance, and no security deposit."* French Consulate in Montreal.

v) A typical lease in France has 20 pages (font 8) ; in Quebec it has 5 pages (font 14).

## 1 Introduction

The objective of this paper is to draw a parallel between the housing and labor markets and to understand how rationing and discrimination emerge in the housing market. We notably investigate how market forces and discrimination interact with regulations. The main result is that the tougher the legislation or the practice vis-à-vis landlords, the more they discriminate. If they don't like discriminating, they have recourse to intermediaries (agency), which further raises transaction costs. In any case, such regulations tend to introduce a higher level of mismatch, i.e. coexistence of both vacant dwellings and agents unsatisfied with housing, higher rents and tighter housing markets from tenants perspective.

As a matter of fact, very few markets are more regulated than housing markets. The need for regulation arises from two fundamental aspects. A first reason is that free markets may not be spontaneously efficient in the presence of moral hazard, adverse selection and other asymmetries of information. The second reason is that the short-run supply of housing is extremely inelastic. Since consumption of housing can represent up to 50% of a household's net income, a temporary boom in the demand for housing will raise rental prices and generate strong inequality, in the absence of transfers or other policy interventions.<sup>2</sup>

Accordingly, there are strong pressures on policy makers to smooth over the functioning of the rental housing market and to introduce regulations interacting with market forces. In the best cases, they have designed laws and regulations that partly correct for inefficiencies and reduce inequality. In many cases, they have just transformed some inefficiencies into other ones. In worst cases, they have amplified the problem. The excerpts above illustrate some of these aspects. Quote i) illustrates the generosity of the major French law that governs the contractual relations between tenants and landlords. Very similar objectives can be found in the laws of most European countries. However, quote ii) illustrates that, in

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<sup>1</sup>Meaning that having a home is a very basic right of individuals. This right is regulated by the law.

<sup>2</sup>According to INSEE Premiere (2004), in France in 2002, the effort rate (ratio of rent to income) is on average 19.7%, but reaches 40.1% of low income households (social + private sector) and 50.8% of those in the private sector. After transfers, the effort rate falls 16.1% for all low income households and 25.7 for low income households in the private sector. According to CMHC 04-008 (2004), in Canada in 2001, the shelter cost-to-income ratio (including the rent, water and energy consumption) was on average 28.3%, and reached 47.8% for those households "unable to access acceptable housing".

spite of this generosity, there is a significant degree of mismatch in some local housing markets in Paris, and the same is true in most large cities in France. Points iii) and v) give an idea of the transaction costs in the French housing market, while iv) and v) emphasize differences with the province of Quebec. This will be a basic premise of this paper: more regulation does not necessarily raise the welfare of those supposedly protected by the law.

These statements may remind labor economists of the way labor regulations in several Continental European countries affect labor markets. By protecting employees against abuses with employment protection and wage laws (minimum wage, collective bargaining), they have excluded many workers from employment, notably youth, women and unskilled workers. The parallel between housing and labor markets goes rather far indeed. First, tenants' quality, as well as workers' quality, is unobserved: notably, the quality of the maintenance by the tenant and, his/her ability to sustain the payment of the rent. Second, the job's characteristics, like the dwelling's characteristics, such as its quality and that of its environment, are usually not exactly precisely known ex-ante. Third, separation is costly and time consuming. Laws and regulations typically complicate or slow down the process of termination of the contractual relationship and make it more costly for firms/landlords to fire an employee/evict a tenant. Forth, there exist upwards rigidities in rents as well as downwards nominal wage rigidities.

In this paper, we adapt tools from labor economics and take advantage use of several theoretical advances made in the past two decades. We import three modelling aspects from labor. First, we introduce search frictions in the matching process between landlords and tenants. Second, we integrate uncertainty and asymmetric information into the post-match contractual relation. Finally, we adapt the modelling of workers' dismissal procedures to account for the difficulties by landlords have to terminating a lease and expelling tenants when part of the obligations mentioned in the lease are not fulfilled (such as paying the rent or the basic maintenance of the housing good). This allows us to understand how landlords wish to screen and statistically discriminate against potential prospective tenants. They do so when housing regulations are more stringent. If they have a taste against statistical discrimination, notably because their statistical test will be correlated with observable factors such as race, religion, sexual orientation or others, they are more likely to have recourse to agencies to outsource screening.

Urban economic theory has dealt with perfect market conditions, and when dealing with market imperfections, has mainly focused on public goods and externalities. See the very detailed book by Fujita (1989). Less frequent are the attempts to introduce search frictions (Wheaton 1990 for endogenous matching frictions), as well as several search models with exogenous search processes but without en-

dogenuous matching frictions (Read 1997, 1993, 1991, 1988, van Ommeren et al. 1997, Anas 1997 and Thies 1993). As put forth by Richard Arnott (1987), the systematic inclusion of imperfections remains to be investigated.<sup>3</sup> The very recent forth Volume of the Handbook series—on Cities and Geography—has rather focused on other sources of market imperfections such as increasing returns to scale, rather than developing asymmetric information models of the housing markets.<sup>4</sup>

In Section 2, we review a few housing markets regulations across countries, and detail their functioning. In particular, preliminary descriptive evidence of Quebec-France differences in housing regulations and housing market functioning is provided, which is used in support of the model in the next sections. In Section 3 we illustrate the partial equilibrium interactions between housing regulations and landlords strategies. In Section 4 we undertake a numerical exercise to provide quantitative insights. In Section 5 we develop some general equilibrium implications. Section 6 concludes.

## 2 A brief comparative study of housing markets

In this Section, we illustrate a few aspects of the sometimes large cross-country differences in housing markets. In the first part, we investigate general differences in laws and legal practices in two localities, the province of Quebec and France. In the second part, we detail eviction procedures.

### 2.1 Legal environment

The main text in France regulating the lessor-lessee relation is the "Loi dite Quilliot relative aux Droits et Obligations des Locataires et des Bailleurs du 22 juin 1982", with significant amendments in the "Loi 90-449 du 31 mai 1990" and the "Loi de modernisation sociale du 17 janvier 2002". The text is about 25 pages in length. In Quebec, the text specifying the regulation of leases can be found in the general civil law: Title Two (Nominate Contract); Lease (Chapter IV); Sections I to IV. It is 51 pages long but is written in two languages (French and English), so that both texts have about the same informational content. A significant difference is that the Quebec law starts with a definition of concepts and terms, while the French law does not. In some instances, the text is barely understandable and thus a source of confusion. This is not neutral, since any failure to fulfill the smallest details of conflicting procedure leads to nullity, which can typically be exploited by the defaulting party.

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<sup>3</sup>In the introduction of his survey in the Handbook of Urban Economics, he stated that "First, the competitive theory of housing markets is reasonably sophisticated and well-developed. Second, there is no well-worked-out, imperfectly competitive or non-competitive theory of the housing market, only partial models." In JEL classification R (Urban, Rural, and Regional Economics) there is no code (yet) for a theory of imperfect markets and notably of flow models.

<sup>4</sup>A few attempts to incorporate matching models of the labor market to other markets have recently been made. For applications to the credit market, see notably Wasmer and Weil (2004) and Garibaldi and Dell'Arricia (2004). For an application to the housing market, see Wheaton (1996) for the seminal paper.

Overall, very significant differences between France and Quebec are revealed, both in the detail and in the spirit of the law. Sometimes, the Devil hides in the details. Table A in Appendix A gives a detailed overview of these differences. One can draw a few general principles:

- In Quebec, a fix term lease specifies that the lessee has to pay the rent until the end of the lease. In France, the lessee may leave with three months' notice, typically reduced to one month when a major reason such as job mobility is invoked. Unanticipated turnover is thus greater in France.
- In Québec, at the end of a lease, the lessor may decide not to renew the lease, but the lessee can object and file a reply. The lessor may also raise the rent, within limits fixed by Quebec's Régie du logement as a recourse if the tenant files an objection. The absence of notification in a month is an explicit agreement of either the new lease or of departure. In France, the lessor requires an explicit and written agreement from the lessee for not renewing the lease or raising the rent. When the tenant does not reply, it is tantamount to a refusal of the change proposed by the lessor. Similarly, for a rent increase to be effective, the tenant has to provide a written agreement to the lessor. The rent increase must always be below the change in a price index calculated by the French institute of statistics (INSEE).
- In case of non-payment by the lessee, the termination procedure is fast and fairly automatic in Québec. In France, it is long, costly and complicated: the laws specifies explicitly the several steps to be carried out by the landlord, each of them associated with delays.
- The cost of entry into a dwelling is minimal for lessees in Quebec. It is substantial for both lessees and lessors in France and involves security deposits, writing of the lease, and a detailed description of the state of the dwelling.

The last point can be interpreted as a compensation for the lessor. Since it is difficult to separate an/or recover foregone rents, the lessor asks more ex-ante. In other words, in France, the contractual relation is risky for the lessor. The termination costs can be prohibitive for the lessor. The entry costs can be prohibitive for the lessee. In Quebec, the contractual relation is much less risky for the lessor. Entry and termination costs are limited.

## 2.2 More on legal procedures

As specified in Article 1889 of Quebec law: "*The lessor of an immovable may obtain the eviction of a lessee who continues to occupy the leased premises after the expiry of the lease or after the date for the*

*surrender of the premises agreed upon during the term of the lease.*” No such procedure is defined in the main French law. The latter simply states that the lease is terminated no less than two months after ”commandement à payer”, i.e. a legal act established and brought by an ”huissier de justice” i.e. a process server. The landlord then must request the eviction of the tenant. Before doing so, the process server must send a letter to the representative of the state (”le préfet”), who may refer the matter to different social and housing councils. Once this is done, and in the absence of payment, the landlord can ask ”un recours à la force publique” to obtain the eviction.<sup>5</sup> The rules are such that, even after an eviction has been decided by a judge, another judge may decide that, if a new dwelling has not been proposed to the lessee by the administration, the lessee may be kept for more than a year in the dwelling.<sup>6</sup> Finally, no eviction can take place during winter time, i.e. between November 1 and March 15.<sup>7</sup> The legal act to obtain the eviction has to account for all steps undertaken before and detail the difficulties encountered with the tenant. The act requires the aid of public force to the representative of the state, who has two months to reply. Not replying becomes a tacit agreement to the procedure. If the tenant does not open the door to the ”huissier”, the ”huissier” must be accompanied by the mayor or someone delegated by him, a police officer or two witnesses. Should the police fail to reply to the request of the ”huissier”, the landlord obtains a compensation from the state (which, in all of France, amounted to 45 millions euro in 1997).

