SHARED RESIDENTIAL OCCUPANCY AND PROPERTY TAX COMPLIANCE *

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Abstract

This article examines for the first time the property tax compliance behavior of homeowners who rent out part of their own home to tenants. This increasingly popular occupancy arrangement typically arises due to the financial constraints of homeowners. Currently little is known about the property tax compliance behavior of homeowners in this shared occupancy arrangement, relative to homeowners who fully occupy their properties. Using granular administrative-level data on occupancy characteristics from the Accra Metropolitan Assembly (AMA) in Ghana, we find that owner-and-tenant-occupied dwelling units have a higher probability of being in tax arrears, as compared to owner-occupied units. Their non-compliance is more sensitive to increases in property tax rates and is greater for those located farther away from local public amenities (suburban police stations and hospitals). Overall, our findings provide new insights for policy-makers on the tax compliance of owner-and-tenant-occupancy arrangements in a weak regulatory environment.

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1. Introduction

"I hate paying taxes. But I love the civilization they give me."

— Oliver Wendell Holmes

The motivations for tax compliance have been extensively studied both theoretically and empirically. Standard models of tax compliance study the trade offs that tax-payers face between the monetary gains from evasion and the costs of being found out and punished (Allingham and Sandmo, 1972). However, empirically tax compliance levels are observed to be much higher than what the theoretical models predict, even when enforcement measures such as audits and fines are minimal (Frey and Torgler, 2007; Alm, 2019). Thus, alternative explanations related to "tax morale", which defines non-pecuniary motivations for tax compliance have emerged, including guilt and shame (Andreoni et al., 1998), culture and social norms (Cummings et al., 2009), reciprocity (Castro and Scartascini, 2015), intrinsic duty-to-comply preferences (Dwenger et al., 2016), and peer behavior (Hallsworth et al., 2017).

Given the non-pecuniary motivations, one expects a higher tax compliance among owner-occupied properties as compared to other tenure arrangements. For instance, Alm et al. (2014), studying property tax compliance in the city of Detroit, at a time marked by high levels of delinquencies and uncollected tax revenues, find that owner-occupied (homestead) properties, especially those with long-time owners, are less likely to be delinquent, relative to non-owner-occupied residences. They attribute this to the former having more to lose, in terms of social connections and assets. Further, Arbel et al. (2017), using data from Israel, where the occupier of the property is liable for property tax payment, find that owner-occupiers in general, but particularly younger ones without children, are more property tax compliant than tenants (renters). In relation to renters, the authors note that renters normally have a strong incentive for property tax evasion owing to their lack of interest in the underlying property, more so if the rent contract is only for a short time-period.

Overall, these results are consistent with the social capital literature, which shows that homeowners are more likely to be "better citizens", who invest in and seek to improve their local communities (see, for instance, DiPasquale and Glaeser, 1999; Hilber, 2010).

In this paper, we study the tax compliance of owner-and-tenant-occupied properties, where a homeowner rents out part of their own home. Such mixed housing tenure arrangements have become increasingly popular in recent times, owing to increased housing costs and economic challenges which limit the prospects of getting onto the property ladder.[1] In developing countries, multi-habitation arrangements have become particularly rife over the years, where a house is either occupied by more than one household, usually sharing facilities or where a household's dwelling space is occupied by the nuclear family and other persons (Willis and Tipple, 1991).

A priori, it is unclear whether the owner-and-tenant-occupied properties will be more or less tax compliant, as compared to owner-occupied properties, in jurisdictions where homeowners are legally liable for property tax payments. On the one hand, the extra rental income suggests that owner-and-tenant-occupied properties should be more tax compliant. On the other hand, one of the reasons for deciding to rent out part of their own homes is normally driven by financial constraints, unlike the case of pure owner-occupiers, which suggests a greater chance of non-compliance due to possible income uncertainty. Furthermore, from a policy perspective, should a homeowner under the owner-and-tenant-occupancy arrangement be regarded as a landlord and taxed more, or considered as an owner-occupier and taxed less, in a bid to encourage homeownership?

To address this important gap in the literature, we develop a theoretical framework in which tax compliance behavior is endogenously determined in a dynamic setting of income

[1]For instance, a survey by SpareRoom.co.uk, which was reported in 2015, revealed that 45% of 'live-in landlords' in the UK could not afford to pay their mortgage without a lodger. "Owner-renting" – owning a house/houses but living in rented property owned by others – exists in large cities in countries like China, where policies which limit housing purchase and high house prices prevent residents, especially migrants, from purchasing homes in these large cities. Thus, there is renting in the large cities but homeownership in smaller and more affordable areas (Huang et al., 2020). Arundel and Doling (2017) also note how a deterioration in labor market conditions in Europe is associated with reduced homeownership especially for young adults.

uncertainty and a weak regulatory environment. The theoretical framework here builds upon the early literature on dynamic household consumption problems under income uncertainty, including Schechtman (1976), Bewley (1977), Mendelson and Amihud (1982), and Deaton (1991). It allows for self-selection into different occupancy types and accounts for non-pecuniary motives for compliance, which we model as an intrinsic moral cost of non-compliance (Fortin et al., 2007; Traxler, 2010; Alm and Torgler, 2011). Our theoretical framework predicts that if income constraints lead to the decision of homeowners to rent out part of their own residences (mixed category), then the additional rental income obtained does not completely relax their income constraints. This occupancy type is thus more likely to be non-compliant and their compliance behavior is more sensitive to property tax rate changes in that they accumulate longer periods of arrears when property tax rates increase. Furthermore, under plausible assumptions on the nature of income uncertainty, we show that these dwelling units are more responsive to these non-pecuniary motives for compliance.

For our empirical investigation, we utilize granular administrative-level data on the occupancy characteristics of all registered dwelling units in the Accra Metropolitan Assembly (AMA) in Ghana. AMA is the largest metropolitan assembly in Ghana, with oversight responsibility for the capital city. Our administrative-level data captures three residential occupancy arrangements: owner-occupancy (where a house is occupied by the homeowner), tenant-occupancy (where a house is occupied by tenants), and mixed/owner-and-tenant-occupancy (where a house is jointly occupied by the homeowner and tenants). The data contains comprehensive individual property-level information on value of the occupied property, the property tax (rating) zone in which it is located, the annual property tax rate, annual property tax payable, and cumulative property tax arrears, for a final sample of 52,786 dwelling units and for the period 2011-2018.

The empirical results show that owner-and-tenant-occupied dwelling units are significantly more likely to be non-compliant, relative to owner-occupied units. The findings support the main predictions of the theoretical model. In terms of the relative risk ratios, the

risk of non-compliance among owner-and-tenant-occupied dwelling units is 11% higher than for owner-occupied units, for short-term arrears up to one year. This relative percentage rises to 26% for long-term arrears of more than eight years. When we consider tenant-occupied dwelling units, relative to owner-occupied units, we do not observe any significant short-term non-compliance. However, tenant-occupied dwelling units have a significantly higher risk of prolonged delinquency (6 years or more) relative to owner-occupied units. In this regard, inefficient tax administration and weak enforcement mechanisms make it difficult to locate homeowners liable to pay taxes for their rented properties, thereby resulting in their protracted non-payment of property taxes. Overall, our main findings are that owner-and-tenant-occupied dwelling units portray greater sensitivity to property tax levies, with significantly higher relative arrears, as compared to owner-occupied units.

Next, we investigate the premise that owner-and-tenant-occupied dwelling units should exhibit stronger reactions to greater increases in property tax rates, since such households are more financially constrained. We classify properties into those that have experienced higher and those experienced lower rate increases over the years. We find a significantly higher likelihood of being in short-term arrears (up to 1 year) for owner-and-tenant-occupied dwelling units with greater increases in property rates, as compared to those with smaller increases in property rates. In terms of long-term arrears, these differences disappear and non-compliance levels are similar for all owner-and-tenant-occupied dwelling units, no matter the level of tax rate changes experienced. This finding is consistent with our theoretical expectation of income constraints which owner-and-tenant-occupied dwelling units are more likely to face. We also observe that tenant-occupancy is associated with a greater likelihood of non-compliance when tax rate increases are high, with results largely not being statistically significant when tax rate increases are low.

Finally, we examine how proximity to public amenities (suburban police stations and hospitals) affects compliance outcomes of the dwelling units. We find that owner-and-tenant-occupied dwelling units which are distant from the amenities are more likely to be non-

compliant, compared with those who live in relatively close proximity to the amenities. This is especially true for the case of longer-term arrears. However, owner-occupied dwelling units have less delinquency with respect to longer-term outstanding arrears, regardless of whether they are distant or close to the amenities. This latter finding is consistent with Alm et al. (2014), who document the importance households attach to public amenities by showing that property tax delinquency is higher in areas which have longer police response times.

Overall, these results provide evidence in favour of reciprocity as a motive which influences tax compliance decisions. As such, we add to the literature on non-pecuniary motives for tax compliance by considering actual access to public amenities. This is unlike previous studies, which rely on perceived access through field experiments, in which households are differentiated by the messages accompanying their tax bills, to investigate these non-pecuniary motives (see, for instance, Castro and Scartascini, 2015; Dwenger et al., 2016; Hallsworth et al., 2017). Additionally, although prior studies have analyzed how distance to public amenities affects property values through capitalization effects (see, for instance, Chin and Foong, 2006; Dubé et al., 2013; Dronyk-Trosper, 2017), we are the first, to our knowledge, to explore how distance to amenities affects property tax compliance for different residential occupancy types.

The findings in the paper have several policy implications for local governments, particularly in developing economies. First, policy interventions aimed at enhancing local property tax revenues need to take into account that mixed and multi-habitation dwelling units are likely to be more sensitive to property tax payments and therefore more susceptible to delinquency. Second, tenant-occupied dwelling units are more likely to be long-term non-compliant and more efficient payment systems are necessary to improve long-term compliance levels. Third, policy-makers should consider the spatial distribution in the provision of public amenities, as better access encourages lower delinquencies. Finally, the findings suggest the importance of more general initiatives and reforms aimed at improving the efficiency of property tax administration systems, such as targeting specific types of occupancy arrangements

in order to sustain and improve their long-term compliance.

