Shared Occupancy and Property Tax Arrears

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September 2023

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Abstract

Shared occupancy arrangements are on the rise in recent years due to affordability constraints in homeownership. This article examines for the first time the property tax compliance behavior of shared dwellings, where homeowners rent out part of their own home to tenants. Using administrative-level data from Ghana, where homeowners are responsible for tax payments, we reveal that shared dwellings, compared to pure owner-occupied homes, are more likely to be in tax arrears. Their noncompliance is more sensitive to property tax hikes than homeowners, and greatest among those in the lower socio-economic status and in least affluent geographic areas. The results underscore the financial vulnerability of homeowners who rent out sections of their primary residence to tenants. Due to financial pressures and income constraints, they are less property tax compliant relative to conventional homeowners. We find that these effects are moderated by reciprocity, where compliance levels are higher in shared dwellings located closer to public services and amenities. The findings provide new insights for policymakers on the tax compliance effects arising in shared occupancies.

JEL Classification: D12, H23, R21

Keywords: Home Ownership; Tax Compliance; Economic Behavior; Reciprocity

1. Introduction

"I hate paying taxes. But I love the civilization they give me." —Oliver Wendell Holmes

The motivations for paying taxes have been extensively studied both theoretically and empirically. The theoretical literature alludes to 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 predicted by these theoretical models, even when enforcement measures such as audits and fines are minimal (Frey and Torgler, 2007; Alm, 2019). Thus, alternative explanations related to "tax morale" and more broadly nonpecuniary motivations for paying tax have emerged, including guilt and shame (Andreoni et al., 1998), culture and social norms (Cummings et al., 2009), reciprocity (Castro and Scartascini, 2015; Fjeldstad and Semboja, 2001), intrinsic duty-to-comply preferences (Dwenger et al., 2016), and peer behavior (Hallsworth et al., 2017).

Given these nonpecuniary motives, one expects a higher tax compliance among owners as compared to renters. For instance, owners have more to lose in terms of assets and social connections (Alm et al., 2014; Arbel et al., 2017). Furthermore, homeowners derive more social benefits than renters, so renters may have a lower incentive for compliance (Foye et al., 2018). The literature on social capital argues that homeowners are more likely than renters 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 examine for the first time the tax compliance behavior of shared occupancy arrangements, where a homeowner lives in the property and rents out part of their own home. Previous studies have ignored such shared housing tenure arrangements, although they 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 devel-

[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

oping countries, multihabitation 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.

A priori, it is unclear whether the owner-and-tenant-occupied dwellings will be more or less tax-compliant, as compared to owner-occupied dwellings, 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 dwellings should be more tax-compliant. On the other hand, one of the reasons for deciding to rent out part of their own homes is driven by financial constraints, unlike the case of pure owner-occupiers, which suggests a greater chance of noncompliance due to possible income uncertainty. Therefore, from a policy perspective, it is a priori unclear whether a homeowner under the owner-and-tenant-occupancy arrangement should 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 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 nonpecuniary motives for compliance, which we model as an intrinsic moral cost of noncompliance (Fortin et al., 2007; Traxler, 2010; Alm and Torgler, 2011). We show that if households rent out part of their home due to income constraints (shared occupancy), their rental income will not completely relax their financial constraints. Thus, the shared occupancy type of households will be more likely to be noncompliant relative to owner-occupiers. Further,

house/houses but living in rented property owned by others – exists in large cities in countries such as China, where policies which limit housing purchase and high house prices prevent residents, especially migrants, from purchasing homes in large cities. Thus, there is renting in 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.

their compliance behavior will be more sensitive to property tax rate changes, and they will accumulate longer periods of arrears when property tax rates increase. Under plausible assumptions on the nature of income uncertainty, we show that these dwelling units will be more responsive to nonpecuniary motives for compliance.

To empirically test these predictions, we utilize granular administrative-level data on the occupancy and property tax characteristics of dwelling units observed over the period 2011 to 2018, obtained from the Accra Metropolitan Assembly (AMA) in Ghana. The 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 shared/owner-and-tenant-occupancy (where a house is jointly occupied by the homeowner and tenants). The data contains individual property-level information on value of the occupied property, the property tax (rating) zone, the street on which it is located, the annual property tax rate, the tax amount payable, as well as the property tax arrears.

Our empirical identification focuses on minimum-rate paying homes, where the rates are determined solely by the budgetary planning of the AMA and do not depend on attributes of the property other than its rating zone. This identification strategy ensures that we capture variation in property taxes, which is exogenous to the property-level characteristics. The final sample comprises 238,140 dwelling unit–year observations.

