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The neighbor is king:

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Abstract

This paper provides a method to single out customer-based discrimination in the housing market. We build a matching model with ethnic externalities where landlords differ in the number of housing units they own within the same building. Multiple-dwelling landlords discriminate more often than single-dwelling landlords only if some tenants are prejudiced against the minority group. By testing the null hypothesis whereby minority tenants are equally likely to have a multiple-dwelling landlord, we can test whether there is customer discrimination or not. We run the test on French data and show evidence of customer discrimination in the rental market.

JEL codes: R21, J71.
Keywords: Customer Discrimination, Matching frictions, Neighborhood Externalities, Housing Market;

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1 Introduction

Providing conclusive evidence of housing market discrimination remains a challenging empirical enterprise (Dymski (2002)). It either requires very detailed datasets or the conduct of randomized experiments (Yinger (1986)). Moreover, most research on housing market discrimination has not benefited as much as it could have from Becker's (1957) theoretical insights into the rationale for customer discrimination. And yet the housing market is the quintessential customer market (Lang (2007)). According to Farley, Steeh, Krysan, Jackson, and Reeves (1994) "*most discriminatory behavior in the housing market is founded upon either the personal prejudices of agents or their belief that it is in their financial interest to cater to the presumed prejudices of their Anglo customers*". In particular, the respective roles played by landlords' and tenants' prejudice in the discrimination process are seldom clearly disentangled, even though the parallel is easily drawn between landlords and employers and between customers and tenants. This paper addresses both the theoretical and empirical challenges to single out customer discrimination from statistical discrimination and taste-based discrimination in the housing market. To our knowledge, we provide the first theoretical model of customer discrimination for this market; this model paves the way for a specific empirical strategy, which we implement on French data.

Becker's model of customer discrimination focuses on the good market. In Becker (1957), firms do not hire black applicants for jobs in contact with customers because white customers' racial prejudice reduces black employees' productivity. Transposed to the housing market, Becker's reasoning implies that tenants' utility depends on the ethnic composition of the neighborhood. Prejudiced applicants care about the racial makeup of the neighborhood and they refuse to move in next to a neighbor whose ethnic composition they dislike. Landlords are aware of that and it may affect their decision to accept a minority tenant regardless of their own prejudice. Accepting a minority tenant creates a negative externality at the neighborhood level. How landlords react to prejudiced whites depends on their ability to internalize the externality, which in turn depends on the number of apartments they own within the same neighborhood. Namely, the more apartments they own, the more sensitive to applicants' prejudice and the more often they discriminate.

In this paper, the negative externality created by a minority tenant intervenes at the building level. We mainly focus on the rental market and model landlords' decision-making process in a dynamic framework with ethnic heterogeneity, two-dwelling buildings, and matching frictions (Section 2). Rents are fixed and some Whites are prejudiced against Black tenants. Landlords have to choose whether they accept an applicant or wait for another applicant. Landlords are heterogenous with respect to the number of housing units they own within the same building (one or two). Single-dwelling landlords sharing a building property play a dynamic game whose (Markovian) equilibria are studied. Multiple-dwelling landlords run the building efficiently.

The model predicts that all landlords have the same behavior when faced with unprejudiced White applicants. However, when there are prejudiced Whites, landlords who own two contiguous apartments discriminate more often than those who only own one apartment. Indeed, the latter only care about the impact of their selection decision on their ability to rent out the same apartment again in the future (dynamic externality), while the former also care about the

impact of their decision on their current ability to rent out the other vacant lot (static externality). This leads to the prediction that Black tenants should less often have landlords who own several housing units within the same neighborhood only in the event of customer-based discrimination against Black applicants. This result is valid even though there may be multiple equilibria in the strategic game played by single-dwelling landlords. This prediction is testable on regular survey data and constitutes a direct test for the presence of customer-based discriminatory practices in the housing market.

We then provide an empirical application on French data (Section 3). The French case is relevant for two reasons. First, the difficult integration of ethnic minorities is a major public policy concern. The urban riots of Fall 2005, where more than nine thousand vehicles were burned in three weeks (with a climax of almost four thousand in three nights), showed that France had ethnic-relation issues, even though the mere possibility of a specifically ethnic problem had long been denied by the color-blindness that ostensibly informs French political philosophy. We seek here to investigate whether some of the difficulties experienced by ethnic minorities in France (mainly people coming from former French colonies in Africa) may be attributed to customer discrimination. The second reason for picking France is that there is little legal room for price discrimination in the French rental market, which suits our fixed-price model. The asked rent is generally posted on the ad and landlords are not allowed to increase it unilaterally before signing the lease. Moreover, a set of laws and regulatory practices prevents them from fixing prices at their will on many segments of the private rental market. Price discrimination must be covert: it may involve the amount of the security deposit (two or three months), or temporary discounts in exchange for improving the quality of the dwelling. Our assumption here is that the bulk of discrimination, if any, has to come through quantity rationing.[1] This assumption is tested through the course of our empirical investigation.

Section 3 conducts a direct empirical test of the theory. This test relies on the assumption that, conditional on all *observable* characteristics of the dwelling, tenants do not directly derive utility from whether the landlord owns several contiguous apartments or not. Under this assumption, the conditional allocation of tenants across landlords' types can be interpreted as the result of a quasi natural experiment, which only reflects the supply side of the market and does not raise selection issues regarding the choice of residence. Using data from the French National Housing Survey, we show that first-generation immigrants of Non-European origin who live in privately-rented apartments are less likely to have a landlord who owns the entire building. This result is interpreted as the expression of a supply constraint exerted by multiple-dwelling landlords upon minority applicants. Since it is equivalent to rejecting the null hypothesis whereby minority tenants are equally likely to have a multiple-dwelling landlord, this result constitutes a strong indication of customer-based discriminatory practices in the French private rental market.

This direct test contributes towards a new way of providing empirical evidence on housing market discrimination. So far, two methodologies have been developed to detect discrimination

[1] A similar phenomenon occurs in the labor market. According to Aeberhardt, Fougère, Pouget, and Rathelot (2010), non-European immigrants are paid less and suffer higher unemployment rates. However, controlling for individual characteristics, residual ethnic wage differentials are very small, whereas residual unemployment disparity is very large.

in consumer markets but both are subject to criticism (Yinger (1998)). The first method uses available survey data and looks for the effect of the consumers' ethnic status on the characteristics of the goods to which they have access. This is done to answer the following question: everything else equal, do minorities have to resort to lower quality goods and/or pay higher prices than other consumers? In the US, price discrimination in the housing market has been studied since the 1960s, when the growing expansion of the Afro-American and Hispanic middle class was starting to modify the racial makeup of Suburbia (Rapkin (1966), King and Mieszkowski (1973)). Numerous studies based on hedonic methodology and geographical discontinuities show that Blacks often have to pay a premium to enter formerly all-white neighborhoods (Yinger (1997)). The use of large-scale representative surveys is well grounded from a policy-oriented viewpoint since it gives an idea of the aggregate impact of discrimination. However, this methodology requires the availability of extremely detailed information in order to minimize the risk that the observed pattern might be due to a third factor, either from the consumers' side or from the suppliers' side. Moreover, this methodology does not provide evidence on discrimination in the making: how and why agents discriminate remains unknown and discrimination, if attested, remains a black box.

The second method hinges on pair-based audits, which highlight the role played by realtors. Many such audits have been conducted in the US since the late 1970s. For instance, using the results from an audit conducted in 1981 in Boston, Yinger (1986) shows that black applicants are offered up to 30% fewer opportunities to visit housing units: two decades later, this gap narrowed but was far from having closed (Zhao, Ondrich, and Yinger (2006)). Another example could be found in the Housing Discrimination Study of 1989, where a series of audits on 25 US metropolitan areas led to another wave of evaluations (see, e.g., Ondrich, Stricker, and Yinger (1999)). Recently, field experiments using newly available matching techniques, such as the Internet, have been conducted. Ahmed and Hammarstedt (2008) provide strong evidence for gender and ethnic discrimination in the Swedish rental market, by looking at the reaction of landlords who had posted an ad on the Web and were contacted by fictitious applicants with distinctively ethnic and gender names (see also Hanson and Hawley (2011) who conduct a similar study on U.S. cities).

Our methodology borrows from both kinds of studies. We go back to the theory of discrimination and extract one specific rationale for discrimination out of the black box. In this respect, the closest paper to ours is the one by Charles and Guryan (2008), who focus on taste-based discrimination. We then derive an identification strategy, which relies on fairly weak assumptions regarding consumers' and suppliers' tastes. This strategy is in line with a recent study based on a series of field experiments, which aims to provide empirical frameworks for analyzing the nature of discrimination observed (Gneezy, List, and Price (2012)).[2] Thanks to the use of an original variable on the geography of landlords' real estate portfolios, we are able to isolate the impact of customer discrimination.

[2]Gneezy, List, and Price (2012) distinguish two broad classes of discrimination: when the nature of discrimination is *animus* and when statistical discrimination occurs. They do not focus on customer discrimination, and they do not examine the housing market.

2 Customer discrimination in the housing market: theory

2.1 The model

We describe the rental pattern of a two-dwelling building in a context where some of the majority renters are prejudiced against people from (ethnic) minorities. We distinguish two cases. In the first one, the building is owned by a unique landlord. In the second one, it is owned by two separate landlords who act non-cooperatively. We refer to single-dwelling landlords as type-1 landlords and to multiple-dwelling landlords as type-2 landlords.

Set-up.—Time is continuous. The building comprises two apartments. Each apartment is occupied by a white tenant (w), a black tenant (b), or is vacant (v). The state space of occupancy for each building is $\{v, w, b\} \times \{v, w, b\}$. Owners with a vacant dwelling meet applicants at constant rate η. The applicant may be white with probability $p_w = p$ or black with complementary probability $p_b = 1 - p$. Prejudice is one-sided: nobody is prejudiced against Whites; Blacks are not prejudiced against Blacks; a fixed fraction α of the population of Whites is prejudiced against Blacks.[3] Prejudiced Whites refuse to enter a dwelling when the neighbor is Black. However, they do not move out if a black tenant moves in next to them.[4] We briefly discuss the alternative case in Section 2.6.

When a black applicant is willing to enter the dwelling, the landlord accepts with some probability. In all generality, such a probability may depend on many different factors such as time and building occupancy state history (including the current state). We restrict our attention to Markovian processes, whereby the acceptance probability depends only on contemporaneous building state. Let $\beta = (\beta_{bv}, \beta_{bw}, \beta_{bb}) \in [0,1]^3$ denote the vector of stationary probabilities of entering state b when the other dwelling is in state $l = v, w, b$. Similarly, $\bar{\beta} = \left(\bar{\beta}_{bv}, \bar{\beta}_{bw}, \bar{\beta}_{bb}\right) \in [0,1]^3$ denote the vector of stationary probabilities for the other dwelling.

Landlords receive a *fixed* rent R that does not depend on a tenant's race. However, to account for the event of statistical discrimination, the "net" rent is ethnic-specific with $R_w \geq R_b$. This assumption accounts for cases where Blacks would be more likely to default on the rent or cause higher maintenance costs. The differential rent may also result from arbitrary beliefs that landlords may have vis-à-vis Blacks.

At each date, landlords cannot evict a tenant, but tenants leave the apartment they rent with flow probability q.

Dwellings' values.—Landlords, whatever their type, are risk neutral and discount time at rate r. Let $\Pi : [0,1]^3 \times [0,1]^3 \to \mathbb{R}^9$ denote the function of gains associated with the ownership of *one* apartment. The typical element is $\Pi^{kl}\left(\beta, \bar{\beta}\right)$, where $k, l = v, w, b$ denote the occupancy status of each dwelling. The dependence vis-à-vis β and $\bar{\beta}$ will be omitted whenever this does not cause a misunderstanding.