The remainder of this paper is structured as follows. Section 2 presents a theoretical framework of the relationship between occupancy status and property tax arrears. Section 3 gives a brief overview of property tax systems in Ghana. The data and variables are discussed in Section 4. Section 5 details our empirical analysis. Sections 6 concludes the paper.

2. Theoretical framework

In this section, we present a stochastic household income fluctuation problem in which we consider, in addition to the standard consumption and saving decisions, two further aspects of household decision-making: consumption of housing services and property tax compliance.[2] In line with recent advancements in the theoretical literature, non-compliance in our model is associated with moral cost, which enters in the utility function of the tax payer (see, for example, Gordon, 1989, Fortin et al., 2007, Traxler, 2010, Alm and Torgler, 2011). In the current model, we identify the occupancy status of households by their optimal housing consumption decision. The owner-occupier type of household consumes in equilibrium its entire housing endowment, while the owner-and-tenant-occupancy type sacrifices part of its housing consumption in exchange for rental income. The stochastic income component of the model allows us to use the solution of the dynamic optimal consumption problem in order to transform the stochastic realization of income into a stochastic build-up of arrears. Using the solution of the problem, we explore how the distribution of cumulative arrears differs across occupancy types. We show generally that the owner-and-tenant household category remains more income constrained compared to owner-occupiers, even after accounting for rental income. That is, they build on average longer arrears. We study the differences

[2]The theoretical model developed here builds upon the class of dynamic household consumption problems under income uncertainty introduced by Schechtman (1976) and Bewley (1977) and later analyzed by Mendelson and Amihud (1982). An overview of the early theoretical results on optimal consumption and precautionary savings of liquidity-constrained households can be found in Deaton (1991).

in the build-up of arrears using a numerical simulation. For ease of access, the following presentation follows the notation and terminology of Deaton (1991). Further extensions and more recent advancements of the literature on the buffer-stock theory of savings are described by Carroll (1997).

Model. Consider an infinitely lived homeowner who receives in each period t stochastic labor income given by

$$\widetilde{y}_t = \mu + \epsilon_t, \tag{1}$$

where ϵ_t is a stationary random variable with a mean of zero and support $[\epsilon_l, \epsilon_h]$. We denote the cumulative distribution function of labor income by $F(y)$ and assume that the lower bound of its support is non-negative, i.e. $\mu + \epsilon_l \geq 0$. The owner of a home of size $H > 0$ makes a long-term decision to either occupy the entire property by choosing housing consumption level $h = H$ (i.e. the housing unit belongs to the owner-occupied category) or occupy the space $h \in [0, H)$ and rent out the remaining space to a tenant (i.e. the housing unit belongs to the owner-and-tenant category).[3] In the latter case, the homeowner receives rental revenue of $k(H - h)$ per period, where $k > 0$ is the rental price per unit of space. Further, in each period t, the homeowner chooses the level of non-housing consumption, c_t^{nh}, and decides whether to pay the property tax τ.

We denote total expenditures by c_t and consider first when it is optimal for the household not to comply, i.e. consume $c_t^{nh} = c_t$ and when it is optimal to pay the property tax, i.e. consume $c_t^{nh} = c_t - \tau$. Following the standard modelling approach in the theoretical literature (cf, Traxler, 2010, Alm and Torgler, 2011), we assume that non-compliance is associated with implicit (psychological, moral, or social) cost for the homeowner given by $g(c_t, \tau, \alpha)$, whereby $\alpha \geq 0$ is the coefficient of compliance pressure in the residential area.[4]

[3]Rental contracts in Accra span multiple years, and hence, the decision to rent (part of) their homes can be viewed as a long-term decision for homeowners.

[4]In the empirical section, we analyze reciprocity as a relationship between the taxpayer and the state, that is we consider proximity to local amenities as a source of compliance pressure.

The cost of non-compliance is assumed to be increasing in c_t and α and decreasing in the amount of tax τ. The contemporaneous utility of non-housing consumption is denoted by $u(c_t)$ and it is assumed to be strictly increasing and concave. Thus, the expenditure threshold level $\overline{c} = \overline{c}(\tau, \alpha)$, below which the homeowner is non-compliant, is determined by the solution to the equation:

$$u(c_t) - g(c_t, \tau, \alpha) = u(c_t - \tau), \tag{2}$$

whereby the left-hand-side denotes the utility of arrears and the right-hand-side the utility of compliance.[5] Given this optimal choice, the instantaneous (sub)utility of non-housing consumption can be expressed as:

$$U(c_t) = \begin{cases} u(c_t) - g(c_t, \tau, \alpha) & \text{for} \quad c_t < \overline{c}(\tau, \alpha) \\ u(c_t - \tau) & \text{for} \quad c_t \geq \overline{c}(\tau, \alpha). \end{cases} \tag{3}$$

We assume that $U(c_t)$ is strictly increasing and concave. Further, we denote the instantaneous utility of housing consumption by $v(h)$ and assume that it is also strictly increasing and concave.

The household maximizes its intertemporal expected utility given by:

$$E_0 \sum_{t=0}^{\infty} \beta^t \big[U(c_t) + v(h)\big] \tag{4}$$

under the budget constraint:

$$A_{t+1} = (1 + r)[A_t + \widetilde{y}_t + k(H - h) - c_t]. \tag{5}$$

Here A_t denotes the savings carried forward to the next period. The parameter β denotes

[5]The equation can be rearranged as $u(c_t) - u(c_t - \tau) = g(c_t, \tau, \alpha)$ and from the concavity of $u(c_t)$ it follows that the left hand-side is strictly decreasing in c_t while the right hand-side is increasing. Hence the equation has a unique solution.

the household's personal discount factor and r is the interest rate. We focus on the scenario $\beta(1+r) < 1$, which ensures that the household is impatient enough so as not to have an incentive to accumulate savings indefinitely (see, for example, Deaton, 1991 or Carroll, 1996). We consider the baseline case where saving and borrowing is not allowed ($A_t = 0$) and the case where saving is allowed but borrowing is not, i.e. $A_t \geq 0$ (the model can straightforwardly be extended to allow for a fixed limit on borrowing, see, for example, Deaton, 1991).

Equilibrium. We denote the "cash on hand" in each period t by the amount of savings, labor income and rental income available for spending in this period:

$$x_t = A_t + \widetilde{y}_t + k(H - h). \tag{6}$$

Case $A_t = 0$. In the baseline model all cash on hand consists of labor and rental income and is spent in each period, i.e. $c_t = x_t = \widetilde{y}_t + k(H - h)$. The housing consumption decision is determined by the first-order condition:

$$\frac{k}{1-\beta} \cdot v'(h) = E_0 \sum_{t=0}^{\infty} \beta^t \big[u'(x_t)\big] \tag{7}$$

which reduces to:

$$k \cdot v'(h) = Eu'(x_t). \tag{8}$$

When the solution to this equation is $h < H$, the optimal housing consumption is $h^* = h$ and the dwelling unit belongs to the owner-and-tenant category. When the solution to the equation is $h \geq H$, the optimal housing consumption is $h^* = H$ and the dwelling unit belongs to the owner category. Further, when $c_t < \overline{c}(\alpha, \tau)$, the homeowner defaults on their property tax payment and when $c_t \geq \overline{c}(\alpha, \tau)$, the household is compliant. Thus, the decisions on occupancy type and property tax payment in each period are determined endogenously in

the model.

Case $A_t \geq 0$. To describe the equilibrium properties in the model with liquidity constraints and precautionary savings, we follow the notation and terminology in Deaton (1991). A solution is a stationary consumption policy function $c_t = f(x_t)$, which determines the part of the cash on hand that will be consumed and the part that will be carried forward. We denote the associated marginal utility of money by:

$$p(x_t) := u'(f(x_t)).$$

The associated Euler equation is given by $u'(c_t) = \max[u'(x_t), \beta(1+r)E_t(u'(c_t))]$. Expressed in terms of cash on hand $x = x_t$, this Euler equation yields the following stationary equilibrium condition:

$$p(x) = \max\big[u'(x), \beta(1+r)\int p\{(1+r)(x_t - f(x) + k(H-h) + y^i\}dF(y^i)\big]. \tag{9}$$

As illustrated in Deaton (1991), the solution $f(x)$ and the corresponding $p(x)$ are unique and have the following properties:

(i) When realized labor income is so low that cash on hand x is below a critical level x^*, all cash on hand is consumed, $f(x) = x$, and when $x > x^*$ the household saves, $f(x) < x$.

(ii) The marginal utility of money $p(x)$ is decreasing in x.

(iii) When $x_t - f(x_t) > 0$, the marginal utility is a martingale, i.e. $E_t p(x_{t+1}) = \frac{1}{\beta(1+r)}p(x_t)$. When $x_t - f(x_t) = 0$, the process loses memory and the marginal utility is constant $E_t p(x_{t+1}) = E(p(y + k(H-h))$

With these preliminaries, the optimal level of housing consumption is determined by the first

order condition:

$$\frac{k}{1-\beta} \cdot v'(h) = E_0 \sum_{t=0}^{\infty} \beta^t \big[p(x_t)\big] \tag{10}$$

The household defaults in period t when its cash on hand falls below the critical level given by the condition $x_t < \overline{x} = f^{-1}(\overline{c})$.

Compliance behavior. We next compare the equilibrium compliance behavior of an owner-occupied unit with that of an owner-and-tenant-occupied unit. Let us assume that two neighbors have homes of equal size, identical consumption preferences, and face the same property tax compliance pressure pertinent to their neighborhood. Under the assumptions of the model, the difference in their choice of housing consumption could only be driven by differences in their labor income distributions. In other words, the two homeowners self-select in the two dwelling unit occupancy categories based on their labor income distributions. If the optimal choice of one of them is to sacrifice part of his/her housing consumption in exchange for rental income, as we will show, this homeowner must have a lower labor income. Further, we establish that the additional rental income of the owner of the dwelling unit with a tenant is not sufficient to compensate for their difference in labor incomes. This means that the owner-and-tenant household has, on average, a lower amount to spend on property tax payments and non-housing consumption. That is, the model generates the following theoretical prediction.