Table B in the Appendix shows the evolution of the legal procedures and the effective recourse to police in the last few years. There are about 100 000 procedures per year. 80% lead to a legal decision of eviction. Half lead to a ”commandement à quitter les lieux”, i.e. the application of the legal decision. Of these 50 000 cases, only 30 000 to 35 000 cases require the intervention of the police. In half to two thirds of cases, a decision is made to allow the police to intervene. Effectively, they intervene in 6 000

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<sup>5</sup>The rules governing eviction are specified in two other texts: the Code Civil (article 1422 and 1743) and the Code de la Construction et de l’Habitation (Partie Législative, Article L613-1). A decree has also been issued, explaining how to interpret the text: ”Décret n° 92-755 du 31 juillet 1992 instituant de nouvelles règles relatives aux procédures d’exécution pour l’application de la loi du 9 juillet 1991”. ”Décret n° 92-755 du 31 juillet 1992 instituant de nouvelles règles relatives aux procédures d’exécution pour l’application de la loi du 9 juillet 1991”.

<sup>6</sup>Article L613-1L: ”Le juge des référés ou le juge de l’exécution, selon le cas, du lieu de la situation de l’immeuble peut, par dérogation aux dispositions de l’article 1244 du code civil, accorder des délais renouvelables excédant une année aux occupants de locaux d’habitation ou à usage professionnel, dont l’expulsion aura été ordonnée judiciairement, chaque fois que le relogement des intéressés ne pourra avoir lieu dans des conditions normales, sans que lesdits occupants aient à justifier d’un titre à l’origine de l’occupation. Le juge qui ordonne l’expulsion peut, même d’office, accorder les mêmes délais, dans les mêmes conditions. Cette disposition n’est pas applicable lorsque le propriétaire exerce son droit de reprise dans les conditions prévues à l’article 19 de la loi n. 48-1360 du 1er septembre 1948 portant modification et codification de la législation relative aux rapports des bailleurs et locataires ou occupants de locaux d’habitation ou à usage professionnel et instituant des allocations de logement ainsi que lorsque la procédure de relogement effectuée en application de l’article L. 442-4-1 n’a pas été suivie d’effet du fait du locataire.

<sup>7</sup>As explained by an association of landlords (<http://sos.proprietaires.free.fr/fichesexecjugement%20expul/fhiver.htm>), in practice, if the ”huissier de justice” calls for an eviction on September First, the administration has two months to reply. In a best case scenario, no eviction can take place until March 16, so that the landlord loses at least six months rent.

Table 1: Duration (days) of eviction procedures

Country	Duration until completion of service of process	Duration of trial	Duration of enforcement	Total
Canada	5	21	17	43
France	16	75	135	226

Source: Djankov et al. (2003), table V, pp. 494-97.

cases. These figures should be interpreted with caution. As it happens, at some stage of the procedure, an agreement is usually reached between the two parties.

Nevertheless, the investment in time and energy for the landlord is significant. Given the complexity of the procedure, there is a general consensus that obtaining eviction of a bad tenant is random, costly and time-consuming. It is worth noting that the main difficulty for landlords arise from the complexity of a procedure that has to be respected very carefully. A good lawyer is able to obtain the nullity of an entire procedure if a step specified in one of the laws or decrees has not been fulfilled. This sharply contrasts with the spirit of application of the law in Quebec: the law explicitly gives entire discretion to the judge to decide whether to examine the case when some documents are missing in the procedure. Article 1 in Division 1 of another text "Rules of procedure of the Régie du Logement" states that : "Unless the commissioner decides otherwise, any delay, or formal or procedural irregularity may be remedied before him at the hearing."

Finally, table 1, based on Djankov et al. (2003), gives additional and precise evidence that the duration of the eviction procedure considerably differ between France and Canada (no figure is available at the regional level for Quebec).

### 3 A partial equilibrium model

The term sclerotic or fluid usually describing differences in labor markets across countries may thus be easily applied to characterize cross-country differences in housing markets. Obviously, the model will not embed all these ingredients. We will simply argue that the duration and randomness of the procedure to obtain the eviction of a tenant failing to pay the rent is a crucial factor for determining the various strategies of the agents and subsequently the equilibrium in the housing markets .

#### 3.1 Timing

Time is continuous. Agents are risk-neutral and discount future events with interest rate  $r$ . Potential tenants are heterogenous. The ex-ante distribution of quality  $Q$  has support  $(Q_{\min}, Q_{\max})$  and is denoted

by  $g(Q)$ . Cumulated distribution function is  $G(Q)$ . The relationship between landlords and tenants can be described by three stages.

1. In stage 1, a landlord with a vacant unit of housing prospect the market, either directly or by contracting out with an agency. He makes random contacts with applicants, i.e. he does not know  $Q$  ex-ante.
2. In stage 2, the landlord decides whether or not to offer a lease. If this is the case, the applicant is "hired" and becomes a tenant with no duration limit, with an agreement on a rent.
3. In stage 3, the tenant undergoes an adverse shock (unemployment, other income shock, sickness, divorce, emotional disorder) and he stops paying the rent, i.e. he defaults. The landlord attempts to evict the tenant. When successful, he/she is back to stage 1.

All transitions between these different stages are governed by Poisson processes, with parameters specified in next sub-Section. In order to reach the main theoretical point rapidly (i.e. the effect of housing regulations and the willingness to sub-contract screening), we ignore several aspects of "real life" rental contracts in the housing markets. Notably, we assume that tenants never quit spontaneously, either in stage 2 or stage 3. This assumption is rather innocuous and only marginally affects the calculation of asset values of landlords. This is briefly explored in the robustness sections. A less innocuous assumption is that the debt accumulated by the tenant in stage 3 has no effect whatsoever on the transition rates (which conveniently keeps all Poisson intensities of transition time-independent) and that this debt cannot be recovered by the landlord. These two assumptions preserve the stationarity of the problem and allow for the derivation of close-form solutions to the problem, and thus a more detailed analysis of the role of the various parameters. Note that, given that agents are risk-neutral, the uncertainty of the timing of transition between the different stages has no impact per se, only the average gains and loss from different qualities of tenants matters, as is often the case in search-matching models of the labor market (e.g. Pissarides 2000).

In what follows, we thus ignore any time-dependence of decisions and denote the different stages by a subscript 1, 2 or 3.

### 3.2 Landlord asset values

We will first describe stage 2, in which a tenant and landlord are already mutually matched. We assume that tenants' quality  $Q$  affects the Poisson arrival rate of an adverse shock leading him/her to stop paying the rent, denoted by  $\lambda(Q)$  with  $\lambda'(Q) < 0$ . Thus, the lower the quality, the more likely the default by the tenant. Thanks to the assumption of a Poisson process for default, some tenants of quality  $Q$  may

never default, some may default very fast, while on average, time elapsed without a default is  $1/\lambda(Q)$ . In the absence of default, the rent paid on a flow basis is denoted by  $R$ .<sup>8</sup>

Let  $O_2$  represent the asset value of a landlord with a tenant of quality  $Q$ . Let  $O_3$  be the asset value of a landlord after the default by the tenant. Both quantities are linked by the conventional Bellman equation, with the following recursive linkage:

$$rO_2 = R + \lambda(Q)(O_3 - O_2). \quad (1)$$

This states that the equity value of being in stage 2 is the sum of the net rent received  $R$  and the capital gain from the transition to stage 3 (in this case, the difference between  $O_2$  and  $O_3$  will be negative which represents a capital loss) multiplied by the transition intensity  $\lambda(Q)$ .

We can now describe the details of the legal procedure to evict a tenant. Casually, such a procedure is both time-consuming and bears direct pecuniary costs. It is also random, as the timing of the success is unpredictable: it may depend on the number of files handled by judges, on their "social profile", on the defense strategy of the tenants—involving, for instance, claims on landlords' default regarding some of his/her obligations.

Interestingly, the details of these legal procedures parallel those prevalent in the labor market. Firms may find it difficult, costly and random to dismiss workers. Garibaldi (1998) has investigated the theoretical implications of such procedures. He notably models a legal advance notice period in the labor market, during which the worker is paid but is unproductive (so that the cash-flow of the firm is negative) and at the end of which the worker is dismissed. He assumes that the transition to dismissal follows a Poisson process. We take a similar perspective here by introducing two "institutional ingredients".

First, we assume that the legal procedure costs the landlord a flow cost  $c$ . Second, we assume that the procedure is successful with a Poisson intensity  $\mu$ , where  $\mu$  can take all values between 0 and  $+\infty$ . When  $\mu = 0$ , the procedure is infinitely long—this is an extreme case of a sclerotic rental housing market—, whereas as  $\mu$  goes to infinity, the market becomes infinitely fluid. Note that here, success means that the landlord gets back his vacant unit of housing. As previously argued, the landlord cannot hope to be paid part of the accumulated debt by the tenant, who is assumed to have no collateral on his/her own.

The asset value of being in the procedure stage for the landlord follows the following Bellman equation:

$$rO_3 = -c + \mu(\text{Max } O_1 - O_3), \quad (2)$$

where  $\text{Max } O_1$  is the value of a vacant unit of housing to the landlord. The Max operator indicates that the landlord will use the best of all available strategies detailed below. To simplify notations, we replace

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<sup>8</sup>Note that we could specify that  $\lambda$  depends on both  $Q$  and  $R$ , with  $\partial\lambda/\partial R > 0$ . This would mean that the arrival of the adverse shock is partly affected by the financial tension experienced by the tenant. This would introduce interesting but complex mechanisms affecting the rent determination. At this early stage it is better to ignore such considerations and set  $\partial\lambda/\partial R = 0$ .

Max  $O_1$  by  $O_1$  when there is no ambiguity. Equation (2) states that the equity value of undergoing the legal procedure is the negative of the procedure costs  $c$ , plus the capital gain  $O_1 - O_3$  of getting back the vacant unit, multiplied by the Poisson intensity  $\mu$  of the success of the procedure.

Equations (1) and (2) jointly determine the value of  $O_3$  as a function of institutional parameter  $\mu$  and of  $O_2$  as a function of  $\mu$  and of the quality of the tenant and lead to the following result.

**Proposition 1.** *For a given level of rent and of  $O_1$ , a faster eviction procedure (higher  $\mu$ ) as well as a less costly one (smaller  $c$ ) raise the landlord's welfare in both stages 2 and 3.*

**Proof:** we have

$$O_3(\mu) = \frac{-c + \mu O_1}{r + \mu}, \quad (3)$$

$$O_2(Q, R, \mu) = \frac{R + \lambda(Q)O_3}{r + \lambda(Q)} = \frac{R + \lambda(Q)\frac{-c + \mu O_1}{r + \mu}}{r + \lambda(Q)}. \quad (4)$$

Note that  $O_3$  can be negative if  $\mu$  is sufficiently low. It is positive if  $O_1 > c/\mu$ . Moreover,  $O_3$  tends to  $O_1$  when the expulsion procedure is infinitely fast, i.e.  $\mu$  goes to infinity. In this case, the gap in the asset values between state 1 and state 3 from the landlord's perspective no longer exists. Finally, we have that, in all cases,

$$\partial O_3(\mu)/\partial \mu = \frac{rO_1 + c}{(r + \mu)^2} > 0, \quad (5)$$

$$\partial O_2(Q, R, \mu)/\partial \mu = \frac{\lambda(Q)}{\lambda(Q) + r} \frac{rO_1 + c}{(r + \mu)^2} > 0, \quad (6)$$

which means that the faster the procedure, the better off the landlord in both stages 2 and 3. We also easily obtain  $\partial O_2/\partial c < 0$  and  $\partial O_3/\partial c$ .<sup>9</sup> ■

Proposition 1 contains nothing surprising since in stage 3, landlords only experience losses, those losses being reduced by lower costs and a faster procedure.