For all $i, j = w, b$, the elements of the gain function at a stationary state are recursively

[3] US studies show that more than 70% of Whites are not willing to move into a neighborhood which is more than 50% Afro-American, whereas more than 80% of Afro-Americans are willing to move into a neighborhood with only a few black neighbors (Farley, Steeh, Krysan, Jackson, and Reeves (1994)).

[4] This assumption is compatible with the behavior of US White households as described by Ellen (2000).

defined as follows:

$$
\begin{aligned}
r\Pi^{ij} &= R_i + q\left[\Pi^{vj} + \Pi^{iv} - 2\Pi^{ij}\right], && (1)\\
r\Pi^{iv} &= R_i + q\left[\Pi^{vv} - \Pi^{iv}\right] + \eta\sum\nolimits_l p_l\left(1-\alpha_{li}\right)\bar{\beta}_{li}\left[\Pi^{il} - \Pi^{iv}\right], && (2)\\
r\Pi^{vj} &= q\left[\Pi^{vv} - \Pi^{vj}\right] + \eta\sum\nolimits_k p_k\left(1-\alpha_{kj}\right)\beta_{kj}\left[\Pi^{kj} - \Pi^{vj}\right], && (3)\\
r\Pi^{vv} &= \eta\sum\nolimits_i p_i\beta_{iv}\left[\Pi^{iv} - \Pi^{vv}\right] + \eta\sum\nolimits_i p_i\bar{\beta}_{iv}\left[\Pi^{vi} - \Pi^{vv}\right], && (4)
\end{aligned}
$$

with $\alpha_{wb} = \alpha$ and $\alpha_{kl} = 0$ in all other cases, and $\beta_{wl} = \bar{\beta}_{wl} = 1$ for all $l = v, w, b$.

The system (1)–(4) comprises nine linear equations. Changes in the occupation status of one dwelling generally affect the value of the other because having a black neighbor leads prejudiced Whites to refuse the dwelling. Consider equation (2). It states that a dwelling occupied by a type-i tenant with no neighbor yields instantaneous profit R_i, but its value is likely to turn into Π^{vv} if the tenant leaves (an event occurring at rate q) as well as into Π^{il} if the other dwelling is occupied by a type-l tenant. This new tenant, who arrives at rate η, is of type l with probability p_l, accepts the dwelling offer with probability $(1-\alpha_{li})$, and is accepted by the landlord with probability $\bar{\beta}_{li}$.

Single-dwelling landlords' strategies.—Landlords choose who they accept and who they refuse. In other words, they set the probability vectors β and $\bar{\beta}$. They accept or reject applicants in a non-cooperative way. We reduce the possible strategies to state-dependent strategies. For each owner the *strategy space* is reduced to $B = \{\beta_{bl}; \beta_{bl} \in [0,1],\, l = v, w, b\}$. The *profit function* of a particular landlord is $\Pi_1 : B \times B \to \mathbb{R}^9$ with typical element $\Pi_1^{kl}\left(\beta, \bar{\beta}\right) = \Pi^{kl}(\beta, \bar{\beta})$.

A *best-response strategy* to strategy $\bar{\beta} \in B$ is a strategy $\beta \in B$ such that

$$
\beta \in \arg\max_{\tilde{\beta}\in B} \Pi\left(\tilde{\beta}, \bar{\beta}\right). \tag{5}
$$

From equations (1)–(4), best-response strategies are such that

$$
\beta_{bl} = \begin{cases} 1 \text{ if } \Pi^{bl}\left(\tilde{\beta}, \bar{\beta}\right) > \Pi^{vl}\left(\tilde{\beta}, \bar{\beta}\right) \\ [0,1] \text{ if } \Pi^{bl}\left(\tilde{\beta}, \bar{\beta}\right) = \Pi^{bl}\left(\tilde{\beta}, \bar{\beta}\right) \\ 0 \text{ else} \end{cases}. \tag{6}
$$

A *symmetric Nash equilibrium* is a vector β^* such that

$$
\beta^* \in \arg\max_{\tilde{\beta}\in B} \Pi\left(\tilde{\beta}, \beta^*\right). \tag{7}
$$

A *pure-strategy symmetric equilibrium* is a symmetric Nash equilibrium with $\beta_{bl} = 0$ or $\beta_{bl} = 1$ for all $l = v, w, b$. We also define the set of pure-strategy equilibria $B^* = \{\beta^*; \beta^* \text{ is a pure-strategy symmetric equilibrium}\}$.

The game is dynamic and the set of conditions (7) includes subgame perfection requirements. Suppose for instance that the Nash equilibrium features $\beta^*_{bv} = \beta^*_{bw} = 0$. In words: Blacks are discriminated against when the other dwelling is vacant or when it is occupied by a White

tenant. If both dwellings start vacant, then there will never be black tenants in the building. Landlords will never be confronted with a Black neighbor; they do not need to compute optimal strategies in such a case. However, subgame perfection requires that equilibrium strategies must also be optimal in situations that do not occur along the equilibrium path. Such conditions are important because they set individual-deviation gains. To pursue the example, suppose also that $\beta^*_{bb} = 1$: landlords do not discriminate against Blacks when the other dwelling is occupied by a Black. Deviating in the first stage then means accepting a black tenant knowing that the other landlord may well accept a black tenant in the future. This reasoning is crucial to establish that not deviating is the best strategy.

Multiple-dwelling landlord's strategies.—The strategy set is $B_2 = B \times B$. The profit function is $\Pi_2 : B_2 \to \mathbb{R}^9$ with typical element $\Pi_2^{kl}\left(\beta, \bar{\beta}\right) = \Pi^{kl}(\beta, \bar{\beta}) + \Pi^{lk}(\bar{\beta}, \beta)$. Multiple-dwelling landlords maximize the value of the building rather than the value of each dwelling separately.

Since the externality takes place at the building level, type-2 landlords are able to make efficient decisions. A *symmetric efficient strategy*, therefore, results from

$$\hat{\beta} \in \arg\max_{\tilde{\beta} \in B} \Pi_2 \left(\tilde{\beta}, \tilde{\beta}\right). \tag{8}$$

Such a strategy must satisfy

$$\hat{\beta}_{bl} = \begin{cases} 1 \text{ if } \Pi^{bl}(\beta,\beta) + \Pi^{lb}(\beta,\beta) > \Pi^{vl}(\beta,\beta) + \Pi^{lv}(\beta,\beta) \\ [0,1] \text{ if } \Pi^{bl}(\beta,\beta) + \Pi^{lb}(\beta,\beta) = \Pi^{vl}(\beta,\beta) + \Pi^{lv}(\beta,\beta) \\ 0 \text{ else} \end{cases}. \tag{9}$$

A *pure-strategy symmetric efficient strategy* is a symmetric efficient strategy with $\beta_{bl} = 0$ or $\beta_{bl} = 1$ for all $l = w, b, v$. We also define $\hat{B} = \{\hat{\beta}; \hat{\beta} \text{ is a pure-strategy symmetric efficient strategy}\}$.

We will mainly focus on pure symmetric strategies. Thus, we will omit the dependence of landlords' payoffs vis-à-vis $\bar{\beta}$. We will simply write $\Pi^{kl}(\beta) \equiv \Pi^{kl}(\beta, \beta)$.

2.2 The home-sale market case

We start with a simplified model where the quit rate is zero, $q = 0$. Landlords interact with applicants in the beginning of the building history, and accepted tenants stay in the building forever. This case also corresponds to the home-sale market. Such an interpretation requires the selling price to be defined as R_i/r.

The following result considers the case where there are no prejudiced tenants, i.e. $\alpha = 0$.

Proposition 1 UNPREJUDICED NEIGHBORS WITHOUT SEPARATION. *Assume $\alpha = 0$ and let $\sigma_w = \eta p/(r + \eta p)$. Then, $\hat{B} = B^* = \{(1,1,1)\}$ when $R_b/R_w \geq \sigma_w$, and $\hat{B} = B^* = \{(0,0,0)\}$ when $R_b/R_w < \sigma_w$.*

Refusing a black tenant features an option value. Blacks are discriminated against when this option value is higher than the value of the dwelling occupied by a black tenant. With

unprejudiced neighbors, the strategic interaction between single-dwelling landlords disappears. Consequently, only statistical discrimination may take place, and it is equally likely for both types of landlords.

Statistical discrimination occurs when the rent ratio R_b/R_w is sufficiently low. Then, landlords are willing to wait for a white tenant. The limit value σ_w increases with the rate at which Whites show up, and decreases with the discount rate r. More patient landlords (r small), in a rental market where the contact rate is high (η large) and there are few Blacks (p small) are more likely to discriminate.

That type-1 and type-2 landlords behave similarly when there are unprejudiced tenants lies behind our empirical strategy to test for the presence of customer discrimination on the rental market. If Blacks are discriminated against by multiple-dwelling landlords and not by single-dwelling landlords, then there are prejudiced tenants.

We now characterize the equilibrium and efficient strategies when $\alpha > 0$.

Proposition 2 EQUILIBRIUM AND EFFICIENT STRATEGIES WITHOUT SEPARATION. *Assume $\alpha > 0$, and consider the following thresholds $\sigma_b = \eta(1-\alpha)p/[r+\eta(1-\alpha)p]$, $\sigma_w = \eta p/(r+\eta p)$,*

$$\begin{aligned}
\sigma_{1v} &= \sigma_w \frac{r^2 + r\eta(2-\alpha+p) + p\eta^2(3-\alpha-p-\alpha p)}{r^2 + r\eta(2+p(1-\alpha)) + p\eta^2(3-\alpha-p-\alpha p)} < \sigma_w, \\
\sigma_{2v} &= \sigma_w \frac{r^2 + 3r\eta + 2\eta^2 + \alpha(r^2 + r\eta - 2p^2\eta^2)}{r^2 + 3r\eta + 2\eta^2 - \alpha\sigma_w(r^2 + (1+2p)r\eta + 2p^2\eta^2)} > \sigma_w.
\end{aligned}$$

Then,

(i) If $R_b/R_w < \sigma_b$, then $B^* = \hat{B} = \{(0,0,0)\}$;
(ii) If $R_b/R_w \in [\sigma_b, \sigma_{1v})$, then $B^* = \hat{B} = \{(0,0,1)\}$;
(iii) If $R_b/R_w \in [\sigma_{1v}, \sigma_w)$, then $B^* = \{(0,0,1),(1,0,1)\}$ and $\hat{B} = \{(0,0,1)\}$;
(iv) If $R_b/R_w \in [\sigma_w, \sigma_{2v})$, then $B^* = \{(1,1,1)\}$ and $\hat{B} = \{(0,1,1)\}$;
(v) If $R_b/R_w > \sigma_{2v}$, then $B^* = \hat{B} = \{(1,1,1)\}$.

There are five possible equilibrium and efficient strategies. Such strategies are $(0,0,0)$—Blacks are always discriminated against—, $(0,0,1)$—Blacks are accepted when the other tenant is black, and discriminated against otherwise—, $(0,1,1)$—Blacks are accepted whenever the other dwelling is occupied and rejected when it is vacant—, $(1,0,1)$—Blacks are discriminated against when the neighbor is white, and accepted otherwise, $(1,1,1)$—discrimination does not occur.