Our baseline results show that owner-and-tenant-occupied dwellings are significantly more likely to be noncompliant, relative to owner-occupied homes. Their likelihood of failing to fully pay their property taxes is 2.2% higher than that of owner-occupied homes, with the difference being statistically significant. We also observe important heterogeneity in this noncompliance behavior. AMA distinguishes location quality according to rating zones. Exploring these rating zone classifications, we find that shared dwelling units in less wealthy neighborhoods are more likely to be in full or partial arrears, compared with those in the most affluent areas. Further, we examine response heterogeneity according to socio-economic status, proxied by the type of materials used in the construction of the property. Prior studies allude to the use of expensive materials to build homes as a status symbol (Malkawi and Al-Qudah, 2003). We find that owner-and-tenant-occupied dwellings belonging to the lowest socio-economic bracket (those in properties made of the cheapest building materials) are more vulnerable to property tax arrears.

Next, we investigate property taxpayers' reactions to exogenous rate shocks seen in the years 2012 and 2018, when relatively large tax rate hikes were observed. We note that annual tax rates are exogenously determined by the AMA in line with budgetary targets. We find that rate shocks increase the probability of arrears for a dwelling unit. The most significant effect observed is that a property moves from full compliance to partial noncompliance. In the specific case of shared dwelling units, we see that their experience of higher property rates translates into a significantly higher likelihood of noncompliance.

Exploiting the geographic coordinates of the properties, we assess how proximity to public amenities (suburban police stations and hospitals) affects compliance outcomes. Consistent with the theory of reciprocity, we find a positive relationship between distance to the amenities and noncompliance outcomes. We also find that owner-and-tenant-occupied dwellings that are distant from the amenities are about 3% more likely not to pay their property taxes. This is also true of the two other dwelling types although the magnitudes differ. This latter finding is consistent with Alm et al. (2014), which documents the importance households attach to public amenities by showing that property tax delinquency is higher in areas with longer police response times.

Overall, these results provide evidence in favor of reciprocity as a motive for property tax compliance. As such, we add to the literature on nonpecuniary motives for tax compliance by considering actual access to public amenities. This is unlike previous studies that rely on perceived access using field experiments, in which households are differentiated by the messages accompanying their tax bills to investigate these nonpecuniary 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 depending on residential occupancy types.

The findings in the paper have several policy implications in developing economies, particularly with trends toward increased decentralisation of public service delivery to local governments, who then rely on property taxes as a major source of government revenue to fund local needs and reduce poverty levels (see, for example, Bardhan and Mookherjee, 2006; Ramírez et al., 2017; Tang et al., 2011). First, policy interventions aimed at enhancing local property tax revenues need to take into account that mixed and multihabitation dwelling units are more sensitive to changes in property taxes and more susceptible to delinquency. On the other hand, tenant-occupied dwelling units are more likely to be long-term noncompliant and therefore more efficient payment systems are necessary to improve long-term compliance levels. Thus, from a public policy perspective, the findings of this paper bring into debate for the first time on whether or not owners renting out sections of their home to tenants should be considered as pure landlords and hence be subject to similar taxation policies. Second, policymakers should consider the spatial distribution in their provision of public amenities, since better access reduces delinquencies among shared occupancy arrangements. Overall, it is important that reforms aimed at improving the revenue-raising capability of local governments take into account the nuances in the multihabitation arrangements. Recent studies have demonstrated the role of regulatory protection to enhance compliance in the context of multifamily households (McCollum and Milcheva, 2023).

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 administration in Ghana. The data and variables are discussed in Section 4. Section 5 details our empirical analysis. Section 6 concludes the paper.

2. Theoretical predictions

In this section, we develop a stylized model in which housing consumption (and corresponding tenure choice) as well as property tax compliance are endogenous decisions for the household. Our objective is to demonstrate that affordability considerations and social pressure – defined as the cost of noncompliance – are driving both the tenure choice and the tax compliance behavior of households. In our model, an "owner" household is one that occupies its entire home, while an "owner-and-tenant" household is one which shares its living space with a tenant in exchange for rental income. To capture the affordability constraint of households, we consider a classical dynamic household consumption problem under income uncertainty (see, for example, Schechtman (1976), Bewley (1977) and Mendelson and Amihud (1982))[2] in which we embed a choice of housing consumption and property tax compliance. We show that in equilibrium an income-constrained household is renting out part of its home to generate additional income, yet, this rental income does not fully relax its affordability constraint. Consequently, the "owner-and-tenant" household is more likely to be noncompliant and on average accumulate longer periods of property tax arrears than the "owner" household. Furthermore, we show that the owner-and-tenant category of households is more sensitive to compliance pressure, and to changes in property tax rates.