### 3.3 The rent-quality trade-off

As clearly apparent from equation (4), the landlord has an indifference curve between the quality of the tenant and the rent he/she receives: the owner is ready to sacrifice a little percentage of rent in order to raise the quality of the tenant and reduces the arrival of the procedure. One can calculate the marginal rate of substitution in defining  $\bar{R}(Q, \bar{O}_2, \mu)$  which is the net rent insuring a level of utility  $\bar{O}_2$ :

$$\bar{R} = r\bar{O}_2 + \lambda(Q) [\bar{O}_2 - O_3(\mu)]. \quad (7)$$

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<sup>9</sup>Note that the sign of all these derivatives depends on the implicit assumption  $rO_1 > -c$ : this condition simply insures the value of holding a vacant unit of housing cannot be smaller than that of paying procedure costs forever, which we assume to be satisfied.

We have

$$\frac{\partial \bar{R}}{\partial \bar{Q}} = \lambda'(Q) [\bar{O}_2 - O_3(\mu)] < 0, \quad (8)$$

$$\frac{\partial \bar{R}}{\partial \mu} = -\lambda(Q) \frac{dO_3}{d\mu} = -\lambda(Q) \frac{rO_1 + c}{(r + \mu)^2} < 0, \quad (9)$$

$$\frac{\partial^2 \bar{R}}{\partial \mu \partial Q} = -\lambda'(Q) \frac{rO_1 + c}{(r + \mu)^2} > 0. \quad (10)$$

In words, the first equation above states that in order to maintain a fixed level of utility  $\bar{O}_2$ , a decrease in the quality of the tenant requires a rent increase. The second equation similarly states that to maintain  $\bar{O}_2$ , a decrease in the efficiency of the procedure requires a higher rent. Both act in the same way as the compensating differentials in wages. This may partly rationalize why in countries with very regulated housing markets, rents are so high compared to the income of tenants.

The last equation shows that the effects of the two quantities  $Q$  and  $\mu$  complement each other: the cross-derivative is positive. The propensity of a landlord of accepting a reduction in rent for a marginally better tenant is increased when the expulsion procedure is slow. This suggests that in imperfect housing markets—the imperfection is captured by the parameter  $\mu$ —, when rents cannot adjust, landlords will be more likely to screen intensely their tenants. If quality cannot be screened and is fixed, landlords may be tougher on rent bargaining in imperfect housing markets. In general, landlords may have the two adjustment margins,  $R$  and the screening of tenants and their quality  $Q$ . We are going to neglect first the effects going through rent, and assume instead that rent  $R$  is exogenous. We will relax this assumption later on.

### 3.4 Strategies of landlords in stage 1

The structure of the rental market in stage 1 is as follows. Tenants and landlords meet randomly according to a matching process (see Wheaton 1990). We denote by  $p$  the Poisson intensity at which landlord face tenants,  $p$  being treated as given by agents. This quantity is an index of matching frictions: when  $p \rightarrow \infty$ , frictions disappear and matching is instantaneous.

The key issue for the landlord is thus to determine an optimal strategy to find tenants of quality  $Q$  given the heterogeneity among potential tenants and the cost associated with selection. The landlord has three possible strategies, indexed by  $\emptyset, S, A$  standing for "No selection", "Selection" or "Agency". In the first strategy, the landlord pays a minimal flow cost denoted by  $\gamma$ —for instance the cost of organizing visits to applicants—, does not determine quality  $Q$  of applicants and thus never rejects any applicant. In the second strategy, the landlord makes a selection, i.e. he pays higher screening costs  $\gamma^S > \gamma$ , determines quality  $Q$  of applicants and rejects some of them according to a rule determined below. He however incurs a loss from rejecting applicant: this may be taste against discrimination (a utility cost

– $d$ ) or costs associated with legislations protecting minorities, like a fine  $F$  in the event of being detected as discriminating which occurs with probability  $\pi$ .

The last possibility is to sub-contract the procedure to an intermediary which we hereafter refer to as an "Agency". The landlord pays the agency for discriminating against applicants. In exchange for this service, the agency charges the landlord a flow fee  $\phi$  during the screening state 1, a fixed premium  $C$  in case of successful recruitment and a fraction of the rent  $\delta R$  during the lease. The structure of the costs arising in equilibrium depends on the incentive structure of the landlord and the agency. Indeed, a subtle issue here is that the landlord faces a moral hazard problem vis-a-vis the agency. If the agency is paid a too large  $\phi$ , it may not provide much effort to find tenants.<sup>10</sup> If it is paid a too high  $C$ , it is not going to operate a proper selection of tenants. We get rid of the first problem by setting  $\phi = 0$  and think of  $C$  as small and exogenous—typically a month or two of rent.<sup>11</sup> Finally, the agency is also subject to a fine  $F^A$  in case it is caught discriminating, with the same probability  $\pi$ . The agency does not feel guilty discriminating however:  $d^A = 0$ . Further, it is assumed that the agency has a better matching technology, i.e. the contact rate is  $p_A = \sigma_A p$  where  $\sigma_A > 1$  is an efficiency parameter.

Denoting by  $\frac{E}{Q}$  the expected operator given the ex-ante uncertainty on  $Q$ , and  $\frac{E}{Q \setminus A}$  the expected operator conditional on the agency's selection procedure, we have the following asset values for this strategy  $O_1^\emptyset$ ,  $O_1^S$  and  $O_1^A$  as functions of  $\mu$  and  $R$ :

$$rO_1^\emptyset = -\gamma + p \left\{ \frac{E}{Q} O_2(R, Q, \mu) - O_1^\emptyset \right\}, \quad (11)$$

$$rO_1^S = -\gamma^S + p \frac{E}{Q} \text{Max}\{O_2(R, Q, \mu) - O_1^S; -\pi F - d\}, \quad (12)$$

$$rO_1^A = p_A \frac{E}{Q \setminus A} \{O_2[(1 - \delta)R, Q, \mu] - C - O_1^A\}. \quad (13)$$

In equation (11), the landlord pays a flow cost  $\gamma$  and makes a capital gain  $\frac{E}{Q} O_2(R, Q, \mu) - O_1^\emptyset$  according to a Poisson process of parameter  $p$ . In equation (12), the landlords pays higher costs  $\gamma^S$ . The Max operator here reflects the opportunity by landlords to re-optimize after a meeting with an applicant, i.e. decides to reject the application if he is unsatisfied with the signal  $Q$  he receives, at a cost  $\pi F$  and disutility  $d$ . In equation (13), the landlord pays no screening cost, but the anticipated net rent received is reduced by a fraction  $\delta$  going to the agency. He also pays a fee  $C$  when a contact leads to a lease.

The asset value of the agency in stage 2 is similar to that of landlords, i.e. we have that

$$A_2(Q) = \frac{\delta R + \lambda(Q) \overline{A_3}}{r + \lambda(Q)}, \quad (14)$$

---

<sup>10</sup>Such problems seem typical of trilateral relationship in continuous time. In the credit market, a similar moral hazard problem exists in Wasmer and Weil (2004): when banks finance the start-up stage (recruitment, initial low profitability) on a flow basis, the firm in turn may decide to exert a sub-optimal level of effort.

<sup>11</sup>There may be optimal contracts where both  $\phi$  and  $C$  are strictly positive, to the extent that  $\delta R$  is large enough but we do not enter these subtleties at this stage.

where  $\overline{A_3}$  is the value of the agency after default has occurred. We simplify at this stage by setting  $\overline{A_3} = 0$ , which means that the agency has only a role of providing adequate candidates to the landlord.<sup>12</sup> In stage 1, we have

$$rA_1 = -\gamma^A + p_A E[\text{Max } A_2(Q) + C - A_1, -\pi F^A]: \quad (15)$$

the agency pays its own screening cost  $\gamma^A$  and the Max operator indicates that agency also makes a selection of tenants. Rejecting an applicant is also subject to a fine  $F^A$  with probability  $\pi$ .

### 3.5 Reservation strategies

Let us start with the strategy of an agency. Given that  $A_2(Q) = \frac{\delta R}{r+\lambda(Q)}$  is increasing in  $Q$ , the agency will follow a simple reservation rule: it accepts the applicant with quality  $Q$  if  $Q \geq Q^A$ , and rejects him if  $Q < Q^A$ , where  $Q^A$  is the unique value of  $Q$  satisfying

$$A_2(Q^A) + C = A_1 - \pi F^A. \quad (16)$$

In words, the agency problem is to balance an immediate profit  $\delta R$  when it accepts a quality  $Q$  with the prospect of having in the future a better tenant insuring a longer period of payment and an immediate threat of paying a fine  $F^A$ .

The selection criterion of the landlord when he screens himself is pretty similar. Indeed, given that  $\partial O_2 / \partial Q$  is positive from equation (4), there is a unique  $Q^S$  satisfying

$$O_2(R, Q^S, \mu) = O_1^S + \pi F + d, \quad (17)$$

with landlords accepting an applicant if and only if  $Q \geq Q^S$ . The same intuition as that of equation (16) applies.

### 3.6 Partial equilibrium

We can now define a partial equilibrium, i.e. optimal strategies when the matching rate  $p$  and the rent  $R$  are given to agents.