The main lesson of Proposition 2 is that Type-2 landlords discriminate more often than type-1 landlords. This phenomenon arises when the other dwelling is vacant. On the one hand, type-1 landlords face a coordination problem, whereas type-2 landlords do not. The coordination problem may lead to multiple equilibria. This occurs when the black-white rental ratio R_b/R_w belongs to $[\sigma_{1v}, \sigma_w)$. The two equilibria are $(1,0,1)$ and $(0,0,1)$. In both equilibria, landlords discriminate when the neighbor is white and do not when s/he is black. Discriminating when the other dwelling is vacant vehicles strategic complementarity. Suppose you are one of the landlords. If the other landlord discriminates, then the option value of keeping your own dwelling vacant is high; this leads you to discriminate. The opposite effect takes place when the other

landlord does not discriminate, whereas your own dwelling is vacant. Such multiple equilibria can be Pareto-ranked. The value of a vacant dwelling is larger when both discriminate than whey they do not.

On the other hand, type-2 landlords internalize the externality induced by the acceptance of a black tenant in a vacant building. This leads type-2 landlords to discriminate more than type-1, even when the latter coordinate on the most discriminatory equilibrium.

More formally, consider the limit situation where $R_b/R_w = \sigma_w$. Then type-1 landlords accept black tenants in all circumstances. In particular, we have $\Pi^{bv}((1,1,1)) - \Pi^{vv}((1,1,1)) = 0$, which implies that they accept black tenants when the other dwelling is vacant. In the same parametric situation, a type-2 landlord accounts for the value of the building. S/he accepts a black tenant if

$$\Pi^{bv}\left((1,1,1)\right) - \Pi^{vv}\left((1,1,1)\right) \geq \Pi^{vv}\left((1,1,1)\right) - \Pi^{vb}\left((1,1,1)\right). \tag{10}$$

The left-hand side term between brackets corresponds to the wealth gain obtained for the first dwelling. This gain is the same for both types of landlords. However, the right-hand side term accounts for the loss in value for the other dwelling. When $R_b/R_w = \sigma_w$, the former term is nil, but the latter term is positive. Type-2 landlords reject black applicants as a result.

Type-1 and type-2 landlords behave similarly when the other dwelling is occupied. Landlords of different types adopt the same behavior because, in this case, $\Pi^{ib}(\beta) - \Pi^{iv}(\beta) = 0$, $i = b, w$, i.e. once occupied, the value of the second dwelling does not depend on the neighbor's color. It follows that $\Pi^{bi}(\beta) - \Pi^{vi}(\beta) = \Pi^{bi}(\beta) - \Pi^{vi}(\beta) - (\Pi^{bi}(\beta) - \Pi^{vi}(\beta))$, which, by definition, means that type-1 and type-2 landlords face similar gains.

In this simplified model without separation, type-1 landlords never discriminate when $R_b = R_w$. Conversely, type-2 landlords may or may not discriminate in the same case. Formally, the threshold σ_{2v} may be larger or lower than one. When it is larger than one, black tenants may be discriminated against by type-2 landlords when the other dwelling is vacant.

2.3 The rental market case

We now turn to the general case where $q > 0$. Separation implies that customer discrimination is a more likely outcome than without separation. Accepting a black tenant vehicles a dynamic composition effect, which is due to the other landlord's strategy. Such a composition effect is not important when the tenant stays in the dwelling forever; however, the landlord must take it into account when separation is likely.

Proposition 3 COMPARING TYPE-1 AND TYPE-2 LANDLORDS. *(i) If $\alpha = 0$, then there is a unique Nash equilibrium, which coincides with the efficient strategy. We have $\hat{B} = B^* = \{(0,0,0)\}$ if $R_b/R_w < \eta p/(r+q+\eta p)$, and $\hat{B} = B^* = \{(1,1,1)\}$ otherwise.*

(ii) If type-2 landlords choose not to discriminate in all circumstances, then not discriminating in all circumstances is also a Nash equilibrium of the two single-dwelling landlords' game—that is, for all $j = v, w, b$, $(1,1,1) \in \hat{B}$ implies $(1,1,1) \in B^*$.

(iii) If discriminating in all circumstances is a Nash equilibrium of the two single-dwelling landlords' game, then discriminating in all circumstances is also the efficient strategy of type-2 landlords—that is,

for all $j = v, w, b$, $(0,0,0) \in B^*$ *implies* $(0,0,0) \in \hat{B}$.

Part (i) extends Proposition 1 to the rental separation case. With unprejudiced neighbors, type-1 and type-2 landlords behave similarly. They reject black applicants when the rent ratio R_b/R_w is sufficiently low. The threshold increases with the rate at which Whites apply for the rental, and decreases with the rental separation rate and the discount rate.

Part (ii) and (iii) highlight two significant cases where type-2 landlords discriminate more than type-1. Given the other tenant's type, that type-1 landlords always discriminate implies that type-2 landlords also discriminate in all circumstances (Part (i)). Similarly, that type-2 never discriminate also implies that type-1 never discriminate (Part (ii)).

The presence of prejudiced neighbors means that accepting a black tenant entails two effects. The first effect is static. Having a black tenant today reduces the chances that the other dwelling will be rented by a white tenant. Therefore the value of the other dwelling goes down. Type-1 landlords do not take this effect into account. The second effect is dynamic. Accepting a black tenant today affects the future composition of the building. In turn, this composition may alter the chances of finding another tenant in case of separation. Both types of landlords face the dynamic effect, whereas only type-2 landlords internalize the static externality. They are more likely to discriminate as a result.

We cannot find analytical results for the intermediate cases where landlords discriminate in some situations and not in others. We therefore proceed to numerical simulations.

2.4 Numerical simulations

The model is parameterized on a monthly basis. Table 1 presents the values of the different parameters. The model outputs depend only on the ratio R_w/R_b and so we normalize R_b to 1. We then cover the entire set of reasonable values for all the parameters: q between 0.7% and 7% means that the average duration of a rental is between 15 months and 150 months (in France the average length of stay is 72 months), r between 0.2% and 2% amounts to between 2.4% and 26.8% annual interest rate (high values correspond to liquidity-constrained individuals), η between 0.25 and 4 means that the average waiting period for a vacant unit before a possible match is between one week and four months (we have no reliable source of information about this parameter), and p and α describe the entire set of possible values. Statistical discrimination is made possible up to a 20% net rent differential between black and white tenants.

Table 1: Parameter values

	R_w/R_b	q	r	η	p	α
Value	$1 + i/10$	$i/150$	$i/500$	$i/4$	$i/20$	$i/20$
Span of i	$0 \to 2$	$1 \to 10$	$1 \to 10$	$1 \to 16$	$1 \to 20$	$1 \to 20$

Notes: the second line of the table gives the actual value of the corresponding parameter that is used in the simulation, as a function of the counter i; the third line describes the range of values taken by the counter i.

Nash equilibria.—Table 2 describes the equilibrium outcomes of the game played by type-1 landlords.

Table 2: Distribution of the symmetric Nash equilibria of the game played by type-1 landlords.

$(\beta_b^*, \beta_v^*, \beta_w^*)$	Nb observations	Proportion
$(0,0,0)$	642,868	33.48%
$(b,0,0)_{b\in(0,1)}$	88,707	4.62%
$(1,0,0)$	251,456	13.10%
$(1,0,0),(1,1,1)$	1,230	0.06%
$(1,0,0),(1,1,0)$	6,304	0.33%
$(1,0,0),(1,1,0),(1,1,1)$	1,020	0.05%
$(1,0,0),(1,0,1)$	6,271	0.33%
$(1,0,0),(1,0,1),(1,1,1)$	9,002	0.47%
$(1,0,0),(1,1,0),(1,0,1),(1,1,1)$	5,632	0.29%
$(1,0,1)$	6,497	0.34%
$(1,0,1),(1,1,1)$	15,497	0.81%
$(1,1,1)$	885,516	46.12%
Total	1,920,000	100%

There are five pure-strategy Nash equilibria: $(0,0,0),(1,0,0),(1,0,1),(1,1,0)$ and $(1,1,1)$. Simulating the general model reveals a number of phenomena that the no-separation case cannot predict. First, there may be up to four equilibria at a time, against two at most in the no-separation case. Such multiple equilibria only arise in 2.5% of the simulations. Second, in 4.5% of the simulations there are no pure-strategy equilibria, whereas there are always pure-strategy equilibria in the no-separation case. Such configurations admit a mixed-strategy equilibrium of the form $(b,0,0)$, with $b \in (0,1)$. Landlords discriminate with certainty when the neighbor is white or when the other dwelling is vacant, whereas they discriminate with probability $1-b$ when the neighbor is black.

There are seven situations where multiple equilibria are possible. To compare the equilibrium strategies with the efficient ones, we assume that landlords coordinate on the most-discriminating highest-payoff equilibrium. This equilibrium is actually the closest one to the efficient strategy. We obtain the proportions described in the first two columns of Table 3.

Efficient strategies.—The third and fourth columns of Table 3 show the distribution of efficient strategies over the different possible outcomes.

We can rank the different strategies, from the least discriminatory to the most discriminatory: $(1,1,1) \prec (1,0,1) \prec (1,0,0) \prec (b,0,0)_{b\in(0,1)} \prec (0,0,0)$. This allows us to recover the fundamental result stating that type-2 landlords always discriminate at least as much as type-1. This can be expressed as the following matrix, displayed in Table 4.

The matrix is upper triangular, which means that there are no cases where type-1 landlords discriminate more than type-2. The probability mass above the main diagonal is about 21%. Type-2 landlords, therefore, discriminate strictly more than type-1 landlords in 21% of simulations.

Table 3: Comparison of the distribution of symmetric Nash equilibria of the game played by type-1 landlords when they coordinate on the most discriminatory equilibrium and the distribution of efficient symmetric strategies decided by type-2 landlords

	Type-1 landlords		Type-2 landlords	
	Nb observations	Proportion	Nb observations	Proportion
$(0,0,0)$	642,868	33.48%	853,914	44.47%
$(b,0,0)_{b\in(0,1)}$	88,707	4.62%	0	0
$(1,0,0)$	280,915	14.63%	240,621	12.53%
$(1,0,1)$	21,994	1.15%	111,153	5.79%
$(1,1,1)$	885,516	46.12%	714,312	37.20%
Total	1,920,000	100%	1,920,000	100%

Table 4: Equilibrium and efficient strategies

	$(1,1,1)$	$(1,0,1)$	$(1,0,0)$	$(b,0,0)$	$(0,0,0)$	Total
$(1,1,1)$	37.20%	5.79%	3.13%	0	0	46.12%
$(1,0,1)$	0	0	1.15%	0	0	1.15%
$(1,0,0)$	0	0	8.26%	0	6.37%	14.63%
$(b,0,0)$	0	0	0	0	4.62%	4.62%
$(0,0,0)$	0	0	0	0	33.48%	33.48%
Total	37.20%	5.79%	12.53%	0	44.47%	100%

Notes: Each column corresponds to a particular efficient strategy $(\hat{\beta}_b, \hat{\beta}_v, \hat{\beta}_w)$, whereas each line corresponds to a particular equilibrium strategy $\left(\beta_b^*, \beta_v^*, \beta_w^*\right)$. The number in each cell corresponds to the percentage of our simulations that engender this particular configuration. In case of multiple equilibria, we only consider the most-discriminating equilibrium.

We now examine in depth the role played by each parameter. We start with the rent ratio R_b/R_w.

Statistical discrimination.—The likelihood of discrimination decreases with the rent ratio. Tables 10 to 12 in Appendix B show how equilibrium and efficient outcomes vary with the rent ratio. When the rent ratio is equal to one, there always is a pure-strategy equilibrium; moreover, discriminating in all circumstances is neither an equilibrium, nor an optimal strategy. The frequency of the situations where there is no pure-strategy equilibrium then increases when the rent ratio decreases. Tables 10 to 12 also show that the differential behavior between landlord types does not change with the rent ratio: the probability mass above the main diagonal is roughly constant.