[2] An overview of the early theoretical results on optimal consumption and precautionary savings of liquidity-constrained households can be found in Deaton (1991). Further extensions and more recent advancements of the literature on the buffer-stock theory of savings are described by Carroll (1997).

2.1 Model setup

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

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

where ε_t is a stationary random variable with a mean of zero and support $[\varepsilon_l, \varepsilon_h]$. We denote the cumulative distribution function of labor income by $F(y)$ and assume that the lower bound of its support is nonnegative; i.e., $\mu + \varepsilon_l \geq 0$. 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 nonhousing consumption, c_t^{nh}, and decides whether to pay the property tax τ. While the payment of property tax leaves less funds for current nonhousing consumption, noncompliance is associated with cost as explained below.

Let us denote nonhousing expenditures by c_t. A property tax–compliant household consumes the amount $c_t^{nh} = c_t$, while a noncompliant household consumes $c_t^{nh} = c_t - \tau$. Following the standard modelling approach in the theoretical literature (cf, Traxler, 2010, Alm and Torgler, 2011), we assume that noncompliance 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. Compliance pressure arises from the relationship between the taxpayer and the state. When the household enjoys a higher level of public

[3]Rental contracts in Ghana span multiple years, and hence, the decision to rent (part of) their homes can be viewed as a long-term decision for homeowners. In this shared arrangement, owners share a dwelling unit with a tenant for a fixed payment, usually paid in advance, often up to several years of rent. This type of shared arrangement differs from caretaker arrangements also found in Ghana (Gough and Yankson, 2011).

services provided by the state, it is more likely to be compliant. This relationship underlies the concept of "reciprocity" introduced in the recent literature (Luttmer and Singhal, 2014). In the empirical section, we consider proximity to local amenities as a sources of compliance pressure.

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

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

where the left-hand-side denotes the utility of arrears and the right-hand-side the utility of compliance.[4] Given this optimal choice, the instantaneous (sub)utility of nonhousing consumption can be expressed as:

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

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:

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

[4]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.

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 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, 1997). We consider both 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., $A_t \geq 0$).

2.2 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:

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

We first consider the 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.

Next, we consider the case $A_t \geq 0$. 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:

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

The solution $f(x)$ and the corresponding $p(x)$ are unique and have the following properties:[5]

(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

[5]See Deaton (1991) for an overview of equilibrium analysis of stochastic income fluctuation problems.

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 $x_t < \overline{x} = f^{-1}(\overline{c})$.

2.3 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 nonhousing consumption. That is, the model generates the following theoretical prediction.

Proposition 1. (Noncompliance probability). *The owner-and-tenant-occupied dwelling (Owner-Tenant) is more likely to be noncompliant than the owner-occupied dwelling (Owner).*

The proof is in Appendix A. As the proposition shows, the homeowner with a lower income rents out part of their home to subsidize nonhousing consumption and property tax expenditure. While this additional income serves to lower noncompliance rates, in equilibrium, the rental income does not entirely compensate for the lower labor income of the

Owner-Tenant-occupancy category, and this occupancy category is more often noncompliant. The proposition allows us to further investigate how changes in property taxes and compliance pressure affect 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 (Owner-Tenant), and let these functions be convex in an open neighborhood around the income level y. The following relationships apply regarding the noncompliance probabilities of these two units:*

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

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

The proof is in Appendix A. 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].

[6] Assuming that the income distribution is log-normal, Carroll (1992) estimates a coefficient of less than

2.4 Numerical example

We provide an illustration of the compliance behavior of owner-occupied and owner-and-tenant-occupied dwellings by numerically solving the considered stochastic dynamic optimization problem 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 subsequent comparative statics exercise, we consider the effect of an increase in compliance pressure or a decrease in property tax that 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 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,

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).

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 is illustrated by comparing 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 noncompliance (i.e., the noncompliance 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

Structure and legal framework

Property taxes are raised at the local level in Ghana through local authorities known collectively as Metropolitan, Municipal and District Assemblies (MMDAs). The MMDAs are created based on the main criterion of population size. District Assemblies and Municipal Assemblies oversee areas with a minimum population of 75,000 and 95,000, respectively.

