Licensing and the informal sector in rental housing markets: theory and evidence∗

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Abstract

Licensing seeks to regulate the quality of services or products that individuals or firms provide. However, it can increase costs and lead to services being provided “underground” (i.e. in the informal sector) and cause some firms to exit. In this paper we examine the impact of licensing landlords; that is, permits given to landlords who meet quality standards and accordingly, allow them to rent legally. We develop a theoretical model to examine the degree to which licensing leads to higher rents, an increase in the underground rental market, vacancies, as well as homelessness. Theoretical results show that the impact of tighter regulations have an ambiguous effect on housing quality, vacancies, and homelessness. Hence, we calibrate this model using a data from Baltimore City, Maryland. The data set is unique because it directly observes and measures those rentals operating illegally in the informal sector, and those that have exited the market (perhaps due to the licensing). Our results indicate that when regulations are tightened, vacancies increase and overall quality falls. Further, rents of high quality housing may increase or decrease and overall homelessness can rise when licensing regulations are tightened.

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1 Introduction

Licensing is used to regulate many industries and occupations from day-care centers to rental properties. Currently, around 25% of occupations require some form of licensing in the U.S. (Nunn, 2016). One industry that is regulated through licenses is the rental housing market. Currently almost all of the 50 largest cities in the U.S. require some form of rental licensing, with many cities expanding their licensing requirements. For example, the city of Minneapolis expanded their licensing of landlords in 2016. Thus, the use of licensing as a regulatory tool is not only widespread but also expanding.

Despite its widespread use, there is much debate concerning the value of licensing. The presumptive goal of licensing is usually to maintain quality and safety for both consumers and workers in those industries. Specifically, when consumers cannot easily observe quality, then licensing can serve to assure consumers about product quality (Leland, 1979). This could limit the adverse outcomes that typically arise from asymmetric information in markets. Although scholars and policy-makers acknowledge this benefit from licensing, they question its effectiveness because of two potential, perverse, side-effects (Schneider and Buehn, 2016). First, licensing increases the barriers to entry, causing some firms to leave the industry even while it may improve quality among those firms who remain. This reduces the supply for consumers, often affecting low income individuals who can only afford low quality products. Second, licensing creates scope for an “underground economy of firms that operate without a license, thereby allowing them to bypass quality standards entirely. Thus, whether licensing is beneficial can depend on the magnitude of these two side-effects.

The goal of this paper is to determine the impact of licensing on both the supply and the demand of rental housing. On the supply side our goal is study the impact of licensing on the informal economy, overall housing quality, and vacancies. On the demand side we wish to understand how licensing affects rents and homelessness. To our knowledge although there is a vast literature on regulation and the informal economy, few have examined the impact on consumers and demand. Specifically, we

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1Despite the widespread use of licensing landlords, there is almost no systematic data on this at the national level. This count is based on the authors’ calculations.

2We define the underground economy as “those economic activities that circumvent government regulation, taxation, or observation” (Del’Anno and Schneider, 2003). Note that we also use the term “shadow” and underground interchangeably throughout this paper.
wish to examine whether licensing can cause consumers and landlords to be “priced out the market,” thereby potentially increasing homelessness.

Identifying both the benefits and costs to licensing is especially important within the context of rental licensing. In many rust belt and de-industrialized U.S. cities, the housing stock is of low quality, and low-income renters often must rent from “slum lords” who minimally invest in property maintenance. Thus, licensing that ensures that rental housing meets some quality standards (such as removal of lead paint) can improve the safety and health of occupants.\(^3\) Despite these benefits, the adverse side-effects from licensing, identified in the literature, can be especially consequential in an impoverished urban community. Specifically, licensing may reduce the availability of affordable housing to economically vulnerable individuals who cannot afford much else besides low-quality, low-rent, housing. The lack of low-quality housing could increase homelessness and also create a demand for underground rentals that rent without license. These, underground dwellings, which do not meet quality standards, can be especially dangerous to tenants.\(^4\) Thus, determining the impact of licensing on rental markets is a critically relevant issue.

To achieve this goal we develop a theoretical model of rental licensing with an underground sector and where consumers have a preference for housing quality. We derive the equilibrium of this model and determine conditions under which landlords will choose to keep their properties vacant because licensing requirements are too stringent. This in turn can lead to an outcome in which the market is not fully covered, so that there are renters who wish to rent a low quality-low rent home, but such quality-price combinations are unavailable. We calibrate the model using data from Baltimore, in order to better understand how licensing impacts landlords’ decisions to rent underground or exit the market. Besides this, our approach also allows us to connect theory we data more closely. Indeed, although there is vast literature on licensing and the informal sector, as (Schneider and Buehn, 2013) note,

\[
\text{[t]he link between theory and empirical estimation of the shadow economy is still unsatisfactory.}
\]

Our paper addresses this shortcoming in the our knowledge, within the context of rental licensing.

\(^3\)In 2017, the Baltimore Sun reported that one family “paid $1,200 a month for a house that immediately began to fall apart with holes in the roof Mold. Lead paint. And...rats ate away at the rubber on [their] baby’s bottles.

\(^4\)“Not just shabby and dismal, illegal rentals can kill” New York Times, Oct 8, 1996.
Besides linking theory to data our paper possesses unique features both theoretically and empirically. Theoretically, our model consists of two sectors: an unregulated sector of small scale firms and a regulated sector consisting of larger ones. This reflects how licensing policies are implemented in many contexts. For example, in Baltimore landlords who rent properties that consist of one or two rental units are not required to be licensed. Whereas the regulated sector consists of properties with three or more dwelling units, which are known as “multi-family dwellings,” henceforth MFD. MFDs are required to meet certain quality and safety standards before they are granted a license to rent. Such practices are not unique to rental licensing, and it is common practice to segment an industry into a licensed and an unlicensed sector. For example, many cities require permits or licenses for large scale construction or building renovations. But, smaller construction can often be done without a permit. Similarly, a small lemonade stand run by a neighborhood is not regulated, while larger food sellers are clearly regulated. Finally, daycare providers in many states are only required to be licensed if they have more than a certain number of children. From a theoretical standpoint, this issue of scale concerning licensing is important, especially in relation to the informal sector (Schneider and Buehn, 2013). Findings suggest that the informal sector is usually relegated to the small scale firms, since large scale firms find it harder to hide their production. If small scale firms are exempt from the regulation, then there may be little incentive for an informal sector to emerge. We discuss this in greater detail when we discuss the findings of our model. Our model, therefore, analyzes the effects of having both regulated and unregulated suppliers within the same industry which to date has not been studied in the literature. Second, as we have noted, in our framework, the rental market need not fully covered so that in equilibrium the market need to be fully covered unlike much of the literature on the informal sector ((Ahlin and Pinaki, 2006);(Choi and Thum, 2005);(Cuff Katherine and Roberts, 2011)).