**Definition.** A partial equilibrium is a set of value functions  $O_1^\Sigma$  for  $\Sigma = \emptyset, S, A$  and two reservation strategies  $Q^A$  and  $Q^S$ , satisfying

$$O_1^\emptyset = \frac{-\gamma + p \int_{Q_{\min}}^{Q_{\max}} \frac{R+\lambda(Q) \frac{-c+\mu \text{Max } O_1}{r+\mu}}{r+\lambda(Q)} dG(Q)}{r+p}, \quad (18)$$

$$O_1^S = \frac{-\gamma^S + p \int_{Q^S}^{Q_{\max}} \frac{R+\lambda(Q) \frac{-c+\mu \text{Max } O_1}{r+\mu}}{r+\lambda(Q)} dG(Q) - pG(Q^S)(\pi F + d)}{r+p[1-G(Q^S)]}, \quad (19)$$

<sup>12</sup>In practice, some agencies may actually intervene even in stage 3, to the extent that the landlord has subscribed an insurance.

$$O_1^A = \frac{p_A \int_{Q^A}^{Q_{\max}} \left( \frac{R(1-\delta) + \lambda(Q) \frac{-c + \mu \text{Max } O_1}{r + \mu}}{r + \lambda(Q)} - C \right) dG(Q)}{r + p_A [1 - G(Q^A)]}, \quad (20)$$

where  $Q^S$  and  $Q^A$  are defined by the equality

$$\frac{R + \lambda(Q^S) \frac{-c + \mu \text{Max } O_1}{r + \mu}}{r + \lambda(Q^S)} = O_1^S - \pi F - d, \quad (21)$$

$$\frac{\delta R}{r + \lambda(Q^A)} + C = A_1 - \pi F, \quad (22)$$

and, using (14) and (15),  $A_1$  defined by

$$A_1 = \frac{-\gamma^A + p^A \int_{Q^A}^{Q_{\max}} \left( \frac{\delta R}{r + \lambda(Q)} + C \right) dG(Q) - pG(Q^A) \pi F^A}{r + p_A [1 - G(Q^A)]}. \quad (23)$$

**Proposition 2.** *A partial equilibrium exists and is unique.*

Proof: i) Use equations (21) to determine  $Q^S$  as a function of  $O_1^S$ . ii) Using (23) and (22), one also obtains  $Q^A$  as a function of parameters. iii) Replacing  $Q^S$  and  $Q^A$  by their value in Equations (18) to (20), the problem can then be reduced to a fixed point problem in  $(O_1^\emptyset, O_1^S, O_1^A)$ . These equations define a function of  $\mathfrak{R}^+ \times \mathfrak{R}^+ \times \mathfrak{R}^+$  into itself, which can be shown to be a contraction. This insures existence and uniqueness of the value functions. ■

## 4 Numerical exercise

### 4.1 Benchmark

The optimal strategy of landlords can be numerically determined as a function of various parameters. All parameters are quarterly. We choose an iso-elastic default function  $\lambda(Q) = \lambda_0 Q^{-\varepsilon}$  on support  $Q_{\min} = 0.1$ ,  $Q_{\max} = 5$ ,  $\varepsilon = 1$  and  $\lambda_0 = 0.1$  which means that the average rental time without default is  $\int_{Q_{\min}}^{Q_{\max}} 1/(\lambda_0 Q^{-\varepsilon}) dG(q) = 6.3$  years. The quarterly rent is normalized to 1. The contact rate between a landlord and a tenant is  $p = 1$  (meaning an average duration of search of a quarter). The agency is more efficient in matching than landlords and we set  $p_A = 2$  meaning an average duration of search of 1.5 months for the agency. The flow vacancy cost  $\gamma$  is 0.3. To interpret this number, remember that a landlord in strategy 0 pays  $\gamma$  during on average  $1/p$ . The total cost  $\gamma/p$  amounts to one month of rent. When the landlord screens, this double the vacancy cost:  $\gamma^S = 2\gamma$ . The agency face smaller screening costs:  $\gamma^A = \gamma/5$  which can be interpreted as the existence of increasing returns to scale in screening. The contract between an agency and a landlord specifies that  $\delta = 5\%$  of the rent is paid over the duration of the lease. In addition, a fee  $C = 1/4$  of the quarterly rent is paid by the landlord upon signature of the lease. When landlords or the agency rejects an application, there is a probability  $\pi = 0.0375$  to be prosecuted and convicted for discriminatory practice. The landlord pays a fine  $F = 4$ , while the agency

Table 2: Calibration parameters

Scale default rate $\lambda_0$	0.1	Fine landlords $F$	4
Elasticity default rate $\varepsilon$	1	Fine agency $F^A$	12
Quarterly rent $R$	1	Fine probability	0.0375
Vacancy cost $\gamma$	0.30	Landlords aversion to discr. $d$	0.5
Screening cost $\gamma^S$	0.60	Contact rate for landlords $p$	1
Agency screening costs $\gamma^A$	0.06	Contact rate for agency $p^A$	2
Fraction of rent to agency $\delta$	0.05	Agency fee for a lease $C$	0.25
Flow cost of eviction $c$	0.1	Speed of eviction proc. $\mu$	$\{1, 1/4, 1/8\}$

Table 3: Values of endogenous variables

	$\mu = 1$	$\mu = 1/8$	$\mu = 1/4$
Value of strategy 0: $O_1^0$	89.7	70.0	79.8
Value of strategy S: $O_1^S$	88.3	72.3	80.0
Value of strategy A: $O_1^A$	88.2	71.7	80.1
Optimal strategy	0	S	A
Optimal landlord acceptance rate $1 - G(Q^S)$	96%	62%	74%
Optimal agency acceptance rate $1 - G(Q^A)$	78%	78%	78%
Capital loss from default $\log(O_3/O_1)$	-1.1%	-8.5%	-4.4%

pays  $F = 12$ . Thus, the expected cost  $\pi F$  is respectively 0.15 of a quarterly rent for the landlord and 0.60 for the agency. On top of that, rejection of an applicant is associated with disutility  $d = 0.5$  for landlords.

The characteristics of the equilibrium depend on the value chosen for the efficiency parameter of the eviction procedure. Intuitively, for large values of  $\mu$ , i.e. when the average duration of eviction is close to zero, landlords choose strategy 0, i.e. don't need to discriminate: the consequence of default is minimal, because they rapidly recover their dwelling. For small values of  $\mu$ , i.e. when the duration of eviction is large, the consequence of a default are more dramatic and landlords instead choose to screen tenants, either directly or through delegating to an agency. To illustrate this, we chose two values,  $\mu = 1$  aiming at representing a typical Quebec housing market and  $\mu = 1/8$  aiming at replicating the French case. Both values would correspond respectively to an average procedure of a quarter (costing overall 10% of a quarterly rent) and of an average procedure of 2 years (costing 80% of a quarterly rent). An intermediate value of  $\mu = 0.25$  is also explored. Table 3 displays the equilibrium quantities in the two configurations.

Strategy 0 is indeed optimal for  $\mu = 1$ , as  $\text{Max}(O_1^0, O_1^S, O_1^A) = O_1^0$ , while direct screening by landlords is optimal when  $\mu = 1/8$ :  $\text{Max}(O_1^0, O_1^S, O_1^A) = O_1^S$ . In the latter case, landlords accept only 62% of applicants, i.e. reject 38% of applicants. The optimal screening rate of the agency does not depend on  $\mu$ , as the agency is not concerned by the value of housing in stage 3: the fraction  $\delta R$  of the rent paid by the agency stops when a default occurs. Note that delegation to an agency is not optimal in each of these extreme two cases, but for some range between 1 and 1/8, around  $\mu = 1/4$ , delegating the screening to an agency is optimal by a small margin. Another insight is that, whatever the strategy chosen, the value

of housing declines quite fast, from about 90 to less than 70 when the duration of eviction goes from a quarter to two years. To interpret these figures, one can usefully think of the real estate value of a housing yielding an annual rental value of 10 000 dollars a year. Its price would then be  $90 \cdot 10000 / 4 = 225\,000$  in a world with  $\mu = 1$ , and  $70 \cdot 10000 / 4 = 175\,000$  with  $\mu = 1/8$ . The parameter  $\mu$  is thus a crucial determinant of the rental value of housing. The approximated elasticity of  $O_1$  to  $\mu$  is about  $-0.1$ .

Finally, one can calculate, for various values of  $\mu$ , the loss incurred by landlords when a tenant default on the rent. For  $\mu = 1$ , the value of  $O_3$  is 1.1% less than the value of  $O_1^\emptyset$ : default has almost no consequence. When  $\mu = 1/4$ , the best strategy is  $A$  and the value of  $O_3$  is now 4.4% less than  $O_1^A$ . When  $\mu = 1/8$ , the best strategy is  $S$  and  $O_3$  is 8.5% below  $O_1^S$ : landlords may face a 8.5% capital loss when they face a default. This explains why, ex-ante, landlords value  $O_1$  less when  $\mu$  is smaller: they anticipate that at some point they will engage an eviction procedure. Note that, for smaller (and implausibly small) values of  $\mu$ , for example  $\mu = 0.05$ , one can calculate that the capital loss in case of default reaches -22.5%!

One can also offer a graphical representation of the dependence of optimal strategies to  $\mu$ : the properties of the optimal strategies are illustrated in Figures 1 to 3. Figure 1 represents the evolution of the asset values of a vacant unit of housing,  $O_1^\emptyset$ ,  $O_1^S$  and  $O_1^A$  associated with strategies  $\emptyset$ ,  $S$  and  $A$ , as a function of the duration (in years) of the eviction procedure  $1/4\mu$ . As already discussed in Table 3, each of the three strategies can be the optimal, depending on the value of  $\mu$ . Given the scale of the y-axis, it is not very easy to determine which strategy is optimal: Figure 2 shows in more details the respective values of  $O_1$  when  $\mu$  changes over a smaller range: when the duration of the eviction procedure is below 0.8, landlords do not screen. When the duration of the eviction procedure is above 1.2, they screen themselves. For intermediate values of  $\mu$ , they delegate screening to the agency.

For other parameter values, strategy  $A$  can dominate over strategy  $S$  when  $\mu$  becomes very small. This would notably be the case if  $d$  the discrimination aversion of  $F$  (landlord's penalty for discrimination) were slightly raised. The preference for strategy  $A$  or  $S$  actually all depends on the selection rule  $Q^A$  by the agency as compared to the desired one ( $Q^S$ ) by the landlord. In fact, as revealed in Figure 3, top chart, for a procedure duration around 0.8 year, the acceptance rate of the agency and the landlord do indeed coincide. This is why, in this case, the landlord prefer to delegate the screening to the agency, as he avoids paying screening costs and a fine in case of detected discriminatory practice, for an equivalent outcome.

Alternatively, raising the agency fee  $C$  or the fraction of the rent  $\delta$  would shift the curve  $O_1^A$  down and strategy  $A$  would then never occur in equilibrium. In addition, the middle chart in Figure 3 shows, respectively, that the average duration of rent paid to landlords without default is about 6.5 years in the absence of screening of tenants, slightly above 7.5 years, while, as  $\mu$  declines, landlords become more and more selective which reduce the default rate. The top chart of Figure 3 reveals that, for an average duration of the eviction procedure below 0.15, they even chose  $Q^S = Q_{\min}$  indicating the absence of

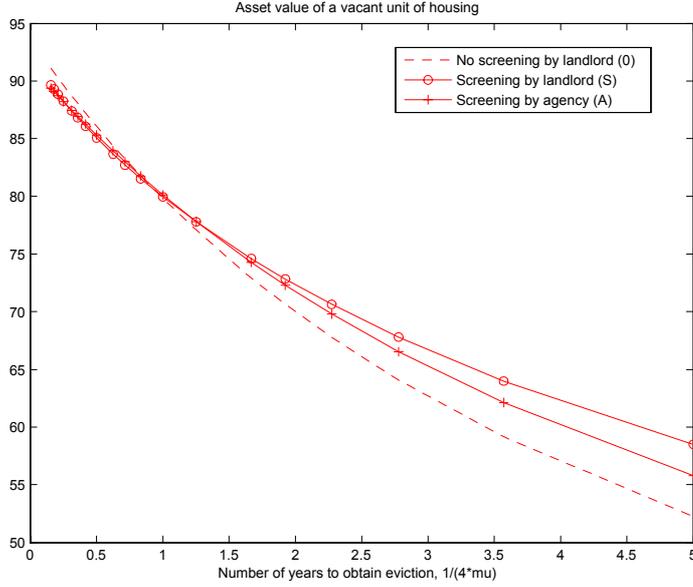


Figure 1: Impact of the eviction procedure on  $O_1^\emptyset$ ,  $O_1^S$  and  $O_1^A$  and on the optimal strategy of landlords.

screening. When the procedure lasts 0.25 (a quarter), they eliminate merely 4% of the potential tenants. When it lasts 2 years, they are much more conservative and reject 37% of applications. As a result, as revealed in the last chart of Figure 3, strategy  $S$ , the average prospection time of tenants increases, from a quarter to six months over the range of  $\mu$ . The prospection time with strategy 0 (no screening) is set as a benchmark to a quarter, while given  $Q^A$  and the relative efficiency of agencies to find and screen applicants, the average time of prospection for agencies is below a quarter.