Metropolitan Assemblies, such as the AMA, have oversight of a metropolis, with a minimum population of 250,000 people. Consideration is also given to the geographical contiguity and economic prospects of the area in the MMDA-creating decision. New MMDAs are formed by splitting or carving them out of an already existing one. They can also be formed by an upgrade in status, for example, from a Municipal Assembly to a Metropolitan Assembly. As of the end of 2018, there were 6 Metropolitan Assemblies, 109 Municipal Assemblies and 145 District Assemblies in Ghana. To provide even greater decentralization, the MMDA structure includes the establishment of subunits, namely the Sub-Metropolitan District Councils, Urban Councils, Town or Area Councils, and Unit Committees, to correspond with the area of authority for each MMDA. This results in four tiers of local governance for Metropolitan Assemblies and three tiers for both Municipal and District Assemblies. Figure A1 in the Online Appendix graphically illustrates this tiered local governance structure in Ghana.

The current regulatory framework within which the MMDAs operate dictates that the MMDAs bear direct responsibility for the overall development of respective districts, while empowering them to generate their own revenues, with a key source coming from property rates. In the following subsections, we explain the institutional setting related to the collection of the property tax, along with relevant legal terminology.

Ratable values

Ratable values are the monetary values of properties which form the tax base for calculating the property tax in Ghana. They are determined by the Lands Commission of Ghana, a parastatal, which is tasked with the creation of 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 improvements. However, owing to the huge outlay, these valuations are only infrequently carried out. The rateble 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.

Property tax rates

Property tax rates (or property rates) are set in the annual publication of the Local Government Bulletin of District Assemblies, as defined by the regulations of the MMDA, in view of their budgetary needs. 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." Property rates are deemed to be levied by the annual publication of notice in its Local Government Bulletin, as defined by the regulations of the MMDA. There is also a Rate Assessment Committee to which persons aggrieved by their ratable values or by their property tax rates can apply for a review.

The rate impost is the tax rate which is multiplied by the ratable value of the property to determine the annual property tax due in the local currency (Ghana Cedi (GHS)). An MMDA would typically have a rating zone classification, especially for residential property rating purposes. This classification reflects differences in location quality within an MMDA. Thus, properties in a rating zone for prime locations usually attract a higher rate impost than those in other rating zones. Properties within a particular rating zone, however, could attract different rate imposts on account of other building characteristics or factors taken into consideration by the MMDA. To illustrate how this works, we include the 2017 bulletin for the AMA, as shown in Figure 1. We see different rating impost ranges for the various rating zones, with 1A, the most affluent residential areas, attracting the highest rates, and 3C, representing the least affluent areas, having the lowest rates. Ignoring the A, B, and C subclassifications, the photographs in Figure A2, in the Online Appendix, show examples of a neighborhood belonging to the most affluent rating zone 1 (East Legon), the less affluent rating zone 2 (Adabraka) and the least affluent rating zone 3 (Nima).

When the rate impost and the ratable value of a property are low, resulting in a low overall property tax amount, the MMDAs set a lower bound on the property tax bill, which is referred to as the minimum rate. Each financial year, the MMDAs set the minimum rates to be imposed on residential properties within the Assembly in view of its budget requirements and revenue stream forecasts for the year. These rates are also published at the beginning of the year in its Local Government Bulletin and vary by area. A key distinction between the rate impost and the minimum rate is that with the rate impost, properties within a particular rating zone could face different tax bills, whereas with the minimum rate, all properties within a particular rating zone face the same property tax bill. We see from Figure 1 that the minimum rate varies by rating zone, with a systematic decline in the minimum rate paid as one moves from the most affluent to the least affluent residential areas. For example, the minimum rates paid by households within the aforementioned neighborhoods of East Legon, Adabraka and Nima, for the year 2017, were GHS 200, GHS 80, and GHS 60, respectively, as shown in the bulletin.

[Insert Figure 1 about here]

Tax burden and collection of property taxes

The property owner has a legal obligation for payment of property taxes. 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.

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 rate collectors who embezzle the monies collected or other similar offences.

4. Data and variables

4.1 Data sample

Our analysis is based on administrative panel data obtained from the Accra Metropolitan Assembly (AMA). The AMA is responsible for the Greater-Accra region of Ghana and is one of only six Metropolitan Assemblies in the entire country. It has oversight responsibility for Accra, the capital city, which is the center of economic activity and seat of government in Ghana. The data cover all ten of the AMA's Sub-Metropolitan District Councils for the period 2011–2018. The dataset captures information on the property tax arrears, occupancy status, rate imposts, minimum rates, ratable values, street names and rating zones. It also includes a spatial dimension, detailing the building floor areas and geographical coordinates of properties.

4.2 Minimum rate payers

Our empirical assessment focuses on minimum rate–paying properties which cover more than 97% of properties in our sample. Minimum rate payers represent a homogeneous group for which the property tax payment liability is determined solely by the budgetary planning of the AMA and does not depend on attributes of the property other than its rating zone. This selection aids our identification to ensure that we capture variation in property taxes, which is exogenous to the property-level characteristics. Our final data sample contains 238,140 property-year observations.