Our empirical analysis is also unique in that we are able to utilize data that overcomes two major shortcomings when examining the impact of licensing and the shadow economy. First, with most data it is difficult to identify what the supply would be in the absence of regulation because firms that leave the industry (or never entered), due to the regulatory burden imposed by licensing, cannot be observed.

5The rational for such a two-tiered system ensures that bigger buildings, where safety hazards are more harmful, have all the safety provisions. We elaborate on the regulatory framework in Section 2.
Second, the association between licensing and the underground economy is limited because the shadow economy is also hard to observe. Measures of this shadow economy usually rely on self-reported data from surveys which are not likely to be reliable in this context (Schneider and Buehn, 2013).

Our data overcomes both of these problems. First, by merging data from two distinct administrative sources from the City of Baltimore we are able to directly identify MFDs operating without a license. Second, because homes that are not rented do not vanish, and vacant properties are also tracked by the city, we can identify properties that exit the rental market. Whereas in most other industries firms that exit the market (or may never enter) are not observed, here we can observe landlords who choose to keep their property vacant, or who choose to exit the rental market. Thus, we can calibrate our model to these two variables that typically not observed in empirical models of housing.

To utilize this data to its full potential, we develop a theoretical model that incorporates both the demand and supply of rental units in a market where rental units are licensed. Licensing ensures that the property meets some standard of housing quality that is valued by consumers but costly for landlords to provide. Landlords can respond to this regulation in one of three ways: (1) comply with regulations and obtain a license, (2) not comply and rent in the shadow economy, or (3) keep their property vacant. Consumers’ have heterogeneous preferences with regard to quality so that some may be willing to give up higher quality housing in exchange for lower quality, low-rent, housing. We derive the demand and supply of high quality (licensed) and low quality (shadow) properties, which in turn determines the size of the underground rental sector, the licensed sector, and vacancies.

Theoretically, we obtain several novel comparative statics with respect to the fines as well as the dwelling threshold. Regarding fines, increasing the fines (strengthening enforcement) for not complying in the regulated sector (i.e. MFDS) encourages more landlords to enter the formal sector. This increases the equilibrium quantity of high quality housing, but it need not lower the rent of high quality housing. This surprising result arises because increasing the fines lowers the supply of informal housing which raises rents in the informal sector. In turn, some consumers now prefer to rent in the

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6 We discuss how this is accomplished in detail in the data section.

7 We refrain from labeling our model as a general equilibrium model because agents are either landlords or tenants and do not have a choice. But it possesses many characteristics of a general equilibrium model.
formal sector, shifting demand of formal rentals to the right. Since both supply and demand in the formal “shift right,” formal sector rents need not fall. Similar results also arise from evaluating the impact of raising fines on other market outcomes.

We also find that altering the dwelling threshold has surprising results with respect to the rental market equilibrium. Specifically, expanding (lowering the dwelling threshold) the range over which rentals must be licensed need not increase the equilibrium quantity of high quality housing. Specifically, by expanding the range, the supply of low quality housing falls causing rents of low quality/informal housing to rise. The supply of high quality housing may rise if more firms choose to become high quality instead of becoming vacant. Further, demand in the high quality/formal market also rises because informal rentals are now more expensive causing more consumers switch to renting in the formal market. Consequently, expanding regulation need not raise the quantity of high quality rentals, nor does it necessarily raise rents of high quality rentals.

The results just described depends critically on the several parameters. Hence, we conduct a calibration exercise using data from the universe of rental properties. This allows us to determine the effects of various policies using a realistic set of policy parameters. Addition, to direction, we are able to determine the magnitude of a change in policies whether the effect is economically significant. Finally, our numerical simulations can help policymakers struggling to determine the effects of housing policy.

Our analysis produces two key (descriptive) findings. First, the rental market in Baltimore consists of a high percentage of underground rentals. Around 36 percent of MFDs overall are unlicensed. This is a noteworthy especially since small scale landlords, which according to the literature are most likely to be underground, are actually not required to be licensed. Most of the underground rentals are medium scale rentals with 3 or 4 rental units in a dwelling. Second, in equilibrium the market is not fully covered in that there are individuals who wish to rent a low quality home but the supply is unavailable. Lack of coverage, in this framework, effectively implies that such individuals are homeless.\(^8\) We believe that identifying such demand effects is an important feature our paper. To our knowledge none of the prior literature.

In addition, we use our calibrated model to conduct “counter-factual analysis” to determine how the rental market, especially the size of the informal sector are

\(^8\)See O’Flaherty (1995) for an economic definition of homelessness.
affected by changes to the licensing regime. This exercise produces several insights. First, decreasing the threshold at which a property must be licensed, reduces quality, and leads to a limited increase in the number vacancies. In contrast, raising the threshold for licensing increases the percentage of homes that choose to be licensed among those units that are still required to be licensed. This arises because relaxing the threshold, raises the rent differential between the licensed and the unlicensed units, which incentives firms who previously were in the informal sector to become licensed. It further has a small positive effect on rents of licensed and high quality homes, but rents of low quality homes remains almost level before and after the policy change. Finally, we find that the impact on vacancies is non-monotonic in the dwelling unit so that the vacancy rate falls when the threshold is raised up to some point, and then it rises again. These findings suggest that the threshold for licensing business must be chosen carefully by regulators.

There is a vast theoretical and empirical literature on the relationship between licensing and the underground economy. Many of the earlier papers focused on the informal sector as the suppliers’ response to evading regulations, but almost none consider the effects of the informal sector on demand and consumer surplus. Hence we focus on primarily those findings that incorporate both sides (i.e. supply and demand). In this regard, our paper is similar to (Cuff Katherine and Roberts, 2011) who study the optimal policy in an informal labor market, and who consider both the supply and demand for informal labor. Firms in the formal sector pay taxes and employ formal or informal sector workers, whereas those in the informal sector do not pay taxes. Informal sector workers can only work for informal sector firms, whereas formal sector workers can work in either industry. A key finding of this paper is that wages equalize between formal and informal workers. Relatedly, (?) study a paper where informal firms avoid taxes and cannot be detected as long as their scale is below a certain level. Firms may produce intermediate goods used by other firms or final goods. Producers of final goods can choose intermediate goods that are produced formally or informally (in addition to choosing whether to be formal or informal themselves). Their model makes two key predictions. First, informality is closely related to scale with smaller firms choosing to be informal. Second, informal

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9 Another literature that we do not discuss directly is that connecting the informal sector to corruption such as (Choi and Thum, 2005) and (Ahlin and Pinaki, 2006). We ignore this literature because bribery is not widespread in the U.S., which is source of data. Where relevant to our results, we discuss these papers.
producers of final firms are more likely to produce with inputs that are also informal. They test these implications with data from a survey of firms in Brazil and find that their predictions are broadly supported by the data.\textsuperscript{10}

A theoretical shortcoming of most of these papers is that ignore “demand side” effects of regulating the informal sector. However, as our results show ignoring demand side effects in the informal sector could potentially overlook important effects, which the previous literature has not considered. Further, in equilibrium regulating the informal sector does prevent the market from being fully covered in the sense that tightening regulations, or eliminating the informal sector does not reduce consumer surplus. Thus, the full cost of eliminating the informal sector is not recognized. In our framework, eliminating the informal sector reduces market coverage so that there are some consumers who wish to purchase a low quality informal sector product at a lower price, but may be unable to do so, if the informal sector is sanctioned too stringently. Further in \textsuperscript{?} and (Amir and Burr, 2015), informal sector products are of the same quality as those produced in the formal sector. In contrast, in our model there is a price-quality trade-off that consumers must make when choosing a product in the informal sector. Finally, few of these models are able to link theory to data closely. Thus, the policy implications of these theoretical models are harder to identify. The approach in our paper enables us to overcome these shortcomings.

