Information Asymmetry, Regulations, and Equilibrium Outcomes: Theory and Evidence from the Housing Rental Market*

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Abstract

Following the financial crisis, rental markets in the U.S. remain tight. It is unclear, however, whether the shortfall in rental housing supply is transitory or structural. We explore the role of information asymmetry and regulations on equilibrium outcomes in rental markets in order to document the role of government regulations in reducing rental supply. We show that while landlords price the cost of regulations into rent, they also invest in tenant screening as regulation costs soar, restricting access to privately-supplied rental housing. Although the additional tenant screening is understandable, its magnitude is somewhat surprising.

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"The rent is too damn high!"

Jimmy McMillan[1]

Following the collapse of the housing market in 2007, numerous households lost their homes to foreclosure and turned to the rental market, causing the rent population to rise to a 20-year high of 35.5% in 2014.[2] Despite a steady increase in housing supply following the financial crisis, many rental markets still remain tight with the Bureau of Labor Statistics reporting the average rent of primary residence increasing 3.8% during the 12 months ending August 2016.[3,4] As a result, the Joint Center (2015a) reports that in 2013 only 34% of rental units were affordable to households with very low incomes. Thus, as the quote above demonstrates, rents and affordable housing issues continue to remain contentious political issues.

However, it is unclear whether the shortfall in rental housing supply is transitory or structural in nature. Thus, following Stiglitz and Weiss (1981), we explore the role of information asymmetry and regulations on equilibrium outcomes in order to document the role of government regulations in exacerbating problems in the rental market. Figure 1 illustrates the potential connection between local rental regulations and housing affordability. The figure plots each state based on our landlord regulation index against the percentage of households moderately burdened by rents greater than 30% of their incomes.[5] The positive trend line supports the contention that areas with higher regulatory costs face greater problems with affordable housing. While a rich literature focuses on the impact of regulations on the price of rental housing (e.g. via rent control or rent stabilization programs), we focus on rental regulations since landlords may be able to

[1]Quote from Jimmy McMillan, a political activist who ran for mayor of New York City in 2005 and 2009 based on a campaign that housing costs in New York City were too high (http://www.rentistoodamnhigh.org).

[2]Joint Center (2015b).

[3]See Bureau of Labor Statistics (2016), Table 1: Consumer Price Index for All Urban Consumers (CPI-U): U.S. city average, by expenditure category and commodity and service group.

[4]The Joint Center (2015a) reports that rental vacancy rates in 2015 were the lowest since 1985 with rates below 5% in almost three-quarters of the top-50 largest markets.

[5]See section 3 for details on the construction of our lease regulation index.

imperfectly mitigate the associated costs of these regulations by acquiring additional information on prospective tenants.

Lease contracts are often subject to numerous local and state regulations. Enacted through statutes or established by courts, these regulations generally tend to strengthen tenant rights to the detriment of landlords. Consequently, they impose costs on landlords by limiting their basic rights to determine rent (often through rent control or rent stabilization programs), to gain possession of a property (through eviction procedures), and to choose tenants.[6] While rental regulations are often touted as protecting tenants' rights, they also impose costs on society, including costs associated with landlords' inability to evict bad tenants (Miron, 1990). Thus, even the most well-intentioned regulations may have unforeseen consequences that could harm the intended beneficiaries. For example, several empirical studies show that rent control regulations that are initially meant to protect tenants from unscrupulous property owners end up imposing substantial costs on tenants, and society as a whole, by causing lower rental supply and a deterioration of rental property stocks.[7] Most regulations, particularly rent control and stabilization programs, were put in place in the 1970s during a time commonly referred to as the progressive period in landlord-tenant law (Rabin, 1983; Goetz, 1983). Furthermore, as the quote from Jimmy McMillan illustrates, calls for intervention in rental markets tend to intensify during periods of increasing rent.

Regulations are also likely to affect market outcomes. As the economic cost of a regulation increases, it may reach a point where it becomes optimal for the regulated party to significantly alter its activity or cease operation all together. In the context of rental housing, regulations affect the landlord profit maximization problem by increasing operating costs (Miron, 1990) and are therefore priced in equilibrium rents to the extent

[6] We use the term "*regulations*" loosely to refer to both local and state regulations. These regulations may also interfere in the right of landlords and tenants to decide the extent of landlord services (Rabin, 1983).

[7] Turner and Malpezzi (2003) provide an exhaustive review of the empirical literature on the costs and benefits of rent control.

permitted by the elasticity of demand. This first order effect of regulations on rents, which has been documented for various types of regulation (e.g., Hirsch et al., 1975; Miron, 1990; Malpezzi, 1996), should normally lead to more rent payment defaults, ceteris paribus. However, the resulting increase in defaults is predictable and inevitably leads to more screening of prospective tenants by landlords to reduce the information asymmetry.[8] Although lease applicants may be required to cover the cost of a credit check, landlords bear the cost of contacting previous lessors, verifying employment, etc. Thus, when regulation costs are high, screening and rejecting poor quality lease applicants becomes a dominant strategy because the alternative would likely lead to higher defaults and lower profits. We propose a simple tenant screening model that analyzes this effect of regulations on tenant screening, and ultimately rent defaults.

This study is not about rent control or stabilization. It rather examines the effects of regulations similar to habitability laws (namely, repair and deduct, rent withholding, receivership, and retaliatory eviction) covered by Hirsch et al. (1975) as they alter the business fundamentals of landlords. However, we take a more comprehensive approach by examining how regulations affect the tradeoff between rent and tenant risk faced by landlords, for regulations simultaneously affect rent and the level of tenant risk landlords are willing to bear. For example, the costlier it becomes to evict problem tenants, the greater the incentive for landlords to become more cautious and selective when reviewing rental applications by investing in credit screening to reduce any potential information asymmetry about applicant quality. Although Miron (1990) graphically describes this tradeoff within the context of security of tenure, this tradeoff has not been directly modeled or empirically tested.

[8]In residential leasing, landlords may be exposed to a self selection problem if they cannot identify the type of lease applicant and to moral hazard because the contracted fixed rent payments may incite tenants to over-consume housing, a problem referred to as the rental externality (Henderson and Ioannides, 1983). Generally, landlords can alleviate the self selection problem by investing in credit screening. The moral hazard problem, which is not the focus of this study, is generally handled within the lease contract. In dealing with the information asymmetry problem, landlords trade off screening and regulation costs.

We develop a model that assumes that landlords cannot directly observe the quality of a lease applicant, but can improve the strength of a signal about the applicant's quality by investing in credit screening. Holding rent constant, we show that the return on investing in tenant screening increases with regulation costs, which should translate ex-post into a negative relation between regulations and rent defaults. Intuitively, if regulation costs are high, the gain from screening out bad applicants may exceed the cost of screening; and the riskier the tenant pool, the larger the gain.[9] In contrast, the return from detailed tenant screening may be low or even negative when low landlord regulations allow for a swift and efficient termination of leases and removal of delinquent tenants. As a result, landlords may be more willing to approve riskier applicants and, possibly, to supply additional rental units to accommodate the resulting increase in rental demand. Of course, regulations have a positive first-order effect on rent, hence causing more rent defaults. In high-regulation states, landlords would not only invest in applicant credit screening, but they may also pass on regulation costs to tenants by increasing asking rent to the extent permitted by the elasticity of demand since the regulatory environment limits their ability to collect on unpaid rent and expenses related to property damage.

Empirically, we verify the model predictions by examining rent and tenant default using a national database of individual lease payment records. As expected, the results document a positive relation between rent and regulations. Furthermore, we find no evidence of risk-based rent pricing by landlords. More importantly, we document that the likelihood of lease default declines by 5.5% for a one-unit increase in our regulation index. Our results persist after various robustness checks. For example, we estimate a simultaneous equations model to confirm that our findings are robust to concerns regarding the potential for a contemporaneous relationship between rent and expected defaults. In addition, we implement an instrumental variables model to control for the

[9]These gains include avoided rent losses, additional maintenance costs, and legal expenses to collect past-due rents.

possibility that regulations arise endogenously in response to rental market risk. The evidence consistently supports the model prediction that landlords are likely to invest more in tenant screening in response to higher regulation costs. We do not find evidence supporting the argument that smaller landlords may have more incentives to screen lease applicants to minimize turnover compared to larger landlords.[10]

Ours is the first study to explore the equilibrium interaction among rental regulation, equilibrium rent, and lease default. Our study also benefits from the use of micro-level rental lease performance data. In contrast, previous studies of rental regulations using survey rent data fail to consider the tenant risk dimension.[11] Thus, our study provides greater precision in capturing the complex relations between rent, tenant risk, and landlord screening. As a result, our findings should aid policy makers in evaluating the soundness of landlord regulations in the context of housing affordability.

The rest of the paper is organized as follows. The next section presents a simple illustrative model of a landlord's profit maximizattion problem under asymmetric information. Section 2 develops the empirical methodology used to test our predictions. Section 3 discusses the various datasets and main variables used in the empirical analysis presented in section 4. Finally, section 5 concludes.

1 A Simple Tenant Screening Model

We present a simple one-period model that captures landlords' incentives to screen potential tenants in a perfectly competitive environment in reaction to increasing regulation costs. Though the model is incomplete in the sense that housing demand, and therefore rent, is not rigorously modeled, we believe it provides some useful intuition regarding the relationship between tenant-friendly landlord regulations and tenant screening by landlords. This simplification does not represent a major shortcoming because

[10] See Downs (1996).
[11] See Hirsch et al. (1975).

we focus on the impact of landlord regulations on tenant screening.