Proposition 1 (Non-compliance probability). *The owner-and-tenant-occupied dwelling unit (Owner-Tenant) is more likely to be non-compliant than the owner-occupied dwelling unit (Owner).*

Proof. Let dwelling unit i be an owner-occupier with an average labor income of μ_i, and dwelling unit j be owner-and-tenant-occupiers with an average labor income of μ_j which receives additional rental income of $k(H-h)$. We consider first the scenario without borrowing and lending.

Case $A_t = 0$. As $v(h)$ is concave, $v'(h) > v'(H)$. From equation (8) it follows that

$$Eu'(x_t^i) < Eu'(x_t^j)$$

Denoting by G_i is the distribution of $x_i = y^i$ and by G_j is the distribution of $x_j = y^j + k(H - h^*)$, the above inequality can be represented as

$$\int u'(x_t^i) dG_i(x_t^i) < \int u'(x_t^j) dG_j(x_t^i) \tag{11}$$

As $u'(x_t^i)$ is decreasing, from the above inequality and equation (1) it follows that G_i first order stochastically dominates G_j and hence $\mu^i > \mu^j + k(H - h^*)$. Therefore $G_i(\overline{x}) < G_j(\overline{x})$, i.e. dwelling unit i is less likely to default than dwelling unit j.

Case $A_t \geq 0$. From equation (10) it follows that

$$E_0 \sum_{t=0}^{\infty} \beta^t \big[p(x_t^i)\big] < E_0 \sum_{t=0}^{\infty} \beta^t \big[p(x_t^j)\big] \tag{12}$$

We proceed by contradiction. Assume that $\mu^i < \mu^j + k(H - h^*)$ and thus dwelling unit i is more likely to be non-compliant. From the definition of "cash on hand" (see equation (6)) as well as the martingale and memory renewal property of x_t (see property (iii)) it follows that, for each period t, the probability distribution $G_t^j(x_t^j)$ first order stochastically dominates $G_t^i(x_t^i)$. As $p(x_t)$ is monotonically decreasing, it follows that for each period t

$$\int p(x_t^i) dG_t^i(x_t^i) > \int p(x_t^j) dG_t^j(x_t^i), \tag{13}$$

Hence

$$\sum_{t=0}^{\infty} \beta^t E\big[p(x_t^i)\big] < \sum_{t=0}^{\infty} \beta^t E\big[p(x_t^j)\big] \tag{14}$$

a contradiction to (12). □

As the proposition shows, the homeowner with a lower income rents out part of their home to subsidize non-housing consumption and property tax expenditure. While this additional income serves to lower non-compliance rates, in equilibrium, the rental income does not entirely compensate for the lower initial labor income of the *Owner-Tenant*-occupancy category, and this occupancy category is more often non-compliant. The proposition allows us to further investigate how changes in property taxes and compliance pressure affects the compliance of these two household categories.

Proposition 2 (Sensitivity to property taxes and compliance pressure). *Let $F_i(y)$ be the income distribution function of the owner-occupied unit (Owner), $F_j(y)$ be the income distribution of the owner-and-tenant-occupied dwelling unit (Owner-Tenant), and let these functions be convex in an open neighborhood around the income level $y \in (\overline{x}-\varepsilon, \overline{x}+\varepsilon)$ where $\varepsilon > 0$. The following relationships apply regarding the non-compliance probabilities of these two units:*

a) *An increase in the property tax rate increases the non-compliance probability of the owner-and-tenant-occupied unit (Owner-Tenant) more than the owner-occupied unit (Owner):*

$$\frac{\partial F_j(\overline{x}(\tau,\alpha))}{\partial \tau} > \frac{\partial F_i(\overline{x}(\tau,\alpha))}{\partial \tau}.$$

b) *An increase in the compliance pressure decreases the non-compliance probability of the owner-and-tenant-occupied unit (Owner-Tenant) more than that of the owner-occupied unit (Owner):*

$$\frac{\partial F_j(\overline{x}(\tau,\alpha))}{\partial \alpha} < \frac{\partial F_i(\overline{x}(\tau,\alpha))}{\partial \alpha}.$$

Proof. From Proposition 1 and the income distribution defined in equation (1) it follows that $F_i'(y) < F_j'(y)$ for $y = \overline{x}(\alpha,\tau)$. Part a) holds because by assumption $\frac{\partial \overline{x}(\tau,\alpha))}{\partial \tau} < 0$ and Part b) holds because $\frac{\partial \overline{x}(\tau,\alpha)}{\partial \alpha} > 0$. □

We note that this result is based on the assumption that the income distribution function is convex at least in a neighborhood around the critical income level. While we are not

aware of any studies estimating income uncertainty in Ghana, extant research on the income distribution in the U.S. implies convexity of the labor income distribution for the part of the cumulative distribution function below the mean (see, for example, Carroll, 1992)[6].

Numerical example. We provide an illustration of the compliance behavior of owner-occupied and owner-and-tenant-occupied units by solving the considered stochastic dynamic optimization problem numerically for given homeowner preferences and labor income distribution.[7] In particular, we consider a homeowner exhibiting constant relative risk aversion, i.e. $U(c_t) = \frac{c_t^{1-\gamma}}{1-\gamma}$ and $v(h) = \frac{h^{1-\gamma}}{1-\gamma}$, where $\gamma = 0.5$. Further, we normalize the size of the house to $H = 1$ and the rent to $k = 1$. Labor income of the owner-occupied unit follows a log-normal distribution and has a mean of $\mu_i = 1$ and standard deviation of $\sigma_i = 0.5$. For the owner-and-tenant-occupied unit, we assume that the labor income distribution has a mean of $\mu_j = 0.5$ and a standard deviation of $\sigma_j = 0.5$. For these parameter values, the owner of the owner-and-tenant-occupied unit finds it optimal to rent out 18% of the home and to occupy the remaining 82% so that their average income per period amounts to 0.68. The average cash on hand in equilibrium of the owner-occupied unit is 1.56 and that of the owner-and-tenant-occupied unit is 1.33. We assume that the owner-occupied unit defaults in periods in which its cash on hand falls below 60% of this long-term average, and we use the same threshold for the owner-and-tenant-occupied unit. In a consequent comparative statics exercise, we consider the effect of an increase in compliance pressure or a decrease in property tax which leads to a shift in the threshold level from 60% to 55%, and we examine the effect of this shift on the arrears behavior of owner-occupied and owner-and-tenant-occupied dwelling units. For this numerical exercise, we generate 10,000 vectors of fifty labor income realizations from the lognormal distribution for the owner-occupied unit and the owner-and-tenant-occupied unit as per the above assumptions. Starting from the steady-state cash on

[6]Assuming that the income distribution is log-normal, Carroll (1992) estimates a coefficient of less than 0.2. The distribution for parameters below 1.0 implies convex distribution for all income levels y below the average income.

[7]This numerical example is solved with the Matlab routines available in the CompEcon toolbox of Miranda and Fackler (2002).

hand values for the two occupancy types, we simulate the optimal consumption and savings choices as well as the compliance/arrears behavior of the two households. To capture the equilibrium distribution, we report only the number of arrears during the last ten periods. These simulation results are presented in Table 1.

[Insert Table 1 about here]

The table allows us to appreciate the size of the effects described in Propositions 1 and 2. The result reported in Proposition 1 can be illustrated by the comparison of Columns (1) and (6), which represent the arrears frequency for the owner-occupied and the owner-and-tenant-occupied dwelling units, respectively, when the cash on hand arrears threshold value is 60% of the average cash on hand in equilibrium. As can be observed, the owner-occupied unit is compliant with a probability of about 20%, while the owner-and-tenant-occupied unit is compliant with a probability of only about 2%. Further, from the comparison of columns (2) and (7), we observe that the odds for non-compliance (i.e. the non-compliance probability divided by the compliance probability) of the owner-and-tenant-occupied unit is greater for each period of arrears considered. According to Proposition 2, the owner-and-tenant category of dwelling units are more sensitive to changes in compliance pressure and property tax rates than the owner category. The numerical implications of this result can be appreciated by comparing columns (5) and (10). We observe that the changes in the odds are greater for the owner-and-tenant dwelling unit. Indeed, while the change in the threshold level decreases the arrears of the owner-occupier on average by 0.9 years, it decreases the arrears of the owner-and-tenant on average by 1.47 years.

3. Property tax administration in Ghana

Property taxes are raised at the local level in Ghana. Local authorities, known collectively as Metropolitan Municipal and District Assemblies (MMDAs), are given the authority to levy these taxes, which are payable by the owners of the respective properties. The current regu-

latory framework within which the MMDAs operate is the Local Governance Act, 2016 (Act 936).[8] As the MMDAs bear direct responsibility for the overall development of respective districts, Act 936 empowers them to generate their own revenues, with a key source coming from property rating.[9] In the following paragraphs, we explain the institutional setting related to the collection of the property tax along with relevant legal terminology.

Rateable values: These are the monetary values of the properties which the property tax rates are charged to. The Lands Commission of Ghana, a parastatal, is tasked with determining these values and preparing a valuation list for every MMDA. The Lands Commission uses a depreciated replacement cost (DRC) method of property valuation. The DRC works by estimating the cost of the building as though it were new and then allowing for depreciation and other improvements. However, owing to the huge outlay, these valuations are infrequently carried out. The rateable value shall not exceed 50% of the replacement cost for owner-occupied properties and not be less than 75% of the replacement cost for any other occupancy arrangement. Owner-occupiers therefore enjoy a greater discount than other occupier types.

Rate Determination: Section 145(1) of Act 936 specifically states that "A District Assembly shall levy sufficient rates to provide for the total estimated expenditure to be incurred by the District Assembly during the period in respect of which the rate is levied." The rate levied is usually at a specified rate per the local currency (Ghana Cedi) on the rateable value of the property. An MMDA would typically have "rating zone classes" especially for residential property rating purposes. This classification reflects differences in location quality within an MMDA. Thus, properties in a rating zone class for prime locations usually attract a higher rate impost than those in other rating zone classes. Property rates are deemed to be levied by the publication of notice as defined by the regulations of the MMDA. There is also a Rate Assessment Committee to which persons aggrieved by their rateable values or

[8]This act superseded the Local Government Act, 1993 (Act 462).