Our paper proceeds as following. In section 2 we discuss the institutional background of rental licensing. In Section 3 we develop our model of rental markets with licensing and in section 4 conduct policy analysis. Section 5 discussions our calibration, while section 6 our numerical policy experiments. We conclude in Section 7.

\section{Institutional Background}

The regulatory process for housing in Baltimore City is as follows. Every year all non-owner occupied homes are required to register with the city, even if they are vacant, or uninhabitable. The type of registration depends on the type of property, with each property classified as a one or two family dwelling, MFD, vacant commercial

\textsuperscript{10}(Winkelried, 2005) studies a model of the informal economy where there is an entry fee to become licensed. He then uses this framework to study the impact of licensing and the informal sector or inequality.
property, or a vacant lot.

MFDs have additional regulatory requirements and must be licensed in order to legally rent to tenants. In order to obtain a license the building must be registered and associated fees paid, obtain a lead certification, and have had an annual housing inspection. All prior violations and notices must also be abated. There is a fairly modest fee of $35 per year per dwelling unit for the license.

Perhaps the most important of these requirements is the annual inspection. Prior to the expiration of a rental license the city commissioner will notify the landlord of a time and date for their inspection. The landlord has the option to reschedule in a two week period, but if the landlord does not permit access to the building a license cannot be issued. During the inspection a notice can be issued for any building code violations and landlords are provided a period, consistent with the severity of the violation, to abate the deficiency. An inspector will return to the building to reinspect the property. If the violation has been remedied there is no further action, however, if the violation persists fines can be levied up to $500 a day.

An “inspection” may also occur because of a tip from a neighbor, tenant, or a patrolling inspector. The city also maintains a hotline for reporting violations by citizens. Once a complaint is received, inspectors will typically come to a residence within 15 days. When the inspector visits the property, if a violation is found, a notice will be issued to abate the code violation. Thus even non-MFD properties may receive inspection.

Notices issued during an inspection are typically remedied voluntarily, but if not, in addition to being fined, violators can be prosecuted and a license can be revoked. To revoke a license the commissioner is required to provide at least ten days notice, as well as being entitled to a hearing.

In addition, to issuing notices, housing officials also have the power to issue a citation and an associated fine. Citations are issued for smaller infractions often of a technical nature or having to do with health or sanitation, such as leaving trash out, rodent issues, letting the grass grow too long, or failing to register a property. Citations always carry a monetary fine, but can be contested with the Environmental Control Board.

In March 2018, Baltimore City Council passed an ordinance that requires all properties to obtain a license. Consequently, going forward all dwellings will be subject to the same, more stringent regulation that MFDs currently operate under. In our numerical experiments we will explore the effects of this policy change, particu-
larly whether it will result in landlords deciding to simply not rent their properties at all, or rent them in the informal economy. We also explore the impact this policy has on housing quality and affordability.

3 A model of rental housing markets

We develop a model of rental housing that allows for both a formal and an informal rental housing sector. There are a total of $T$ landlords in a city who each possess a rental property. Each of these rental properties contains $d$ distinct dwelling units of housing (apartments, lofts, etc) where $d = \{1, 2, ... M\}$. Let $l(d)$ be the number of landlords who own properties with $d$ units of housing so that $\sum_{d=1}^{M} l(d) = T$. (Or, assume a continuous but non-atomless distribution over $d$ so that the lebesgue measure of a landlord with an integer number of units may be positive.) We take this distribution as given, in the sense that each landlord is endowed with a property containing $d$ distinct dwelling units.

All landlords can choose one of two housing quality levels $\lambda > \lambda$, where higher values of $\lambda$ represent higher quality (could be a hedonic index of quality). For any landlord, it costs $k \sim U[0, K]$ of supplying $d$ units of housing at quality $\lambda$ and $\alpha k$ to supply $d$ units of housing at quality $\lambda$, and $\alpha \in (0, 1)$. We assume that quality is observable so that the consumers can distinguish between the two types. Thus, $\bar{r}$ and $r$ is the market rent per unit of high and low quality housing respectively, which price taking landlords receive for their housing (and that will be determined in equilibrium).

The quality choices of landlords are determined by both regulatory and market forces. Specifically, (a) whether or not they are regulated, (b) costs and benefits to providing high or low quality housing (including any regulations). There are two sectors in this rental market: the regulated sector, where the superscript $R$ will denote this sector, and the unregulated sector denoted by $N$. Whether a landlord is regulated depends on her size $d$. If $d \leq d^P$, the landlord is unregulated and can choose either to remain vacant, or operate with either low or high quality housing. If $d > d^P$, then the landlord’s rental unit quality must be $\lambda$. Landlords with $d \leq d^P$ are unaffected by quality regulation, instead they choose whether to be high quality $\lambda$, low quality $\lambda$ or vacant. Landlords in the regulated sector however can choose to be formally licensed, rent underground in the informal sector, or be vacant. Choosing to
be formally licensed requires landlords to meet the quality standard \( \bar{\lambda} \), and joining the informal sector is equivalent to choosing \( \bar{\lambda} \) (and operating in the shadow or underground economy). Becoming vacant \( v \) faces the same incentives as before. Landlords who choose \( \bar{\lambda} \) (i.e are licensed) face a cost \( k \) as well as a fixed cost \( c > 0 \).  

11 Landlords fail to meet the standards (i.e. are unlicensed) are caught and fined an expected fine of \( f_s \). That is, the expected fine is higher for landlords with bigger apartment buildings (harder to hide). Thus, in the regulated sector providing high quality housing is equivalent to being compliant with the regulation or being in the underground economy. Whereas in the unregulated sector a landlord provides housing quality solely based on the market incentives and the distinction between the shadow and the official economy is moot. All landlords can always choose to opt of the market and keep their home vacant, we denote this decision by \( v \).