Role of the different parameters.—We now abstract from statistical discrimination and focus on the occurrence of customer discrimination. Thus $R_w = R_b$. To highlight the role played by each parameter, we compute the percentage of simulations where discrimination occurs in equilibrium and in the efficient strategy for the different values of the parameters. Namely, we consider a binary variable equal to 1 if the landlord adopts anything but the $(1, 1, 1)$ strategy and 0 otherwise. We then average this variable on all the other parameters. For instance, suppose that we wish to analyze the impact of parameter α. This parameter has 20 different values in our simulations. Therefore we average the binary variable on 640,000/20=32,000 observations for each value of α.

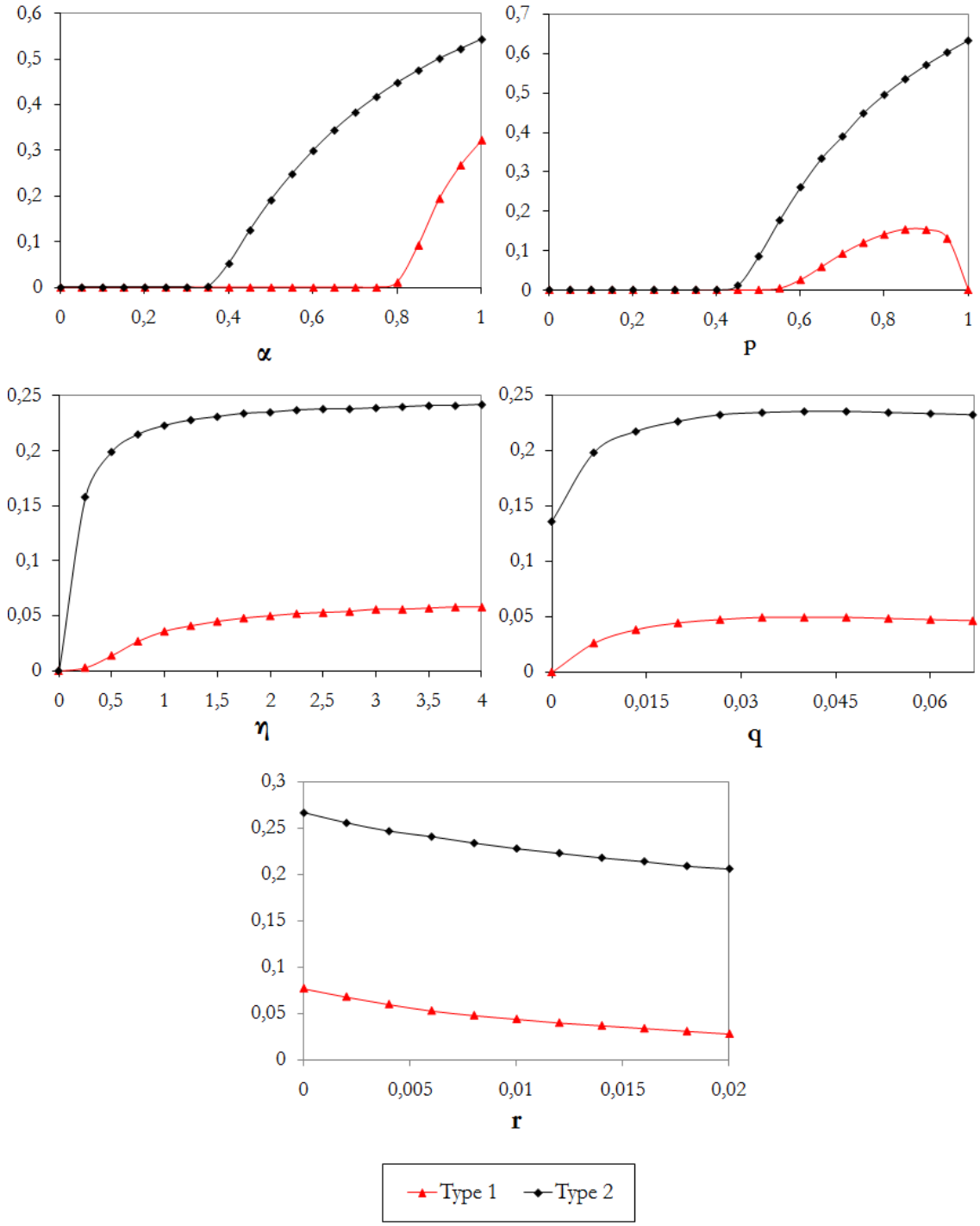
The panel of Figures displays the results. There are two curves. The curve with triangles is the proportion of cases where type-1 landlords discriminate, whereas the curve with squares is the proportion of cases where type-2 landlords discriminate. The former curve is always below the latter, which reflects the general result whereby type-2 discriminate more than type-1.

Three parameters have an unambiguous impact: α, η, and r. The other two parameters, p and q, have an ambiguous impact. The impact of α is straightforward. Increasing the proportion of prejudiced Whites then leads both types of landlords to discriminate more often. There is a minimum value below which customer discrimination is never adopted. This threshold is around 35% for type-2 landlords and around 75% for type-1 landlords.

The effect of η is also unambiguous. Parameter η measures landlords' market power. Increasing the rate at which landlords receive applications makes it less risky to discriminate by ensuring that other applicants will be met shortly. The occurrence of discrimination is nil when η is equal to 0. When η tends to infinity, the discrimination probability reaches 6.8% for type-1 landlords, and 24.9% for type-2 landlords.

Finally, the higher the discount rate, the less likely landlords are to discriminate. This is true for both types of landlords. Adopting a discriminatory strategy means preferring keeping the dwelling vacant against the hope of a better match in the future. A very high r will always make landlords prefer avoiding current vacancy, and choose not to discriminate. However, discrimination does not respond much to changes in discount rate. For each type of landlord, there is a maximum value of r above which none will ever choose to discriminate. This threshold is 11.8% for type-1 landlords, and 734% for type-2 landlords. These values are well above reasonable monthly discount rates.

Figure 1: Probability of adopting customer discrimination as a function of the model parameters



Notes: Probability that landlords adopt everything but the non-discriminating strategy when $R_w = R_b$, as a function of each parameter. The probability is computed by averaging the results of the simulations for each parameter's value. The number of observations over which each point is computed is 32,000 for α and p, 64,000 for q and r and 40,000 for η. The results presented in Tables 1 to 4 are obtained from simulations performed over a range of reasonable values for q, r and η, and in particular, for a minimum value of η equal to 0.25, a minimum value of q equal to 0.7%, and a minimum value of r equal to 0.2%. We extend the five graphs to include one additional point at the zero limit. One can check that, as already explained in the text, the probability of discriminating drops to zero for both types of landlords when η is nil, as well as the probability of discriminating for type-1 landlords when q is nil.

As for α, the impact of the white proportion p is unambiguously positive on the probability that type-2 landlords adopt a discriminatory strategy. The minimum value below which no landlord discriminates is around 40% for type-2 landlords and around 50% for type-1 landlords. These values around one half are interesting in that they provide a relationship between customer discrimination and the fact that it will mostly matter to people who belong to an ethnic minority, minority here understood in quantitative terms.

However, p has an ambiguous impact on the behavior of type-1 landlords. An increase in p generally leads to an increase in discrimination. Landlords expect that, after separation, they are very likely to encounter a white applicant. This leads them to reject the current application of a black person. When p gets close to 1, its effect becomes negative. The dynamic externality is no longer a concern. Each landlord knows that the other landlord will mostly meet white applicants. Thus they are sure that the other dwelling will either be occupied by a white tenant, or stay vacant. This leads them to accept black applicants. When p is equal to one, the reasoning becomes obvious and so type-1 landlords never discriminate.

It follows that differences in discrimination behavior between landlord types increase with the proportion of Whites. These are maximized when p is close to one, in which case only type-2 landlords practice customer discrimination, whereas type-1 landlords do not.

Similarly, the impact of the separation rate q is ambiguous. There are two competing effects at work. On the one hand, a smaller q reduces the dynamic externality problem, since a tenant, once accepted, will stay for a long time. As explained above, in the extreme case when $q = 0$, type-1 landlords only discriminate because of a rent differential. On the other hand, a smaller q magnifies the static externality problem for the other apartment. The result from the combination of these mechanisms is that the relationship between the discrimination probability and the separation rate is bell-shaped. Type-1 landlords do not discriminate when q is above 1.41 (the mean stay is 3 weeks), against 8.02 for type-2 landlords (the mean stay is half a week). The corresponding rental durations are well below reasonable values for the average stay of a tenant in an apartment.

As for differences between landlord types, the static and dynamic externalities interact so that such differences increase with the separation rate. They are minimized in the no-separation case. The practical implication is that the test strategy should be more successful at detecting customer discrimination in the rental market than in the home-sale market.

2.5 From theory to the empirical strategy

Our model of customer discrimination predicts that multiple-dwelling landlords discriminate more against Blacks than single-dwelling landlords only if there are prejudiced persons in the population of white tenants. This prediction leads to an eye-ball test of ethnic customer-based discrimination in the rental market.

The test strategy requires that the survey documents the ownership and occupancy status of each housing unit so we can identify whether a dwelling belongs to a multiple-dwelling landlord or not. Survey data do not tell who applied for the dwelling; they describe the personal characteristics of successful applicants and of their dwelling.

Prediction 1 DETECTING CUSTOMER DISCRIMINATION IN THE HOUSING MARKET *If black tenants are less likely to have a type-2 landlord than white tenants, then there are prejudiced Whites in the rental market.*

In the absence of prejudiced Whites, Proposition 3 shows that type-1 and type-2 landlords behave similarly. Thus black and white tenants are equally likely to have a multiple-dwelling landlord. The probability is equal to the proportion of dwellings owned by multiple-dwelling landlords. When there are prejudiced Whites, multiple-dwelling landlords may discriminate more than single-dwelling landlords. In this case, black tenants are less likely to have a multiple-dwelling landlord. Consequently, the only reason we could observe a difference in the model between single- and multiple-dwelling landlords is because there are prejudiced white tenants.

2.6 Discussion

We assess the theoretical robustness of our test strategy to detect customer discrimination in the housing market by considering various possible extensions concerning landlords' prejudices, pecuniary externalities, endogenization of some parameters, stronger prejudice from consumers, and heterogeneity in building size.

Prejudiced landlords and statistical discrimination.—Considering that some of the landlords may be prejudiced against black tenants does not necessarily affect the test strategy. Suppose that type-1 landlords who do not want to interact with a black tenant are in proportion γ_1, against γ_2 for type-2 landlords. That landlords have a taste for discrimination does not modify Prediction 1 whenever $\gamma_1 \geq \gamma_2$. Put otherwise, the test strategy fails when multiple-dwelling landlords are also more prejudiced against black tenants than single-dwelling landlords. The same remark holds for statistical discrimination. Our model assumes that the potentially negative effects that Blacks may have on the landlord's profits do not change with the landlord type. Stated otherwise, our strategy is robust to various omitted factors provided such factors are not too much correlated with the landlord type.

The test strategy is not robust to omitted externalities at the building level. Consider the case of pecuniary externalities. Suppose that the net rent decreases for both apartments as soon as a black tenant has been accepted in the building. This might arise if unobservable characteristics correlated with ethnicity make Blacks more likely to deteriorate the shared amenities of the building for instance. Accepting a black tenant in one of the two apartments lowers the value of the entire building. Type-1 landlords do not internalize this externality, while type-2 do. Therefore, Blacks could be less likely to have a type-2 landlord, even though there is no customer discrimination.