[9]Property rating is the term used in Act 936 and practice in Ghana, instead of property taxation. In this paper we use these terms interchangeably.

by their property tax rates can apply for a review.

Tax burden: The property owner has the legal obligation for payment of property taxes.

Tax exemptions: The Act exempts certain properties from property assessment and rating, including those designated as: public worship centres, cemeteries, charities, public hospitals, and diplomatic missions. The MMDAs also have the power to reduce or cancel payment of the property rate due to the poverty of the person liable for payment.

Non-payment of property rates: If the property rate amount due is not paid within a period of 42 days, after first serving a default notice to the person liable for payment, the MMDA can apply to the courts for an order to sell the property. In practice, however, many of these cases are not sent to court or not promptly adjudicated by the MMDAs concerned. This lack of enforcement creates a build-up of arrears in property tax payments.

Collection of property taxes: The MMDAs are expected to appoint suitable persons as rate collectors, whose job is to collect property rates due and pay the amounts collected to their respective local authorities. They are also to report to the MMDA, any person who fails to pay the property rate. Penalties exist for offending rate collectors.

4. Data and variables

Our data is from the Accra Metropolitan Assembly (AMA), in the Greater-Accra region of Ghana. This Assembly has oversight responsibility over Accra, the capital city, which is the center of economic activity and seat of government in Ghana. The data includes property-level information from all the ten sub-metropolitan district councils within AMA that existed during the sample period. We exclude non-residential properties and residential properties with indeterminate occupancy status, rate imposts of zero, and rating zone classes that are not defined.

The data sample provides information on 52,786 dwelling units for the 2011-2018 period. Table 2 presents summary statistics of the main variables used in our analysis. It contains

descriptive statistics for the sample as well as across the three dwelling unit types. Owner-occupiers make up 60% of the observations, with owner-and-tenant-occupiers and tenant-occupiers making up 18% and 22% respectively.

[Insert Table 2 about here]

In the dataset we observe the total amounts that dwelling units had to pay as of 2018. These cumulative arrears represent current taxes and unpaid taxes accumulated since 2007.[10] The average cumulative arrears figure is GHS 377.[11] However, there are some dwelling units which have paid-up or even prepaid their property taxes. Owner-and-tenant-occupied dwelling units have the lowest arrears amount, an average of about GHS 336. The mean rateable value is GHS 32,793, while the property rate impost ranges between 0.05% and 1.65%.[12] Owner-and-tenant-occupied units have lower average estimates compared with those for both owner-occupied and tenant-occupied units. The minimum rate is a fixed amount paid by a dwelling unit when its property tax fee is lower than a fixed threshold.[13] For this sample, the minimum rate ranges from a low of GHS 10 to a high of GHS 600.

The rating zone classes differentiate between suburbs in terms of their quality, and are correlated with the property tax rate levels. Rating zone class 1, which comprises the most prime suburbs within the AMA, attracts the highest property tax rates, and accounts for 13% of the observations. Nearly 18% of tenant-occupied units are in rating zone class 1, which represents the highest concentration among the occupancy types for this rating zone class. Rating zone class 3 consists of the least prime locations and accounts for about 55% of the sample. Within this rating zone class, we find 67% of all owner-and-tenant-occupied

[10] Officials at the AMA noted that computerized recording of the data began in 2007. This suggests that the earliest arrears records can be deemed to go 12 years back, from 2007.

[11] This corresponds to about USD 77, using a USD/GHS exchange rate of 4.9139 prevailing at the end of 2018 (`bloomberg.com`).

[12] This range is consistent with prior research, which shows that the rates are typically low, ranging between 0.5% - 1% (Slack, 2013).

[13] The minimum rate is determined by the AMA on an annual basis and varies with the rating zone class, much like the property rate imposts. This minimum rate information can be deduced from the data and the official AMA Local Government Bulletin on the imposition of rates.

units – the highest proportion compared with the other dwelling unit types.[14] Figure 1 provides visual representation of the rating zone classes using three suburbs in the Accra metropolis, one for each class.

[Insert Figure 1 about here]

The property tax impost of each dwelling unit i in year t is calculated as the property rate, r_{it}, multiplied by the taxable value of the home PV_i. In cases where the property rate impost is below the minimum property tax rate, q_{jt}, the household is charged this minimum rate. The minimum rate, q_{jt}, depends on the rate zone in which the property is located. Thus, the property tax payment for each dwelling unit is given by:

$$PT_{it} = max\{q_{jt}, r_{it} \cdot PV_i\}. \tag{15}$$

For dwelling units that pay the minimum rate, we can estimate an effective property rate impost, as the original property rate impost levied by the AMA no longer applies. The effective property rate impost in this case is greater than the original property rate impost.

For each dwelling unit in our dataset, we have information on the unpaid property taxes for the 2011-2018 time period. Combining this information with the property tax due for all these years, we derive the number of years for which the dwelling unit has not paid property tax. In other words, we calculate the cumulative property tax arrears of the dwelling unit, measured in years, as the ratio of the unpaid property taxes to the total amount of taxes due, multiplied by eight years. We note that some dwelling units are in arrears of more than eight years because they have already been in arrears prior to 2011. The distribution of arrears periods of dwelling units is represented in Figure 2. About 13% of dwelling units are fully compliant, while about 35% have not paid for more than 8 years. A little over half of the remaining units have arrears ranging from just under a year to a period of 8 years.

[14]The AMA's residential rating zone classes are: 1A, 1B, 2A, 2B, 3A, 3B, and 3C, with 1A representing the most prime areas within the AMA and 3C the least prime areas. For simplicity, and to facilitate the interpretation of results, we group the units in the A, B, and C sub-categories. This gives us three residential rating zone classes: 1, 2, and 3.

[Insert Figure 2 about here]

5. Empirical analysis

In this section, we assess empirically how property tax arrears depend on the occupancy status of dwelling units, on the changes in property tax imposts over time, and on the proximity of the property to local amenities. We employ multinomial logistic regressions, which allows us to test the main hypotheses derived from the theoretical framework.

5.1 Occupancy status and arrears

As a first step, we analyze the relationship between the occupancy status of a dwelling unit and the risk of being in arrears. To this end, we construct a categorical variable for the time period in which the dwelling unit is in arrears:

$$Arrears\ Category_i = \begin{cases} A_0\ if\ there\ are\ no\ arrears, \\ A_1\ if\ arrears\ are\ up\ to\ 1\ year, \\ A_2\ if\ arrears\ are\ between\ 1\ to\ 2\ years, \\ A_3\ if\ arrears\ are\ between\ 2\ to\ 4\ years, \\ A_4\ if\ arrears\ are\ between\ 4\ to\ 6\ years, \\ A_5\ if\ arrears\ are\ between\ 6\ to\ 8\ years, \\ A_6\ if\ arrears\ are\ more\ than\ 8\ years. \end{cases}$$

We examine how compliance varies by occupancy status by estimating the following multinomial logistic regression model:

$$Y_i = \alpha_0 + \alpha_1 Owner\text{-}Tenant_i + \alpha_2 Tenant_i + \alpha_3 Property\ value_i + \alpha_4 Rating\ zone\ 1_i + \alpha_5 Rating\ zone\ 2_i + \varepsilon_i, \quad (16)$$

where

$$Y_i = log\left[\frac{Prob(Arrears\ Category_i = A_m)}{Prob(Arrears\ Category_i = A_0)}\right]$$

gives the log-odds of arrears category A_m ($m = 1, 2, \ldots 6$), relative to the baseline category of full compliance, A_0. $Owner\text{-}Tenant_i$ and $Tenant_i$ are indicator variables which respectively take the value of one if a dwelling unit is jointly occupied by the homeowner and tenants and solely by tenants, and zero otherwise. $Property\ value_i$ is the logarithm of the rateable value for dwelling unit i. $Rating\ zone\ 1_i$ and $Rating\ zone\ 2_i$ are indicator variables which respectively take the value of one if a dwelling unit is in rating zone class 1 and rating zone class 2, and zero otherwise; ε_i is the standard normal error term.

The regression results are reported in Table 3. In this table, owner-occupied dwelling units ($Owner$) is the reference category of occupancy status and rating zone class 3 is the reference rating zone. We report the coefficients for the relative risk ratios, which in this case, measure the risk that a dwelling unit is in arrears for each of the arrears groupings from columns (1) to (6), relative to the excluded "no arrears" category.

Owner-and-tenant-occupied dwelling units are about 11% more likely to be in arrears of up to one year than the owner-occupied dwelling units (relative risk ratio of 1.107). With the exception of the 1 to 2 years arrears period, there is a consistent trend of increased risk of arrears across all the other columns for owner-and-tenant-occupied units, with an almost 26% increased risk in the more than 8 years arrears period. Results for the tenant-occupied category are statistically significant only for the log-odds for 6 to 8 years and more than 8 years. The risk of being in the 6 to 8 years category of arrears, relative to being fully compliant, is almost 22% higher for tenant-occupied units than it is for owner-occupied units. This risk is even higher (about 56%) for the more than 8 years arrears category, as shown in the last column. One likely reason for this difference in compliance is the inefficient tax administration systems that make it hard to track homeowners who do not reside in the property, but are responsible for property tax payments instead of the property occupiers

(tenants). In an environment of weak regulatory enforcement, it is expected that these harder-to-reach payers are more likely to accumulate long-term arrears.

Overall, the results in Table 3 support the hypothesis that owner-and-tenant-occupied units are more likely to be non-compliant.