We now consider the payoffs in each of the two sectors. To simplify our notation we let \( T = \{ \bar{\lambda}, \lambda, v \} \) be the set of available choices (types) for a landlord, where \( \tau \in T \). In the unregulated sector landlords’ payoff are,

\[
\pi^N(\tau) = \begin{cases} 
\tau d + b - k & \text{if } \tau = \bar{\lambda} \\
\tau d - f_N d^2 - \alpha k & \text{if } \tau = \lambda \\
- \phi & \text{if } \tau = v.
\end{cases}
\]  

(1)

In the regulated sector a landlords’ payoff is,

\[
\pi^R(\tau) = \begin{cases} 
\tau d + b - c - k & \text{if } \tau = \bar{\lambda} \\
\tau d - \alpha k - f d^2 & \text{if } \tau = \lambda \\
- \phi & \text{if } \tau = v.
\end{cases}
\]

(2)

We turn to consider landlord decisions in each of the two sectors. First, consider the unregulated sector. Here a landlord chooses,

\[
\lambda = \begin{cases} 
\bar{\lambda} & \text{if } k \leq \frac{d(\tau - r) + f_N d^2 + b}{(1 - \alpha)} \equiv k \in [0, k_1^N] \\
\lambda & \text{if } k \in \left[ \frac{d(\tau - r) + f_N d^2 + b}{(1 - \alpha)}, \frac{\tau d - f_N d^2 + \phi}{\alpha} \right] \equiv k \in [k_1^N, k_2^N] \\
v & \text{if } k > \frac{\tau d - f_N d^2 + \phi}{\alpha} \equiv k \in [k_2^N, K]
\end{cases}
\]

(3)

11 One may interpret \( k \) is the cost of becoming compliant but \( c \) is the cost of remaining compliant.
In the regulated sector, a landlord chooses, 

$$\lambda = \begin{cases} 
\overline{\lambda} & \text{if } k \leq \frac{d(\tau - r) + fd^2 + b - c}{(1 - \alpha)} \equiv k \in [0, k^R_1] \\
\lambda & \text{if } k \in \left[\frac{d(\tau - r) + fd^2 + c + b}{(1 - \alpha)}, \frac{rd - fd^2 + \phi}{\alpha}\right] \equiv k \in [k^R_1, k^R_2] \\
v & \text{if } k > \frac{rd - fd^2 + \phi}{\alpha} \equiv k \in [k^R_2, \infty) 
\end{cases}$$

(4)

In equilibrium we assume that all three sector’s exist for the range for data available (this is an empirical question.)

### 3.1 Supply of Housing

Using the landlords’ decisions characterized above, we know derive the supply of housing. To simplify notation let \(d^p = d^R + 1\), i.e. the smallest \(d\) that is considered regulated. First consider the supply of high quality housing. The supply is,

$$S(\lambda) = \frac{1}{K(1 - \alpha)} \left( (\tau - r) \sum_{d=1}^{M} l(d)d^2 + f_N \sum_{d=1}^{d^p} l(d)d^3 + f \sum_{d=d^p}^{M} l(d)d^3 - c \sum_{d=d^p}^{M} l(d)d + b \sum_{d=1}^{M} l(d)d \right)$$

therefore,

$$S(\overline{\lambda}) = \frac{1}{K(1 - \alpha)} \left( (\tau - r)\mathcal{X} + \mathcal{F} - \mathcal{C} + \mathcal{B} \right).$$

(5)

Similarly, the supply of low quality housing is,

$$S(\lambda) = \frac{1}{K\alpha(1 - \alpha)} \times \left\{ (\tau - \alpha \overline{\tau}) \sum_{d=1}^{M} l(d)d^2 - (f_N \sum_{d=1}^{d^p} l(d)d^3 + f \sum_{d=d^p}^{M} l(d)d^3 + c \sum_{d=d^p}^{M} l(d)d \right\}$$

$$+ (1 - \alpha) \phi \sum_{d=1}^{M} l(d)d - \alpha b \sum_{d=1}^{M} l(d)d \}$$

(6)
\[ S(\Delta) = \frac{1}{K\alpha(1-\alpha)} ((r-\alpha \bar{r})\mathcal{X} - \mathcal{F} + \alpha C + (1-\alpha)\Phi - \alpha B) \]  

(7)

### 3.2 Demand for housing

We now consider the consumers in this market. There is a mass of atomistic consumers indexed by \( \theta \sim \mathcal{U}[0, \Theta] \) who each choose to rent either 1 or 0 units of housing. If they rent, their utility for housing is given by,

\[ U(\lambda) = \theta \lambda - r. \]

or 0 if they choose not to rent (in which case they are homeless). Note that consumers with a higher \( \theta \) obtain a higher utility from quality (standard quality IO model). Consumers choose either high or low quality or no housing depending on their \( \theta \) and the rent. Thus, a consumer demands a high quality house if \( \theta \bar{\lambda} - r > \theta \lambda - r \) and no housing if \( \theta \bar{\lambda} - r < 0 \). Thus, the demand for high quality housing is:

\[ D(\lambda) = \Theta - \frac{r - r}{\Delta \lambda} \]  

(8)

where \( \Delta \lambda = \bar{\lambda} - \underline{\lambda} \). The demand for low quality housing is then,

\[ D(\lambda) = \frac{r - r}{\Delta \lambda} - \frac{r}{\lambda} \]  

(9)

All households with \( \theta < \frac{r}{\lambda} \) choose no housing. This is a very standard notion of equilibrium (rational) homelessness in the model (see Flaherty for e.g.) It should be noted that these demand curves take rents as given, however, in equilibrium it will need to be verified that

\[ \Theta - \frac{r - r}{\Delta \lambda} > 0. \]
3.3 Equilibrium

The equilibrium rents in this model are determined by setting the supply and demand of high and low quality housing equal to each other. We identify an equilibrium in which there are positive levels of vacancies (essentially assuming that the really big buildings don’t matter for this equilibrium). In this case the conditions needed for this equilibrium are:

**Condition 1**

\[ \bar{r} > r \iff K \Theta (1 - \alpha) + C - F - B > 0. \]

**Condition 2** In equilibrium,

- \[ k_2^N - k_1^N \iff \bar{r} - \alpha \bar{r} - f_N d + (1 - \alpha) \Phi - \alpha b \geq 0 \text{ at } d = d^P \]
- \[ k_2^R - k_1^R \iff d (\bar{r} - \alpha \bar{r}) - f d^2 + \alpha (c - b) + (1 - \alpha) \Phi \geq 0 \text{ at } d = M. \]

**Condition 3** Demand for high quality housing must be positive, that is:

\[ F - C + X + B \Theta (\bar{\lambda} - \lambda) > 0. \]
Demand for low quality housing must be positive.
\[
\frac{(K\Theta(1 - \alpha) + C - \mathcal{F} - B)}{K(1 - \alpha) + \lambda\Delta\lambda} - \frac{F + \alpha\Theta K - \Phi}{\alpha K + \lambda\mathcal{X}} > 0.
\]

**Proposition 1** If conditions 1-3 are satisfied, the equations 8, 5, and 9, 7, form the system of equations that yield the equilibrium \( r^* \) and \( r^* \). In this equilibrium rents in the high and low quality markets are given by,

\[
\bar{r}^* = \underline{r}^* + \frac{\Delta\lambda(k\Theta(1 - \alpha) - F + C - B)}{k(1 - \alpha) + \lambda\Delta\lambda} \tag{10}
\]

\[
\bar{r}^* = \frac{\lambda(F + \alpha\Theta K - \Phi)}{\alpha K + \lambda\mathcal{X}} \tag{11}
\]

**Proof.** Setting equations 8 equal to 5, and 9 equal to 7 yields a system of linear equations in rents which when solved yield the equilibrium rents in this proposition.