We assume that a tenant θ can be either good ($\theta = 1$) or bad ($\theta = 0$) reflecting his propensity to default. If the tenant is good (bad), he always (never) pays his rent in full. The proportion of bad tenants in the population is δ, and thus

$$\theta = \begin{cases} 1 & \text{with probability } 1 - \delta \\ 0 & \text{with probability } \delta \end{cases}. \tag{1}$$

The quality of a prospective tenant is not directly observable by the landlord. Instead, the landlord receives a signal $s \in [0, 1]$ of the tenant's quality θ. We think of this signal as an outside measure or hard information, such as a credit score, that provides information about the tenant. These signals are drawn from the following conditional probability density function

$$f(s|\theta) = \begin{cases} \alpha s^{\alpha-1} & \text{if } \theta = 1 \\ \alpha(1-s)^{\alpha-1} & \text{if } \theta = 0 \end{cases} \tag{2}$$

where $\alpha \geq 1$ is the quality of the signal received by the landlord, as in Quint (2015). When $\alpha = 1$, the landlord's signal is completely uninformative about the tenant's quality θ, and as α increases, the quality of the signal improves, hence improving the ability of the landlord to guess the quality of the applicant. Put another way, α measures the landlord's investment in screening potential tenants. For example, a landlord may expend resources to check references only on applicants with a marginal signal above a minimum threshold. However, the incentive to expend additional resources may decline for applicants with exceptionally strong credit signals. Therefore, for each tenant, the level of investment in screening made by the landlord will be conditional on the signal

received, causing α to vary across applicants. Thus, the joint distribution of s and θ is

$$f(s,\theta) = (1-\delta)\alpha s^{\alpha-1} + \delta\alpha(1-s)^{\alpha-1}. \tag{3}$$

For each prospective tenant, the landlord seeks to maximize the expected rent he collects net of the cost of screening investment and other costs of operation. That is,

$$\max_{\alpha\geq 1} \mathbb{E}\left[Rent(Regulations)|s\right] - c(\alpha) - g(\mathbf{x}) \equiv$$

$$\max_{\alpha\geq 1} \left(\frac{\Pr(\theta=1)\cdot f(s|\theta=1)}{\Pr(\theta=1)\cdot f(s|\theta=1) + \Pr(\theta=0)\cdot f(s|\theta=0)}\right)\cdot 1 \cdot Rent(Regulations)$$
$$+ \left(\frac{\Pr(\theta=0)\cdot f(s|\theta=0)}{\Pr(\theta=1)\cdot f(s|\theta=1) + \Pr(\theta=0)\cdot f(s|\theta=0)}\right)\cdot 0 \cdot Rent(Regulations) - c(\alpha) - g(\mathbf{x})$$

$$\equiv \max_{\alpha\geq 1} \left(\frac{(1-\delta)s^{\alpha-1}}{(1-\delta)s^{\alpha-1} + \delta(1-s)^{\alpha-1}}\right)\cdot Rent(Regulations) - c(\alpha) - g(\mathbf{x}) \tag{4}$$

where *Regulations* is a measure of the regulatory environment used in the empirical analysis (either a raw index score or a standard normal transformation), $Rent(Regulations)$ is a reduced-form relationship between monthly rent and regulations (as measured by our regulation index), $c(\alpha)$ is the total cost of investment in screening, and $g(\mathbf{x})$ are rental costs due to a vector $\mathbf{x}$ of variables that do not depend on regulations or screening.[12] After some algebra, the first order condition in α of the landlord's profit maximization problem yields

$$Rent(Regulations) = c'(\alpha)\left[\frac{(1-\delta)^2 s^{2\alpha-2} + 2\delta(1-\delta)\left[s(1-s)\right]^{\alpha-1} + \delta^2(1-s)^{2\alpha-2}}{\delta(1-\delta)\ln(s)\left[s(1-s)\right]^{\alpha-1} - \delta(1-\delta)\ln(1-s)\left[s(1-s)\right]^{\alpha-1}}\right].$$

[12]This formulation implies that regulation costs mainly affect the landlord in the event of tenant default. The landlord has basically to decide how much to invest in screening today in order to reduce the likelihood of facing a default at the end of the period and not being able to collect the past-due rent because of tenant-friendly regulations. Without loss of generality, we assume that default leads to no payment.

(5)

Since it is well-documented in the literature that market rents typically increase when tenant-friendly regulations are imposed, we assume that *Rent* is a strictly increasing and strictly concave function of *Regulations*.[13] Specifically, we use the function

$$Rent(Regulations) = \psi_0 + \psi_1\sqrt{Regulations} \tag{6}$$

with ψ_0 and $\psi_1 > 0$ to describe this reduced-form relationship between *Rent* and *Regulations*. Furthermore, we assume that the screening investment costs $c(\alpha)$ are strictly increasing and strictly convex in α so that the marginal cost is strictly increasing in α. Finally, we assume that $c(1) = 0$, since the landlord can always obtain a free uninformative signal. Thus, we use the function $c(\alpha) = (\alpha - 1)^2$.

We solve the model for the optimal level of screening investment numerically. To avoid issues with negative values, we first transform the regulation index using the standard normal cumulative distribution function ($\Phi(\cdot)$). We obtain the parameters ψ_0, and ψ_1 in equation (6) from an ordinary least squares regression of rent on a constant and the standardized regulation index. Specifically, $\psi_0 = 808.33$, and $\psi_1 = 219.06$. For various values of δ, the proportion of bad tenants in the population, we solve the model at four different values of the regulation index along a fine grid for s. Strictly speaking, α is not a function of s since the signal realization s is drawn from a distribution parameterized by α. Rather, in the results that follow, we interpret the relationship between s and α as an ex-post relationship.

Figure 2 presents results from the procedure described in the previous paragraph for $\delta = 0.10$. Screening investment is increasing in the level of regulation. Interestingly, no investment in screening occurs when $s \leq 0.5$; our interpretation is that when such a

[13]The pricing of regulation costs into rents has been widely documented (e.g. Hirsch et al., 1975; Miron, 1990, among others).

signal is received, the probability of the tenant being bad is so high that obtaining more information about the tenant is futile - the landlord would rather reject the tenant's application outright. Similarly, as s approaches one, the landlord's incentive to invest in screening decreases because the probability that he is facing a good tenant is very high. Thus, peak screening investment occurs when the landlord has the greatest uncertainty about the tenant's quality, which is when he receives a signal $s \in (0.5, 0.8)$.[14]

As expected, a higher proportion of risky tenants in the market (δ) increases the level of investment in screening (α) for a given credit quality signal (s) over the range $0.5 \leq s \leq 1$. Figure 3 shows the screening investment α as a function of the population's true default probability δ assuming $s = 0.55$. We see that screening investment increases as the tenant pool becomes riskier and as regulations increase.[15]

To summarize, our model predicts that in a cross-sectional analysis of markets with heterogeneous regulations, landlord's will engage in greater tenant screening in markets with higher regulation costs, all else being equal. As a result of this greater level of screening, markets with higher regulations will have lower ex post tenant defaults.

2 Methodology

To understand the effect of state regulations governing residential lease contracts on landlord behavior, we separately examine the relation between regulations and observed lease equilibrium rents and defaults. By imposing non-negligible costs on landlords, landlord-tenant regulations become an important consideration in the landlords' profit

[14]Results from raw regulation index scores are indistinguishable from those using the standardized regulation index. Also, our results are unchanged when rent and total cost are modeled using log and exponential functions, receptively, as follows: $Rent(Regulations) = \beta_0 + \beta_1 \ln(Regulation)$ and $c(\alpha) = \exp(\alpha - 1) - 1$.

[15]As a robustness check, we abstracted away from the full default model by allowing partial defaults on rent. That is, we set up the model so that a good tenant θ_g always pays his rent in full (so that $\theta_g = 1$) but that a bad tenant θ_b only pays a fraction of his rent (i.e., $\theta_b = 0.5$ or 0.75). The results do not change substantively. Since there is less risk for the landlord in a partial default model, incentives to invest in screening are not as high, and thus less screening occurs at all regulation scores and signal realizations. However, the general shape of the investment functions are unchanged.

maximization problem. The costs considered here are those stemming broadly from limitations on the landlords' ability to terminate leases and recover past-due rent payments, property damages, and legal fees. Most landlords have the ability to accurately assess and price tenant risk. But for fear of exposure to discrimination lawsuits under the Fair Housing Act of 1968, they are generally reluctant to use risk-based pricing by charging different rents for identical units based on the tenants' risk. The Fair Housing Act prohibits discrimination in the sale, rental, and financing of dwellings, and in other housing-related transactions. While the law does not specifically prohibit risk-based pricing in residential leasing, it does prohibit discrimination based on race, color, national origin, religion, sex, familial status, and disability.[16] Thus, to the extent that tenant risk may be highly correlated with personal characteristics covered by the Fair Housing Act, landlords could be exposed to lawsuits based on disparate impact. As a result, landlords typically do not utilize risk-based pricing in leasing and basically face a choice between accepting or rejecting lease applicants at the posted rents, which normally reflect the weight of exiting regulations and general conditions of the rental market.[17]

The focal point of this study is on documenting the effect of regulations on the tenant risk (the level of lease defaults) that landlords are willing to accept by examining lease defaults across states. But since risk and rent are endogenous, landlord regulations also affect equilibrium rents. As noted above, landlords generally charge the same rent for identical units, even in the absence of information asymmetry about tenant risk, due to a fear of discrimination lawsuits. We expect contract rent to be lower in less-regulated states due to a variety of reasons. For example, landlords may be able to swiftly remove delinquent tenants before rent delinquencies accumulate, or they may have a better chance of collecting past due rents at lease termination. Therefore, fewer regulatory restrictions on landlords should translate into lower rents because there is no need for

[16]See: http://portal.hud.gov/hudportal/HUD?src=/program_offices/fair_housing_equal_opp/FHLaws
[17]Risk-based pricing could also lead to rationing in rental markets as in Stiglitz and Weiss (1981).

landlords to price high default costs, ceteris paribus.[18] On the other hand, stringent regulations may impose considerable costs, likely resulting in landlords adopting more conservative leasing policies by lowering $\bar{\theta}_i$, with average rent likely reflecting the higher cost of regulations. Thus, we first examine the regulation-rent relation by estimating the following model:

$$\begin{aligned} ln(Rent_{i,t}) &= \alpha_R + \beta_R Regulations + \zeta_R Default_t + \gamma_R Local\_Rent_t + \delta_R X_{,t} \\ &\quad + \phi_R Z_t + msa + y_t + \xi_{i,t} \end{aligned} \tag{7}$$

where the dependent variable $Rent_{i,t}$ is the individual lease contracted rent. *Regulations* represents differing state level tenant/landlord laws and is measured at the state level using our developed regulation index. The default variable ($Default_t$) is measured at the property or MSA level to avoid the possible endogeneity between default and rent. *Local_Rent* is average local rent, standardized to income. X_t represents various property-level control variables, if possible, and Z_t is a vector of macro-economic control variables. We also include MSA (msa) and lease-year (y_t) fixed effects, and $\xi_{i,t}$ represents the error term. We compute the regulation variable ($Regulations$) such that it increases as regulations become more tenant friendly, thus costly to landlords. Thus, we predict a positive relation between tenant regulations and rents.

The effect of defaults on rents is unclear. At the individual lease level, risk-based pricing dictates a positive relation between lease default and rent. The assumption of no information asymmetry about tenant risk should reinforce this expectation. However, higher rent is likely to lead to more defaults. As a result, increasing rents in response to defaults may not be the most optimal course of action for all landlords. Furthermore, we measure default at the property or MSA level, rather than at the individual lease level since individual default and rent are endogenous. Thus, it is unclear that the best

[18] We note that fewer landlord regulations alone do not guarantee lower rents. Rather, competition is needed to ensure that landlords do not use the superior bargaining power to the detriment of tenants.

response to deteriorating tenant risk is further rent increases. When faced with mounting defaults, landlords may ration credit by expelling delinquent tenants and lowering $\bar{\theta}$. In summary, the relation between average default and rent becomes an empirical question.