## 4.2 Matching rate

Another dimension of the space parameter is the  $p$ , the rate at which landlords meet applicants. This is an important quantity depending, in principle, on the tightness of the market, i.e. in the spirit of matching models of the labor market, on the ratio of unmatched tenants over vacant housing. This parameter  $p$  is determined in equilibrium by the long-run supply of housing. At this stage, we simply explore how the equilibrium strategies depend on  $p$ . Figures 4 and 5 represent the evolution of partial equilibrium quantities with respect to a change in  $p$  from 0.6 to 1.4 (at the same time,  $p_A$  is set to two times  $p$ , i.e.  $p_A$  increases from 1.2 to 2.8) for different values of  $\mu$ . In Figure 4,  $\mu = 1$  while in Figure 5  $\mu = 0.125$ . As Figure 4 shows, the optimal strategy is  $A$  for low values of  $p$ , but when  $p$  becomes larger than 0.8, the optimal strategy is  $\emptyset$ , i.e. no screening. The reason is that, when  $p$  is low, the option of having recourse

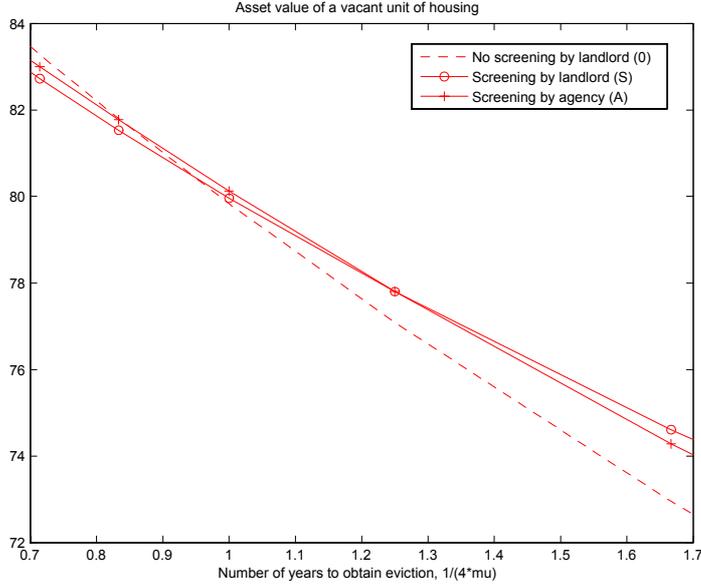


Figure 2: Impact of the eviction procedure on  $O_1^0$ ,  $O_1^S$  and  $O_1^A$  and on the optimal strategy of landlords, detail ( $0.7 < 1/4\mu < 1.7$ ).

to an agency becomes more attractive as matching is twice as much efficient with an agency. The result is not as trivial as it seems, because remember that we set  $p_A/p = \sigma_A = 2$ : when  $p$  is low,  $p_A$  is low too, although larger than  $p$ .<sup>13</sup>

Note also that in Figure 4, strategy  $S$  seems to never be optimal, as  $O_1^S < O_1^A$ . The figure would suggest that the gap between  $O_1^S$  and  $O_1^0$  is reduced for larger  $p$ , but we found that even for  $p = 15$ , the gap remains positive. The bottom part of Figure 4 shows that in strategy  $S$ , a larger  $p$  makes tenants slightly more discriminatory, as they reject less than 2% of applicants with  $p = 0.6$  but slightly more than 5% with  $p = 1.4$ . The reason is that, the larger  $p$ , the larger the value of  $O_1$ , and thus, the higher  $Q^S$  has to be for landlords to be indifferent between accepting and rejecting an applicant: in other words, if landlords can draw frequently and fast in the distribution of tenants, they can afford to be more selective. However, the screening rate is not very elastic to  $p$ .

In contrast, when  $\mu$  is lower, say, 0.125, one can see in Figure 5 that strategy  $S$  dominates for large values of  $p$ —above 0.9. Strategy  $A$  is optimal when the matching process is slow for landlords— $p < 0.9$ —and strategy  $0$  never dominates. As before, for low values of  $p$ , landlords benefit from a higher relative

<sup>13</sup>This result is reminiscent of the fact that, in tight labor markets, i.e. when firms face difficulties to locate specific skills in the labor market (top executive, managers), they have more frequently recourse to intermediaries to locate and pre-screen applications.

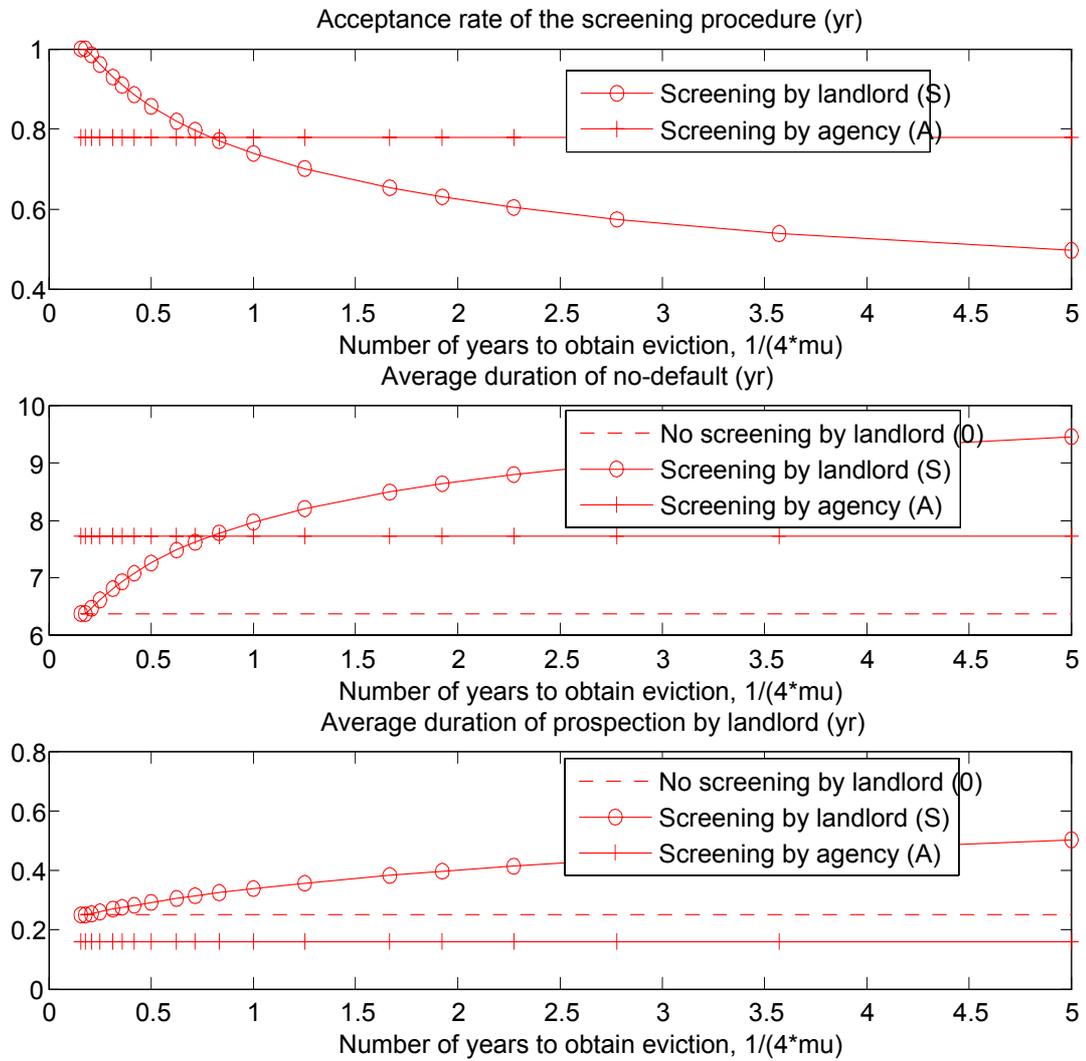


Figure 3: Impact of the eviction procedure on: the acceptance rate of agencies and landlords  $G(Q^A)$  and  $G(Q^S)$ ; the average duration of no default for a lease; and the average prospection time of landlords and the agency.

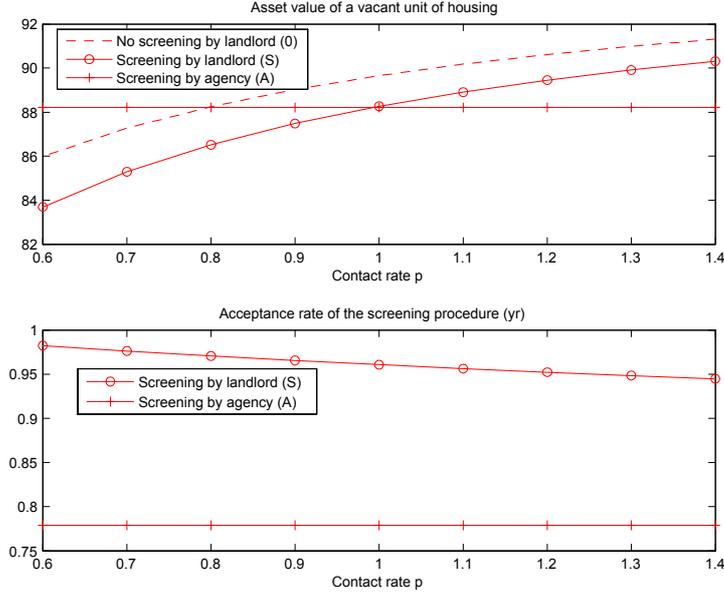


Figure 4: Impact of the matching rate on  $O_1^\emptyset$ ,  $O_1^S$  and  $O_1^A$  and the optimal selection rules, in the case  $\mu = 1$  (procedure lasts one quarter).

efficiency of agencies to generate contacts. As before, landlords tend to increase their level of selectivity as  $p$  increases: for  $p$  above 1.2, they eliminate more than 40% of the applicants.

Finally, combining the two Figures 4 and 5, one may have the intuition that it is possible to find intermediate values of  $\mu$  for which the three strategies become turn in turn about dominant as  $p$  describes the interval (0.6 ; 1.4). This is indeed the case with value  $\mu = 0.4$ , as Figure 6 shows: strategy A,  $\emptyset$  and S are successively optimal as  $p$  increases.