[Insert Table 3 about here]

5.2 Arrears and property tax rate changes

It is well established that taxpayers are resistant to property tax rate hikes, particularly in developing countries (see, for instance, Bahl and Wallace, 2008). In this section, we examine how the relative compliance behavior of the three occupancy types changes in response to changes in property tax rates. In particular, based on our theoretical model, we test the hypothesis that owner-and-tenant-occupied dwelling units exhibit a stronger reaction to changes in property tax rates. We denote the effective tax rate, R_{it}, as the ratio of the property tax to property value,

$$R_{it} = \frac{PT_{it}}{PV_i},$$

and determine, for each dwelling unit, the effective percentage property rate change from 2011 to 2018:

$$\overline{\%\Delta R_i} = \frac{(R_{i,2018} - R_{i,2011})}{R_{i,2011}} \cdot 100\%$$

The median value of the rate changes of dwelling units for the 2011-2018 period, $\overline{\%\Delta R_i}$, is 380% and we separate dwelling units into two categories depending on whether they experience an increase in their property tax rate that is higher or lower than the median increase. For these two categories, we examine how the risk of being delinquent depends on occupancy type, using our empirical specification given in equation (16). Since the property

rate changes are from 2011 to 2018, we observe arrears of up to 8 years.

The results of this analysis are presented in Table 4. For the category of dwelling units experiencing a higher-than-median property rate increase, the owner-and-tenant-occupied properties are 20.4% more likely to be in arrears of up to one year, compared to the owner-occupied properties. Among the dwelling units that experience a lower-than-median property rate increase, there is no significant difference in non-compliance of up to one year between the owner-and-tenant-occupied and the owner-occupied dwelling units. For longer non-compliance periods (i.e. more than two years), we observe that owner-and-tenants are more likely to be in arrears than owners. In particular, the risk of being in long-term arrears (6 to 8 years) is more than 30% higher for the owner-and-tenant-occupied units compared to the owner-occupied category. Landlords who do not live in the home they own (tenants) also have a higher risk of being in long-term arrears compared to the homeowners who live in their own home (owner-occupiers). For this category, we also observe that the dwelling units experiencing higher-than-median rent hikes are more likely to be non-compliant than the dwelling units that experience lower-than-median rent hikes.

[Insert Table 4 about here]

5.3 Arrears and distance to amenities

In this section, we examine the relationship between distance to public amenities and the property tax arrears of dwelling units. Theoretically, the proximity to local amenities is a source of compliance pressure for households. Indeed, previous studies have found that people tend to be more tax compliant when they receive a higher quality of public services for their tax payments (see, for instance, Alm et al., 2014).

This positive relationship between access to public goods and compliance is at the foundation of the "reciprocity" hypothesis formulated by Luttmer and Singhal (2014). The new element that we add to this literature is the measurement of the distance to amenities as a proxy for access to public services. Hence, our empirical tests could be viewed as an alter-

native test of the "reciprocity" hypothesis. The analysis also relates to the literature on the relationship between amenities and local housing markets. A number of studies document that the proximity to public services is capitalized in property values (see, for instance, Chin and Foong, 2006; Dronyk-Trosper, 2017; Dubé et al., 2013). There are, however, to the best of our knowledge, no studies that examine the effect of amenities on property tax compliance, which is the focus of our analysis.

We use road-based Google Maps distance estimates to two classes of public amenities in Accra: suburban police stations and hospitals. As a measure of proximity, we use the shortest travel distance by road in kilometers (km) between the amenity and the suburb in which the property is located.[15] In the case of police stations, we take the distance to the nearest police station within the immediate precincts of the suburbs.[16] In total, the distance to twenty-two police stations is measured. This allows for a direct test as regards the provision of public services in a specific local area. In the case of hospitals, we select three of the most popular and best resourced hospitals in Accra: Korle-Bu Teaching Hospital, 37 Military Hospital, and Greater Accra Regional Hospital. For each suburb, we take the distance of the suburb to the nearest hospital. Summary statistics of the distance to police stations and hospitals are presented in Table 5.

[Insert Table 5 about here]

In Table 6, we present the results of OLS regressions for the relationship between distance to amenities and arrears. The coefficients for this relationship are positive across all the model specifications. In column (3), we include both police and hospital distance as regressors, but do not control for other factors. We find that for every 1 kilometer increase in distance to the nearest police station (hospital), the arrears period increases by about 71

[15] We exclude 5 suburbs whose exact locations were unknown, owing mainly to vague details provided in the data. There were also a few cases of suburbs which, although known to exist, were not showing up in Google maps. For these suburbs, we use the nearest neighbouring suburbs or landmarks as the benchmark. We also merge some sub-divisions or extensions of a suburb with the main suburb in cases where they could not be singularly identified via Google maps. This leaves us with a final count of 124 suburbs.

[16] There were a few cases where a known police station could not be located on Google maps. Hence, we used the nearest landmark to the police station within the suburb.

days (76 days). When we include the value of the property and the rating zone as controls, the coefficient for the distance to hospitals increases, while the coefficient for distance to police stations decreases and loses significance. These initial tests are in line with the concept of reciprocity: spatially disadvantaged dwelling units, as regards the siting of public amenities, are generally more likely to be in arrears.

[Insert Table 6 about here]

We further analyze the effect of distance to amenities on arrears within the multinomial logistic framework, shown in equation (16). We create two sub-samples of dwelling units based on whether their distance to amenities is above or below the median distance. In the case of the suburban police stations, the median distance is 1.8 km, while in the case of hospitals, the median distance is 4.7 km. For each amenity, the dwelling units situated at a distance below the median are considered "short distance" (higher access) units while the dwelling units situated at a distance above the median are considered "long distance" (lower access).

The results for suburban police stations are presented in Table 7. As we are interested in testing for reciprocity, we use the tenant-occupied dwelling units as the reference category. The owners of these units, who pay the property tax, are not present in tenant-occupied units. Thus, their tax payment decisions are unlikely to be influenced by distance to the amenities as they do not directly enjoy them. The opposite is true of the two other dwelling unit types which feature a property-tax paying homeowner, and we examine how the compliance of these dwelling units differs based on their access to amenities.

[Insert Table 7 about here]

For the periods of up to two years, there are no significant differences in compliance across occupancy types, yet differences emerge for longer arrears periods. The probability of arrears is greater for owner-and-tenant-occupied dwelling units with a long distance to police

stations for the 2 to 4 years (by 24%), 4 to 6 years (by 50%), and 6 to 8 years (by 34%) arrears periods. These results are highly significant statistically and stand in contrast to those for the corresponding short-distance owner-and-tenant-occupied units, which are not significant. In the more than 8 years arrears period, we find that short-distance owner-and-tenant-occupied units are about 30% less likely to be delinquent, compared to the tenant-occupied category. In sum, access to amenities has little or no effect on the risk of arrears for owner-and-tenant-occupied dwelling units, in the initial stages of delinquency. However, for longer periods of arrears, the compliance of the owner-and-tenant-occupied units is sensitive to access to amenities. Owner-and-tenant-occupied dwelling units with high access to police stations are more compliant than the ones with low access.

Among owner-occupied dwelling units, there is a reduced risk of arrears for those with a short distance to police stations in the 4 to 6 years (by 12%), 6 to 8 years (21%), and more than 8 years (38%) arrears periods. Interestingly, long-distance owner-occupied dwelling units also have a decreased risk of non-compliance in the 6yrs-8yrs and more than 8yrs arrears periods, albeit by a slightly smaller margin than that of short-distance owner-occupied units. Overall, for arrears periods of six or more years, the owner-occupied category is more compliant than the tenant-occupied category, regardless of their proximity to police stations. This result is consistent with the social capital literature, which shows that homeowners – owner-occupied units in our case – are "better citizens" (see, for instance, DiPasquale and Glaeser, 1999; Hilber, 2010).

[Insert Table 8 about here]

The results for hospitals are presented in Table 8. The likelihood of being in arrears is greater for owner-and-tenant-occupied dwelling units with a long distance to hospitals in the 2 to 4 years (by 41%), 4 to 6 years (by 47%), and 6 to 8 years (by 33%) arrears periods. The coefficients for short-distance owner-and-tenant-occupied dwelling units in the same periods, however, are not significant. In the more than 8 years arrears period, the risk of being in arrears for short-distance owner-and-tenant-occupied dwelling units is 34% lower compared

to tenants, while for the long-distance owner-and-tenant-occupied dwelling units, there are no significant differences in the risks of owner-and-tenants and tenants. All these results are quite similar to the results for police stations.

Also similar is the result that owners are more compliant than tenants. This holds true across all arrears periods, but is particularly pronounced for longer periods of arrears. In particular, in the more than 8 years arrears periods, the risk of owners being in arrears is about 37% lower than the risk of the tenants. Further, for the 6 to 8 years period, there is a decreased risk of arrears for owner-occupied dwelling units with a short-distance to hospitals, much like the results based on distance to suburban police stations.

6. Conclusion

In understanding tax (non-)compliance behavior, the residential real estate literature so far focuses on the pecuniary and non-pecuniary motives driving the decision-making of dwelling units occupied by owners and renters. In recent years, multi-habitation arrangements within dwelling units have become increasingly popular, where homeowners rent out part of their properties to tenants, thus allowing homeowners to utilise the additional rental income to support their financial needs.

In this paper, we study the property tax non-compliance behavior among dwelling units jointly occupied by homeowners and tenants, within a tax administration system where owners are responsible for making property tax payments. Using a theoretical framework, we show that homeowners sharing their dwelling space with tenants have constraints and motives that are distinct to those of landlords and of pure owners, who fully occupy their properties. Therefore, their compliance levels differ from those of pure owners and landlords. On the one hand, since homeowners are renting out parts of their house to tenants, their compliance levels should be higher than those of pure owners due to the extra rental income. On the other hand, homeowners normally decide to share their residential space with tenants

due to binding income constraints, making them more susceptible to non-compliance than pure owners, and more sensitive to property tax rate increases.

Our empirical investigation draws from the detailed administrative-level data on cumulative property tax arrears for the period 2011-2018 and occupancy characteristics on all registered dwelling units in the Accra Metropolitan Assembly (AMA), Ghana. The property-level data consists of 52,786 registered dwelling units. We find that owner-and-tenant-occupied dwelling units are more likely to renege on their property tax obligations compared to owner-occupied units. For instance, the risk of short-term (long-term) non-compliance, with arrears of up to one year (eight years), is 11% (26%) higher among dwelling units jointly occupied by homeowners and tenants, than it is for pure owners. Our results also confirm that dwelling units that are solely occupied by renters stand a greater risk of prolonged delinquency, relative to owner-occupied units. Further, we observe significantly higher probabilities of being in short-term arrears of up to 1 year for owner-and-tenant-occupied dwelling units experiencing higher increases in property rates, while no significant effects are observed for smaller hikes in property rates. However, longer-term arrears among the owner-and-tenant-occupied dwelling units are observed to be significant for any level of increase in property tax rates. When we investigate the responses of dwelling units to non-pecuniary motives, as measured by distance to public amenities such as suburban police stations and hospitals, we find that owner-and-tenant-occupied dwelling units that are distant from amenities have a significantly greater likelihood of property tax delinquency.