A key condition is the rent differential \( \bar{r}^* - \underline{r}^* \).
\[
\Delta\lambda(K\Theta(1 - \alpha) + C - \mathcal{F} - B)
\]

\[
K(1 - \alpha) + \lambda\Delta\lambda
\]

### 4 Policy Analysis

#### 4.1 Comparative Statics

To conduct our analysis we note that is,
\[
\Delta\lambda(K\Theta(1 - \alpha) + C - \mathcal{F})
\]

\[
K(1 - \alpha) + \lambda\Delta\lambda
\]

Then we have the following comparative static results on the equilibrium:

**Proposition 2** An increase in the expected regulated sector fine \( f \)

1. decreases the rent differential between formal and informal/low-quality housing
2. increases the rent of low quality housing
3. has an ambiguous impact on rent of high quality housing
4. decreases the quantity of informal housing
5. increases the quantity of high quality housing
6. increases the vacancy rate
7. increases the level of homelessness.

Proof.

- The rent differential is clearly increasing in $F$, in turn $F$ is increasing in $f$ and $f_N$.
- Observe that the equilibrium rent $r^*$ is increasing in $F$.
- $\frac{r^*}{F} = \frac{k(λ - λα)}{(αK + X(1-α) + XΔλ)} \frac{∂F}{∂f} > 0$.
- $\frac{∂D^*(λ)}{∂f} = -\frac{∂(r^* - r^*)}{∂f} > 0$.
- Observe that the rent differential is decreasing in $f$ and $r^*$ is increasing in $f$.
  Hence $D^*(λ)$ is decreasing in $f$.
- The vacancy rate is:
  \[ V \equiv \frac{1}{K} \left( K \sum_{d=1}^{M} l(d)d - \frac{1}{α} Φ - \frac{r}{α} X + \frac{F}{α} \right). \]
  Thus,
  \[ \frac{∂V}{∂f} = -\frac{X}{α} \frac{∂r}{∂f} + \frac{∂F}{∂f}. \]
  \[ \frac{∂F}{∂f} \left( \frac{1}{α} - \frac{Xλ}{α(αK + λX)} \right), \]
  \[ \frac{∂F}{∂f} \left( \frac{α^2 K}{α(αK + λX)} \right) > 0. \]
- The level of homelessness
This proposition reveals three key insights. First, an increase in the expected fines for being a poor quality rental increases the cost of low quality housing. This shifts the supply of low-quality/informal housing to the left as firms “on the margin” between being informal and formal housing, or informal and vacant housing choose to become formal/licensed rentals or become vacant. Accordingly, the rents in the informal housing market fall (ceteris-paribus). In the market for high quality housing an increase in the fine shifts supply to the right, which pushes rents down in the formal sector. However, this is offset by the fact that because formal and informal housing are substitutes, the increase in the informal sector rent shifts the demand for high quality housing to the right. Since both demand and supply in the formal sector shift right, whether high quality rents rise or fall depends on which effect is stronger.

Second, the impact of a change in the fine on the equilibrium quantity of formal housing can be understood by recognizing that since $S(\lambda)$ and $D(\lambda)$ shift right, $r^*$ may rise or fall, but quantity always rises. Similarly, since $S(\lambda)$ shifts left, equilibrium quantity of high quality housing falls.

Third, because the rent of informal housing rises, homelessness rises. However, although informal sector rents rise the number of vacancies rise. An increase in the rent of informal housing makes renting more attractive. But this increase in the rent is not sufficient to offset the increase in the cost of renting informally (due to the higher fine) because consumers lower their demand for low quality housing (and some exit the market; i.e. homelessness rises). Consequently, the net effect is that vacancies rise.

It is worth contrasting this result with the existing literature on the informal sector. In this literature the focus is on the supply-side effects of licensing (e.g. Choi and Thum (2005), Ahlin and Pinaki (2006), Amir and Burr (2015)). Hence, an increase in the fines for operating in the informal sector, which reduces the number of firms in the informal sector.\footnote{Most of this literature does not consider the impact of this on prices.} What this result shows is that if formal and informal sector firms produce substitutable goods, then there are consequential “demand side” effects that should not be overlooked.

Next, we study the impact of changing the threshold $d^P$ on the equilibrium in this market. Note that changing the threshold involves a discrete change. Thus, we
employ the theory of monotone comparative statics to determine how a change in the threshold affects the housing market equilibrium following methods discussed in van Zandt (2005).

**Proposition 3** An increase in the regulatory threshold has the following effect on the equilibrium in the housing market.

1. has an ambiguous effect on the rent differential between formal and informal/low-quality housing if $f > f_N$. Otherwise, decreases the rent differential
2. decreases the rent of low quality housing if and only if $f > f_N$
3. has an ambiguous impact on rent of high quality housing
4. has an ambiguous effect on the quantity of informal/low-quality housing if $f > f_N$. If $f < f_N$, then it decreases the quantity of informal/low-quality housing
5. has an ambiguous effect on the quantity of high quality housing
6. reduces vacancies if and only if $f > f_N$
7. reduces the level of homelessness if and only if $f > f_N$.

**Proof.** First, note that $C$ is decreasing in $d^P$, and second $F$ is increasing in $d^P$ if and only if $f > f_N$.

- The rent differential,
  \[
  \frac{\partial (r - r)}{\partial d^P} = \frac{1}{\Delta \lambda} \left[ \frac{\partial C}{\partial d^P} - \frac{\partial F}{\partial d^P} \right] \frac{1}{K(1 - \alpha) + \Delta \lambda}. 
  \]
  This expression may be positive or negative when $f > f_N$ and it is negative when $f < f_N$.

- The rent of low quality housing
  \[
  \frac{\partial f^*}{\partial d^P} = \frac{\lambda}{\alpha K + \Delta K} \left( \frac{\partial F}{\partial d^P} \right) < 0,
  \]
  if and only if $f > f_N$. 


The rent of high quality housing,

\[ \frac{\partial r^*}{\partial dP} = \frac{\partial F}{\partial dP} \left( \frac{K(\lambda - \bar{\lambda}\alpha)}{(\alpha K + \bar{\lambda}\lambda)(K(1 - \alpha) + \lambda\Delta\lambda)} \right) + \frac{\partial C}{\partial dP} \frac{\Delta\lambda}{K(1 - \alpha) + \lambda\Delta\lambda}. \]

This expression can be positive or negative.