Conditional on the regulatory environment and the state of the rental market, we assume that each landlord's profit maximization problem dictates an optimal threshold ($\bar{\theta}_i$) of acceptable tenant risk. Since state laws governing tenant/landlord relations impose costs on landlords in the case of tenant default, $\bar{\theta}_i$ is a function of the regulatory environment. Thus, the less restrictive (or less costly to landlords) regulations become, the higher $\bar{\theta}_i$ and the higher the observed average risk of approved lease applicants, which should result in more lease defaults *ex post*. In addition, the more competitive the rental market, the higher $\bar{\theta}_i$. A high $\bar{\theta}_i$ strategy becomes optimal when regulation costs are low because the regulatory system allows landlords to efficiently deal with rogue tenants. In contrast, restrictive regulations will result in significantly less risk taking by landlords, i.e., lower $\bar{\theta}_i$, which is tantamount to credit rationing. As unsatisfied rental demand builds up due to the negative effect of regulations on rental supply, the social cost of regulations soars and pressure mounts on governments to tighten regulations further. We estimate using probit the following reduced form equation relating lease default to lease, property, location, and legal characteristics:

$$\begin{aligned} Pr(Default_{i,t} = 1) &= \Phi(\alpha_D + \beta_D Regulations + \gamma_D Rent\_Prop_t \\ &\quad + \delta_D X_t + \phi_D Z_t + msa + y_t) \end{aligned} \tag{8}$$

where $Default_i$ is a 0/1 variable indicating whether individual i defaulted on her lease originated at time t; $Rent\_Prop_t$ is the average contract rent at t at the property level and therefore also captures building quality; $Regulations$, X_t, Z_t, msa, and y_t have the same meanings as in equation 7; and $\Phi(\cdot)$ represents the cumulative normal distribution function.

Again the variable $Regulations$ increases as regulations become more tenant friendly.

Thus, we expect a negative estimated coefficient for β_D reflecting landlords' decisions to choose lower $\bar{\theta}$s (low risk tenants) when regulation costs are high. In addition, we expect lease defaults to be positively related to rent and rental supply as landlords relax tenant screening to improve absorption, and negatively related to rental demand as landlords become more selective due to the higher level of rental demand. The rent variable is measured at the property level to avoid potential endogeneity between rent and default at the individual lease level. To confirm the robustness of our results, we will also estimate equation (8) using property-level data with MSA fixed effects.

3 Data

Residential leases are contracts that give tenants the right to use (enjoy) real property in exchange for payment of a consideration to the property owner. As a contract, the lease spells out the rights and responsibilities of all parties to the contract. In addition, leases are governed by state contract laws in the jurisdiction where the property is located. Historically, these laws recognized the special nature of residential leases in providing shelter to the tenant. As a result, state laws governing residential leases evolved to provide significant protections to both parties. Furthermore, as real property is generally the purview of local jurisdictions, significant heterogeneity exists in these laws and regulations. To study the effect of heterogeneity in tenant/landlord regulations, we compiled and summarized current state laws and regulations governing residential lease contracts for the U.S. states and the District of Columbia from Nolo, a private legal data and service provider.[19] The regulations are coded in state statutes or established by legal precedence and cover many tenant-landlord contractual aspects, from security deposit related issues to conditions under which landlords may unilaterally terminate leases without prejudice. We categorized the state tenant-landlord regulations into the

[19]Nolo is a wholly owned subsidiary of Interest Brands. More information about the data and Nolo can be found at http://www.nolo.com/legal-encyclopedia/state-landlord-tenant-laws. We use of current landlord regulations because they are generally stable over time.

following four summary groups:

- *Termination for Lease Violation*: The minimum number of days a landlord must give notice to a tenant before unilaterally ending a lease in case of serious violation of contract terms. Longer notice periods protect tenants and increase regulation costs to landlords.

- *Right to Withhold Rent*: Regulations that allow tenants to withhold rent to force landlords to perform repairs and maintenance.

- *Security Deposit Return*: The maximum number of days a landlord may wait before refunding security deposits, with longer waiting periods favoring landlords to the detriment of tenants.

- *Small-Claims Court Limit*: The maximum dollar amount a landlord can sue a tenant for in small-claims courts. This limit effectively caps tenant liability and consequently represents a broad indicator of the regulatory environment.

For comparison and aggregation purposes, we recode the regulation variables using a linear scoring system that increases with the level of landlord regulations. With the exception of the *Right to Withhold Rent*, which is coded as a dummy variable, we assign scores ranging from 0 to 3 to each regulation group. Regulations granting the greatest flexibility to landlords have the lowest score (0) and those that seriously restrict landlord rights receive the highest score (3). For the *Right to Withhold Rent* group, states that do not grant tenants this right are assigned 0 and those that do receive 1. Next, we combine the individual regulation scores into an index that is then standardized to the standard normal distribution across the sample (Figure 4).[20] The individual regulations and the derived index are listed in Table 1. Figure 5 shows the geographic distribution of regulations in continental U.S. Michigan has the highest regulation score, closely

[20]To give *Right to Withhold Rent* regulation its full weight in the index, we assign it a value of 0 for states that do not allow rent withholding and 3 for states that allow rent withholding.

followed by Virginia, Washington, and Washington DC. In contrast, Georgia and Illinois are the most landlord-friendly states. Even though we present the results based on the standardized index values, estimations using the regular index produce similar results.

Table 2 presents the correlation matrix of landlord regulations across the states. The variables are generally moderately correlated, indicating heterogeneity in landlord/tenant regulations. Table 3 gives the summary statistics of the raw and recoded regulation variables. We see that most states require security deposits to be returned within 30 days, even though some states allow as much as 180 days. On average, landlords may terminate leases within 8 days, but the majority of states permit almost immediate lease termination in 3 days or less for serious violations. The small-claims court limits range from \$2,500 to \$25,000, with a mean of roughly \$8,800.[21] Since the average limit is more than five times the mean rent of \$939 (in first row of Table 4) and the typical residential lease is twelve months, this regulation may affect how landlords treat delinquent tenants. On the other hand, the majority of states allow tenants the right to withhold rent in the event a landlord fails to perform repairs and maintenances required under the lease. Again, the regulation scores reported in the bottom half of Table 3 are computed such that higher scores correspond to stricter landlord regulations. The combined state regulation indexes range from 3 to 12 with a mean of 8. Since identification is achieved by examining variations across states, we normalize this index for use in the subsequent analysis.

To measure the impact of tenant-landlord laws and regulations, we use multifamily rental data from January 2000 to November 2009 compiled by Experian RentBureau. RentBureau maintains residential rental performance data collected nationally from property management companies. The database contains lease characteristics (lease start date, lease termination date, renter move-in date, renter move-out date, last transaction date), property location information (city, state, and zip-code), and rent payment

[21] We assign \$25,000 to states that do not set a limit. Otherwise, the average falls to \$5,000.

records.[22] The company updates rent payment records every month, noting whether rent was paid on time or not, the type of payment delinquency, if applicable, the accrued number of late payments, and any write-off on rent and non-rental expenses due. Ambrose and Diop (2014) more fully describe the data.

We restrict our sample to leases with rent between $250 and $5,000 and retain MSAs with at least 30 leases in any given year. Table 4 summarizes the data by year. Our sample comprises 1,749,981 leases covering 2,601 properties spread over 200 MSAs and 41 states. RentBureau increased its geographic coverage over time from 15,343 leases in 477 properties spread over 104 MSAs in 2000 to 531,563 leases in 1,957 properties located in 176 MSAs by the end of 2009. The average property had 67 units. We do not expect the increase in geographic coverage over time to pose any particular problem to our analysis because the data was already geographically diverse in 2000, containing 477 properties located in 30 states. However, in section 4.3 we report a robustness check to control for the change in geographic coverage. Average rent increased over the sample period from $711 to $1,004. The top section of Table 5 Panel A provides summary statistics for the rent variable.

We measure rent default using the lease payment records compiled by RentBureau. RentBureau reports rent payments of tenants in a 24-digit vector, recording each tenant's historical payments over the last 24 months starting from the month of reporting or the month the lease ended. The reported payment records are therefore left censored.[23] Monthly rent payments are coded in the data as P (on-time payment), L (late payment), N (insufficient funds or a bounced check), O (outstanding balance at lease termination), W (write-off of rent at lease termination), or U (write-off of non-rent amount owed at lease termination).[24]

[22] In addition to the rent performance data, RentBureau also tracts collections on terminated leases. To maintain privacy, limited information is disclosed on individual tenants and property locations.

[23] As most residential leases are short term (a year or less), issues associated with left censoring of the data are minimized since leases of problem tenants are generally not renewed.

[24] Payment vectors sometimes contain missing records. If the missing values are between two P cells, we recode then as P. Similarly, if the missing values occur at the end of a payment vector, we assign P

We use the payment vectors to generate a 24-month payment time series for each lease. We label any month that is not coded as P, L, or missing as a default. Panel A of Table 5 summarizes rent payment defaults at the lease, property, and MSA levels. The lease-level 6-month, 12-month, and 24-month default dummy variables indicate whether a payment was missed over the last 6, 12, or 24 months, respectively. As expected, lease-level defaults increase with the observation period from 11% in 6 months to 23% over 24 months. Average monthly lease defaults, which are equal to periodic default counts divided by the number of months, are much smaller. An 11% likelihood of payment default over 6 months represents roughly 2% per month. Panel A also summarizes average property-level and MSA-level defaults.

Panel B of Table 5 reports summary statistics of the locality and macroeconomic control variables. These variables proxy for factors driving the rental market and the general economy. To capture changes in local rents, we include MSA Fair Market Rents (FMR).[25] Everything else equal, a surge in local rents should result in higher contract rent and more defaults. Default should also be function of tenant quality. Unfortunately, we do not directly observe tenant risk; we only observe the actual rents paid by tenants. Thus, following Ambrose and Diop (2014), we control for tenant risk by including average rent at the property level and MSA per capita income. We acknowledge that average property rent is also a proxy for unobserved property quality. We expect average rent to be negatively related to defaults. We also control for rental vacancy at the property level and locally using state rental vacancy rates. Vacancy is expected to be positively related to default and negatively related to rent, as landlords relax screening, reduce rent, or both to increase absorption. To account for the overall growth in the supply of rental housing, we include the number of building permits for rental units issued during the year in each state. To control for shifts in rental demand, we include where appropriate

to those cells as long as they are posterior to the lease signing date. Otherwise, missing records are left empty.

[25]FMR data are produced by the U.S. Department of Housing and Urban Development (HUD). http://www.huduser.org/portal/datasets/fmr.html

the percentage of the state's population in the 20-year to 34-year age group relative to the state's population.