The findings contribute to recent policy considerations by local authorities on understanding occupancy characteristics and residential property non-compliance, especially in developing nations with weak regulatory enforcement. Targeted policy interventions to increase compliance levels should consider the higher sensitivity observed in the case of owner-and-tenant-occupied dwelling units, as compared to pure owner-occupied units. Further, since compliance levels are influenced by the benefits derived from public amenities, policymakers should consider reciprocity effects when planning their spatial allocation of public amenities

– a balanced spread of benefits derived from public amenities can encourage residents to reciprocate with higher compliance levels in property taxes.

References

Allingham, M. G. and Sandmo, A. (1972). Income Tax Evasion: A Theoretical Analysis. *Journal of Public Economics*, 1(3-4):323–338.

Alm, J. (2019). What Motivates Tax Compliance? *Journal of Economic Surveys*, 33(2):353–388.

Alm, J., Hodge, T. R., Sands, G., and Skidmore, M. (2014). Detroit Property Tax Delinquency: Social Contract in Crisis. Working Paper WP14JA3, Lincoln Institute of Land Policy.

Alm, J. and Torgler, B. (2011). Do Ethics Matter? Tax Compliance and Morality. *Journal of Business Ethics*, 101:635–651.

Andreoni, J., Erard, B., and Feinstein, J. (1998). Tax Compliance. *Journal of Economic Literature*, 36(2):818–860.

Arbel, Y., Fialkoff, C., and Kerner, A. (2017). Removal of renter's illusion: Property tax compliance among renters and owner-occupiers. *Regional Science and Urban Economics*, 66:150 – 174.

Arundel, R. and Doling, J. (2017). The End of Mass Homeownership? Changes in Labour Markets and Housing Tenure Opportunities Across Europe. *Journal of Housing and the Built Environment*, 32(4):649–672.

Bahl, R. and Wallace, S. (2008). Reforming the Property Tax in Developing Countries: A New Approach. International Center for Public Policy Working Paper Series, at AYSPS,

GSU paper0819, International Center for Public Policy, Andrew Young School of Policy Studies, Georgia State University.

Bewley, T. (1977). The Permanent Income Hypothesis: A Theoretical Formulation. *Journal of Economic Theory*, 16(2):252–292.

Carroll, C. D. (1992). Buffer Stock Saving and the Permanent Income Hypothesis. *Unpublished paper. Washington, D.C.: Federal Reserve Board*.

Carroll, C. D. (1996). Buffer Stock Saving: Some Theory.

Carroll, C. D. (1997). Buffer-Stock Saving and the Life Cycle/Permanent Income Hypothesis. *The Quarterly Journal of Economics*, 112(1):1–55.

Castro, L. and Scartascini, C. (2015). Tax Compliance and Enforcement in the Pampas: Evidence from a Field Experiment. *Journal of Economic Behaviour & Organization*, 116:65–82.

Chin, H. C. and Foong, K. W. (2006). Influence of School Accessibility on Housing Values. *Journal of Urban Planning and Development*, 132(3):120–129.

Cummings, R. G., Martinez-Vazquez, J., McKee, M., and Torgler, B. (2009). Tax Morale Affects Tax Compliance: Evidence from Surveys and an Artefactual Field Experiment. *Journal of Economic Behavior & Organization*, 70(3):447–457.

Deaton, A. (1991). Saving and Liquidity Constraints. *Econometrica*, 59(5):1221–1248.

DiPasquale, D. and Glaeser, E. L. (1999). Incentives and Social Capital: Are Homeowners Better Citizens? *Journal of Urban Economics*, 45(2):354–384.

Dronyk-Trosper, T. (2017). Searching for Goldilocks: The Distance-Based Capitalization Effects of Local Public Services. *Real Estate Economics*, 45(3):650–678.

Dubé, J., Thériault, M., and Rosiers, F. D. (2013). Commuter Rail Accessibility and House Values: The Case of the Montreal South Shore, Canada, 1992–2009. *Transportation Research Part A: Policy and Practice*, 54(Supplement C):49 – 66.

Dwenger, N., Kleven, H., Rasul, I., and Rincke, J. (2016). Extrinsic and Intrinsic Motivations for Tax Compliance: Evidence from a Field Experiment in Germany. *American Economic Journal: Economic Policy*, 8(3):203 – 232.

Fortin, B., Lacroix, G., and Villeval, M.-C. (2007). Tax Evasion and Social Interactions. *Journal of Public Economics*, 33:2089–2112.

Frey, B. S. and Torgler, B. (2007). Tax Morale and Conditional Cooperation. *Journal of Comparative Economics*, 35(1):136–159.

Gordon, J. P. (1989). Individual Morality and Reputation Costs as Deterrents to Tax Evasion. *European Economic Review*, 33:797–805.

Hallsworth, M., List, J. A., Metcalfe, R. D., and Vlaev, I. (2017). The Behavioralist as Tax Collector: Using Natural Field Experiments to Enhance Tax Compliance. *Journal of Public Economics*, 148(4):14 – 31.

Hilber, C. (2010). New Housing Supply and the Dilution of Social Capital. *Journal of Urban Economics*, 67(3):419–437.

Huang, Y., Yi, D., and Clark, W. A. V. (2020). A Homeownership Paradox: Why Do Chinese Homeowners Rent the Housing They Live In? *Housing Studies*. Available at `https://doi.org/10.1080/02673037.2020.1793916`.

Luttmer, E. F. P. and Singhal, M. (2014). Tax Morale. *Journal of Economic Perspectives*, 28(4):149–168.

Mendelson, H. and Amihud, Y. (1982). Optimal Consumption Policy under Uncertain Income. *Management Science*, 28(6):683–697.

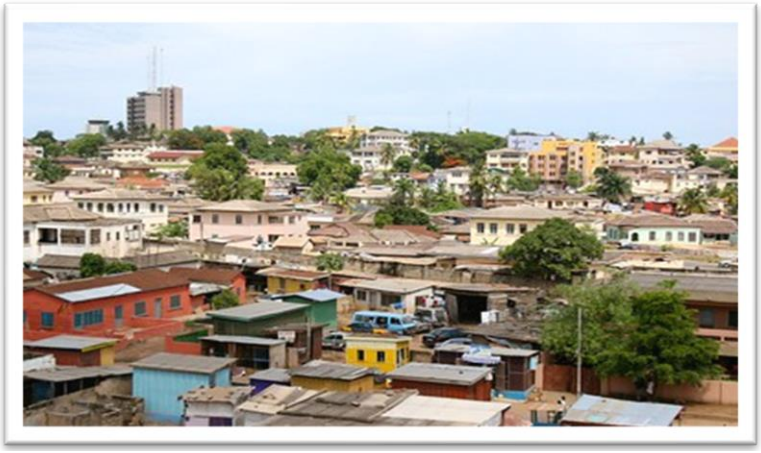
Miranda, M. and Fackler, P. (2002). *Applied Computational Economics and Finance*. MIT Press, Cambridge, Mass.

Schechtman, J. (1976). An Income Fluctuation Problem. *Journal of Economic Theory*, 12(2):218–241.

Traxler, C. (2010). Social Norms and Conditional Cooperative Taxpayers. *European Journal of Political Economy*, 26(1):89–103.

Willis, K. G. and Tipple, A. G. (1991). Economics of Multihabitation: Housing Conditions, Household Occupancy and Household Structure Under Rent Control, Inflation, and Nonmarketability of Ownership Rights. *World Development*, 19(12):1705–1720.

(a) East Legon (Class 1) - [average rateable value GHS 83,666.17 and rate impost 0.33%]



(b) Adabraka (Class 2) - [average rateable value GHS 29,857.35 and rate impost 0.22%]

(c) Nima (Class 3) - [average rateable value GHS 19,073.89 and rate impost 0.16%]

Figure 1: Residential Rating Zone Classes

The figures shows examples of properties in AMA's three residential rating zone classes, along with their respective average rateable values and average rate impost as of 2018. Class 1 and Class 3 are the most prime and least prime locations, respectively. (All images are from `flickr.com`, under Creative Commons licensing [Accessed November 19, 2020]: (a) is from `https://www.flickr.com/photos/sweggs/534895571`; (b) is from `https://www.flickr.com/photos/sweggs/510700598`; (c) is from `https://www.flickr.com/photos/caetie/9035079273`.