## 5 General equilibrium feedback

### 5.1 Supply of housing

In general equilibrium,  $p$ , the matching rate of between landlords and applicants and  $R$ , the rent paid by tenants—both so far treated as exogenous—will adjust. We derive both quantities through two free-entry conditions: the first one is a free-entry condition on tenants. The second one is a free-entry condition on the long-run supply of housing.

Denote by  $K$  the building cost of a new dwelling. It must be that in equilibrium,

$$K \geq \max_{\Sigma=\emptyset, S, A} O_1^\Sigma.$$

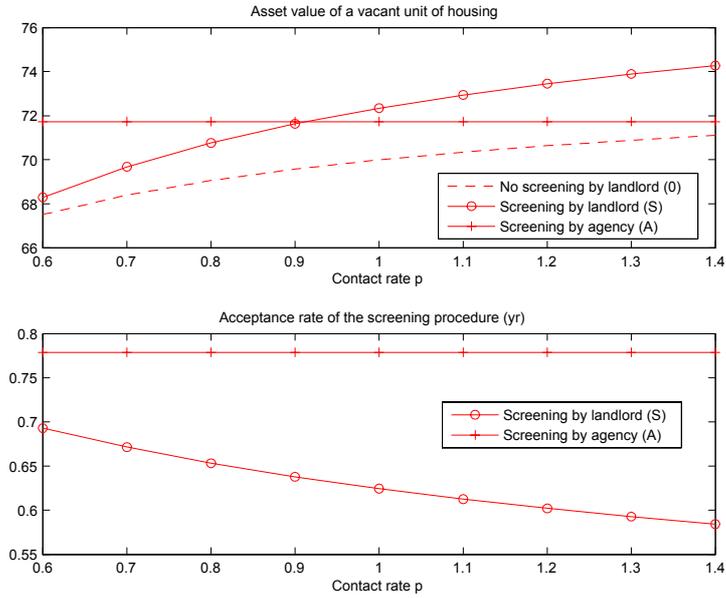


Figure 5: Impact of the matching rate on  $O_1^0$ ,  $O_1^S$  and  $O_1^A$  and the optimal selection rules, in the case  $\mu = 0.125$  (procedure lasts 2.5 years).

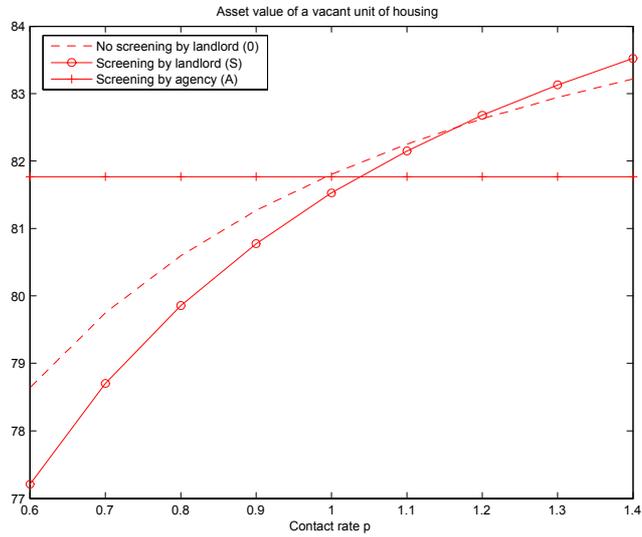


Figure 6: Impact of the matching rate on  $O_1^0$ ,  $O_1^S$  and  $O_1^A$  and the optimal selection rules, in the case  $\mu = 0.4$  (procedure lasts 1.9 quarters).

Indeed, if  $K < \text{Max } O_1$ , entrepreneurs would build new housing. See Glaeser et al. (2004) and Glaeser and Gyourko (2002) for a similar long-run condition. We consider further an equilibrium steady-state in which

$$K = \text{Max}_{\Sigma=\emptyset, S, A} O_1^\Sigma. \quad (24)$$

We have:

**Proposition 3.** *Equation (24) determines a negative relation between  $R$  and  $p$ , denoted by  $R^K(p)$ .  $R^K(p)$  is continuous but has discrete changes in slope (when the optimal strategy changes). A smaller  $\mu$  (a slower eviction procedure) or a larger  $K$  (more expensive housing costs) shifts  $R^K(p)$  up.*

*Proof.* For a given strategy  $\Sigma = \emptyset, S, A$ , equation (24) defines an indifference curve between  $p$  and  $R$ : landlords in stage 1 may accept a lower rent if matching is faster. For each strategy  $\Sigma$ , there is thus an indifference curve  $R^{K, \Sigma}(p)$ . A larger  $K$  or a smaller  $\mu$  increase the rent needed to remain on the a given level of utility  $O_1^\Sigma$ . The optimal strategy changes in some cut-off points denoted by  $p_1, p_2$ , etc... For instance, Figure 5 suggests that there is only one cut-off point  $p_1 = 0.9$ . Assume for instance that if  $p_{i-1} < p < p_i$ , optimal strategy is  $\emptyset$  while it is  $S$  if  $p_i < p < p_{i+1}$ . We know that  $O_1^\emptyset(p_1) = O_1^S(p_i)$ , so that  $R^{K, \emptyset}(p_i^-) = R^{K, S}(p_i^+)$  where the exponent  $-$  or  $+$  indicate the left- or right- limit of  $p_i$ . It follows that  $R^K(p)$  is continuous, although its slope is not continuous. The same is true for all  $p_i$  defining the indifference between two strategies. ■

## 5.2 Tenants and equilibrium

The free entry of tenants generates a second, positive relation between  $R$  and  $p$  denoted by  $R^T(p)$ . It actually reflects an indifference curve of the agent with the lowest quality  $Q^{\min}$  between  $R$  and the matching rate  $p$ . The relation states that, the tighter the labor market for landlords (lower  $p$ ), the easier it is for tenants to prospect in the housing market. They thus accept a larger rent. We do not derive this relation here and leave the details for Appendix C. Notably, the free-entry curve is specified such that the position of the curve in  $(R, p)$  is independent of  $\mu$ .

The general equilibrium is represented in Figure 7 in the space of the rent and the matching rate of landlords, for two different values of  $\mu$ . Note that each break in the slope correspond to a change in the optimal strategy of landlords. When  $\mu = 1$ , the eviction procedure is fast, and the long-run supply of housing is high, resulting into a low rent and a low matching rate for landlords: this is equivalent, through equation (C4) in Appendix C, that tenants face many opportunities in the housing market and can get a match rather fast. The opposite happens when  $\mu$  is low: there is a lower long-run supply of housing, resulting in higher rent, a higher matching rate for landlords and thus a slower matching rate for tenants.

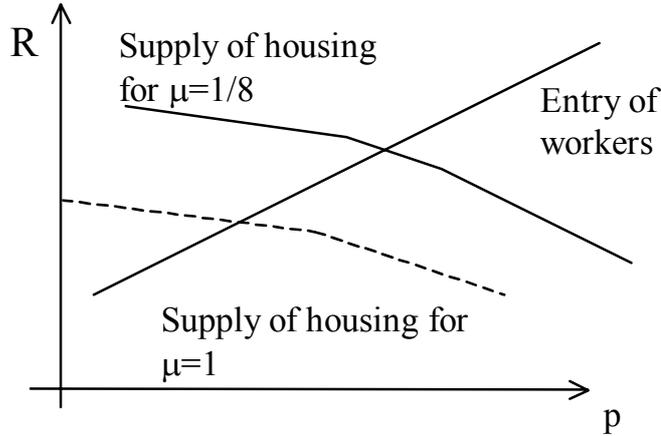


Figure 7: General equilibrium in the space  $R$  (rent) and  $p$  (matching rate for landlords). Solid line: sclerotic housing market ; dashed line: fluid labor market.

### 5.3 A Beveridge curve representation

The matching process specified in Appendix C allows for a convenient representation in the space of the number of vacant dwellings (denoted by  $V$ ) and the number of tenants in stage 1 (denoted by  $S$ ). See this Appendix for details. In Figure 8, the upward sloping curve reflects the equilibrium ratio  $V/S$  which comes directly from the equilibrium value of  $p$ . The downward sloping, convex curve is the Beveridge curve: it is a steady-state condition obtained when inflows and outflows into housing are balanced. It simply reflects the number of vacant dwellings necessary to maintain a constant number of unmatched tenants, conditional on a matching technology and the reservation strategies of agents. The main insight here is that when matching is less efficient or when landlords (or the agency) are more selective, the curve is shifted away from the origin. The distance to the origin is a measure of the degree of mismatch in the housing market. We also know, from Figure 7, that a lower  $\mu$  is associated with a lower  $p$  and thus a higher  $V/S$  ratio. On Figure 8), the net effect on  $S$  is ambiguous but  $V$  is definitely higher.

## 6 Conclusion

Starting from the observation of a relatively poor functioning of the French housing market compared to Quebec, we have explored the details of regulation and legislation in both regions. We have identified a few differences, notably in terms of protection of tenants with respect to landlords. The reading of the two laws of Quebec and France gives the impression that the balance of power between landlords and tenants is carefully designed, although it is at different point: as stated above, in Quebec, landlords cannot

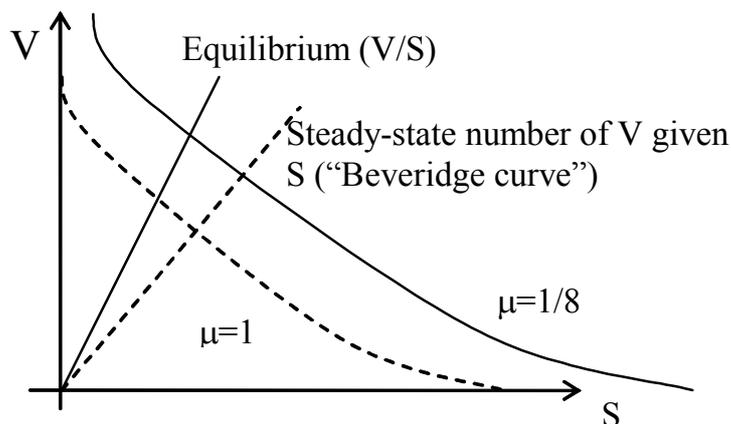


Figure 8: An alternative representation of the equilibrium for different values of  $\mu$ . Solid line: sclerotic housing market ; dashed line: fluid labor market.

ask security deposits but can terminate a lease rather fast and possibly evict a tenant rather rapidly. In France, landlords cannot easily terminate the contractual relation and eviction is very uncertain and costly but the law let them ask two months security deposits and numerous guarantees.