Local and national economic conditions affect the riskiness of the rental market and therefore landlords' decisions. To control for cross-sectional differences in local economic conditions and temporal variations in macroeconomic conditions, we include unemployment, inflation, and housing affordability as additional explanatory variables in the default and rent models. Measured at the MSA level, the unemployment rate controls for differences in economic activity across MSAs. Higher unemployment is likely to depress the rental market, limiting rent growth or even causing a decrease in rent. However, its effect on default is less clear. It is possible that negative income shocks from unemployment may increase defaults as renters struggle to make ends meet. However, housing and food are necessities and, therefore, are usually the last consumption items affected by negative income shocks, minimizing the impact of unemployment on rental defaults.

The effects of inflation on default and rent is straightforward. Inflation should be positively related to rent. It should also positively affect default, for income lags inflation. Housing affordability may affect households' tenure decisions and possibly rents and defaults. We use the Housing Opportunity Index (HOI) developed by the National Association of Home Builders (NAHB) and Wells Fargo to control for geographic differences in housing affordability. HOI compares the median family income to median house prices quarterly at the MSA level. Thus, the more affordable a market, the higher HOI.[26]

We estimate the models using lagged values of the explanatory variables relative to the dependent variable. We also include MSA and lease-year fixed effects to con-

[26]The HOI is defined as the share of homes sold in an MSA that would have been affordable to a family earning the MSA median income, based on standard mortgage underwriting criteria. NAHB assumes that a family can afford to spend 28 percent of its gross income on housing. HOI is the share of houses sold in a metropolitan area for which the monthly median income available for housing is at or above their monthly mortgage costs. http://www.nahb.org/reference_list.aspx?sectionID=135

trol for possible systematic differences in local market conditions and general changes macroeconomic conditions not captured by our models.

4 Results

4.1 Regulations and Rent

As we noted section 1, a cross-sectional analysis should reveal that higher regulation costs lead to higher rent in equilibrium.[27] To confirm this prediction, we begin by reporting in Table 6 the OLS estimation results of equation (7). The variable of interest (*Regulations*) is the standardized aggregate regulation index, which ranges from -2.16 to 1.62 with a standard deviation of one. Column (1) shows our baseline specification with lease default measured as the average MSA monthly default rate predicted for the next 12 months based on an ARMA(1,1) forecast. Since our measure of MSA rental default risk is somewhat arbitrary, we provide two alternative default rate specifications in columns (2) and (3).[28] Consistent with findings reported in the literature, the results across all specifications confirm that rents are higher in more regulated cities, providing evidence that regulations ostensibly designed to help renters ultimately hurt the intended beneficiaries. Although the estimated coefficients clearly indicate a positive relation between our summary regulations index and rents, the economic effect is relatively minor as a one-unit increase in the regulation index is associated with a 0.3% to 0.6% increase in average rent. To place this in perspective, we note that the average annual rent in 2009 in cities characterized as being the least regulated was $11,016. Thus, the estimated coefficients imply that landlords would respond to a one-unit increase in the regulatory burden (to the next category) by increasing annual rents between $33 to

[27]Lower levels of regulation may also enhance competition by facilitating market entry, leading to lower rent in equilibrium and limiting the ability of landlords to increase rent.

[28]Column (2) reports the estimation results with rental default based on a 12-month moving average of each MSA's historical default rate and column (3) reports the results with rental default measured as the one-month lagged MSA average default rate.

$66 per apartment. However, our summary regulation index masks the impact of the individual regulations. We note that the positive relation between rents and regulations holds across each individual regulation and that changes to these regulations can have a material affect on rents. For example, column (4) in Table 6 replicates our baseline specification for only the small-claim court limit regulation, which is a broad indicator of landlord regulations. The estimated coefficient shows that a one standard deviation increase in the average small-claims court limit (from $8,817 to $15,499), corresponds to a 6% increase in average rent, or approximately $56.5 per month at the mean.[29] To place this increase into perspective, the 2009 median household income for all renters was $31,463.[30] Thus, a 6% increase in the average 2009 rent level (from $12,048 to $12,770) would increase the mean rent-to-income ratio (a measure of housing affordability) from 38% to 41%.

We use the lagged average 12-month rent default forecast to proxy for changes in credit risk at the MSA level. As noted in section 1, the impact of defaults on rent is an empirical question. Thus, the negative and statistically significant (at the 1% level) coefficients for our measures of lease default confirm that higher default rates have negative impacts on rent. The estimated coefficient for the default variable in Table 6 implies that a one-point increase in the predicted default rate is associated with a 0.24% decline in the average monthly rent. Although prices are generally expected to adjust positively to increases in risk, the significantly negative coefficient on rental default implies that landlords respond to a deterioration in credit risk by lowering rent, rather than by risk-adjusting rent upward, which might cause more defaults and higher losses.

We also see that the various control variables, which are lagged relative to the dependent variable, display the expected influence on rent. For example, contracted rents are positively correlated with local rent standardized to income. Furthermore, rents tend to

[29] 0.009 times 6.682 ($6,682 in Table 3 divided by 1,000) times $939 in Table 4.

[30] Source: *Current Population Survey* (CPS) Annual Social and Economic (ASEC) Supplement for 2010, accessed at http://www.census.gov/data/tables/time-series/demo/income-poverty/cps-hinc/hinc-01.2009.html.

positively adjust to inflation and are negatively correlated with local unemployment and rental vacancy rates. Also, areas with greater rental demand, as measured by the change in the proportion of potential renters in the population, are associated with higher rent, whereas an expansion in rental supply, proxied by the number of building permits issued, has a negative effect on rent. The fact that our model is able to reproduce these intuitive results gives us comfort about the predicted positive relation between rents and regulations and the negative relation between rents and defaults. We also derive additional comfort from the property-level OLS estimation results reported in Table A.1 of the Appendix, which confirm our findings using more granular lease data.

In summary, estimated coefficients from the rent model depicted in equation (7) confirm the pricing of regulations by landlords. However, we find no evidence of risk-based pricing.

4.2 Regulations and Lease Defaults

We now turn to an analysis of rental regulations and ex post tenant risk to gain more insights into landlords' behavior. In Table 7 we report multivariate estimations of lease defaults following equation (8). The results reveal a negative relation between regulations and lease defaults over 6, 12, and 24 months in the first three columns. The marginal effects suggests that a one-unit increase in the regulation index translates at the mean to 4.5%, 5.5%, and 3.9% fewer defaults over 6, 12, and 24 months, respectively.[31] Although the magnitude of the effect of regulations over 24 months is slightly smaller, it remains statistically significant at 1% level. The lower effect of regulations over 24 months likely reflects landlords' reluctance to renew leases after the initial 12 months for delinquent tenants. We explore this further by examining defaults during the second year of leases in column (4) and find no significant relation between defaults and regulations after the leases' first 12 months. These results imply that stricter landlord regulations are likely

[31] Calculations: 0.005/0.17, 0.006/0.11, and 0.009/0.23 over 6, 12, 24 months, respectively; the denominators are from Panel A in Table 5.

associated with fewer defaults. This is consistent with our theoretical prediction that landlords may optimally invest in tenant screening in order to reduce defaults and their associated costs as regulations increase. In contrast, less-constraining regulations likely lead to landlords accepting riskier tenants. Even though such a strategy would result in more defaults ex-post, the associated costs are relatively low because landlords can easily remove delinquent tenants and re-lease the units.

In addition to lease-year and MSA fixed effects, we employ a battery of control variables likely to explain defaults, namely, rent inflation, income, unemployment, vacancy, rental supply, and housing affordability. The effects of these control variables are relatively intuitive, adding credence to the validity of our model. For example, inflation has a positive effect on default, likely due to the fact that income generally lags inflation causing a tightening of households' budget constraints. Higher local market rent, measured by fair market rent (FMR), is also correlated with greater defaults. In contrast, higher property rent is associated with fewer defaults. This variable likely captures both building quality and tenant credit risk because upscale apartment complexes price out riskier tenants. Also, unemployment reduces the likelihood of default since accumulating rent past due during periods of low job prospects would certainly lead to eviction. As expected, high vacancy at the property level is associated with more defaults as landlords relax credit screening in order to increase absorption. Since homeownership is a substitute to renting, housing affordability, measured by HOI, has a negative effect on the rental market as better quality renters move into homeownership, leaving behind a riskier rental pool, a fact documented by Ambrose and Diop (2014). Finally, an expansion of rental supply, as indicated by the number of building permits issued for rental units, is correlated with more defaults, ceteris paribus.

We also confirm our primary findings on the effect of regulations on the likelihood of lease default by replicating the analysis using only the small-claims court limit regulation. The results in column (5) of Table 7 show that a one standard deviation increase in small-

claims court limit results in a 7.9% increase in default over 12 months at the mean.[32] We also aggregated the individual rent performance data to the property level. The results from this 12-month default estimation strongly confirm the findings from lease-level analysis.[33]

In summary, the above results lead to the conclusion that tenant-friendly regulations may actually harm the intended beneficiaries. First, the associated costs will be passed on to the tenants because of the inelasticity of rental demand. Second, landlords are likely to screen out risky tenants leading to the classic Stiglitz and Weiss (1981) credit rationing phenomena in rental markets.

4.3 Robustness Checks

It is likely that rent and expected lease default are jointly determined locally whether or not landlords practice risk pricing, requiring joint estimation of rent and default models. The introduction of regulations and tenant screening by landlords may further strengthen the contemporaneous relationship between rent and expected default.[34] To directly address this potential endogeneity problem, we simultaneously estimate the rent and default models using maximum likelihood estimation and allow for correlation between the error terms. We achieve identification because the rent and default models do not include the same explanatory variables. Table 8 presents the results of the joint estimation of rent in Panel A and default in Panel B. In line with our previous results, Panel A shows that rent is positively correlated with regulations and negatively correlated with past default. Panel B confirms the previously documented negative relation between default and regulations. Furthermore, the effects of the control variables

[32] 0.002 times 6.682 divided by 0.17 from Table 5

[33] See Table A.2 in the Apppendix for the results from the OLS regression of average lease default at the property level on regulations using the same set of control variables as in Table 7. We use OLS for property-level estimations because the default variable is no longer binary but rather continuous over [0,1].

[34] As a precautionary measure, the previous rent estimations control for default at the property or MSA level using lagged values and the default estimations use lagged average property or MSA rent, even though the analysis is based on observed default rather than expected default.

from the joint estimation are similar as before.

It is unclear whether regulations rise endogenously in response to rental market risk or stem from increased tenant advocacy aimed at strengthening tenant rights. If stricter regulations are enacted by states experiencing higher defaults, this may result in a positive or negative relation between regulations and defaults, depending on the type of regulation. A regulation lowering rent may cause a drop in defaults, whereas one limiting landlords' ability evict bad tenants may cause defaults to rise.