The distribution of annual minimum rates across rating zones for the period 2011–2018 is presented in Table 2.[8] We observe that the minimum rates gradually increase over the 8-year period. Rating zone 1 attracts the highest rates, followed by rating zone 2 and then rating zone 3. With the exception of the 2012-2013, and 2015-2016 periods, where the rates

[8]The USD conversion of these amounts are in Online Appendix Table A1. There was a small number of observations with minimum rates which deviate from the correct values which were dropped from the analysis.

remain unchanged, there are hikes to the minimum rates for all the other years. We also see that the greatest increase in the minimum rates occur in the 2017 to 2018 period. There is also within–rating zone consistency across the A, B, and C subdivisions in terms of the amount, with A always being greater than B, and B always being greater than C.

[Insert Table 2 about here]

4.3 Summary statistics

Table 3 presents summary statistics for the full final data sample and also for each type of housing tenure. There are three housing tenure arrangements: properties occupied solely by their legal owners (Owner); properties rented out to tenants (Tenant); and properties in which the legal owners share the living space with tenants (Owner-Tenant). The majority of the properties (139,830) are of the Owner category, representing 58.72% of all observations. A sizeable share of the properties are of the Tenant (53,585) and Owner-Tenant (44,725) categories, representing 22.50% and 18.78% of the full sample, respectively.

The annual average amount of property tax unpaid across all observations is GHS 53.73, with properties solely occupied by tenants having the highest arrears estimate (GHS 56.36) compared with the other dwelling unit types. The average property tax payable for a property – which corresponds to the minimum rate – for the overall sample is GHS 68.87, with the median payment amounting to GHS 58.00. Properties with shared occupancy between the legal owner and tenants have the lowest average property tax payable (GHS 63.83). To ascertain the proportion of the property tax bill that is unpaid, we express the annual property tax arrears as a fraction of the property tax payable each year, generating the arrears proportion variable. For all the observations, we see that the annual property tax arrears is on average about 72% of the property taxes expected to be paid, whereas the median household records an arrears proportion of 100%, suggesting that it completely reneges on its property tax obligations. Properties rented out to tenants have the highest arrears proportion among the three housing tenure arrangements (77%). The average building floor area for the entire sample is 157.08 square meters. By housing tenure, quite unsurprisingly, the building floor area is largest for properties in which there is shared occupancy between the owner and tenants (161.02 square meters). The average property value is GHS 24,120.53.[9] Comparing average property values across the three housing tenure arrangements reveals that properties jointly occupied by the owner and tenant have the highest value (GHS 25,382.09).

We construct indicator variables to measure property tax compliance. If the property tax for the year is not paid in full, we record the property as being in arrears (Arrears). Further, we make a distinction between no payment at all (Full arrears) and partial property tax payment (Partial arrears). An average of 78% of the all the households in the overall sample are in arrears, with only 22% being compliant. Of those in arrears, 76% have not made any payment and are in full arrears. In terms of housing tenure, property tax arrears are most prevalent for solely tenant-occupied properties (82%), with four-fifths of those in arrears paying none of their property taxes. Overall, these estimates clearly show a high incidence of property tax delinquency within the AMA. Properties from the least prime locations within the AMA (Rating zone 3) are the most represented in the entire sample (62%), with those from the most prime areas (Rating zone 1) being the least represented (6%). There are also differences among the housing tenure arrangements in terms of distribution within rating zones, with the shared owner and tenant occupancy arrangement being predominant in Rating zone 3 (73%) and least concentrated in Rating zone 1 (2%). Information on 2,966 streets is observed in the data sample, which works out to an average of about 80 properties per street.

[Insert Table 3 about here]

[9] Property value is used synonymously with ratable value in the paper. The estimates are valuation-based instead of market-based, with valuations are carried out infrequently owing to huge outlay.

5. Empirical analysis

5.1 Baseline specification

As a first step, we analyze how the property tax compliance behavior depends on the occupancy status of dwelling units. Our baseline specification is given by the following model:

$$NonCompliance_{it} = \mu_i + \delta_t + \alpha_1 Owner\text{-}Tenant_i + \alpha_2 Tenant_i + \varphi' X_{it} + \varepsilon_{it}, \tag{11}$$