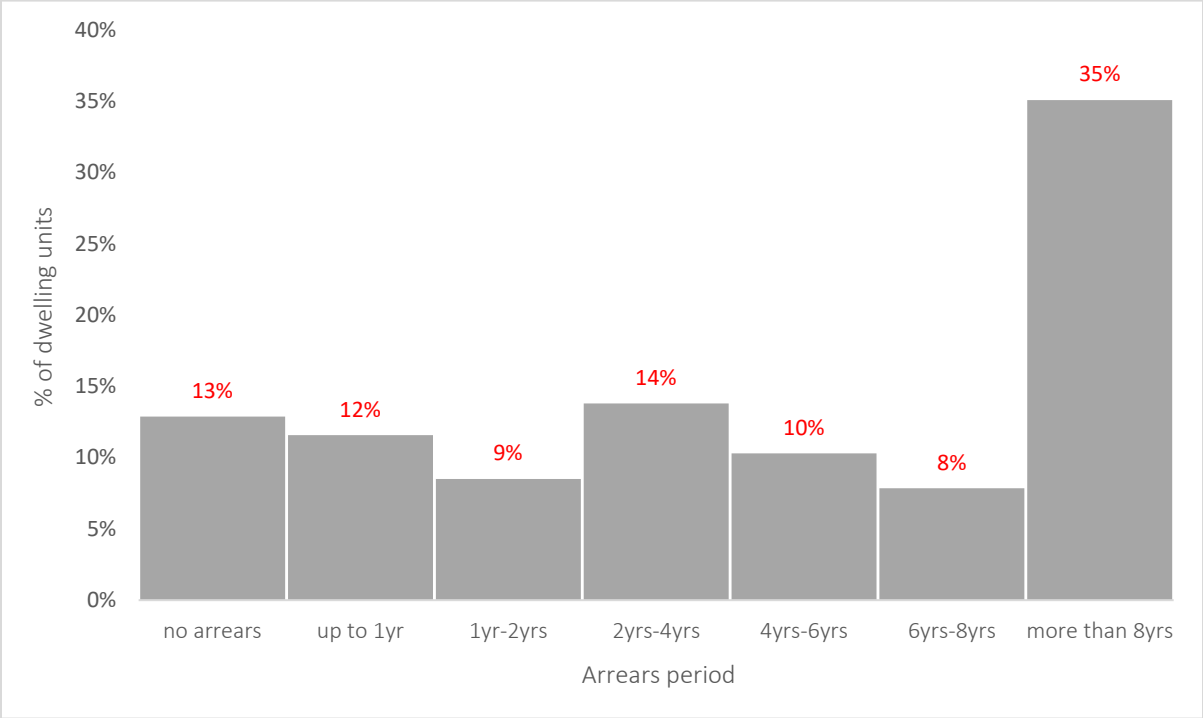


Figure 2: Property Tax Arrears Period

This figure shows the percentage of dwelling units in property tax arrears, grouped by the effective number of years in arrears, as of 2018. The effective number of years in arrears is calculated by taking into account the total amount of unpaid taxes as of 2018 and the total amount of taxes owned over the sample period.

Table 1: Default Frequency and Odds: Owner-occupiers vs. Owner-and-tenant-occupiers

	Owner					Owner-and-tenant				
Cash-on-hand threshold	60%		55%			60%		55%		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Default period	Frequency	Default odds	Frequency	Default odds	Difference in default odds	Frequency	Default odds	Frequency	Default odds	Difference in default odds
0	19.96%		35.44%			1.65%		5.43%		
1	19.80%	0.99	24.26%	0.68	0.31	3.28%	1.99	7.50%	0.21	1.78
2	19.22%	0.96	17.76%	0.50	0.46	5.29%	3.21	9.74%	0.27	2.93
3	14.93%	0.75	11.17%	0.32	0.43	6.85%	4.15	11.66%	0.33	3.82
4	10.68%	0.54	6.56%	0.19	0.35	9.06%	5.49	12.51%	0.35	5.14
5	7.25%	0.36	3.08%	0.09	0.28	10.85%	6.58	12.49%	0.35	6.22
6	4.48%	0.22	1.24%	0.03	0.19	12.12%	7.35	12.13%	0.34	7.00
7	2.34%	0.12	0.33%	0.01	0.11	13.84%	8.39	10.17%	0.29	8.10
8	0.97%	0.05	0.11%	0.00	0.05	13.03%	7.90	8.23%	0.23	7.66
9	0.31%	0.02	0.04%	0.00	0.01	12.22%	7.41	6.18%	0.17	7.23
10	0.06%	0.00	0.01%	0.00	0.00	11.81%	7.16	3.96%	0.11	7.05
Average default period	2.36		1.46		Difference in default period 0.90	6.27		4.8		Difference in default period 1.47

This table reports default frequency, default odds (i.e. probability of default for n years divided by the probability of compliance, where n = 1,2,...,10) and difference in default odds for owner-occupiers and owner-and-tenant-occupiers. Columns (1) and (3) represent the default frequency for the owner-occupier, when default thresholds are set to 60% and 55% of average equilibrium cash-on-hand, respectively. Columns (6) and (8) report the respective figures for the owner-and-tenant dwelling unit. Columns (2) and (4) report the odds for the owner-occupier of being in default up to ten years versus not being in default. Columns (7) and (9) report the respective odds for the owner-and-tenant unit. The difference between columns (2) and (4) and the columns (7) and (9) are presented in columns (5) and (10), respectively.

Table 2: Summary Statistics

	Full Sample				Owner-occupiers	Owner-and-tenant-occupiers	Tenant-occupiers
Variable	Mean	Minimum	Maximum	Std. Dev.	Mean	Mean	Mean
Cumulative arrears (GHs)	377	-2,250	204,282	1,052.01	369.98	336.12	425.07
Fees payable (GHs)	74	10	36,305	184	74.81	62.30	79.68
Rateable value (GHs)	32,793	97	13,000,000	100,022	32,632.26	31,041.04	34,563.15
Minimum rate (GHs)	66.34	10	600	44.11	67.48795	59.40261	68.69979
Property rate impost (%)	0.1126	0.0500	1.6500	0.0532	0.1139	0.1046	0.1153
Owner-occupiers (%)	59.6						
Owner-and-tenant-occupiers (%)	17.6						
Tenant-occupiers (%)	22.8						
Rating zone class 1 (%)	13.4				13.7	6.7	17.7
Rating zone class 2 (%)	32.2				35.9	26.1	27.1
Rating zone class 3 (%)	54.5				50.4	67.2	55.2

This table presents the summary statistics of the data. The sample comprises information on 52,786 dwelling units from the Accra Metropolitan Assembly (AMA) for the sample period 2011-2018. The cumulative arrears is the amount of arrears for the dwelling units in our sample as of 2018. Data on fees payable, minimum rate and property rate impost vary annually over the sample period. The minimum rate is a fixed amount paid by a dwelling unit each year if its property tax amount falls below a predetermined threshold.

Table 3: Occupancy Status and Arrears

	up to 1 year	1 to 2 years	2 to 4 years	4 to 6 years	6 to 8 years	more than 8 years
	(1)	(2)	(3)	(4)	(5)	(6)
Owner-Tenant	1.107**	0.965	1.158***	1.264***	1.318***	1.259***
	(0.0542)	(0.0526)	(0.0541)	(0.0625)	(0.0708)	(0.0508)
Tenant	1.011	0.982	1.057	1.075	1.216***	1.564***
	(0.0457)	(0.0485)	(0.0458)	(0.0505)	(0.0608)	(0.0570)
Property value	0.917***	0.894***	0.817***	0.713***	0.653***	0.499***
	(0.0210)	(0.0225)	(0.0184)	(0.0169)	(0.0168)	(0.0100)
Rating zone 1	1.074	1.000	0.795***	0.669***	0.731***	0.432***
	(0.0535)	(0.0556)	(0.0398)	(0.0382)	(0.0456)	(0.0200)
Rating zone 2	1.216***	1.405***	1.193***	1.234***	1.271***	1.073**
	(0.0500)	(0.0619)	(0.0466)	(0.0513)	(0.0571)	(0.0358)
Observations	12,914	11,288	14,077	12,239	10,942	25,316
Pseudo R-sq.	0.02	0.02	0.02	0.02	0.02	0.02

This table reports the estimated relative risk ratios from the multinomial logit model in equation (16). The dependent variable is categorical, capturing the time period (in years) for which a dwelling unit is in arrears. There are seven distinct arrears period categories considered, with the category in which there are no arrears serving as the base category. Owner-Tenant (Tenant) takes the value of one if a dwelling unit is owner-and-tenant-occupied (tenant-occupied), and zero otherwise. Owner-occupied dwelling units are the base occupancy category. Property value is the logarithm of each property's rateable value, which is a monetary value assigned to each property using a valuation-based approach. The dwelling units belong to three rating zone classes, with rating zone 1 representing the most prime locations and rating zone 3 the least prime. Rating zone 1 (Rating zone 2) takes the value of one if a dwelling unit is in rating zone class 1 (rating zone class 2), and zero otherwise. Robust standard errors are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 4: Arrears and Increases in Property Tax Rates

	up to 1 year		1 to 2 years		2 to 4 years		4 to 6 years		6 to 8 years	
	low rate increase (1)	high rate increase (2)	low rate increase (3)	high rate increase (4)	low rate increase (5)	high rate increase (6)	low rate increase (7)	high rate increase (8)	low rate increase (9)	high rate increase (10)
Owner-Tenant	1.025	1.204***	0.926	1.005	1.170**	1.143**	1.217***	1.302***	1.318***	1.313***
	(0.0718)	(0.0827)	(0.0720)	(0.0771)	(0.0790)	(0.0738)	(0.0889)	(0.0880)	(0.104)	(0.0961)
Tenant	0.909	1.142**	0.874**	1.124	0.998	1.123*	0.927	1.230***	1.114	1.314***
	(0.0557)	(0.0765)	(0.0591)	(0.0815)	(0.0601)	(0.0704)	(0.0625)	(0.0818)	(0.0801)	(0.0931)
Property value	0.871***	0.952	0.821***	1.046	0.770***	0.916**	0.640***	0.838***	0.592***	0.735***
	(0.0297)	(0.0418)	(0.0313)	(0.0504)	(0.0264)	(0.0381)	(0.0228)	(0.0364)	(0.0233)	(0.0329)
Rating zone 1	1.177**	0.944	1.134	0.880	0.909	0.711***	0.836**	0.549***	0.807**	0.660***
	(0.0826)	(0.0693)	(0.0901)	(0.0715)	(0.0653)	(0.0513)	(0.0691)	(0.0456)	(0.0740)	(0.0577)
Rating zone 2	1.199***	1.184	1.453***	1.428***	1.274***	1.325***	1.326***	1.412***	1.283***	1.543***
	(0.0725)	(0.1356)	(0.0975)	(0.1685)	(0.0746)	(0.1384)	(0.0844)	(0.1535)	(0.0893)	(0.1770)
Observations	7,047	5,867	6,135	5,153	7,339	6,738	6,308	5,931	5,656	5,286
Pseudo R-sq.	0.01	0.004	0.01	0.004	0.01	0.004	0.01	0.004	0.01	0.004

This table reports relative risk ratios from the multinomial logit model assessing property tax arrears and increases in tax rate changes. The dependent variable is categorical, capturing the time period (in years) for which a dwelling unit is in arrears. Various arrears period categories of dwelling units are considered, with dwelling units not in arrears serving as the base category. Based on the property tax rate changes, the data is split into two sub-samples: low rate increases and high rate increases. Low rate (high rate) increase columns report results for dwelling units whose average property rate increases are below (above) the sample median increases observed from 2011 to 2018. Owner-Tenant (Tenant) takes the value of one if a dwelling unit is owner-and-tenant-occupied (tenant-occupied), and zero otherwise. Property value is the logarithm of each property's rateable value, which is a monetary value assigned to each property using a valuation-based approach. The dwelling units belong to three rating zone classes, with rating zone 1 representing the most prime locations and rating zone 3 the least prime. Rating zone 1 (Rating zone 2) takes the value of one if a dwelling unit is in rating zone class 1 (rating zone class 2), and zero otherwise. Robust standard errors are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 5: Summary Statistics of Road-Based Distance Estimates to Public Amenities

	Police Stations	Hospitals
Shortest distance (km)	0.26	0.45
Mean distance (km)	2.04	5.83
Median distance (km)	1.8	4.7
Maximum distance (km)	5.7	17.7
Standard deviation (km)	0.97	2.84

This table reports the summary statistics of road-based distance estimates from Google Maps (in kilometers) from the AMA suburbs to suburban police stations and hospitals. Distance estimates for police stations are based on the shortest distance from a given suburb to the nearest police stations. In total, 22 police stations are represented in the data. Estimates for hospitals are based on the shortest distance from a given suburb to the nearest of three hospitals: Korle-Bu Teaching Hospital, 37 Military Hospital, and the Greater Accra Regional Hospital.