Ultimately, the question is whether the regulations were in place prior to the rental data used in our empirical tests. Although most of these regulations were generally enacted in the 1980s, thus before the period covered in this study, and tend to be persistent (Rabin, 1983; Goetz, 1983), we are unable to accurately pinpoint the regulations' enactment dates. To address this issue, we instrument for regulations using the composition of state legislatures in 2001. The choice of this instrumental variable is motivated by documented differences in regulatory philosophies between the two main political parties. Our regulation instrument is a binary variable, based on the split between Democrats and Republicans of the states' combined house and senate seats, that takes 1 if Democrats have the majority. Table 9 presents results of the 2SLS estimation of rent and confirm the previously documented effects of regulations and default on rent. Table 10 also confirms the negative impact of regulations on default using 2SLS.[35]

Finally, the number of leases in our sample increased significantly from roughly 15,000 in 2000 to 531,000 in 2009 as RentBureau expanded its geographic coverage from 104 MSAs in 2000 to 176 MSAs in 2009 (Table 4). As more geographic areas were added to the database, others dropped out, resulting in our sample containing 200 MSAs in total. In addition to expanding its geographic coverage, RentBureau also significantly increased market penetration. To confirm that changes in the sample's composition over time did not bias the results, we reran the analysis using only data from the 104 MSAs

[35]The rent and default estimation results are unchanged when we use 1990 state legislature composition as an instrument due to persistence in state legislatures (unreported table).

represented in our sample in 2000. Table 11 presents the rent and default estimation results from the reduced sample following the rent model of Table 6 and default model of Table 7. Even though the sample size dropped by roughly 11%, the rent and default estimation results remain practically unchanged. Rent remains positively correlated to regulations and negatively related to renter risk. Also, lease defaults decrease with landlord regulations, indicating more vigorous tenant screening by landlords.

4.4 The Importance of Landlord Size

Until now, we have abstracted from the issue of landlord heterogeneity. Although not modeled in this paper, a general equilibrium analysis of the rental market is likely to lead to a separating equilibrium made up of numerous submarkets, each characterized by relatively homogeneous landlords and renters (Miron, 1990). However, our previous landlord optimization analysis remains valid in this context when applied to a submarket as our sample is characteristic of the multifamily submarket predominantly composed of large rental properties. In this section we explore the effects of landlord heterogeneity on rent and default in that submarket. Since the RentBureau data does not include landlord or property owner identifiers, we use property size a proxy. We measure property size as the maximum of the number of leases for each property present in our sample every month during the study period.[36]

Table 12 presents the results from the estimation of variants of our main rent and default models that include a large-size property dummy and its interaction with regulations. The property size dummy is computed annually, taking the value of 1 if the size of the property (i.e., number of individual leases) is higher than the sample's median that year. Column (1) shows that large properties generally have significantly higher rents of about 4.8% on average, after controlling for local amenities (FMR to Income) and renter risk, among others. While we cannot definitely identify the source of this

[36]This measure has some shortcomings. It does not allow changes in property size over time. Also, it leads lower vacancy rates by not reflecting normal vacancy rates.

higher rent, the most plausible explanation lies with larger apartment complexes generally having higher quality amenities.[37] However, rent adjustments to regulations, which are positive, are generally smaller for larger properties, as evidenced by the positive coefficient of regulations and the negative sign of its interaction term with the large-size property dummy. As in the previous rent estimations, column (1) of Table 12 shows the reluctance of landlords to adopt risk-based rent pricing. The effect of regulation on rents is approximately 60% lower for large landlords.

Even though larger properties command higher rents, they do not experience more defaults as evidenced by the insignificance of the coefficient of the size dummy in column (2) of Table 12. This result supports our amenities based theory as the most plausible explanation for higher rents for larger properties. This default estimation again confirms the negative relation between defaults and regulations for both large and small properties. Again, default is positively related to rent at the MSA level and negatively related to average property rents, which likely proxies for property and/or tenant quality. The remaining control variables in these rent and default models behave exactly the same as previously reported.

Lastly, we explore the effect of regulations on vacancy rates. We compute vacancy rates monthly by comparing the total number of leases written on each property to the property size. The estimation of our vacancy model in Table 13 shows that larger properties generally experience lower vacancy, despite having higher rents (Column (1) in Table 12). We note that the results in Table 13 are probably due to higher demand for that type of property, rather than lax tenant screening since default is not higher in those properties (Column (2) in Table 12). Table 13 also documents a positive relation between regulations and vacancy rates, irrespective of property size. As stricter

[37]Other possible explanations include higher bargaining power for larger landlords (Gilderbloom, 1989) or strategic behavior of smaller landlords to lower vacancy (Downs, 1996). Downs argues that smaller owners wish to avoid vacancies and thus may be unwilling to quickly increase rents to market-clearing levels. Gilderbloom hypothesizes that rents tend to be higher in markets dominated by a few large landlords.

landlord regulations cause tighter tenant screening by landlords, which results in the negative relation between regulations and defaults, vacancy should normally rise. Table 13 documents this effect.[38] The remaining control variables in the vacancy model show, as expected, that vacancy increases with rent and decreases with rental demand.

5 Conclusion

Using lease-level performance data, we present new evidence on the impact on landlord behavior and ultimately equilibrium market outcomes of policies aimed at limiting the rights of property owners. We confirm that market rents reflect regulatory costs. However and more importantly, we show that as regulations impinge on landlords' operational flexibility, landlords increase investment in tenant screening to lower incidental costs. Unfortunately, tenant screening by landlords leads to a form of credit rationing and thus reduces the supply of rental housing. As a result, our findings suggest that landlord regulations that presumably were designed to benefit vulnerable lower income tenants may ultimately limit their access to rental housing. Thus, in the long term, low income households are more likely to benefit from policies aimed at increasing the supply elasticity of rental housing rather than from stricter landlord regulations.

[38]The estimated coefficient of regulations is 0.012 for smaller properties and 0.007 (0.012-0.005) for larger properties.

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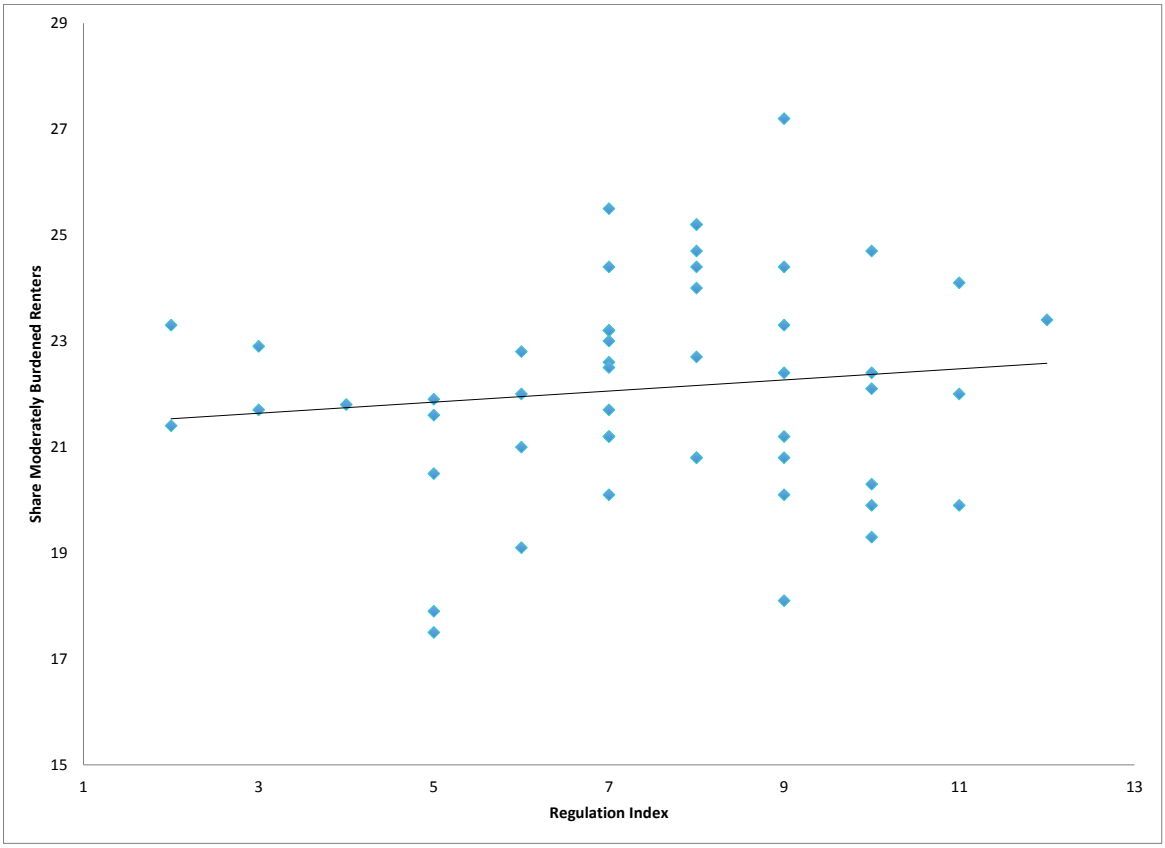

Figure 1. Linear correlation between state rental regulation index and percentage of moderately burdened renters in 2014. Moderately burdened renters have rent greater than 30% of income. Source: Joint Center (2015a)

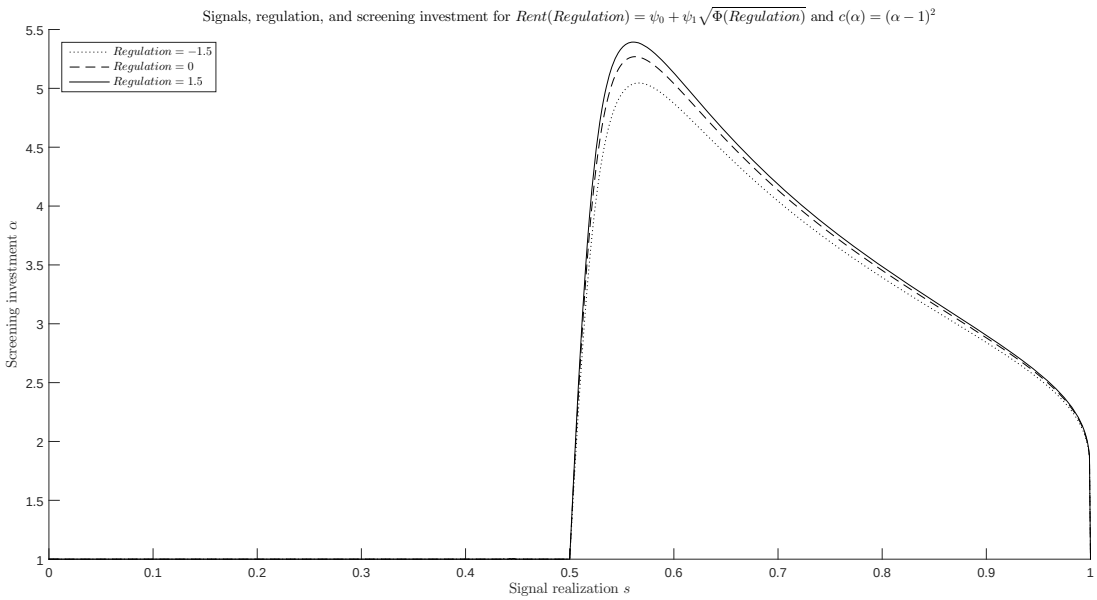

Figure 2. Results from the two specifications using standardized values for the regulation index with $\delta = 0.1$. When $Regulation = -1.5$, screening investment at its peak (where $s = 0.5660$) is $\alpha = 5.0454$, and when $Regulation = 1.5$, screening investment at its peak (where $s = 0.5610$) is $\alpha = 5.3930$, a 6.9% increase in screening investment.