However, such externalities are closely associated with the formation of white prejudice. If black tenants deteriorate the shared amenities of the building, then white tenants are likely to avoid black neighbors. From this perspective, the consideration of omitted externalities at the building level has more to do with the origins of racial prejudice than with a competing theory for the under-representation of Blacks in rentals owned by multiple-dwelling landlords.

Endogenization of the parameters.—We describe the acceptance strategies of landlords for given

characteristics of the housing market. Many such characteristics could be made endogenous. The applicants arrival rate η might depend on the proportion of black applicants and on ethnic-specific rents net of maintenance costs. This would require specifying a matching function and the supply of buildings. Prejudice may also depend on the ethnic make-up of the population. Moreover, the proportion of black applicants may respond to discriminatory behavior. In particular, if p were made endogenous, discrimination might lead to segregation through the constitution of a dual housing market where landlords would specialize in one type of tenant. These extensions would enrich the theoretical model and help better understand discrimination issues. However, they would not affect the test strategy. Optimal tenant acceptance or rejection do not depend on the particular way of closing the model.

Rents could also be made endogenous. They could be bargained between the tenant and the landlord. Bargaining requires an outside option for the potential tenant being set. Where the parties come to an agreement, the bargained rent would imply that the tenant's utility is between the reservation utility and the highest level compatible with landlord's acceptance. As the latter utility level must be lower for a black tenant than for a white tenant, black tenants would pay higher rents at given reservation utility. When the match surplus becomes negative, there is no rent compatible with landlord's acceptance and black applications get rejected. Assuming that match surplus is larger with white than with black tenants, the test strategy would be unaffected. Multiple-dwelling landlords would still account for the negative externality that a black tenant originates. In other words, multiple-dwelling landlords would reject black applicants more often than single-dwelling landlords. This extension receives no further elaboration, since statistical regressions presented in the next section do not conclude that minority tenants pay higher rents, regardless of landlord type.

Stronger definition of prejudice.—Suppose we add the possibility of Whites fleeing, with prejudiced Whites moving out as soon as they have a black neighbor. How this stronger prejudice affects landlords' behavior depends on whether tenants' prejudice is observable or not. Both cases lead the conclusion that type-2 landlords should discriminate more than type-1. Where tenant racial prejudice is observable, type-2 landlords with a prejudiced white tenant in their second apartment always reject black applicants. Type-1 landlords, on the other hand, might care about knowing that they are about to make the neighbor move out, but this will not always prevent them from accepting a black applicant. When there is no rental separation, type-1 landlords always accept the black applicant, whereas type-2 landlords always reject him / her. Where prejudice is unobservable, both types will discriminate more often than with the previous definition of prejudice. However, type-1 landlords still do not care as much as type-2 landlords about the impact of their acceptance decision on the probability that the other tenant might leave as a result.

Heterogeneity in building size and collusion behavior.—The next section will show that using real data implies comparing type-n landlords ($n \geq 2$), who own the entire building, to type-k landlords ($k \in \{1, ..., n-1\}$), who do not. For a given building of size n, former type-1 landlords may then greatly differ from one another. The main theoretical drawback of a framework with only two apartments in the building is that it makes it difficult to rule out the possibility of

collusion between the two type-1 landlords of the same building. If both landlords cooperate, they can no longer be distinguished from a type-2 landlord. Both features (heterogeneity in building size and the possibility of collusion between type-1 landlords), if included in the model, would decrease the probability of observing Prediction 1 in the data. However, since the bias can only be downward, this does not affect the relevance of the test.

3 Customer discrimination in the rental market: test

This section tests for the presence of customer discrimination in the French rental housing market. We describe our dataset and notably the fact that tenants state whether their landlord owns the entire building or not. The main test involves confronting Prediction 1 to data. This test shows that tenants with Non-European origin are less likely to rent from a landlord who owns the entire building. We then check that this result is robust to several possible issues.

3.1 Data

Our dataset involves pooling the last three[5] waves (1996, 2002 and 2006) of the French National Housing Survey (*Enquête Nationale Logement*, henceforth ENL). The ENL is a detailed cross-sectional survey on a nationally-representative sample of around thirty thousand households, thirty-five thousand dwellings and seventy-five thousand individuals.

The main drawback of the ENL is inherited from a French political tradition, which makes it controversial to collect racial or ethnic statistics. Consequently, we isolate a group of "Blacks" composed of first-generation immigrants of Non-European origin: both Non-European citizens and people born outside Europe and not French at birth. Three quarters of them come from Africa, and most of the remaining quarter come from South and Southeast Asia. This measure of ethnicity misses a large number of people, due to the colonial history (people born in the colonies were given French citizenship at birth), to French West Indies and the increasing number of second, third and even fourth-generation immigrants of Non-European origin in France. Moreover, it does not clearly disentangle ethnicity and immigration status. We address this issue in two ways: first, we always consider the group of "European origin" (both non-French European citizens and people born outside France, in Europe and not French at birth) as a second control group, intermediate between "the French-born" and "Non-Europeans". This group should be subject to the same difficulties as all immigrants in terms of language or cultural knowledge of France but its members are not expected to be discriminated against for reasons of race and skin color. Second, we exclude from our sample all households whose respondent was not living in France or was living in someone else's home elsewhere in France four years before. By doing so, we focus on immigrants who are truly settled in France and may have started to integrate the labor market. Each one of these two groups of not-too-recent first-generation European and Non-European immigrants represents around 4.5% of the population of households whose respondent had a place of their own four years before the survey.

[5] Previous waves lack critical information about the origin of the respondent.

Table 13 in Appendix C shows that Non-Europeans are over-represented both in the private rental market and in the market for apartments (broadly defined here as dwellings which share a building with at least one other dwelling). As a consequence, the share of Non-European immigrants in the population of tenants in privately-rented apartments is twice as high as the share of French-born or European tenants. Within this sub-population of tenants, Table 14 in Appendix C shows that Non-European tenants differ in terms of individual characteristics, which is therefore important to control for in regressions. Non-European tenants are less often women and are less educated, their household is less rich per consumption unit, has more members and children.

Apart from individual characteristics, the ENL provides substantial information about the characteristics of the dwelling. It includes a dummy variable indicating whether the apartment is located in a building owned by a single landlord or not. This variable is informed by the respondent himself or, if he does not know, by his neighbors or by the caretaker of the building. Even if this variable does not allow us to identify the cases where the landlord owns part but not the entire building, it does give an idea as to the scale of multiple ownership. This concerns 40% of privately-rented apartments. This rate varies considerably across regions. In what follows, a "multiple-dwelling landlord" is a landlord who owns an entire building, while a "single landlord" does not. Table 15 in Appendix C shows that both types of apartments are similar in terms of size and comfort. However, rents are somewhat lower and buildings are both older and smaller in case of multiple-dwelling landlords. Finally, multiple-dwelling landlords are not randomly allocated across France: they are fewer in densely populated areas and in areas with more single-parent families. All these features are accounted for in the specification we use to test for customer discrimination in the next subsection.

3.2 Test of the main prediction

Prediction 1 states that there is evidence of customer discrimination in the rental market if black tenants less often have a landlord who owns the whole building. To test this prediction, we use the sub-sample of tenants in privately-rented apartments to estimate a probit model of the probability of having a landlord who owns the entire building. We regress this probability on a dummy variable which indicates whether the respondent is of Non-European origin or not. If the coefficient on this variable is negative, there is customer discrimination according to our model.

As already mentioned, this variable of multiple ownership does not identify all the intermediate cases where landlords own several apartments but not the entire building. If the latter discriminate more than single-dwelling landlords, the coefficient is biased downward. Similarly, the Non-European variable misses many racial minority households who are not first-generation immigrants. If these people are as discriminated against as much as first generation immigrants, our coefficient is again biased downward. In any case, the main risk is a lack of significance due to the somewhat narrow categories of discriminating and discriminated groups we consider. Finally, this reduced-form strategy does not allow us to model the selection process in the private rental market; however, this selection is likely to reduce the differences in unobserved hetero-

geneity between immigrants and non-immigrants.

Table 5 shows that the marginal effect of Non-European origin remains significantly negative, regardless of the specification. In particular, it does not decrease when we control for every available characteristics of the tenant, location and apartment (column 4): Non-Europeans remain less likely to have a landlord who owns the entire building by 4 percentage points. We can interpret this negative marginal effect in terms of customer discrimination if we are confident that the other variables included in the regression control adequately for the main differences in the housing supply and the marketing process of both types of landlords. In this perspective, it is interesting to see how the marginal effect varies with the set of controls. Column 2 controls for tenant characteristics and the effect goes up with respect to column 1. As explained before, Non-European households are poorer and larger, while housing units owned by multiple-dwelling landlords are typically cheaper and contain more rooms. Therefore, Non-Europeans should be over-represented in housing units owned by a multiple-dwelling landlord. When we control for their characteristics, the effect is now as high as 8.3% points. However, we also have to account for the particularities of local housing markets. For this reason, in columns 3 and 4, we also control for location, through two sets of fixed effects: the first is a set of MSA fixed effects.[6] Each MSA is assumed to form a separate local housing market. However, since MSAs do not form a partition of France, we also include a set of *départements* (counties) fixed effects, which are intended to proxy a local housing market for households living in rural areas.[7] Controlling for location in columns 3 and 4 reduces the marginal effect (in absolute value). This is due to the fact that multiple-dwelling landlords are over-represented in small cities and rural areas, while Non-European tenants tend to live in larger cities. Finally, controlling for the apartment characteristics slightly re-increases the effect in absolute value. Multiple-dwelling landlords own apartments with characteristics favorable to Non-Europeans. When such characteristics are controlled for, discrimination appears even stronger.

The magnitude of the coefficient can be interpreted as follows. There is a direct effect of discrimination, which reduces the probability of having a multiple-dwelling landlord by as much as 8.3 percentage points for identical characteristics of the tenant. Now, Non-Europeans appear to be located in places where multiple-dwellings are less numerous, which reduces their possibility of being discriminated against. They also tend to be concentrated in large cities. Our model, therefore, predicts that multiple-dwelling landlords discriminate much more than single-dwelling landlords in less dense areas (see the effect of the White proportion in Section 2.4). If choices of location are exogenous, i.e. not at all related to the internalization of the multiple-dwelling landlords' discriminating behavior, the effect is 4 points only. If, at the other extreme, the Non-European population location choices respond to customer discrimination, the overall

[6] We use the 2010 definition of MSA (*aires urbaines*), which distinguishes between 765 MSAs in continental France and regroups half of all French municipalities. The definition of MSAs is functional: they are formed by a main employment center, with at least 1,500 jobs, and by all the surrounding municipalities that send at least 40% of their employed residents to that employment center. In 2008, 85% of the French population lived in a MSA. Households in our sample come from 276 different MSAs. However, we are more precise for the ten largest MSAs, for which we distinguish the main municipality of the MSA. For Paris MSA, in addition to isolating Paris municipality, we also distinguish between the 20 different boroughs (the *arrondissements*).

[7] Départements are roughly comparable to US districts. The 94 départements form a partition of continental France.

impact of discrimination is then 8.3 points. In other words, we estimate an upper and a lower bound of the effect of discrimination, which is between 4 and 8.3 percentage points depending on how much such discrimination has an impact on the location choices of discriminated populations.