The quantity of low quality housing,

\[ \frac{\partial D^*(\lambda)}{\partial dP} = -\frac{\partial F}{\partial dP} \left( \frac{K + \bar{\lambda}\lambda}{(K(1 - \alpha) + \lambda\Delta\lambda)(\alpha K + \bar{\lambda}\lambda)} \right) + \frac{\partial C}{\partial dP} \left( \frac{1}{K(1 - \alpha) + \lambda\Delta\lambda} \right). \]

The second term is negative because \( C \) is decreasing in \( dP \). The first term is positive when \( f > f_N \). Hence, the effect is ambiguous if \( f > f_N \). If \( f < f_N \), then both terms are negative, so \( D^*(\lambda) \) is decreasing in \( dP \).

Since \( dP \) has an ambiguous effect on the rent differential when \( f > f_N \), the quantity of high quality housing may rise or fall with \( dP \). When \( f < f_N \) then the rent differential falls with \( dP \), so \( D^*(\lambda) \) increases with \( dP \).

From the expression for vacancies,

\[ \frac{\partial V}{\partial dP} = \frac{1}{K} \frac{\alpha^2 K}{\alpha^2(\alpha K + \lambda\bar{\lambda})}. \]

When \( f > f_N \) (\( f < f_N \)), then \( F \) is decreasing (increasing) in \( dP \) hence vacancies fall (rise) with the threshold.

This proposition reveals several important consequences regarding changing the regulatory threshold \( dP \). Recall that raising the regulatory threshold implies that fewer landlords are required to meet quality standards. This increases the supply of low quality housing shifting supply of low quality housing to the right, lowering low quality rents. As we saw earlier this results in both a supply and and demand effect in the market for formal/high quality firms. On the demand side, because rents of low quality housing falls, consumers substitute from high to low quality housing. However, supply of high quality housing may shift to the left or to the right because of two effects. Raising \( dP \) implies that fewer landlords must bear cost \( c \), which causes
supply to increase. However, it also implies that fewer firms face the higher fine $f > f_N$ from being low quality. This second effect causes supply $S(\lambda)$ to decrease. Thus, depending on whether supply increases or decreases, rents in the formal sector may rise or fall. And, for similar reasons quantity of formal/high-quality housing may increase or decrease. Thus, as noted earlier, accounting for both sides of this market yields important insights into how the presence of an informal sector affects regulation.

### 4.2 Complete regulation

We now consider the impact of strengthening the licensing requirement to include all housing units $d \in [0, M]$. We refer to this as complete regulation. Note that the consumer (demand) equations will remain unchanged and the only relevant supply equations are those derived from 4 and 2. This results in the supply of housing:

$$S(\lambda) = \frac{1}{K(1 - \alpha)} \left( (\bar{r} - r) \sum_{d=1}^{M} l(d)d^2 + f \sum_{d=1}^{M} l(d)d^3 - c \sum_{d=1}^{M} l(d)d \right)$$

therefore,

$$S(\lambda) = \frac{1}{K(1 - \alpha)} \left( (\bar{r} - r)X + F' - C' \right). \quad (12)$$

Similarly, the supply of low quality housing is,

$$S(\lambda) = \frac{1}{K\alpha(1 - \alpha)} \left( (\bar{r} - \alpha r) \sum_{d=1}^{M} l(d)d^2 - f \sum_{d=1}^{M} l(d)d^3 + \alpha c \sum_{d=1}^{M} l(d)d \right)$$

therefore,

$$S(\lambda) = \frac{1}{K\alpha(1 - \alpha)} \left( (\bar{r} - \alpha \bar{r})X - F' + \alpha C' \right). \quad (13)$$

An important observation is that $F' > F$ and $C' > C$. This implies that switching to complete regulation is equivalent to raising $F$ hence $\bar{r}^*$ rises resulting in more homelessness. Whether the equilibrium quantity of high and low quality homes rises
or falls in total depends on the parameters of model, specifically whether the rent differential in equilibrium \((r^* - r^*)\) rises or falls in the complete regulation regime relative to the partially regulated regime. Let \(r'\) and \(r'\) be the rent differential under complete regulation. Then,

\[
(r^* - r^*) - (r' - r') = \frac{\Delta \lambda}{K(1 - \alpha) + \lambda \Delta \lambda} ((C - C') - (F - F')) .
\]

This yields,

\[
\frac{\Delta \lambda}{K(1 - \alpha) + \lambda \Delta \lambda} \left( -c \sum_{d=d_P}^M l(d)d + (f - f_N) \sum_{d=1}^{d_P} l(d)d^3 \right) .
\]

Depending on whether this is positive or negative, will affect \(8\) and \(9\), which will affect demand.

## 5 Calibration

We calibrate this model using data from Baltimore, Maryland. As discussed above, Baltimore offers an interesting case study in terms rental licensing. Prior to 2018, Baltimore had a “regulated” and “unregulated” sector in the rental market. Unregulated properties were those that had one (single family homes) or two dwellings and were not required to obtain a rental license to legally rent their properties. Properties with more than two dwellings we consider regulated and were required to obtain a rental licensing every year, which in addition to a nominal fee requires passing an annual inspection. In addition, to being an interesting case study, Baltimore city has graciously provided us with a wealth of enforcement data on the city, which allows us to realistically calibrate the model to the city’s experience.

Leveraging this data, we calibrate the model to closely mimic the city’s housing market and policy. First, under the pre-2018 structure of Baltimore’s housing policy we set \(d_P\) to two, reflecting the cutoff between the unregulated and regulated sectors.

The next features of the Baltimore housing market we try to capture is the maximum dwellings in a property, \(D\), and total demand, \(\Theta\). Properties in Baltimore range from single family homes, one dwelling properties, to large complexes with as many as 652 units. An overwhelming number of properties however, 99.63\%, have less
Table 1: Data Sources and Descriptive Statistics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Baseline Value</th>
<th>Source and Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(d^P) (Threshold of regulated sector)</td>
<td>2</td>
<td>Corresponds to Baltimore Policy</td>
</tr>
<tr>
<td>(D) (Maximum dwelling units)</td>
<td>50</td>
<td>Maximum dwelling units</td>
</tr>
<tr>
<td>(\Theta) (Demand when (\bar{r} = r))</td>
<td>715,845</td>
<td>Total dwellings in Baltimore</td>
</tr>
<tr>
<td>(K) (Maximum cost parameter)</td>
<td>3,507,805</td>
<td>Calibrated to condition 2</td>
</tr>
<tr>
<td>(f) (fines regulated sector)</td>
<td>86.70</td>
<td>Calibrated to condition 3</td>
</tr>
<tr>
<td>(f_N) (Unregulated Fines)</td>
<td>18.02</td>
<td>Based on probability of fine in unregulated sector</td>
</tr>
<tr>
<td>(b) (Fixed benefit to higher quality)</td>
<td>834,990</td>
<td>Match high quality single family homes</td>
</tr>
<tr>
<td>(c) (Fixed cost of license)</td>
<td>137,555.66</td>
<td>Match licensing rate for properties near (D) dwellings</td>
</tr>
<tr>
<td>(\phi) (Cost of vacancy)</td>
<td>2,238,708.40</td>
<td>Matches vacancy and licensing rates</td>
</tr>
<tr>
<td>(\alpha) (Cost parameter for (\lambda_h))</td>
<td>0.7</td>
<td>Equilibrium requirement</td>
</tr>
<tr>
<td>(\bar{\lambda}) (High quality units)</td>
<td>0.1674</td>
<td>Calibrated to match Baltimore rental data</td>
</tr>
<tr>
<td>(\Lambda) (Low quality units)</td>
<td>0.1641</td>
<td>Calibrated to match Baltimore rental Data</td>
</tr>
</tbody>
</table>
than 50 units and 99% are less than thirteen units (see histogram in Figure 2). Rather than include the whole sample, and have these very few large properties unduly influence the calibration, we truncate our sample at 50 units by setting $D = 50$. We interpret $\Theta$, in Equation 8, as the total demand when rents are homogeneous across all quality types. If this was the case we assume there would be demand for the total number of housing units currently in Baltimore, which is $\Theta = l'p'd = 715,845$.