where $NonCompliance_{it}$ captures the property tax noncompliance behavior of dwelling unit i in year t. We use four types of noncompliance behavior, namely, $Arrears_{it}$, which takes the value of one if dwelling unit i is in arrears in year t, and zero if the property tax for the year t has been paid in full; $Full\ arrears_{it}$, which takes the value of one if dwelling unit i has not made any payment in the year, and zero if the tax has been paid in full; $Partial\ arrears_{it}$, which takes the value of one if dwelling unit i has paid some tax but not the full amount, and zero if the tax has been paid in full; and $Arrears\ proportion_{it}$, which gives the percentage of dwelling unit $i's$ property tax in year t that was not paid for that year. μ_i and δ_t are the street and year fixed effects, respectively. $Owner\text{-}Tenant$ is an indicator variable which takes the value of one if the property belongs to the Owner-Tenant category, and zero otherwise. The indicator variables for the $Tenant$ and $Owner$ categories are defined analogously, with the latter as our base category. The vector, X_{it}, captures three property-specific covariates recorded by the AMA – the recorded property value, the building floor area and the property tax payable. We use standard errors clustered at the household level. Detailed definitions of all variables are provided in Appendix B.

Table 4 presents our baseline results. Columns (1)–(3) report linear probability estimates, with Arrears, Full arrears and Partial arrears as the dependent variables, respectively. We observe that properties with shared owner and tenant occupancy, our main dwelling unit of interest, are less compliant relative to those that are solely owner-occupied, with a probability of nonpayment being about 2.2% higher for the former. Tenant-only dwelling units are least compliant in that they are 5.2% less likely to pay their taxes in full relative to solely owner-occupied dwelling units. These differences are highly significant and robust across the four different noncompliance specifications. The coefficients for property value, property tax payable and building floor area are also highly significant and largely have the expected negative signs, indicating that more expensive and bigger properties are less likely to be in arrears.

We perform a number of robustness checks for our results. First, we employ the high-dimensional street times year fixed effects. This allows the street-level fixed effects to vary over time. We also include double-clustered standard errors at the household and year levels in another specification, owing to the potential for error-term correlations in both entity and time dimensions. The results are reported in the Online Appendix Tables A2 and A3, respectively. We observe that the coefficients for shared owner and tenant and the coefficient for solely tenant-occupied properties remain positive and highly statistically significant across all the model specifications.

Overall, the results support the hypothesis that properties jointly occupied by the owner and tenant are more likely to be associated with noncompliant behavior.

[Insert Table 4 about here]

5.2 Heterogeneity across rating zones

Next, we explore whether differences in compliance behavior are driven by the affluence level of neighborhoods. To this end, we use the multivariate regression model in Equation 11 and examine noncompliance across the three subsamples of the AMA's residential rating zone classifications: rating zone 1, rating zone 2, and rating zone 3. The classification reflects differences in location quality.[10]

[10] The A, B and C rating zone sub-classifications are jointly considered for ease of analysis.

The results of the analysis are presented in Table 5. In columns (1)–(3), we examine the probability of nonpayment for rating zones 1, 2 and 3, respectively. As shown in column (1), in the most affluent rating zone 1, there are no significant differences between the probability of nonpayment for shared owner-and-tenant dwellings relative to the baseline (solely owner-occupied) category. Highly significant differences in compliance, however, emerge in the less affluent rating zones 2 and 3, as shown in columns (2) and (3). The same pattern is observed for the full nonpayment specification of the model, of which the results are reported in columns (4)–(6), for rating zones 1, 2 and 3, respectively. For the partial nonpayment specification, of which the results are reported in columns (7)–(9), for rating zones 1, 2 and 3, respectively, significant differences are observed only in the least affluent neighborhoods (rating zone 3). This is shown in column (9), where shared owner and tenant and solely tenant-occupied dwelling units are 2.5% and 2.9% more likely to make a partial payment, relative to the solely owner-occupied category. In Online Appendix Table A4, we report results of the heterogeneity analysis with the arrears proportion as the dependent variable. The results confirm the susceptibility to arrears of the shared owner and tenant housing arrangement in less affluent locations, relative to those residing in more affluent neighborhoods.

In sum, the results in Table 5 suggest that the property tax compliance outcomes of dwelling units are associated with the affluence levels of the neighborhoods to which they belong. In particular, we see that owner-and-tenant-occupied dwellings in less wealthy neighborhoods are more likely to be in arrears, whether full or partial, compared to those in the most affluent areas. Comparing results across all noncompliance measures and affluence categories for the owner-and-tenant-occupied dwellings, we see that partial nonpayment of property taxes is driven by only those in the least well-off locations. The results indicate that owner-and-tenant-occupied dwellings, our category of interest, may be willing to pay their property taxes, as highlighted by their partial arrears, but may be prevented from doing so owing to financial constraints.