Table 5: Probability of having a landlord who owns the entire building

	(1)	(2)	(3)	(4)
Non-European origin	-0.033**	-0.083***	-0.037**	-0.039**
	(0.013)	(0.013)	(0.016)	(0.017)
European origin	0.016	-0.019	-0.006	-0.031
	(0.023)	(0.023)	(0.025)	(0.026)
Individual characteristics		X	X	X
Location fixed effects			X	X
Apartment characteristics				X
Time dummies	X	X	X	X
Nb observations	11139	11139	10972	10875
Pseudo-R^2	0.01	0.03	0.14	0.21

Notes: (i) Marginal effects of a Probit model reported. (ii) Standard errors in parentheses. Significance: ***: 1%, **: 5%, *: 10% (iii) Sample: All tenants in privately-rented apartments who had a place of their own in France four years before the survey. (iv) Individual and apartment characteristics: Those reported in Tables 14 and 15 (in Appendix C). (v) Location fixed effects: MSAs and départements.

In Table 16 in Appendix D, we replicate these estimations but we also make a distinction between African and Non-African origin Non-European immigrants. The estimates for these two subgroups are very similar to the ones exposed here. However, smaller sample sizes make them less precise. As a consequence, we use the ternary partition of the population.

3.3 Discussion

Quality and price discrimination. To test Prediction 1, both types of landlords must provide a similar good, so that all kinds of applicants are indifferently looking across both types. The set of controls we introduce makes it unlikely that the characteristics of the dwelling itself might be sufficiently different between the two types of landlords to explain the exclusion of Non-Europeans by differences in taste with respect to housing. Similarly, different prices between the two types of landlords should not play a significant role in this phenomenon, first due to the French institutional design of the housing market we already commented on in the Introduction. Typically, any significant increase between the posted price (on the ad) and asked price (before signing the lease) may be considered as an expression of misleading advertising and, as such, be prohibited by article 121-1 of the French Consumer Code. Second, our preferred specification in column 4 of Table 5 includes the rent among controls.

Moreover, Table 6 presents the regression of the rent paid by tenants without and with controls (the individual and apartment characteristics, the same location effects as before, the tenant

origin and the landlord's type, the last two also being interacted). All else being equal, Non-European tenants do not face higher rents, even when they rent from multiple-dwelling landlords. Without any controls, Non-European immigrants pay higher rents, but the effect disappears when location controls are introduced. This is mainly due to the fact that such immigrants live in larger cities where housing prices are higher. In any case, they do not pay higher rents when they rent from multiple-dwelling landlords, even without any controls. Multiple-dwelling landlords offer lower rents to all tenants, this mainly being due to the type of apartments they rent even if the effect does not completely disappear with all controls.

Table 6: Determinants of the rent

	(1)	(2)
Non-European origin	0.252***	0.007
	(0.016)	(0.012)
European origin	-0.113***	-0.087***
	(0.031)	(0.021)
Multiple landlord	-0.265***	-0.091***
	(0.011)	(0.008)
Non-European origin × Multiple landlord	-0.029	-0.016
	(0.027)	(0.018)
European origin × Multiple landlord	0.024	0.007
	(0.049)	(0.032)
Controls		X
Nb observations	11055	11055
R^2	0.54	0.65

Notes: (i) Ordinary-least-square regression of the log of rent by square meter (2006 euro). (ii) Standard errors in parentheses. Significance: ***: 1%, **: 5%, *: 10% (iii) Controls: Those considered in column (4) of Table 5, except rent. (iv) Sample: All tenants in privately-rented apartments who had a place of their own in France four years before the survey.

Prejudiced landlords.—One can also be confident that, in the absence of applicants' prejudice, both types of landlords would equally provide their apartments to all kinds of applicants. However, racial preferences might be correlated with the landlord type. For instance, multiple-dwelling landlords may less often be immigrants and wealthier, hence maybe more conservative. In terms of our model, the proportion of prejudiced landlords would be higher among type-2 landlords than among type-1. Or both types of landlords may be prejudiced, but only multiple-dwelling landlords would have enough market power to discriminate at their will. In terms of our model the application rate η would be higher for type-2 landlords in a given rental market. This property is unlikely because we refer to the per-dwelling application rate. Of course, multiple-dwelling landlords receive more applications because they have more rentals. But it is not clear why, in a given residential area and for a given set of rental characteristics, such landlords would receive more applications per dwelling.

A more relevant issue is that personal prejudice would play a greater role if the landlord also lived in the neighborhood. While our data does not indicate when the landlord also lives

in the building, this situation is largely restricted to small buildings of two or three apartments, often located in rural areas and involving intergenerational coresidence (Bessière and Laferrère (2002)). This specificity of the housing supply of multiple-dwelling landlords could explain part of our result. Table 7 shows that this is not the case. The effect of being of Non-European origin does not decrease in absolute value when the size of the building increases, if anything it increases slightly.

Finally, one may also think of other interactions between landlord and tenant, apart from coresidence. In particular, the rent payment constitutes another potentially regular interaction. If multiple landlords are more prejudiced and also tend to collect the rent more directly than single landlords, this omitted variable bias could explain our result. We have information about this in the ENL, where households are asked whether the rent is collected by an intermediary, or directly by the landlord. Indeed, 69% of tenants who have a multiple-dwelling landlord declare that they give the rent directly to the landlord, against 55% of tenants with a single-dwelling landlord.[8] However, as shown in column (2) of Table 8, controlling for this factor does not affect our result.

Table 7: Replication of column (4) of Table 5 by building size

Nb of apartments	All	≥ 5	≥ 20	≥ 40
	(1)	(2)	(3)	(4)
Non-European origin	-0.039**	-0.050***	-0.040**	-0.074**
	(0.017)	(0.016)	(0.019)	(0.030)
European origin	-0.031	-0.031	-0.032	0.011
	(0.026)	(0.025)	(0.030)	(0.056)
Controls	X	X	X	X
Nb observations	10879	8631	3625	1502
Pseudo-R^2	0.21	0.16	0.15	0.20

Notes: (i) Marginal effects of a Probit model reported. (ii) Standard errors in parentheses. Significance: ***: 1%, **: 5%, *: 10% (iii) Sample: All tenants in privately-rented apartments who had a place of their own in France four years before the survey. (iv) Controls: Those considered in column (4) of Table 5.

Statistical discrimination.—Statistical discrimination means that Non-European immigrants are, on average, worse tenants. They may cause greater maintenance costs or their probability of rent default may be higher. Statistical discrimination is not an issue for our test strategy if both types of landlords react similarly to this situation. However, there are two reasons why they may actually behave differently.

On the matter of maintenance costs, Section 2.6 mentions that the test strategy is not robust to omitted externalities at the building level. If unobservable characteristics correlated with origin make Non-European tenants more likely to cause damage to shared amenities in the building, multiple-dwelling landlords will be more likely to internalize this externality, regardless of tenants' prejudice. Non-Europeans are actually more likely to report having witnessed vandalism against the common parts of the building (23% of them against 16% for the rest of the tenant

[8]Both differences are significant at the 1% confidence level.

population). Interestingly, this statement is not robust to the control of individual and apartment characteristics (not reported here). Nevertheless, the raw correlation may induce false beliefs, whereby Non-Europeans are more likely to deteriorate the shared amenities. In turn, multiple-dwelling landlords would respond to such beliefs by discriminating more. This possibility is partly taken into account in column (3) of Table 8, where we control for whether the tenant witnessed such property damage. The estimates are unaffected.

As for the probability of rent default, one may argue that multiple landlords, who dispose of a greater information set, are more likely to know the differences in default risk between the different groups of tenants. If, in addition, unobserved characteristics correlated with ethnicity make Non-European immigrants more likely to default on rent, this omitted variable may jeopardize our test strategy.[9] In the ENL, tenants are asked if they have had difficulty paying the rent over the past two years. The answer can be considered as a good proxy for default risk. Non-European immigrants are, indeed, more likely to default on rent. The unconditional probability for Non-European immigrants of answering "yes" to this question is twice as high as for the rest of the population of tenants (26% against 13%) and the gap does not fully close when controlling for household observed characteristics, such as current income.[10] To rule out this statistical discrimination story, column (4) of Table 8 therefore controls for the default variable. The estimates are unaffected.

Could search be directed by heterogenous marketing channels?—One last possible issue involves differences in the marketing process for both types of landlords. For example, single-dwelling landlords may be more likely to use non-standardized advertising, where social networks help applicants to be notified of a new vacancy. If, simultaneously, Non-European applicants are more likely to mobilize social networks when they search, they will more often be matched with single-dwelling landlords.

The ENL provides information on the way private tenants had heard about the dwelling they currently occupy. However, this item of information is only available for those who moved in less than four years ago. It appears that Non-European applicants do mobilize social networks more frequently: on average during the decade 1996-2006, 33% of Non-European private tenants who had recently moved into a new apartment had heard about it from a friend or a relative, while this was only the case for 22% of the other private tenants in apartments. However, multiple-dwelling landlords also seem to benefit substantially from such informal networks. If anything, they benefit from them even more than single landlords, since, among all the tenants who had recently moved into their apartment, 27% of those with a multiple-dwelling landlord had heard about their apartment from a friend or a relative, while this was only the case for 20% of the tenants facing a single-dwelling landlord. Column (5) in Table 8 focuses on this sample of tenants who moved in less than four years ago. It shows that controlling for the nature of the information channel marginally affects the estimates.

[9] This argument is actually rather weak. There is another effect at work. Multiple-dwelling landlords are more experienced landlords. They can more easily detect whether the individual is a high-default risk. They would discriminate less often as a result.

[10] Part of the explanation probably stems from a higher volatility in earnings for this population, as shown in Decreuse and Schmutz (2012) for African immigrants.

Table 8: Replication of column (4) of Table 5 with controls for taste-based discrimination, statistical discrimination or networks

	(1)	(2)	(3)	(4)	(5)	(6)
Non-European origin	-0.039**	-0.042**	-0.040**	-0.037**	-0.044*	-0.043*
	(0.013)	(0.017)	(0.017)	(0.017)	(0.025)	(0.025)
European origin	-0.031	-0.026	-0.031	-0.030	-0.021	-0.023
	(0.026)	(0.025)	(0.026)	(0.026)	(0.046)	(0.046)
Rent paid directly		0.093***				0.105***
		(0.011)				(0.017)
Degradation of shared amenities			0.031**			0.031
			(0.014)			(0.021)
Proxy for default				-0.012		-0.022
				(0.012)		(0.021)
Friends or relatives					0.025	0.001
					(0.018)	(0.018)
Controls	X	X	X	X	X	X
Nb observations	10875	10857	10875	10857	5232	5232
Pseudo-R^2	0.21	0.22	0.21	0.21	0.23	0.23

Notes: (i) Marginal effects of a Probit model reported. (ii) Standard errors in parentheses. Significance: ***: 1%, **: 5%, *: 10% (iii) Rent paid directly: rent is paid directly to the landlord; proxy for default: has had difficulty paying the rent in the past two years; Degradation of common parts: the common parts of the building have been recently deteriorated; Friends or relatives: the vacancy was heard of through friends or family networks. (iv) Sample: Columns 1 to 4: All tenants in privately-rented apartments who had a place of their own in France four years before the survey; columns 5 and 6: Restricted to those who have recently moved in. (v) Controls: Those considered in column (4) of Table 5.

Table 9: Probability of being the first owner of the apartment

	(1)	(2)	(3)	(4)
Non-European origin	-0.091**	-0.086**	-0.088**	-0.000
	(0.030)	(0.031)	(0.037)	(0.004)
European origin	-0.024	-0.037	-0.077	-0.000
	(0.043)	(0.041)	(0.043)	(0.011)
Individual characteristics		X	X	X
Location fixed effects			X	X
Apartment characteristics				X
Time dummies	X	X	X	X
Nb observations	2069	2069	1711	1698
Pseudo-R^2	0.02	0.05	0.11	0.50

Notes: (i) Marginal effects of a Probit model reported. (ii) Standard errors in parentheses. Significance: ***: 1%, **: 5%, *: 10% (iii) Sample: All homeowners in apartments who have moved in for less than four years and had a place of their own in France four years before the survey. (iv) Individual and apartment characteristics: Those reported in Tables 14 and 15, except the rent, now replaced by the buying price of the apartment (in Appendix C). (v) Location fixed effects: MSAs and départements.