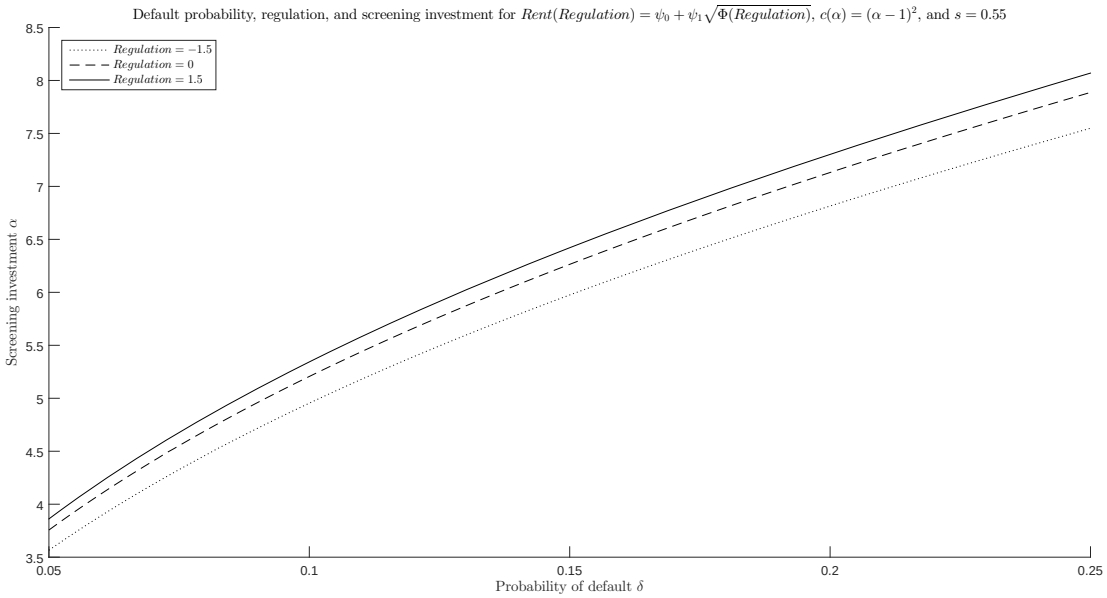

Figure 3. Screening as a function of the true probability of default for the two specifications using standardized values for the regulation index and $s = 0.55$.

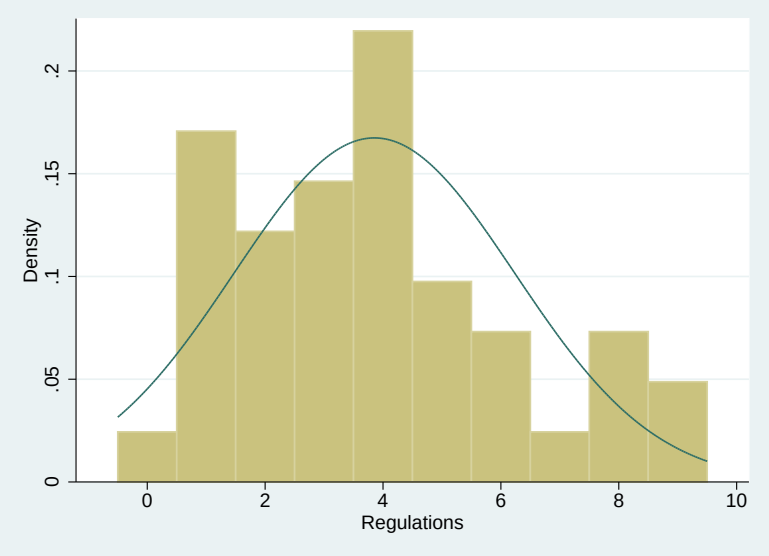

Figure 4. Raw Regulation Index Density Distribution and Fitted Normal Density

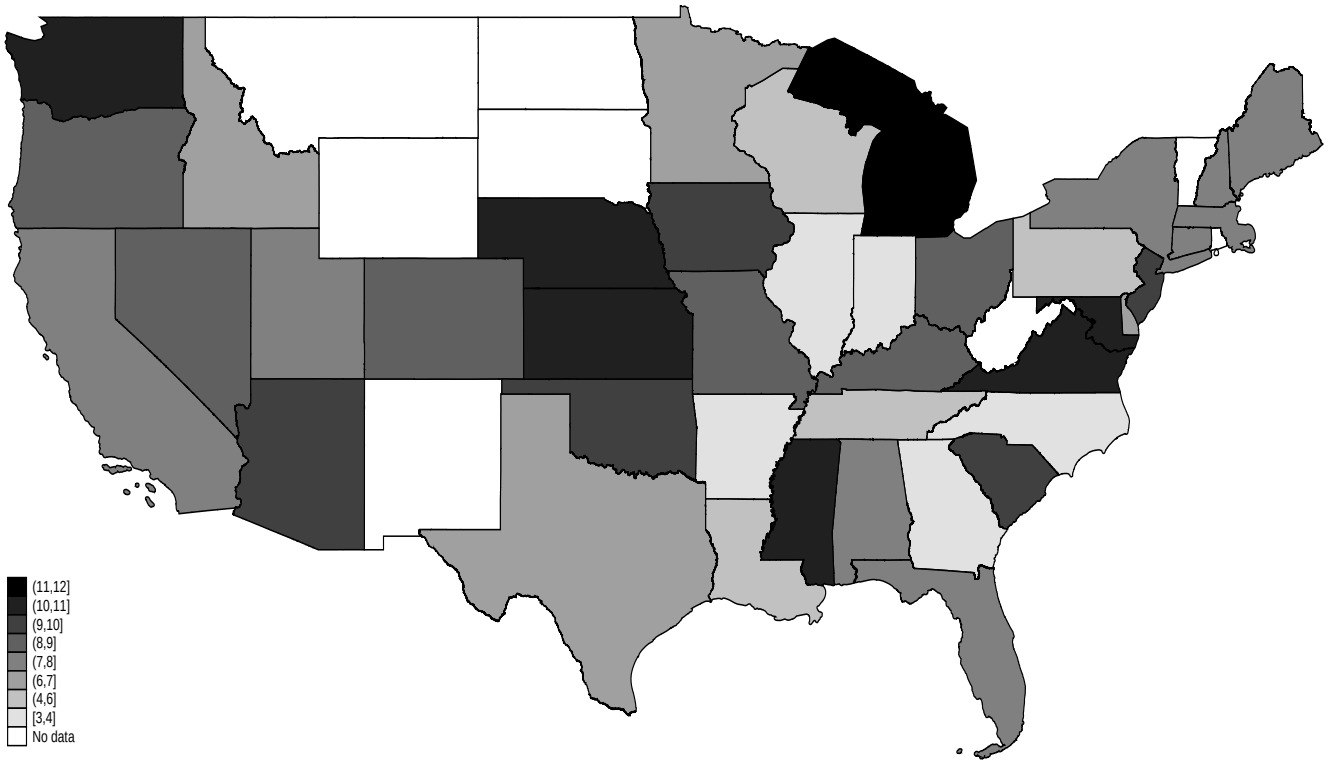

Figure 5. State Landlord Regulations

Table 1. Raw Regulations

State	*Security Deposit Return (Days)*	*Termination Lease Violation (Days)*	*Right to Withhold Rent*	*Small-Claims Court Limit*	*Raw Regulation Index*
Georgia	30	0	No	$25,000	3
Illinois	45	0	No	$10,000	3
Arkansas	60	0	No	$5,000	4
Indiana	45	0	No	$6,000	4
Nortch Carolina	30	0	No	$10,000	4
Tennessee	180	14	Yes	$25,000	5
Louisiana	30	0	Yes	$25,000	6
Pennsylvania	30	0	Yes	$12,000	6
Wisconsin	21	0	Yes	$25,000	6
Delaware	20	7	Yes	$15,000	7
Idaho	21	3	No	$5,000	7
Minnesota	21	0	Yes	$10,000	7
Texas	30	0	Yes	$10,000	7
Alabama	35	14	No	$3,000	8
California	21	3	Yes	$10,000	8
Connecticut	30	15	Yes	$25,000	8
Florida	60	7	Yes	$5,000	8
Maine	30	0	Yes	$6,000	8
Massachussetts	30	0	Yes	$7,000	8
New Hempshire	30	0	Yes	$7,500	8
New York	180	10	Yes	$5,000	8
Utah	30	3	Yes	$10,000	8
Colorado	30	3	Yes	$7,500	9
Kentucky	60	15	Yes	$2,500	9
Missouri	30	0	Yes	$5,000	9
Nevada	30	3	Yes	$7,500	9
Ohio	30	0	Yes	$3,000	9
Oregon	31	14	Yes	$10,000	9
Arizona	14	5	Yes	$3,500	10
Iowa	30	7	Yes	$5,000	10
New Jersey	30	3	Yes	$5,000	10
Oklahoma	30	10	Yes	$7,500	10
South Corolina	30	14	Yes	$7,500	10
Kansas	30	14	Yes	$4,000	11
Maryland	45	30	Yes	$5,000	11
Mississippi	45	30	Yes	$3,500	11
Nebraska	14	14	Yes	$3,500	11
Virginia	45	21	Yes	$5,000	11
Washington	14	10	Yes	$5,000	11
Washington D.C.	45	30	Yes	$5,000	11
Michigan	30	30	Yes	$5,000	12

Note: This table presents raw individual regulations and the raw regulation index for the 41 states in our study sample. The index was computed by classifying states in quartile groups for each regulation and assigning states in each quartile a value from 0 to 3 in increasing order of landlord regulation. For *Right to Withhold Rent*, No is coded as 0 and Yes as 3. Small-claims court limit was capped at $25,000 when missing.