[Insert Table 5 about here]

5.3 Exogenous property rate shocks

It is well established that taxpayers are resistant to property tax rate hikes, particularly in developing countries (Bahl and Wallace, 2008). In this section, we examine how the relative compliance behavior of the three dwelling unit types changes in response to changes in the property rates. The minimum rates are determined at the discretion of the AMA and are set in view of its budgetary objectives. As illustrated in Figure 2, the minimum rate changes vary from one period to the next. For the 2012-2013 and 2015-2016 periods, there is virtually no year-on-year increase in the minimum rates (0%), while for 2011–2012 and 2017–2018, the minimum rates increase by more than 40%, on average.

[Insert Figure 2 about here]

We analyze how dwelling units in different tenure arrangements respond to these property rate shocks by estimating the following regression:

$$\begin{aligned} NonCompliance_{it} = \mu_i + \alpha_1 Owner\text{-}Tenant_i + \alpha_2 Tenant_i + \alpha_3 Rate\ shock_t + \\ \alpha_4 Owner\text{-}Tenant_i \times Rate\ shock_t + \alpha_5 Tenant_i \times Rate\ shock_t \\ + \varphi' X_{it} + \varepsilon_{it}, \end{aligned} \tag{12}$$

where $Rate\ shock_t$ takes the value of one for the years 2012 and 2018, where there has been a large hike in rates, and zero for the years 2013 and 2016, with no rate increases. All the other variables are as previously defined.[11]

Table 6 presents the results of this analysis for the three outcome variables Arrears, Full arrears and Partial arrears, as considered previously. We find that, as expected, dwelling units which experience a property rate shock are significantly more likely to be in arrears in all the regression specifications. In particular, the positive effect of the shock on arrears

[11] Since we are including a dummy variable for the year, we do not include year fixed effects in this model.

is greatest for dwelling units that partially default on their property tax obligations (11%). We also see that the rate shock plays a significant role in worsening the noncompliance probabilities for the shared owner-and-tenant dwellings. That is, homeowners in the shared occupancy arrangement who face a rate shock have a significantly higher probability of not paying their property taxes, relative to the homeowner in the solely owner-occupied category. Interestingly, interacting rate shock with the dwelling units that are solely tenant-occupied reveals that their probability of nonpayment is reduced by the rate shock, although the relationship is weak. Also, the likelihood of full or partial nonpayment for these dwelling units is unaffected by the rate shock.

Overall, the results indicate that the shared owner-and-tenant dwelling type displays greater sensitivity to property rate shocks, which reflects in their increased probabilities of incurring property tax arrears.

[Insert Table 6 about here]

5.4 Reciprocity analysis: Proximity to public amenities

In this section, we examine the relationship between distance to public amenities and the property tax arrears of dwelling units. Theoretically, proximity to local amenities is a source of compliance pressure for households. Previous studies find that people tend to be more tax-compliant when they receive a higher quality of public services for their tax payments (Alm et al., 2014).The positive relationship between access to public goods and compliance is at the foundation of the "reciprocity" hypothesis formulated by Luttmer and Singhal (2014). Hence, our empirical tests could be viewed as a test of the "reciprocity" hypothesis.

We exploit geographic coordinate information (latitudes and longitudes) to calculate geodetic distance estimates to two classes of public amenities in Accra: suburban police stations and hospitals. Drawing on Vincenty (1975), the distance estimation approach takes the length of the shortest curve between two points, using an ellipsoidal model of the earth. The methodology is based on the World Geodetic System 1984 (WGS84) datum, which is the same used by Google Maps, Google Earth and GPS gadgets.[12] In addition to the property-level geographic coordinates available in the data, we hand-collect from Google Earth the coordinates for thirty-eight police stations and the three main and best-resourced public hospitals in Accra.[13] We then estimate the distance from each property to each police station and hospital.[14] Finally, for each property, we select the shortest distance estimate among all the police stations and hospitals, treating both amenity classes separately. To ascertain the effect of proximity to amenities on property tax arrears, we estimate the following linear probability regression model:

$$
\begin{aligned}
NonCompliance_{it} = \mu_i + \delta_t + \alpha_1 Owner_i * Distance\ to\ amenities_i + \alpha_2 Owner\text{-}Tenant_i \times \\
Distance\ to\ amenities_i + \alpha_3 Tenant_i \times Distance\ to\ amenities_i + \\
\alpha_4 Owner\text{-}Tenant_i + \alpha_5 Tenant_i + \varphi' X_{it} + \varepsilon_{it},
\end{aligned}
\tag{13}
$$

where $Distance\ to\ amenities_i$ is the shortest distance to a hospital or police station for any given property. The regressions are run separately for hospitals and police stations. All the other variables are as previously defined.