Policy makers in France have however recognized that, given the increasing difficulties associated with termination of leases, landlords would have incentives to screen tenants more strongly and/or to leave their dwelling vacant at the margin which is inefficient. In response, they have designed a few additional legislations to attempt to counterbalance this trend. The first one is an anti-discrimination one. The text is in Appendix D. It states that discrimination based on a long list of characteristics—notably ethnical characteristics—is explicitly forbidden. Discrimination on income and wealth is however not explicitly prohibited. An important recent innovation of this text is that the burden of the proof is to the defender—in this case, the landlord has to prove that he did not discriminate if he happens to be sued. A second legislation, coming from the observation that 6.8% of dwellings are vacant in France (Sénat, 2003), has been proposed in 1998 by a former minister of social affairs —Martine Aubry—: it imposes a tax on vacant dwelling. The first version of the text was first found in contradiction with the French constitution. The new version has passed, with mixed success (collection costs marginally above the product and few evidence of causal effects).

Our model gives an indication of how economic forces interact with such constraints. We have indeed explored the functioning of the housing market in which tenants can default and landlords may screen, either themselves or via an agency. We have argued that the dimension of the complexity of the eviction procedure after a default could be characterized by two parameters (length and cost), and have adapted

some models from labor theory to discuss their implications in the housing market. Our results are that, in partial equilibrium, more costly and longer eviction procedures lead to more selectivity of landlords. In general equilibrium—characterized by the entry of tenants and a long-run supply of housing—, more costly and longer eviction procedures lead to higher rents, slower matching for tenants and overall, a higher degree of mismatch, characterized by the coexistence of a high number of prospective tenants and of vacant dwellings (in technical terms, the Beveridge curve of the housing market is shifted away from the origin).

The paper is thought as a very first step in order to capture the complexity of the housing market. Future research will attempt to investigate, in this benchmark model, the impact of various housing policies, such as taxation, subsidies and social housing.

## A Legal details, main text law, France and Quebec

Table A: comparison of French and Quebec lease and lessor/lessee relationship

Country	France	Quebec
Duration & Termination		
Typical duration of lease <sup>(a)</sup>	3 years	1 year
Termination of the lease by the lessee before the term of a fixed lease	yes with 3 months notice (can be 1 if new job)	no except for very specific reason <sup>(b<sub>2</sub>)</sup>
Termination of the lease by the lessor before the term of a fixed lease	impossible	6 months <sup>(c<sub>2</sub>)</sup>
Notice to terminate the lease for lessor at the term of fixed lease	3 months <sup>(e<sub>1</sub>)</sup>	3 months <sup>(c<sub>2</sub>)</sup>
Notice to terminate the lease for both parties if unlimited lease	na	Min (term of payment, 3 months)
Automatic renewal of the lease	yes, unless the lessor notifies a serious reason <sup>(d<sub>1</sub>)</sup>	yes, unless the lessee notifies he leaves
Other restrictions to the non-renewal of a lease for the lessor	yes <sup>(e<sub>1</sub>)</sup>	no
Explicit possibility of eviction of lessee after the end of the lease	no	yes <sup>(f<sub>2</sub>)</sup>
Lease		
Lease can be oral	no <sup>(g<sub>1</sub>)</sup>	yes, partly <sup>(g<sub>2</sub>)</sup>
Lease specifies a verification of the state of the dwelling	yes <sup>(h<sub>1</sub>)</sup>	no
Lease has to be in French	yes	no <sup>(i<sub>2</sub>)</sup>
Entry costs		
Compulsory insurance for the lessee	yes	no
Resiliation of the lease for default of insurance	yes if specified <sup>(j<sub>1</sub>)</sup>	
Limit to advance payment demanded by lessor	1 month of rent <sup>(k<sub>1</sub>)</sup>	1 month of rent
Security deposit or post-dated guarantee cheque	less than 2 months of rent	no
Rent increase		
Rent readjustment within the term of the lease	yearly, at fixed date if specified in the lease <sup>(l<sub>1</sub>)</sup>	after 12 months
Automatic revision of the rent specified in the lease	limited <sup>(m<sub>1</sub>)</sup>	no
Rent readjustment at termination of the lease	No unless "evidently undervalued" <sup>(l<sub>1</sub>)</sup>	yes but possibility of "objection"
Notice for lease change by lessor at the end of a fixed lease	At least six months <sup>(n<sub>1</sub>)</sup>	at least 3 months, no more than 6 months <sup>(n<sub>2</sub>)</sup>
Possibility for the lessee to object the modification	Yes even passively <sup>(o<sub>1</sub>)</sup>	Yes if notified <sup>(o<sub>2</sub>)</sup>
Procedure for default of payment		
Automatic resiliation of lease for default of payment	no <sup>(p<sub>1</sub>)</sup>	yes <sup>(p<sub>2</sub>)</sup>
Resiliation of the lease is obtained	2 months after a "commandement à payer" <sup>(q<sub>1</sub>)</sup>	if lessee is more than 3 weeks late or regularly late with prejudice
Explicit causes of nullity of the procedure	A lot <sup>(r<sub>1</sub>)</sup>	no <sup>(r<sub>2</sub>)</sup>
Court discretion about non-resiliation	unlimited <sup>(s<sub>1</sub>)</sup>	limited <sup>(s<sub>2</sub>)</sup>
Miscellaneous		
Punitive damage due to harassment by the lessor	not in the Law	mentioned in the Law
Sublease	no except if lessor agrees <sup>(t<sub>1</sub>)</sup>	yes except for serious reason by the lessor <sup>(t<sub>2</sub>)</sup>
Lessors cannot ask	photograph; social insurance card; <sup>(u<sub>1</sub>)</sup> banking details (relevé ; attestation de bonne tenue)	National insurance card (t.b.c.)

**Table B. Time evolution of legal procedures and effective evictions**

	1997	1998	1999	2000	2001	2002	2003
Contentieux locatifs avec demande de délivrance de titre exécutoire (1)	113 432	100 554	97 575	104 433	107 639	111 395	nd
Décisions de justice prononçant l'expulsion (1)	87 717	75 125	71 323	79 614	81 080	84 138	nd
Nombre de commandements de quitter les lieux (2)	47 821*	47 623*	43 017	50 858 45 828*	52 345 47 473*	52 351 47 605*	nd
Nombre de demandes de concours de la force publique (2)	32 294	33 285	29 823	33 872	36 400	38 151	39 924
Nombre de décisions accordant le concours de la force publique (2)	14 473	13 256	13 915	16 275	16 844	20 087	23 089
Nombre d'interventions effectives de la force publique (2)	4 753	4 359	4 866	5 936	6 337	7 534	9 717

(1) Source : ministère de la justice - Les chiffres du ministère de la justice pour l'année 2003 ne sont pas encore connus.

(2) Source : ministère de l'intérieur

\* hors Paris

Row 1 : legal procedures

Row 2 : legal decision for eviction

Row 3 : formal demand for eviction in application of the legal decision

Row 4 : formal demand for police intervention

Row 5 : acceptance of police intervention

Row 6 : effective police intervention

(a): The regular contract in France. The reference period in Quebec.

(b<sub>2</sub>): If the lessee is allocated a dwelling in a low rental housing ; if handicap ; if elderly and admitted permanently in a care centre.

(c<sub>1</sub>): Article 15: for first degree relatives of the lessor or of his/her spouse of in case of a sale.

(c<sub>2</sub>): Article 1957 and 1959. For first degree relatives of the lessor or of his/her spouse or to divide the dwelling, enlarge it substantially or changes its destination.

(d<sub>1</sub>): Article 10: Si le bailleur ne donne pas congé dans les conditions de forme et de délai prévues à l'article 15, le contrat de location parvenu à son terme est soit reconduit tacitement, soit renouvelé. Article 15: (...) ce congé doit être justifié soit par sa décision de reprendre ou de vendre le logement, soit par un motif légitime et sérieux, notamment l'inexécution par le locataire de l'une des obligations lui incombant. A peine de nullité, le congé donné par le bailleur doit indiquer le motif allégué, et en cas de reprise, les nom et adresse du bénéficiaire de la reprise qui ne peut être que le bailleur, son conjoint (...), ses ascendants, descendants ou ceux de son conjoint. (...) Le congé doit être notifié par lettre recommandée avec demande d'avis de réception ou par notification d'huissier. Pendant la période de préavis, le locataire n'est redevable du loyer et des charges que pour le temps où il a réellement occupé les lieux si le congé a été notifié par le bailleur.

(e<sub>1</sub>): Article 15, III: If the lessee is more than 70 and his income is less than 1.5 times the legal minimum wage, another dwelling has to be proposed to the lessee in specified geographical limits (as defined in article 13bis of the Law of September First, 1948), otherwise the lessor cannot object to the renewal of the lease.

(f<sub>2</sub>): Article 1889: The lessor of an immovable may obtain the eviction of a lessee who continues to occupy the leased premises after the expiry of the lease or after the date for the surrender of the premises agreed upon during the term of the lease.

(g<sub>1</sub>): Article 3: Le contrat de location est établi par écrit. Un état des lieux, établi le cas échéant par huissier, est inclu.

(g<sub>2</sub>): Article 1895: if the lease is oral, a writing setting forth the name and address of the lessor, the name of the lessee, the rent and address of the leased property, (...). The writing forms part of the lease.

(h<sub>1</sub>): Article 1. If this is done by a "huissier", both parties have to be noticed seven days in advance by a "lettre recommandée avec accusé de réception".

(i<sub>1</sub>): Since the French Revolution, all private written contracts have to be in French (it was referred to as the Loi de la Terreur Linguistique meant at eradicating regional languages).

(i<sub>2</sub>): Article 1897: The lease can be drawn-up in another language at the express wish of both parties.

(j<sub>1</sub>): Article 7 alinea g: Toute clause prévoyant la résiliation de plein droit du contrat de location pour défaut d'assurance du locataire ne produit effet qu'après un mois après un commandement demeuré infructueux. Ce commandement reproduit, sous peine de nullité, les dispositions du présent paragraphe.

(k<sub>1</sub>): Article 7: le paiement mensuel est de droit lorsque le locataire en fait la demande

(l<sub>1</sub>): Article 19 specifies that rents serving as reference for the determination of the "underevaluation" must be representative of the rents in the neighborhood for comparable dwellings. The lessor has to produced at least three references, or six in cities (the list of which being established in a special decree!) when they belong to an agglomeration with a population above 1 million.

(m<sub>1</sub>): Article 17 d): automatic increases of the rent cannot exceed the evolution of the price index of new building determined by INSEE (French National Institute of Statistics).

(n<sub>1</sub>): Article 17 c): notifying a change of the rent excludes the possibility of "congé".

(n<sub>2</sub>): Article 1942: if lease is more than 12 months. If it is less, notice has to be between 1 and 2 months

(o<sub>1</sub>): Article 17 c) : En cas de désaccord ou à défaut de réponse du locataire quatre mois avant le terme du contrat, l'une ou l'autre partie saisie la commission de consultation. A défaut d'accord constaté par la commission, le juge est saisi avant le terme du contrat. A défaut de saisine, le contrat précédent est reconduit de plein droit aux conditions antérieures du loyer éventuellement révisé. La hausse convenue entre les parties ou fixée judiciairement s'applique par tiers ou par sixième, selon la durée du contrat. If the rent increase is above 10%, the increase is by fraction of 1/6 of the increase yearly.