The home-sale market—Section 2.2 shows that the theory of customer discrimination also holds for the home-sale market. By analogy with the rental market, we focus on the probability of being the first home-owner of the dwelling, which we assume is highly correlated with being confronted by a seller who owns the whole building. Table 9 controls by the buying price of the apartment. This information is only available for households who have recently moved in. The estimations are performed on this sample of recent movers, hence the small sample sizes. Results indicate that whereas Non-European immigrants seem less likely to be the first owner of their apartment, this is no longer true when controlling for apartment characteristics. How can we reconcile this finding with our previous results whereby there is customer discrimination in the rental market? Section 2.4 shows that the difference in terms of discrimination likelihood between landlord types increases with the separation rate. Thus this difference is minimum when $q = 0$, i.e. for the home-sale market.

4 Conclusion

The nature of the links between discrimination and urban patterns has long been argued about. However, most works on the subject miss the role played by the structure of real estate ownership, although it is a key background factor for apprehending the diversity of urban patterns. This paper is an attempt to illustrate why housing ownership structure matters, both theoretically and empirically. We construct a matching model with ethnic externalities where landlords are heterogenous with respect to the number of housing units they own within the same neighborhood. Regardless of their own preferences, landlords who own several units are more likely to discriminate against ethnic minorities if these minorities are subject to the prejudice of a fraction of the population of mainstream tenants. This prediction is then tested on French survey data. We focus on a sample of tenants in the private market. We show that first-generation immigrants of Non-European origin who live in privately-rented apartments are less likely to have a landlord who owns the entire building. Our results confirm the existence of customer-based discriminatory practices against immigrants of Non-European origin on the French housing market.

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A Proofs

A.1 Proof of Proposition 1

The result can be inferred from the limit properties of system (1)–(4) when α tends to 0.

A.2 Proof of Proposition 2

We solve system (1)–(4) for a given vector $\beta = (\beta_v, \beta_w, \beta_b)$. For $k = w, b$ and $l = v, w, b$, we obtain

$$r\Pi^{kl} = R_k, \tag{11}$$

$$r\Pi^{vb} = \eta \frac{(1-p)\,\beta_b R_b + p\,(1-\alpha)\,R_w}{r + \eta\,[(1-p)\,\beta_b + p\,(1-\alpha)]}, \tag{12}$$

$$r\Pi^{vw} = \eta \frac{(1-p)\,\beta_w R_b + pR_w}{r + \eta\,[(1-p)\,\beta_w + p]}, \tag{13}$$

$$r\Pi^{vv} = \eta \frac{X_b R_b + X_w R_w}{\{r + \eta\,[(1-p)\,\beta_b + p\,(1-\alpha)]\}\,\{r + 2\eta\,[(1-p)\,\beta_v + p]\}} \tag{14}$$

where $X_b = (1-p)\left\{ \begin{array}{c} r^2\beta_v + r\eta\,[\beta_v\,(1-p)\,(2\beta_b + \beta_w) + p\,(3-\alpha)] \\ +\eta^2\,[\beta_v\,(2\,(1-p)\,\beta_b + p\,(1-\alpha))\,(\beta_w\,(1-p) + p) + p\beta_w\,(\beta_b\,(1-p) + p\,(1-\alpha))] \end{array} \right\}$

$X_w = p\left\{ \begin{array}{c} r^2 + r\eta\,[(1-p)\,(\beta_v\,(1-\alpha) + \beta_b + \beta_w) + p\,(3-\alpha)] \\ +\eta^2\,[\beta_v\,(1-\alpha)\,(1-p)\,((1-p)\,\beta_w + p) + (\beta_b\,(1-p) + p\,(1-\alpha))\,(2p + (1-p)\,\beta_w)] \end{array} \right\}$

Step 1. $\beta_b^* = \hat{\beta}_b = 0$ *if and only if* $R_b/R_w < \sigma_b$*, and* $\beta_w^* = \hat{\beta}_w = 0$ *if and only if* $R_b/R_w < \sigma_w$.

We have

$$\Pi^{bb} - \Pi^{vb} = \Pi^{bb} - \Pi^{vb} - \left(\Pi^{bv} - \Pi^{bb}\right) = \frac{rR_b - (1-\alpha)\,p\eta\,(R_w - R_b)}{r\,[r + \eta\,((1-p)\,\beta_b + p\,(1-\alpha))]}. \tag{15}$$

This implies

$$\Pi^{bb} - \Pi^{vb} < 0 \Leftrightarrow \Pi^{bb} - \Pi^{vb} < \Pi^{bv} - \Pi^{bb} \Longleftrightarrow R_b/R_w < \sigma_b = \frac{\eta\,(1-\alpha)\,p}{r + \eta\,(1-\alpha)\,p}. \tag{16}$$

We also have

$$\Pi^{bw} - \Pi^{vw} = \Pi^{bw} - \Pi^{vw} - \left(\Pi^{wv} - \Pi^{wb}\right) = \frac{rR_b - p\eta\,(R_w - R_b)}{r\,[r + \eta\,((1-p)\,\beta_w + p)]}. \tag{17}$$

This yields

$$\Pi^{bw} - \Pi^{vw} < 0 \Leftrightarrow \Pi^{bw} - \Pi^{vw} < \Pi^{wv} - \Pi^{wb} \Longleftrightarrow R_b/R_w < \sigma_w = \frac{\eta p}{r + \eta p}. \tag{18}$$

Step 2. $\beta_v^* = \hat{\beta}_v = 0$ *if* $R_b/R_w < \sigma_b$.

Assume that $R_b/R_w < \sigma_b$. From Step 1, $\beta_i^* = \hat{\beta}_i = 0$, $i = b, w$. Suppose that $\beta_b^* = 0$. Under this condition, we obtain

$$\Pi^{bv} - \Pi^{vv} = \frac{(r + p\eta)\, R_b - p\eta R_w}{r(r + p\eta)}. \tag{19}$$

It is negative whenever $R_b/R_w < \sigma_w$, which is true by assumption.

Conversely, suppose that $\beta_v^* = 1$. Under this condition, we obtain

$$\begin{aligned} \Pi^{bv} - \Pi^{vv} &= \frac{(r + p\eta)\,(r + \eta + p\eta)\,(r + (1-\alpha)\,p\eta)}{r\,(r + 2\eta)\,(r + p\eta)\,(r + (1-\alpha)\,p\eta)} R_b \\ &\quad - \frac{p\eta\left[r^2 + r\eta\,(1 - \alpha + 2p) + \eta^2\,(1-\alpha)\,p\,(1+p)\right]}{r\,(r + 2\eta)\,(r + p\eta)\,(r + (1-\alpha)\,p\eta)} R_w. \end{aligned} \tag{20}$$

It is positive if and only if $R_b/R_w > \frac{p\eta\left[r^2 + r\eta(1-\alpha+2p) + \eta^2(1-\alpha)p(1+p)\right]}{(r+p\eta)(r+\eta+p\eta)(r+(1-\alpha)p\eta)} > \sigma_b$, which is impossible.

A similar reasoning gives $\hat{\beta}_v = 0$ if $R_b/R_w < \sigma_b$.

Step 3. $\beta_v^* = 0$ *if* $R_w/R_b \in [\sigma_b, \sigma_{1v})$, *and* $\beta_v^* = 0$ *or* $\beta_v^* = 1$ *if* $R_w/R_b \in [\sigma_{1v}, \sigma_w)$

Assume that $R_b/R_w \in [\sigma_b, \sigma_w)$. From Step 1, $\beta_b^* = 1$, whereas $\beta_w^* = 0$. Suppose $\beta_v^* = 0$. Under this condition, we obtain

$$\Pi^{bv} - \Pi^{vv} = \frac{(r + p\eta)\, R_b - p\eta R_w}{r(r + p\eta)}. \tag{21}$$

It is negative if and only if $R_b/R_w < \sigma_w$, which is true by assumption.

Alternatively, suppose $\beta_v^* = 1$. Under this condition, we find that $\Pi^{bv} - \Pi^{vv} \geq 0$ if and only if $R_b/R_w > \sigma_{1v} \in (\sigma_b, \sigma_w)$.

Step 4. $\beta_v^* = 0$ *if* $R_b/R_w \geq \sigma_w$

Assume that $R_b/R_w \geq \sigma_w$. From Step 1, $\beta_b^* = \beta_w^* = 1$. Suppose $\beta_v^* = 0$. Under this condition, we find $\Pi^{bv} - \Pi^{vv} < 0$ if and only if $R_b/R_w < \sigma_w$, which is impossible.

Conversely, suppose $\beta_v^* = 1$. Under this condition, we find $\Pi^{bv} - \Pi^{vv} \geq 0$ if and only if

$$R_b/R_w \geq \frac{p\eta(r^2 + (3-\alpha)r\eta + (2 - \alpha - \alpha p^2)\eta^2)}{r^3 + (3 + (1-\alpha)p)r^2\eta + (2 + p(3 - \alpha(2+p)))r\eta^2 + p(2 - \alpha - \alpha p^2)\eta^3}.$$

Let us call A the right-hand side term of this inequality. We have $A - \sigma_w$ is equal to

$$\frac{(-1+p)r\eta(r+\eta)}{(r+p\eta)(r^3 + (3 + p - \alpha p)r^2\eta + (2 - p(-3 + \alpha(2+p)))r\eta^2 - p(-2 + \alpha + \alpha p^2)\eta^3)} < 0$$

Step 5. $\hat{\beta}_v = 0$ *if* $R_b/R_w \in [\sigma_b, \sigma_w)$

Assume that $R_b/R_w \in [\sigma_b, \sigma_w)$. From Step 1, $\hat{\beta}_b = 1$ and $\hat{\beta}_w = 0$. Suppose that $\hat{\beta}_v = 0$. Under

this condition, we find $\Pi^{bv} - \Pi^{vv} + \Pi^{vb} - \Pi^{vv} < 0$ if and only if

$$\frac{R_b}{R_w} < \sigma_w \frac{(1+\alpha)r + (2-p-ap)\eta}{r + (2-p-ap)\eta},$$

which is true by assumption. Similarly, we can show $\hat{\beta}_v = 1$ if and only if

$$\frac{R_b}{R_w} \geq \sigma_w \frac{(1+\alpha)r + (2-p-ap)\eta}{r + (2-p-ap)\eta}.$$

Step 6. $\widehat{\beta}_v = 0$ *if* $R_b/R_w \in [\sigma_w, \sigma_{2v})$ *and* $\widehat{\beta}_v = 1$ *if* $R_b/R_w \geq \sigma_{2v}$

Assume that $R_b/R_w \in [\sigma_w, \sigma_{2v})$. From Step 1, $\hat{\beta}_b = \hat{\beta}_w = 1$. Suppose that $\hat{\beta}_v = 0$. Under this condition, we find $\Pi^{bv} - \Pi^{vv} + \Pi^{vb} - \Pi^{vv} < 0$ if and only if $R_w/R_b < \sigma_{2v}$.

Step 7 (conclusion). Parts (i) to (v) follow from Steps 1 to 6.