Table 2. Correlation Matrix Landlord Regulations

	Security Deposit Return	*Termination for Lease Violation*	*Right to Withhold Rent*	*Small-Claims Court Limit*
Security Deposit Return	1.00			
Termination for Lease Violation	-0.34	1.00		
Right to Withhold Rent	-0.22	0.46	1.00	
Small-Claims Court Limit	-0.35	0.55	0.53	1.00

Note: This is the correlation matrix of the four raw regulation variables. *"Security Deposit Return"* is the maximum time allowed to return security deposits.*"Termination for Lease Violation"* is the minimum time allowed before eviction due to serious lease violation. *"Right to Withhold Rent"*indicates whether rent withholding is allowed in the state. *"Small-Claims Court Limit"* is the maximum dollar amount landlords can sue for in small-claims courts.

Table 3. Descriptive Statistics of Landlord Regulation Variables

	N. Obs.	*Mean*	*Std. Dev.*	*Min.*	*Median*	*Max*
Regulation Variables						
Security Deposit Return (days)	41	40	34	14	30	180
Termination for Lease Violation (days)	41	8	9	0	3	30
Right to Withhold Rent (dummy)	41	0.83	0.38	0	1	1
Small-Claims Court Limit	41	$8,817	$6,682	$2,500	$6,000	$25,000
Regulation Scores						
Security Deposit Return (score)	41	2.56	0.84	0	3	3
Termination for Lease Violation (score)	41	1.15	1.06	0	1	3
Small-Claims Court Limit (score)	41	1.95	1.16	0	2	3
Regulation Index (raw)	41	8.15	2.38	3	8	12
Regulation Index (standardized)	41	0.00	1.00	-2.16	-0.06	1.62

Note: This table gives the distributional characteristics of the raw regulation variables and the derived requlation scores. For each regulation, expect for the binary *"Right to Withhold Rent"* variable, states are ranked in increasing order and assigned a score from 0 to 3. Each state's scores are then aggregated and the resulting regulation index is then standardized across the states.

Table 4. Number of Leases, Properties, and MSA in the Sample

	2000	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	***Total***
Monthly Rent	$711	$701	$717	$738	$762	$819	$917	$973	$1,004	$1,004	$939
N. of Leases	15,343	29,600	33,006	62,527	89,490	142,530	206,321	279,552	360,049	531,563	1,749,981
N. of Properties	477	669	823	1,063	1,366	1,753	1,986	2,070	2,066	1,957	2,601
Avg. Property Size (*units*)	32	44	40	59	66	81	104	135	174	272	101
N. of MSA	104	132	141	139	152	168	169	174	176	176	200
Avg. N. Leases / MSA	148	224	234	450	589	848	1,221	1,607	2,046	3,020	1,039
Avg. N. of Properties / MSA	5	5	6	8	9	10	12	12	12	11	9
N. of States	30	36	36	37	39	40	40	41	41	40	41
Avg. N. Leases / State	511	822	917	1,690	2,295	3,563	5,158	6,818	8,782	13,289	4,385
Avg. N. Properties / State	16	19	23	29	35	44	50	50	50	49	36

Note: The lease data is from RentBureau. Our sample excludes leases with rents less than $250 or greater than $5,000. We only keep MSAs with at least 30 leases in any given year.

Table 5. Descriptive Statistics of Rent Defaults and Control Variables

	N. Obs.	*Mean*	*Std. Dev.*	*Min*	*Median*	*Max*
Panel A: Rent Default						
Lease-Level						
Monthly Rent	1,749,981	$939	$455	$250	$800	$5,000
6-Month Default Dummy	1,749,981	0.11	0.31	0	0	1
12-Month Default Dummy	1,749,981	0.17	0.38	0	0	1
24 -Month Default Dummy	1,749,981	0.23	0.42	0	0	1
Property Level						
6-Month Avg. Monthly Default	10,232	0.03	0.04	0	0.02	1
12-Month Avg. Monthly Default	10,232	0.03	0.04	0	0.02	1
24-Month Avg. Monthly Default	10,232	0.04	0.04	0	0.02	1
MSA Level						
6-Month Avg. Monthly Default	1,117	0.02	0.02	0	0.02	0.16
12-Month Avg. Monthly Default	1,117	0.03	0.02	0	0.02	0.16
24-Month Avg. Monthly Default	1,117	0.03	0.02	0	0.03	0.18
Panel B: Control Variables						
Fair Market Rent (MSA)	1,531	$693	$204	$375	$646	$1,714
Vacancy Rate (MSA)	487	0.10	0.04	0.01	0.10	0.23
Vacancy Rate (State)	381	0.10	0.03	0.03	0.10	0.18
Vacancy Rate RentBureau (Property)	12,072	0.14	0.13	0.00	0.10	0.83
Vacancy Rate RentBureau (MSA)	1,303	0.15	0.13	0.00	0.11	0.66
Unemployment (MSA)	1,468	0.06	0.02	0.02	0.05	0.17
Inflation (Change CPI Region)	40	0.03	0.01	0.00	0.03	0.04
PC Income (MSA)	1,531	$33,839	$7,384	$15,375	$32,893	$79,576
Median Income (MSA)	860	$59,508	$10,747	$30,000	$58,114	$110,000
Population (MSA)	1,518	1,200,000	2,200,000	75,420	450,000	19,000,000
Population (State)	381	7,100,000	6,800,000	580,000	5,200,000	37,000,000
Renter Population (State)	381	1,500,000	1,500,000	150,000	1,100,000	8,100,000
Rental Building Permits (State)	381	9,589	12,277	280	5,642	78,088
Avergage House Price (State)	381	$210,000	$91,504	$93,109	$180,000	$590,000
Median House Price (State)	381	$170,000	$74,627	$80,460	$150,000	$510,000
Housing Affordability Index (MSA)	870	60.99	22.23	3.00	67.56	97.10

Note: The lease data is from RentBureau. Our sample excludes leases with rents less than $250 or greater than $5,000. We only keep MSAs with at least 30 leases in any given year. We define a missed rent payment as an event of default. The 6-, 12-, and 24-month defaults indicate whether an event of default has occurred during the relevant time period. Property and MSA average monthly defaults are the averages of individual lease defaults.

Table 6. OLS Estimation of Lease-Level Rent

	(1) *Log Rent*	*(2)* *Log Rent*	*(3)* *Log Rent*	*(4)* *Log Rent*
Regulations	0.003***	0.003***	0.006***	
	(0.001)	(0.001)	(0.001)	
Regulations: Small-Claims Court Limit				0.009***
				(0.000)
MSA Lease Default (12-Month Forecast)	-0.240***			-0.230***
	(0.032)			(0.032)
MSA Lease Default (12-Month Moving Average)		-0.392***		
		(0.034)		
MSA Lease Default (Lag Monthly Average)			-0.071***	
			(0.012)	
FMR to Income (MSA)	7.941***	7.432***	8.125***	7.837***
	(0.206)	(0.207)	(0.202)	(0.205)
Inflation (Region)	0.022***	0.023***	0.020***	0.022***
	(0.000)	(0.000)	(0.000)	(0.000)
Unemployment (MSA)	-3.942***	-3.954***	-3.763***	-3.817***
	(0.056)	(0.056)	(0.053)	(0.056)
Vacancy Rate (State)	-0.507***	-0.485***	-0.608***	-0.496***
	(0.021)	(0.022)	(0.020)	(0.021)
Growth Rental Demand (State)	1.926***	1.943***	1.620***	1.826***
	(0.057)	(0.058)	(0.052)	(0.057)
Growth Rental Supply (State)	-0.086***	-0.086***	-0.081***	-0.080***
	(0.001)	(0.001)	(0.001)	(0.001)
Constant	-3.228***	-3.322***	-3.021***	-3.126***
	(0.065)	(0.065)	(0.061)	(0.065)
Lease Year F.E.	Yes	Yes	Yes	Yes
MSA F.E.	Yes	Yes	Yes	Yes
Observations	*1,666,477*	*1,647,046*	*1,710,445*	1,666,477
Adjusted R-squared	*0.520*	*0.520*	*0.524*	0.520

Note: These are OLS estimation results of rent at the lease level, using log rent as the dependent variable. The Small-Claim Court Limit variable is in thousands of U.S. dollar. The figures in parentheses are the robust White standard errors of the estimates with the 1, 2, or 3 stars indicating statistical significance at 10%, 5% or 1%.

Table 7. Probit Estimation of Lease Defaults

	(1) *6-mo. Def.*	*(2)* *12-mo. Def.*	*(3)* *24-mo. Def.*	*(4)* *13-24 mo. Def.*	*(5)* *12-mo. Def.*
Regulations	-0.005***	-0.006***	-0.009***	-0.002	
	(0.002)	(0.002)	(0.002)	(0.002)	
Regulations: Small-Claims Court Limit					-0.002**
					(0.001)
FMR (MSA)	0.080***	0.087***	0.102***	0.030***	0.086***
	(0.008)	(0.010)	(0.011)	(0.007)	(0.010)
Income (MSA)	0.002***	0.005***	0.004***	-0.001*	0.005***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Rent (Property)	-0.076***	-0.137***	-0.181***	-0.058***	-0.137***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)
Inflation (Region)	0.004***	0.006***	0.009***	0.005***	0.006***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
Unemployment (MSA)	-0.266***	-0.216*	-0.277**	0.255***	-0.192*
	(0.093)	(0.114)	(0.125)	(0.079)	(0.113)
Vacancy Rate (Property)	0.126***	0.173***	0.100***	-0.096***	0.173***
	(0.003)	(0.003)	(0.004)	(0.002)	(0.003)
Vacancy Rate (State)	0.278***	0.335***	0.390***	0.121***	0.339***
	(0.026)	(0.032)	(0.035)	(0.023)	(0.032)
HOI (MSA)	0.001**	0.001***	0.001***	-0.001**	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Growth Rental Supply (State)	0.012***	0.016***	0.018***	0.001	0.017***
	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)
Lease Year F.E.	Yes	Yes	Yes	Yes	Yes
MSA F.E.	Yes	Yes	Yes	Yes	Yes
Observations	*1,148,588*	*1,148,676*	*1,148,676*	*1,146,945*	*1148676*
Wald Chi2	*18,367*	*39,104*	*59,697*	*27,245*	*39,105*

Note: These are the marginal effects from the Probit estimation of the probability of lease default over various observation periods. The dependent variable is an indicator measuring whether a lease has defaulted over the observation period. For example, *12-mo. Def.* indicates equals 1 if the tenant defaulted at least once over the first twelve months of the lease. The Small-Claim Court Limit variable is in thousands of U.S. dollar. The figures in parentheses are the robust White standard errors of the estimates with the 1, 2, or 3 stars indicating statistical significance at 10%, 5% or 1%.