Our next step in the calibration is to ensure that the model approximates the actual vacancy rate (proportion of properties that are vacant) and the licensing rate (proportion of properties that are licensed). Using equations (3) and (4) we can then establish two threshold levels of $k$, $k_v^*$, such that when $k > k_v^*$ properties are left vacant and $k_r^* > k$ properties will be high quality.

$$k_v^*(d) = \frac{rd - \hat{f}d^2}{\alpha} I(d \geq d_p) + \frac{rd - \hat{f}_Nd^2 + \phi}{\alpha} I(d < d_p)$$ (14)

$$k_r^*(d) = \frac{d(\overline{r} - r) + fd^2 - c}{(1 - \alpha)} I(d \geq d_p) + \frac{d(\overline{r} - r) + \hat{f}_Nd^2}{(1 - \alpha)} I(d < d_p)$$ (15)
where \( I(d \geq d^p) \) is an indicator variable that is one for the regulated sector, and 0 otherwise.

To calibrate the model to the Baltimore vacancy and licensing rates we must make two further assumptions:

1. \( k \) is uniformly distributed across properties, so that vacancy rate is given by \( 1 - \frac{k^*_v(d)}{K} \) and the proportion of high quality units is given by \( \frac{k^*(d)}{K} \) for any size properties with \( d \) dwellings
2. \( 1 - \frac{k^*_v(D)}{K} = 0 \)
3. \( \text{argmax}_d k^*_v(d) = D \)

We then set \( K \) so that Condition 2 holds and \( f \) so that 3 holds. This yields a fine of $86.70. To determine \( f_N \), fines in the unregulated sector, we examine the proportion of properties in the unregulated sector that do not receive a fine, which is just under 21%. Interpreting \( f_N \) as the expected fine, i.e. \( f_N = pf \), where \( p \) is the probability of receiving a fine in the unregulated sector, we set \( f_N = 0.21 \times f = $18.02. \)

Next, we set \( b \) so that the number of single family homes (one dwelling properties) matches the high quality homes in our Baltimore data, which we define as the homes that have not received a citation. Just under, 80 percent (79.4%) of single family homes meet this definition of high quality. Similarly, we identify \( c \) such that the model emulates the licensing rate for buildings with the maximum number of dwellings. Since, the sample size of 50 property dwelling in Baltimore is small, instead of computing the average among just 50 unit properties, we compute the licensing rate among properties between 47 and 50 units. Just under 90% of properties (89.5%) in this range are licensed.

We use one additional parameter to calibrate to Baltimore’s average vacancy and licensing rates, \( \phi \). Rather than use this parameter to mimic the exact vacancy or licensing rates, we set \( \phi \) to minimize the distance between the average vacancy rate and the increase in the quality that occurs from three dwelling units to two dwelling units.

The model’s predictions of the vacancy rate (proportion of properties that are vacant) and the proportion of properties that are higher quality (or licensed in the case of MFDs) along with the actual data from Baltimore can be found in Figure 24.
3. Note, that for one and two dwelling properties, high quality is again defined as properties not receiving a citation. Also as we model, properties with more than two dwellings, are considered high quality if licensed in the figure. The model slightly over predicts the vacancy rate among smaller properties and under predicts for larger properties. It also slightly under predicts the high quality (licensing) rate. In general however the model provides a good prediction of the decline in vacancies and the increase in high quality dwellings (licensing) as the number of dwellings in a property increases.

Three parameters in the model still remain undetermined, $\lambda$, $\bar{\lambda}$, $\alpha$. To set the high and low quality parameters we examine rental data in Baltimore. Unfortunately, we do not directly observe rents from any of our data sources. As a result we supplement our data set with two measures from Zillow, the price-to-rent ratio and the average rent by zip-code. Unfortunately, this data is only available from 2010 to 2016, while the rest of our dataset starts in 2009. In order to extend the Zillow data to 2009, we linearly extrapolate for this year. Next, since our Baltimore data set does have market values for properties, we exploit this data by dividing the market value (price) by the price-to-rent ratio in each zip code to arrive at a preliminary imputed rent. Next, we define low quality housing as the average imputed rent among units that have had one or more notices over the sample period, and have not been appropriately licensed, i.e. operating underground. We define the high quality sector, as licensed units without a notice during the sample period. Using these definitions our preliminary rent for the high quality sector is $6,255 annually and $5,865 for the low quality sector.

The Zillow data reports that average rents are actually significantly higher in Baltimore. To arrive at a final imputed rent we use Zillow’s average rents by zip code to ensure that the data replicates, the ratio between high and low quality rents of our preliminary estimates $\frac{6,255}{5,865} = 1.066$, but mimics the average rents per zip code. The result is an annual rent of $9,218 in the high quality sector and $8,670 in the low quality sector. Then, using equation (10) and (11) we can set $\lambda$ and $\bar{\lambda}$, such that the equilibrium is consistent with $r$ and $\bar{r}$ from the data. The result is $\lambda = 0.1674$ and $\bar{\lambda} = 0.1641$. Lastly, we set $\alpha = 0.7$, a value approximately in the middle of the range of values $\alpha$ guarantee the existence of an equilibrium.

\[\text{For this part of our analysis we do not want our results to be skewed again by the larger dwellings, so we concentrate on the largest properties in the unregulated sector, those with two dwelling.}\]
Figure 3: Actual versus Predicted Vacation and Licensing Rates

Panel A Vacancy Rates

Panel B Licensing Rates
6 Policy Experiments

6.1 Increasing the threshold

In this section we perform several numerical experiments to determine the sensitivity of rents, vacancies, housing quality and the underground economy to a variety of regulatory changes. We first examine how the housing market changes as a result of a change in the minimum number of dwellings a property may have and operate without a license, $d^p$. We refer to this as the policy threshold. Panel A of Figure 4 displays the number of vacancies and high quality units at each level of $d^p$. Panel B presents the number of low and high quality units for each threshold and finally Panel C presents the rents for low and high quality dwellings.
Figure 4: Housing Market Under Various Regulator Dwelling Thresholds

Panel A Vacant and High Quality Units

Panel B Low and High Quality Units

Panel C Low and High Quality Rents
Increasing the threshold and decreasing the scope of regulation has several effects. First, it decreases the number of low quality dwellings that are subject to the larger \( f \) that exists in the regulated sector. This fine effect, lowers the cost for landlords to provide a low quality dwelling, which in turn increases the supply of low quality units and decreases the supply of high quality ones. Offsetting this effect is the cost of maintaining a high quality licensed dwelling, \( c \). If there are fewer dwellings in the regulated sector, more landlords can provide a high quality dwelling, while avoiding this cost. This increases the supply of high quality units, offsetting the fine effect.