A.3 Proof of Proposition 3

Part (i). When $\alpha = 0$, we have $\Pi^{ij}(\beta, \bar{\beta}) = \Pi^{ik}(\beta, \tilde{\beta})$ for all $j, k = v, w, b$ and all $(\beta, \bar{\beta}, \tilde{\beta}) \in B^3$. Dwellings' values no longer depend on the occupancy status of the other dwelling. Thus, we have

$$\arg\max_{\beta \in B} \Pi_2(\beta, \beta) = \arg\max_{\beta \in B} \Pi_1(\beta, .) = \arg\max_{\beta \in B} \Pi(\beta, .). \tag{22}$$

In addition, it becomes unnecessary to distinguish β_b from β_w and β_v.

To find the equilibrium, we define $(\tilde{\Pi}^b, \tilde{\Pi}^w, \tilde{\Pi}^v)$ such that, for $i = w, b$, we have

$$r\tilde{\Pi}^i = R_i + q(\tilde{\Pi}^v - \tilde{\Pi}^i), \tag{23}$$

$$r\tilde{\Pi}^v = \eta p(\tilde{\Pi}^w - \tilde{\Pi}^v) + \eta(1-p)\beta_b(\tilde{\Pi}^b - \tilde{\Pi}^v). \tag{24}$$

We have $\beta_b^* = 0$ if and only if $\tilde{\Pi}^b(0) < \tilde{\Pi}^v(0)$. Resolution yields $\beta_b^* = 0$ if and only if $R_b/R_w < \eta p/(r + q + \eta p)$.

Part (ii). We solve system (1)–(4) when $\beta = \bar{\beta} = (1, 1, 1)$. We then show that $\Pi^{jv} - \Pi^{jb} \geq 0$ for all $j = v, w, b$. The solving yields:

$$\Pi^{jv} - \Pi^{jb} = \alpha p \eta [(q + r)R_w + \eta(1-p)(R_w - R_b)]N^j/D \tag{25}$$

for all $j = v, w, b$, with $D > 0$ and $N^j > 0$. Indeed,

$$D = \left\{ \begin{array}{l} (q+r)^2 (2q+r) \\ +\eta (q+r) (q(3-\alpha p) + r(2-\alpha p)) \\ +\eta^2 \left(q\left(1-\alpha p^2\right) + r(1-\alpha p)\right) \end{array} \right\} \times$$

$$\left\{ \begin{array}{l} (q+r)^2 (2q+r)^2 + \eta (q+r)(2q+r)(q(5-\alpha p) + r(4-\alpha p)) \\ +\eta^2 \left[\begin{array}{c} 4q^2 \left(2(1-\alpha p) + \alpha p^2\right) + r^2 (5-3\alpha p) \\ +qr\left(10(1-\alpha p) + 3\left(1+\alpha p^2\right)\right) \end{array} \right] \\ +2\eta^3 \left[q\left(\alpha (1-p)^2 + (1-\alpha)\right) + r(1-\alpha p)\right] \end{array} \right\} > 0,$$

$$N^w/q = \left[\begin{array}{c} 4q^3 + (r+\eta)(r+2p\eta)(r+\eta(1-\alpha p)) \\ +q^2 (8r + 2\eta(2 + p(3-\alpha))) \\ +q \left[\begin{array}{c} 5r^2 + r\eta(6 + p(7-3\alpha)) \\ +\eta^2 (1 + p(7 - 2\alpha(1+p))) \end{array} \right] \end{array} \right] > 0,$$

$$N^b/q = \left[\begin{array}{c} (q+r)(2q+r)^2 + 2p\eta^3 (1-a) \\ +\eta (2q+r)[q(2+p(3-\alpha)) + r(2+p(2-\alpha))] \\ +\eta^2 \left[\begin{array}{c} q(1+p(5(1-\alpha)) + 2 + \alpha p) \\ +r(1+p(4-3\alpha)) \end{array} \right] \end{array} \right] > 0,$$

$$N^v = \left[\begin{array}{c} (q+r)(2q+r)^3 + \eta (2q+r)^2 [q(3+p(2-\alpha)) + r(3+p(1-\alpha))] \\ +\eta^2 (2q+r) \left[\begin{array}{c} q(3+p(3(1-\alpha)+2-\alpha p)) \\ r(1+p(2-\alpha p)) + 2(1-\alpha p) \end{array} \right] \\ +\eta^3 \left[\begin{array}{c} q\left((1-\alpha p) + p\left(3-\alpha\left(1+p+p^2\right)\right)\right) \\ +r(1+p)(1-\alpha p) \end{array} \right] \end{array} \right] > 0.$$

Part (iii). We solve system (1)–(4) when $\beta = \bar{\beta} = (0,0,0)$. We then show that $\Pi_1^{jv} - \Pi_1^{jb} \geq 0$ for all $j = v, w, b$. For $j = w, b$, we have

$$\Pi^{jv} - \Pi^{jb} = \frac{\alpha p q \eta R_w}{(q+r)(q+r+p\eta)(2q+r+(1-\alpha)p\eta)} \geq 0. \tag{26}$$

Moreover

$$\Pi^{vv} - \Pi^{vb} = \frac{\alpha p (2q+r) \eta R_w}{(q+r)(q+r+p\eta)(2q+r+(1-\alpha)p\eta)} \geq 0. \tag{27}$$

B Equilibrium and efficient strategies as a function of the rent ratio R_b/R_w

Table 10: Equilibrium and efficient strategies when $R_w/R_b = 1$

	$(1,1,1)$	$(1,0,1)$	$(1,0,0)$	$(b,0,0)$	$(0,0,0)$	Total
$(1,1,1)$	77.25%	12.16%	6.16%	0	0	95.57%
$(1,0,1)$	0	0	2.27%	0	0	2.27%
$(1,0,0)$	0	0	2.16%	0	0	2.16%
$(b,0,0)$	0	0	0	0	0	0
$(0,0,0)$	0	0	0	0	0	0
Total	77.25%	12.16%	10.59%	0	0	100%

Notes: See Table 4.

Table 11: Equilibrium and efficient strategies when $R_w/R_b = 1.1$

	$(1,1,1)$	$(1,0,1)$	$(1,0,0)$	$(b,0,0)$	$(0,0,0)$	Total
$(1,1,1)$	22.02%	3.52%	2.13%	0	0	27.67%
$(1,0,1)$	0	0	0.78%	0	0	0.78%
$(1,0,0)$	0	0	14.02%	0	10.41%	24.43%
$(b,0,0)$	0	0	0	0	6.01%	6.01%
$(0,0,0)$	0	0	0	0	41.10%	41.10%
Total	22.02%	3.52%	16.93%	0	57.53%	100%

Notes: See Table 4.

Table 12: Equilibrium and efficient strategies when $R_w/R_b = 1.2$

	$(1,1,1)$	$(1,0,1)$	$(1,0,0)$	$(b,0,0)$	$(0,0,0)$	Total
$(1,1,1)$	12.34%	1.69%	1.09%	0	0	15.12%
$(1,0,1)$	0	0	0.39%	0	0	0.39%
$(1,0,0)$	0	0	8.60%	0	8.70%	17.30%
$(b,0,0)$	0	0	0	0	7.84%	7.84%
$(0,0,0)$	0	0	0	0	59.35%	59.35%
Total	12.34%	1.69%	10.07%	0	75.90%	100%

Notes: See Table 4.

C Descriptive Statistics

Table 13: Tenure status by immigration status

	French-born	European	Non-European
Private rental (share)	0.195	0.188	0.289
	(0.516)	(0.391)	(0.454)
Apartment (share)	0.368	0.425	0.763
	(0.628)	(0.495)	(0.425)
Privately-rented apartment (share)	0.121	0.130	0.247
	(0.425)	(0.336)	(0.431)
Nb observations	78388	3776	5868

Notes: (i) Sample: All households who had a place of their own in France four years before the survey.

Table 14: Tenant characteristics by immigration status

	French-born	European	Non-European
Share of women (household head)	0.41	0.38	0.25
	(0.492)	(0.486)	(0.432)
Average age (household head)	46.1	53.4	44.8
	(17.81)	(18.24)	(13.72)
Middle school degree (household head, share)	0.31	0.23	0.17
	(0.463)	(0.419)	(0.376)
High school degree (household head, share)	0.10	0.04	0.08
	(0.303)	(0.202)	(0.269)
University degree (household head, share)	0.35	0.21	0.27
	(0.476)	(0.410)	(0.444)
Household income by consumption unit (2006 euro)	18938	16580	12594
	(14073)	(14726)	(10944)
Household number of persons	1.83	2.09	2.74
	(1.080)	(1.197)	(1.695)
Household number of children	0.39	0.45	1.05
	(0.782)	(0.829)	(1.341)
Year of arrival in the dwelling	1994	1990	1994
	(11.1)	(11.4)	(8.6)
Nb observations	8669	455	1932

Notes: (i) Sample: All tenants in privately-rented apartments who had a place of their own in France four years before the survey.

Table 15: Characteristics of the apartment, the building and the location, by landlord type

	Multiple landlord	Single landlord
Number of rooms (logarithm)	0.96	0.83
	(0.465)	(0.486)
Size in squared meters (logarithm)	4.06	3.96
	(0.448)	(0.463)
Rent per square meter (2006 euro)	7.22	9.63
	(4.289)	(4.973)
Balcony (share)	0.29	0.52
	(0.455)	(0.500)
Private outdoor space (share)	0.09	0.04
	(0.279)	(0.189)
Large bathtub (share)	0.57	0.69
	(0.495)	(0.463)
Safety device (share)	0.31	0.41
	(0.462)	(0.492)
Parking space (share)	0.28	0.37
	(0.448)	(0.483)
Tenant suffers from cold (share)	0.18	0.16
	(0.381)	(0.362)
Tenant suffers from noise (share)	0.47	0.45
	(0.499)	(0.498)
Number of levels in the building	3.16	5.00
	(2.916)	(3.729)
Number of apartments in the building	14.2	29.5
	(27.38)	(43.78)
Building built between 1949 and 1974 (share)	0.25	0.39
	(0.435)	(0.488)
Building built after 1974 (share)	0.19	0.30
	(0.390)	(0.459)
Département population (1990 Census)	417936	494465
	(292032)	(304918)
Public housing (1990 Census, département share)	0.15	0.14
	(0.060)	(0.058)
Homeowners (1990 Census, département share)	0.51	0.49
	(0.106)	(0.113)
Families with at least three children (1990 Census, département share)	0.09	0.08
	(0.027)	(0.027)
Nb observations	4287	6769

Notes: (i) Sample: All tenants in privately-rented apartments who had a place of their own in France four years before the survey.

D African immigrants versus Non-European immigrants

Table 16: Probability of having a landlord who owns the entire building, distinguishing between African immigrants and non-European, non-African immigrants

	(1)	(2)	(3)	(4)
African immigrant	-0.030**	-0.084***	-0.034*	-0.039**
	(0.014)	(0.015)	(0.017)	(0.019)
Non-European immigrant	-0.040*	-0.080***	-0.047*	-0.042
	(0.022)	(0.022)	(0.025)	(0.025)
European immigrant	0.016	-0.019	-0.006	-0.031
	(0.023)	(0.024)	(0.025)	(0.026)
Individual characteristics		X	X	X
Location fixed effects			X	X
Apartment characteristics				X
Time dummies	X	X	X	X
N	11139	11139	10972	10875
Pseudo-R^2	0.01	0.03	0.14	0.21

Notes: (i) Marginal effects of a Probit model reported. (ii) Standard errors in parentheses. Significance: ***: 1%, **: 5%, *: 10% (iii) Sample: All tenants in privately-rented apartments who had a place of their own in France four years before the survey. (iv) Individual and apartment characteristics: Those reported in Tables 14 and 15 in Appendix C. (v) Location fixed effects: MSAs and départements.