Table 8. Joint Linear Estimation of Rent and Default

Panel A:	*Log Rent*
Regulations	0.022***
	(0.001)
MSA Lease Default (12-Month Forecast)	-0.279***
	(0.032)
FMR to Income (MSA)	6.855***
	(0.205)
Inflation (Region)	0.017***
	(0.000)
Unemployment (MSA)	-2.826***
	(0.056)
Vacancy Rate (State)	-0.211***
	(0.022)
Growth Rental Demand (State)	1.239***
	(0.056)
Growth Rental Supply (State)	-0.020***
	(0.001)
Constant	-3.114***
	(0.064)
Panel B:	*12-mo. Default*
Regulations	-0.009***
	(0.002)
FMR (MSA)	0.056***
	(0.010)
Rent (Property)	-0.127***
	(0.002)
Income (MSA)	0.005***
	(0.001)
Inflation (Region)	0.003***
	(0.001)
Unemployment (MSA)	-0.574***
	(0.117)
Vacancy Rate (Property)	0.196***
	(0.004)
Vacancy Rate (State)	0.155***
	(0.031)
HOI (MSA)	0.001***
	(0.000)
Growth Rental Supply (State)	0.011***
	(0.003)
Constant	-0.642***
	(0.103)
Lease Year F.E.	Yes
MSA F.E.	Yes
Covar. (Rent - Default)	*0.0006****
	(0.0001)
Observations	*1,692,576*

Note: This table presents the results of the simultaneous estimation of rent and lease default at the lease level using maximum likelihood taking the variables as endogenous. The dependent variables, which are modeled linearly, are log rent and twelve-month defaults. The figures in parentheses are the robust White standard errors of the estimates with the 1, 2, or 3 stars indicating statistical significance at 10%, 5% or 1%.

Table 9. IV Estimation of Rent using State Legislatures

Dependent Variable:	*Log Rent*
Regulations	0.037***
	(0.003)
MSA Lease Default (12-Month Forecast)	-0.285***
	(0.032)
FMR to Income (MSA)	6.767***
	(0.206)
Inflation (Region)	0.017***
	(0.000)
Unemployment (MSA)	-2.723***
	(0.058)
Vacancy Rate (State)	-0.179***
	(0.022)
Growth Rental Demand (State)	1.206***
	(0.057)
Growth Rental Supply (State)	-0.015***
	(0.002)
Constant	-3.136***
	(0.065)
Lease Year F.E.	Yes
MSA F.E.	Yes
Observations	*1,659,088*
R-squared	*0.515*

Note: These are results from the 2SLS estimation of log rent at the lease level. We instrument for regulations using the composition of state legislatures in 2001. The figures in parentheses are the robust White standard errors of the estimates with the 1, 2, or 3 stars indicating statistical significance at 10%, 5% or 1%.

Table 10. IV Estimation Default using State Legislatures

Dependent Variable:	*12-mo. Default*
Regulations	-0.007***
	(0.002)
FMR (MSA)	0.054***
	(0.010)
Rent (Property)	-0.121***
	(0.001)
Income (MSA)	0.005***
	(0.001)
Inflation (Region)	0.003***
	(0.001)
Unemployment (MSA)	-0.534***
	(0.117)
Vacancy Rate (Property)	0.196***
	(0.004)
Vacancy Rate (State)	0.161***
	(0.031)
HOI (MSA)	0.001***
	(0.000)
Growth Rental Supply (State)	0.012***
	(0.003)
Lease Year F.E.	Yes
MSA F.E.	Yes
Observations	*1,148,680*
R-squared	*0.039*

Note: These are results from the 2SLS estimation of the likelihood of lease default over 12 months at the lease level. We instrument for regulations using the composition of state legislatures in 2001. The dependent variable indicates whether a lease has defaulted over the last twelve months. The figures in parentheses are the robust White standard errors of the estimates with the 1, 2, or 3 stars indicating statistical significance at 10%, 5% or 1%.

Table 11. Rent and Default in MSAs Reprsented in 2000

	(1)	*(2)*
Dependent Variable	*Log Rent*	*12-mo. Default*
Regulations	0.009***	-0.006***
	(0.001)	(0.002)
MSA Lease Default (12-Month Forecast)	-0.208***	
	(0.035)	
Rent (Property)		-0.140***
		(0.002)
FMR to Income (MSA)	9.067***	
	(0.219)	
FMR (MSA)		0.100***
		(0.011)
Inflation (Region)	0.025***	0.005***
	(0.000)	(0.001)
Unemployment (MSA)	-4.200***	-0.082
	(0.058)	(0.124)
Vacancy Rate (Property)		0.181***
		(0.003)
Vacancy Rate (State)	-0.482***	0.308***
	(0.022)	(0.033)
Income (MSA)		0.005***
		(0.001)
HOI (MSA)		0.000***
		(0.000)
Growth Rental Demand (State)	2.410***	
	(0.058)	
Growth Rental Supply (State)	-0.099***	0.017***
	(0.001)	(0.003)
Constant	-3.736***	
	(0.067)	
Lease Year F.E.	Yes	Yes
MSA F.E.	Yes	Yes
Observations	*1,543,475*	*1,069,438*
Adjusted R-squared / Wald χ^2	*0.518*	*36,114*

Note: This table presents the coefficients of OLS estimation of rent in column 1 and the marginal effects of Probit estimation of the likelihood of lease default in column 2. The dependent variable for the rent regressions is log rent in column 1 and an indicator variable of whether a lease has defaulted over the last twelve months in column 2. The figures in parentheses are the robust White standard errors of the estimates with the 1, 2, or 3 stars indicating statistical significance at 10%, 5% or 1%.

Table 12. Effects of Landlord Size on Rent and Default.

	(1) *Log Rent*	*(2)* *12-mo. Default*
Regulations (CG: Small-Size Properties)	0.030***	-0.013***
	(0.001)	(0.002)
Large-Size Property Dummy x Regulations	-0.012***	0.006***
	(0.001)	(0.001)
Large-Size Property Dummy	0.048***	-0.001
	(0.001)	(0.001)
MSA Lease Default (12-Month Forecast)	-0.292***	
	(0.032)	
Rent (Property)		-0.120***
		(0.001)
FMR (MSA)		0.054***
		(0.010)
FMR to Income (MSA)	6.692***	
	(0.205)	
Income (MSA)		0.005***
		(0.001)
Inflation (Region)	0.016***	0.003***
	(0.000)	(0.001)
Unemployment (MSA)	-2.759***	-0.556***
	(0.056)	(0.117)
Vacancy Rate (Property)		0.197***
		(0.004)
Vacancy Rate (State)	-0.298***	0.167***
	(0.022)	(0.031)
Growth Rental Demand (State)	1.146***	
	(0.056)	
HOI (MSA)		0.001***
		(0.000)
Growth Rental Supply (State)	-0.020***	0.011***
	(0.001)	(0.003)
Constant	-3.014***	-0.649***
	(0.064)	(0.103)
Lease Year F.E.	Yes	Yes
MSA F.E.	Yes	Yes
Observations	*1,663,592*	*1,148,680*
R-squared	*0.518*	*0.039*

Note: This table presents the OLS estimations of rent and default controlling for property size. The dependent variable is log rent in column 1 and a 12-month default dummy in column 2. The large-size property dummy is computed annually, taking the value of 1 if property size is greater than 20 units and the median property size that year. The figures in parentheses are the robust White standard errors of the estimates with the 1, 2, or 3 stars indicating statistical significance at 10%, 5% or 1%.

Table 13. Landlord Size and Vacancy Rates.

Dependent Variable:	*Vacancy Rate*
Regulations (CG: Small-Size Properties)	0.012*
	(0.006)
Large-Size Property Dummy x Regulations	-0.005***
	(0.002)
Large-Size Property Dummy	-0.027***
	(0.003)
Rent (Property)	0.010**
	(0.005)
FMR (MSA)	0.010
	(0.028)
Inflation (Region)	-0.002
	(0.002)
Unemployment (MSA)	-0.601*
	(0.315)
Growth Rental Demand (State)	-1.063***
	(0.220)
Growth Rental Supply (State)	-0.001
	(0.007)
Constant	0.652**
	(0.288)
Lease Yr F.E.	Yes
MSA F.E.	Yes
Observations	7,729
R-squared	0.168

Note: This table presents the OLS estimation of vacancy at at the property level. The dependent variable is monthly property vacancy rates. The large-size property dummy is computed annually, taking the value of 1 if property size is greater than 20 units and the median property size that year. The figures in parentheses are the robust White standard errors of the estimates with the 1, 2, or 3 stars indicating statistical significance at 10%, 5% or 1%.

A Appendix

Table A.1. Property-Level Rent Estimation

Dependent Variable	*Log Avg. Rent*
Regulations	0.020***
	(0.003)
MSA Lease Default (12-Month Forecast)	-0.408***
	(0.094)
FMR to Income (MSA)	2.804***
	(0.725)
Inflation (Region)	0.018***
	(0.002)
Unemployment (MSA)	-3.438***
	(0.189)
Vacancy Rate (State)	-0.163**
	(0.075)
Growth Rental Demand (State)	1.849***
	(0.205)
Growth Rental Supply (State)	-0.055***
	(0.005)
Constant	3.995***
	(0.245)
Lease Year F.E.	Yes
MSA F.E.	Yes
Observations	*105,171*
Adjusted R-squared	*0.534*

Note: These are the coefficient estimates from OLS estimation of rent at the property level. The dependent variable is log of average monthly rent, computed for each property on leases outstanding every month. The figures in parentheses are the robust White standard errors of the estimates with the 1, 2, or 3 stars indicating statistical significance at 10%, 5% or 1%.

Table A.2. Property-Level Default Estimation

Dependent Variable	*12mo. Default*
Regulations	-0.004***
	(0.001)
Rent (Property) to Income	-0.838***
	(0.095)
FMR to Income (MSA)	0.350
	(0.460)
Inflation (Region)	0.001*
	(0.001)
Unemployment (MSA)	-0.091
	(0.137)
Vacancy Rate (State)	0.025
	(0.037)
HOI (MSA)	-0.000*
	(0.000)
Growth Rental Supply (State)	0.000
	(0.003)
Constant	-0.170*
	(0.102)
Lease Year F.E.	Yes
MSA F.E.	Yes
Observations	*6,516*
Adjusted R-squared	*0.092*

Note: These are the coefficient estimates from OLS estimation of average lease default at the property level. The dependent variable is the average annual default rates. The figures in parentheses are the robust White standard errors of the estimates with the 1, 2, or 3 stars indicating statistical significance at 10%, 5% or 1%.