Table 6: Proximity to Amenities and Arrears - Initial OLS Tests

	Arrears period					
	(1)	(2)	(3)	(4)	(5)	(6)
Police	0.551***		0.194***	0.488***		0.023
	(0.0169)		(0.0213)	(0.0170)		(0.0207)
Hospital		0.246***	0.208***		0.283***	0.278***
		(0.0057)	(0.0072)		(0.0057)	(0.0070)
Property value				-1.023***	-1.156***	-1.155***
				(0.0213)	(0.0214)	(0.0214)
Rating zone 1				-1.012***	-0.918***	-0.913***
				(0.0531)	(0.0527)	(0.0529)
Rating zone 2				-0.255***	-0.392***	-0.393***
				(0.0377)	(0.0372)	(0.0373)
_cons	4.122***	3.811***	3.641***	14.73***	15.44***	15.40***
	(0.0389)	(0.0382)	(0.0419)	(0.2136)	(0.2099)	(0.2130)
Observations	52,769	52,769	52,769	52,769	52,769	52,769
adj. R-sq	0.02	0.03	0.03	0.08	0.10	0.10

This table reports OLS regression estimates of the relationship between proximity to public amenities (suburban police stations and hospitals) and the length of arrears. The dependent variable, arrears period, is the property tax arrears period (in years) for each dwelling unit. Police (Hospital) is a distance measure, calculated as the shortest distance in kilometers from a dwelling unit's suburb to the nearest suburban police station (nearest of the three hospitals). All distances are calculated from Google Maps. Property value is the logarithm of each property's rateable value, which is a monetary value assigned to each property using a valuation-based approach. The dwelling units belong to three rating zone classes, with rating zone 1 representing the most prime locations and rating zone 3 the least prime. Rating zone 1 (Rating zone 2) takes the value of one if a dwelling unit is in rating zone class 1 (rating zone class 2), and zero otherwise. Robust standard errors are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 7: Arrears and Distance to Suburban Police Stations

	up to 1 year		1 to 2 years		2 to 4 years		4 to 6 years		6 to 8 years		more than 8 years	
	short distance (1)	long distance (2)	short distance (3)	long distance (4)	short distance (5)	long distance (6)	short distance (7)	long distance (8)	short distance (9)	long distance (10)	short distance (11)	long distance (12)
Owner-Tenant	1.105	1.121	0.964	1.094	1.052	1.239**	1.025	1.497***	0.987	1.338***	0.699***	0.998
	(0.0818)	(0.110)	(0.0809)	(0.115)	(0.0762)	(0.112)	(0.0791)	(0.144)	(0.0827)	(0.135)	(0.0430)	(0.0772)
Owner	0.977	1.003	0.965	1.081	0.975	0.906	0.875**	0.999	0.791***	0.849**	0.618***	0.648***
	(0.0569)	(0.0720)	(0.0622)	(0.0833)	(0.0555)	(0.0609)	(0.0533)	(0.0741)	(0.0520)	(0.0658)	(0.0296)	(0.0371)
Property value	0.941*	0.872***	0.949	0.811***	0.853***	0.751***	0.769***	0.637***	0.721***	0.570***	0.611***	0.410***
	(0.0295)	(0.0303)	(0.0329)	(0.0308)	(0.0266)	(0.0253)	(0.0248)	(0.0232)	(0.0260)	(0.0217)	(0.0167)	(0.0128)
Rating zone 1	1.100	1.080	1.111	0.936	0.867**	0.753***	0.782***	0.520***	0.890	0.579***	0.504***	0.403***
	(0.0672)	(0.0938)	(0.0768)	(0.0888)	(0.0536)	(0.0654)	(0.0534)	(0.0553)	(0.0678)	(0.0653)	(0.0284)	(0.0329)
Rating zone 2	1.275***	1.134**	1.603***	1.173**	1.250***	1.077	1.285***	1.119*	1.552***	0.979	1.009	1.031
	(0.0701)	(0.0715)	(0.0956)	(0.0776)	(0.0667)	(0.0630)	(0.0730)	(0.0696)	(0.0954)	(0.0654)	(0.0468)	(0.0518)
Observations	7,849	5,064	6,710	4,577	8,182	5,892	7,205	5,031	6,449	4,492	12,437	12,866
Pseudo R-sq.	0.01	0.03	0.01	0.03	0.01	0.03	0.01	0.03	0.01	0.03	0.01	0.03

This table reports relative risk ratios from the multinomial logit model assessing property tax arrears and distance to suburban police stations. The dependent variable is categorical, capturing the time period (in years) for which a dwelling unit is in arrears. Various arrears period categories of dwelling units are considered, with dwelling units not in arrears serving as the base category. Using road-based distance estimates from Google Maps, properties are classified into two groups: short distance and long distance. The short (long) distance columns report results for dwelling units whose travel distance to the nearest police stations is below (above) the overall median distance. Owner-Tenant (Owner) takes the value of one if a dwelling unit is owner-and-tenant-occupied (owner-occupied), and zero otherwise. Property value is the logarithm of each property's rateable value, which is a monetary value assigned to each property using a valuation-based approach. The dwelling units belong to three rating zone classes, with rating zone 1 representing the most prime locations and rating zone 3 the least prime. Rating zone 1 (Rating zone 2) takes the value of one if a dwelling unit is in rating zone class 1 (rating zone class 2), and zero otherwise. Robust standard errors are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 8: Arrears and Distance to Hospitals

	up to 1 year		1 to 2 years		2 to 4 years		4 to 6 years		6 to 8 years		more than 8 years	
	short distance (1)	long distance (2)	short distance (3)	long distance (4)	short distance (5)	long distance (6)	short distance (7)	long distance (8)	short distance (9)	long distance (10)	short distance (11)	long distance (12)
Owner-Tenant	1.113	1.140	0.932	1.144	0.972	1.411***	1.081	1.466***	0.996	1.333***	0.663***	1.082
	(0.0831)	(0.111)	(0.0784)	(0.120)	(0.0723)	(0.123)	(0.0869)	(0.135)	(0.0870)	(0.129)	(0.0412)	(0.0826)
Owner	0.985	0.984	1.043	0.984	0.982	0.892*	0.960	0.879*	0.922	0.714***	0.622***	0.633***
	(0.0596)	(0.0672)	(0.0690)	(0.0733)	(0.0582)	(0.0570)	(0.0625)	(0.0603)	(0.0642)	(0.0517)	(0.0308)	(0.0346)
Property value	0.913***	0.863***	0.932*	0.798***	0.826***	0.706***	0.700***	0.621***	0.643***	0.576***	0.466***	0.454***
	(0.0290)	(0.0302)	(0.0334)	(0.0304)	(0.0266)	(0.0241)	(0.0234)	(0.0225)	(0.0237)	(0.0223)	(0.0131)	(0.0142)
Rating zone 1	0.917	1.334***	0.795***	1.382***	0.760***	0.897	0.638***	0.758***	0.668***	0.867	0.415***	0.484***
	(0.0611)	(0.100)	(0.0597)	(0.115)	(0.0515)	(0.0667)	(0.0498)	(0.0636)	(0.0565)	(0.0802)	(0.0254)	(0.0340)
Rating zone 2	1.375***	1.073	1.438***	1.360***	1.322***	0.985	1.317***	1.042	1.226***	1.170**	0.799***	1.106*
	(0.0792)	(0.0653)	(0.0888)	(0.0888)	(0.0748)	(0.0548)	(0.0805)	(0.0610)	(0.0814)	(0.0739)	(0.0400)	(0.0527)
Observations	7,251	5,662	6,315	4,972	7,453	6,621	6,502	5,734	5,913	5,028	12,770	12,533
Pseudo R-sq.	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02

This table reports relative risk ratios of the multinomial logit model assessing property tax arrears and distance to hospitals. The dependent variable is categorical, capturing the time period (in years) for which a dwelling unit is in arrears. Various arrears period categories of dwelling units are considered, with dwelling units not in arrears serving as the base category. Using road-based distance estimates from Google Maps, properties are classified into two groups: short distance and long distance. The short (long) distance columns report results for dwelling units whose travel distance to the nearest hospital is below (above) the overall median distance. Owner-Tenant (Owner) takes the value of one if a dwelling unit is owner-and-tenant-occupied (owner-occupied), and zero otherwise. Property value is the logarithm of each property's rateable value, which is a monetary value assigned to each property using a valuation-based approach. The dwelling units belong to three rating zone classes, with rating zone 1 representing the most prime locations and rating zone 3 the least prime. Rating zone 1 (Rating zone 2) takes the value of one if a dwelling unit is in rating zone class 1 (rating zone class 2), and zero otherwise. Robust standard errors are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.