We find, that for the Baltimore housing market, that this second effect is dominant. High quality units increase by 11% when the threshold goes from zero (all housing units are regulated) to one unit, and another 4% when the threshold is increased by another three dwelling units. It appears that decreasing regulation will increase the quality of the housing stock. This effect diminishes as the threshold increases. This is because the effect of the change in fines increases for larger properties since its impact on landlords’ profits is proportional to the number of dwellings.

Additionally, we also find that as the threshold increases, landlords will substitute from supplying lower quality units in the informal economy to providing a high quality dwellings. The number of low quality dwellings fall significantly, by 30%, when the threshold increases from zero to one unit, and almost another 18% if the threshold increases to four units. Finally, we find that vacancies would decline slightly by about 2,500, from completely regulated market \((d_p = 0)\) to completely unregulated market \((d_p = 50)\) with some landlords deciding that the lower fines would make offering a low quality unit worthwhile. While, this increases the supply of low quality units it does not more than offset landlords making the choice to offer higher quality rather than low quality units. As a result, the supply of low quality units declines despite the decline in vacancies.

As a result of the greater supply of both lower and high quality units, rents decline as the threshold increases. High quality rents in particular are sensitive to an increase in the threshold. Rents decline by about 2% among high quality units when moving from a threshold of zero to a threshold of one, and decline in total 7% when going from completely regulated market \((d_p = 0)\) to completely unregulated market \((d_p = 50)\). The impact is much small for low quality units where rents decline by almost 4% going from completely regulated to a completely unregulated housing market. It appears that increasing regulation can have a moderately adverse impact.
on housing affordability.

Considering the recent decision by Baltimore to regulate all housing units (set $d_p = 0$), our model suggest some adverse consequences. In particular, the number of high quality dwellings is likely to fall substantially as the higher licensing costs drive properties owners of smaller properties to operate underground, and at a lower quality. We might also expect a slight increase in rents of all types of dwellings. For lower income individuals the increased availability of lower quality, less expensive housing that may occur when the threshold goes to zero may be welfare improving.

### 6.2 Increase in Fines

Our next policy experiment is to consider the effect of an increase in fines of 20% across both the unregulated and regulated sectors.\(^{14}\) This translates into about an additional $4 in the unregulated sector and about $17 in the regulated sector. Figure 5 presents the resulting rents for low and high quality dwellings alongside the rents

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\(^{14}\)Since, fines are relatively small in the unregulated sector, the results are quite similar to adjusting fines in just the regulated sector.
in the calibrated version of the model for comparison purposes. The increased fines are passed on to tenants in the form of an approximate $100 increase in rents in both low and high quality dwellings. While a moderate absolute effect, it appears that the rents are very sensitive to changes in fines, increase several times the amount of the actual change in the fine.

Next, Figure 6 Panel A presents the vacancy rate and Panel B the proportion of high quality properties by property size (number of dwellings) for the scenario with 20% higher fees and in the baseline calibration. The effect of this policy change is largely felt among larger properties, with smaller properties seeing almost no discernable change in the proportion that are vacant or high quality. This again is because total fines in our model are proportional to the number of dwellings in a property and as a result have a bigger impact on larger properties.

The largest properties however, do see significant changes. For instance, the vacancy rate increases by 1.4 percentage points among the largest properties. An increase in fines among large properties in the informal sector results in landlords simply deciding to leave their properties vacant. Additionally, among the largest properties, the proportion of landlords that decide to become licensed, and operate a high quality dwelling, increases by almost four percentage points. An additional way in which firms can avoid the fines that come when operating an underground, low quality dwelling is to simply offer a high quality unit and operate in the formal sector.

### 7 Conclusion

An ongoing debate in the economics of regulation is whether licensing benefits or harms welfare. Licensing is costly because on the demand side it a prevents consumers from purchasing products of lower quality, but also at a lower cost. On the supply side (a) it creates scope for an underground economy, and (b) could potentially cause some firms to exit the market (or never enter the industry).

Our paper develops an economic model to test these ideas within the context of rental licensing. To do so we develop a theoretical model that mirrors the licensing policy of rental properties in Baltimore City. A key feature of this licensing policy is that only landlords with properties that contain more than two dwelling units are required to obtain a rental license. Thus, our model consists of both regulated
Figure 6: Impact of increase of fines on vacancy and quality housing

Panel A Vacancy Rate by Property Size

Panel B High Quality Rate by Property Size
sector and an unregulated sector. We find that whether licensing increases or reduces supply, low quality housing, and an underground economy depends on the parameters of the model.

We calibrate this model using data obtained from Baltimore city and use the calibrated model to conduct policy experiments. This data is unique in that we are able to utilize data that overcomes two major shortcomings when examining the impact of licensing and the shadow economy. First, with most data it is difficult to identify what the supply would be in the absence of regulation because firms that leave the industry (or never entered), due to the regulatory burden imposed by licensing, cannot be observed. Second, the association between licensing and the underground economy is limited because the shadow economy is also hard to observe. Measures of this shadow economy usually rely on self-reported data from surveys which are not likely to be reliable in this context (Schneider and Buehn, 2013).

A key set of theoretical findings are that increasing the threshold at which a property must be licensed has an ambiguous effect on the quantity and price of high quality housing, and on the quantity of low quality housing. However, our calibration of this model to data from Baltimore City shows that in this context raising the threshold increases the quality of high quality housing, reduces the quantity and rent of low quality housing, and leads to a limited increase in the number vacancies. Such a policy also reduces homelessness. Thus, although theoretically the impact of weakening regulations is ambiguous, empirically, we find support for less regulation.

Our findings have several implications for regulation and the informal sector that go beyond rental housing. Indeed, there are many other industries in which licensing regulations depend on the scale of the firm (Schneider and Buehn, 2013). For example, in the U.S. many daycare centers need to be licensed if they care for more than a specific number of children. Our findings suggest that the threshold for licensing business must be chosen carefully by regulators. With regards to the informal sector, our model and calibration suggests that it is important to recognize the demand side effects of informality, since we find these effects to be economically significant.
References