(o<sub>2</sub>): Article 1945: lessee can notify he/she objects within a month after the notice. If the lessee does not notify the lessor, he is deemed to accept the new lease. If he notifies the objection, the lessor may apply to the court for the setting of the rent. Otherwise, the former lease is renewed (art. 1947).

(p<sub>1</sub>): see details of the procedure in Appendix B

( $p_2$ ): Article 1971 specifies that if the lessee is three weeks late or regularly late, the lessor can obtain the resiliation of the lease. Article 1973 specifies that the court can grant it immediately or order the debtor to perform his obligation within a period it determines, except where payment of the rent is over three weeks late. Where the debtor does not comply with the decision of the court, the court resiliate the lease.

( $q_1$ ): Article 24. A "commandement à payer" is a legal act established and brought by an "huissier de justice" i.e. a process server.

( $r_1$ ): Article 24. A peine d'irrecevabilité de la demande, l'assignation aux fins de constat de la résiliation est notifiée à la diligence de l'huissier de justice au représentant de l'Etat dans le département, par lettre recommandée avec demande d'avis de réception, au moins deux mois avant l'audience, afin qu'il saisisse, en tant que de besoin, les organismes dont relèvent les aides au logement, le Fonds de solidarité pour le logement ou les services sociaux compétents. (...). Le commandement de payer reproduit, à peine de nullité, les dispositions des alinéas précédents ainsi que du premier alinéa de l'article 6 de la loi 90-449 du 31 mai 1990 visant la mise en oeuvre du droit au logement, en mentionnant la faculté pour le locataire de saisir le fonds de solidarité pour le logement dont l'adresse est précisée. Lorsque les obligations résultant d'un contrat de location conclu en application du présent titre sont garanties par un cautionnement, le commandement de payer est signifié à la caution dans un délai de quinze jours à compter de la signification du commandement au locataire. A défaut, la caution ne peut être tenue du paiement des pénalités ou intérêts de retard.

( $r_2$ ): Quite the contrary. Article 1 in Division 1 of another text "Rules of procedure of the Régie du Logement" states that : "Unless the commissioner decides otherwise, any delay, or formal or procedural irregularity may be remedied before him at the hearing."

( $s_1$ ) Le juge peut, même d'office, accorder des délais de paiement, dans les conditions prévues aux articles 1244-1 (premier alinéa) et 1244-2 du code civil, au locataire en situation de régler sa dette locative. Pendant le cours des délais ainsi accordés, les effets de la clause de résiliation de plein droit sont suspendus ; ces délais et les modalités de paiement accordés ne peuvent affecter l'exécution du contrat de location et notamment suspendre le paiement du loyer et des charges. Si le locataire se libère dans le délai et selon les modalités fixés par le juge, la clause de résiliation de plein droit est réputée ne pas avoir joué ; dans le cas contraire, elle reprend son plein effet.

( $t_1$ ): Article 8: Le locataire ne peut ni céder le contrat de location, ni sous-louer le logement sauf avec l'accord écrit du bailleur y compris sur le prix du loyer. Les autres dispositions de la présente loi ne sont pas applicables au contrat de sous-location.

( $t_2$ ): Article 1870 and 1871: A lessee may sublease all or part of the leased property. In any case, he is bound to give notice of his intention and the name and address of the intended sublessee (...) to the lessor and to obtain his agreement. The lessor may not refuse to consent to the sublease (...) without a serious reason.

( $u_1$ ): Article 22-2.

Other folklore

a) The article 9 created by the French law of the 8th of July 1989 states that: "When two lessees occupying two dwellings belonging to the same landlord in the same residential estate ask for an exchange between them, the exchange must be accepted by the landlord if one of the two families has at least three children and the exchange leads to an increase in the available surface for the more numerous family. Both lessees keep their rights and notably those associated with seniority."

b) The article 10 specifies that if the notification of termination by the lessor is because the dwelling is for sale, the conditions and the price of the sale must be notified or the notification is null. The notification is implicitly an offer to the lessee.

## B Eviction in France: text of the decree

Décret n° 92-755 du 31 juillet 1992 instituant de nouvelles règles relatives aux procédures d'exécution pour l'application de la loi du 9 juillet 1991.

Art.8 - (2ème alinéa) - Le juge de l'exécution ne peut ni modifier le dispositif de la décision de justice qui sert de fondements aux poursuites, ni en suspendre l'exécution si ce n'est dans les cas prévus par la loi pour l'octroi d'un délai de grâce.

Art. 50 - Si l'huissier de justice est dans l'obligation de requérir le concours de la force publique, il s'adresse au préfet.

La réquisition contient une copie du dispositif du titre exécutoire. Elle est accompagnée d'un exposé des diligences auxquelles l'huissier de justice a procédé et des difficultés d'exécution.

Toute décision de refus de l'autorité compétente doit être motivée. Le défaut de réponse dans un délai de deux mois équivaut à un refus.

Ce refus est porté à la connaissance du procureur de la République et du créancier par l'huissier de justice.

Art. 194 - Le commandement d'avoir à libérer les locaux prend la forme d'un acte d'huissier de justice signifié à la personne expulsée et contient, à peine de nullité :

1° L'indication du titre exécutoire en vertu duquel l'expulsion est poursuivie ;

2° La désignation de la juridiction devant laquelle peuvent être portées les demandes de délais et toutes contestations relatives à l'exécution des opérations d'expulsion ;

3° L'indication de la date à partir de laquelle les locaux devront être libérés ;

4° L'avertissement qu'à compter de cette date il pourra être procédé à l'expulsion forcée du débiteur ainsi qu'à celle de tout occupant de son chef. Ce commandement peut être délivré dans l'acte de signification du jugement

Art. 195 - Lorsque l'expulsion porte sur un local affecté à l'habitation principale de la personne expulsée ou de tout occupant de son chef, le commandement d'avoir à libérer les locaux contient, à peine de nullité, en plus des mentions prévues à l'article 194, la reproduction de l'article 62 de la loi du 9 juillet 1991 et celle des articles L. 613-1 à L. 613-5 du code de la construction et de l'habitation.

Art. 197 - L'huissier de justice envoie au préfet du département du lieu de situation de l'immeuble, par lettre recommandée avec demande d'avis de réception, copie du commandement d'avoir à libérer les locaux.

Dans toute la mesure du possible, il communique tous renseignements relatifs à l'occupant dont l'expulsion est poursuivie ainsi qu'aux personnes vivant habituellement avec lui.

## C Matching and entry of tenants

The model is closed by the introduction of a matching function between  $V$  efficiency units of vacant dwelling and  $S$  agents looking for a dwelling: the total number of matches per period is

$$m(V, S) = m_0 V^\alpha S^{1-\alpha},$$

which has constant returns to scale, with  $m_V > 0$ ,  $m_S > 0$  and  $m_{VV}$ ,  $m_{SS} < 0$ . The number of efficiency units  $V$  is simply the number of landlords in strategy 0 and S, plus  $\sigma_A$  multiplied by the number of agencies prospecting for a landlord.

It follows, denoting by  $\theta = V/S$  the tightness of this market, that

$$\begin{aligned} p(\theta) &= m(V, S)/V = m_0 \theta^{-(1-\alpha)}, \\ p_A(\theta) &= \sigma_A m(V, S)/V = \sigma_A m_0 \theta^{-(1-\alpha)}, \end{aligned}$$

and that the Poisson rate at which agents find a landlord with a vacant unit of dwelling is

$$q(\theta) = m(V, S)/S = m_0 \theta^\alpha = \theta p(\theta).$$

Let tenants' asset value in stage  $i$  be denoted by  $T_i$ . Prospection costs for tenants are denoted by  $k$ , they derive a utility  $v$  from the consumption of housing in stage 2. In stage 3, they are hit by the liquidity shock leading to asset value  $T_3$ . We assume that  $T_3$  is also the outside option of tenants denoted by  $L$  and normalized to zero. We then have the following Bellman equations:

$$rT_1 = -k + q(\theta)(T_2 - T_1), \tag{C1}$$

$$rT_2 = v - R + \lambda(Q)(0 - T_2). \tag{C2}$$

Note that both  $T_1$  and  $T_2$  depends positively on  $Q$ , as the probability of facing an adverse shock declines with  $Q$ . It also depends negatively on the rent. We thus have, combining equations (C1) and (C2):

$$T_1(Q, R) = \frac{-k + q(\theta) \frac{v-R}{r+\lambda(Q)}}{r + q(\theta)}.$$

The entry condition of tenants is similar to equation (24): the utility of an agent with quality  $Q$  has to be larger than the outside option  $L = 0$ , implying

$$\begin{aligned} T_1(Q, R) &\geq 0, \\ T_1(Q_{\min}, R) &= 0, \end{aligned}$$

and thus,

$$q(\theta) \frac{v-R}{r + \lambda(Q_{\min})} = -k. \quad (\text{C3})$$

It is very important to note that  $R$  cannot be different across types of tenants, and second, that all types of tenants prospect in the market.

Given that  $p$  and  $\theta$  are monotonically linked, for a given  $p$  there is a unique value of  $\theta$  :  $\theta = (p/m_0)^{-1/(1-\alpha)}$  and thus a unique value  $q(\theta)$ : we have

$$q = m_0 \theta^\alpha = m_0 (p/m_0)^{-1/(1-\alpha)}. \quad (\text{C4})$$

Equation (C3) thus becomes

$$m_0 (p/m_0)^{-1/(1-\alpha)} \frac{v-R}{r + \lambda(Q_{\min})} = -k.$$

Equation (C3) and equation (24) jointly determine  $(R, p)$ .<sup>14</sup> Equation (C3) indeed defines a negative relation between  $p$  and  $R$ , stating that tenants in stage 1 accept a higher rent for a faster matching in the housing market.

## D Anti-discrimination law and access to housing

France. Loi de modernisation sociale du 17 janvier 2002, article 158.

« Aucune personne ne peut se voir refuser la location d’un logement en raison de son origine, son patronyme, son apparence physique, son sexe, sa situation de famille, son état de santé, son handicap, ses moeurs, son orientation sexuelle, ses opinions politiques, ses activités syndicales ou son appartenance ou sa non-appartenance vraie ou supposée à une ethnie, une nation, une race ou une religion déterminée.

« En cas de litige relatif à l’application de l’alinéa précédent, la personne s’étant vu refuser la location d’un logement présente des éléments de fait laissant supposer l’existence d’une discrimination directe ou indirecte. Au vu de ces éléments, il incombe à la partie défenderesse de prouver que sa décision est justifiée. Le juge forme sa conviction après avoir ordonné, en cas de besoin, toutes les mesures d’instruction qu’il estime utiles. »

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<sup>14</sup>One can easily imagine a different, more complex equilibrium where  $Q_{\min}$  would also be endogenous, i.e. some low quality tenants would not try to apply to a given neighborhood. In such case, a third closing condition, specifying for instance how the rent can be determined, would be necessary to close the model. We do not explore this equilibrium here.

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