Panel A of Table 7 reports the summary statistics of the distance estimates to police stations and hospitals. We see that the mean distance from a property to the nearest hospital is 4.42 kilometers, whereas it is only 1.18 kilometers in the case of the police stations. This suggests that on average, the distance to the nearest hospital is greater than the distance to the nearest police station. The estimates are unsurprising, given the greater number of police stations as compared to hospitals, meaning police stations are more likely to be within the immediate precincts of the dwelling units. Proximity to police stations therefore serves as a good proxy as regards the effect of providing public services in a specific local

[12] We use the `geodist` function in Stata for the computation; see Picard (2010) for more details.

[13] Korle-Bu Teaching Hospital, 37 Military Hospital, and Greater Accra Regional Hospital.

[14] The function works by estimating the centroid of each building. The centroid is effectively the geometric center of a building, which in our case is every residential property, police station and hospital, with each building outlined by a polygon.

area. Conversely, the smaller number of hospitals suggests that they are not necessarily localized, providing a means to test of the effect of what is generally a more distant amenity on property tax compliance outcomes.

Panel B of Table 7 presents the results based on distance to hospitals. We report estimates for arrears (columns (1) and (2)), full arrears (columns (3) and (4)) and partial arrears (columns (5) and (6)). In columns (1), (3) and (5), we include only the distance to hospital variable as the regressor, but do not control for other factors. We find that for every 1-kilometer increase in distance to the nearest hospital, the probability of arrears increases by about 3% across all the three specifications, as expected. When the interaction terms and the other covariates (columns (2), (4) and (6)) are included, we find that the initial positive relationship between hospital distance and the likelihood of arrears still holds. In particular, we see from the interaction terms that homeowners in all three dwelling unit types, when these are relatively distant from the nearest hospital, are significantly more likely to be property tax–delinquent, with the probabilities also roughly around the 3% level across the regression models.

Panel C of Table 7 displays the results based on distance to police stations. The results are qualitatively similar to those based on the hospital distance estimates. However, the magnitude of the probabilities is comparatively larger for the police-based estimates when accounting for only the distance estimates in the regressions (columns (1), (3) and (5). Also, in the case of partial arrears (column (6)), the coefficient estimate for the distance to police and shared owner and tenant occupancy interaction term (5.4%) bucks the trend of a monotonic decrease in the magnitude of the other two dwelling unit and distance interaction term coefficients, for both hospital (columns (2), (4) and (6)) and police distance–based results (columns (2), (4)). In Online Appendix Table A5 reports results of the reciprocity analysis using arrears proportion as the dependent variable. The results corroborate previous findings by showing that being far away from public amenities significantly increases the percentage of property tax that is left unpaid.

Overall, the results 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 7 about here]

5.5 Heterogeneity across socio-economic status proxied by building type

In this section, we examine the heterogenous effects in compliance behavior across socio-economic status, by utilizing information on different types of materials used in the construction of the property. The type of building in which a household resides is a powerful social status symbol and serves to reflect differences in wealth distribution of households. In non-western societies, a house made of relatively costly adobe, a tile roof and a cement floor is valued as a status symbol, as a sign of being civilized (Duncan, 1981). The wealthy "new elite" often demonstrate their wealth and social standing through their homes, built with new and often costly materials (Malkawi and Al-Qudah, 2003).

We obtain from the Lands Commission of Ghana a restricted data sample in which the building structure information is provided. In the data, we observe there are three types of building structures, those made of wattle and daub, mass swish, or sandcrete blocks. Wattle and daub buildings are the weakest structures of the three (prone to decay and cracking) and made from wooden frames and clayey soil. Swish buildings are constructed with rammed earth and built in courses. Sandcrete block buildings are made from sand, cement and water, and considered the highest quality. The literature suggests that buildings made of raw earthen materials, such as wattle and daub and mass swish, are likely to appeal to low-income households due to their lower cost and thermal comfort properties (Adegun and Adedeji, 2017). Rammed earth buildings have been found to be 50% to 60% cheaper than sandcrete block buildings (Dabaieh and Sakr, 2015; Zami and Lee, 2008). We merge the data on the building type with the main AMA database used in the study, retrieving a matched sample of 141,015 household-year observations.

For the analysis, we estimate the following regression model:

$$NonCompliance_{it} = \mu_i + \delta_t + \alpha_1 Owner\text{-}Tenant_i + \alpha_2 Tenant_i + \theta' Build\,type_i + \theta' Build\,type_i \times Owner\text{-}Tenant_i + \theta' Build\,type_i \times Tenant_i + \varphi' X_{it} + \varepsilon_{it}, \tag{14}$$

where the vector, $Build\,type_i$, captures the building material types, defined as indicator variables, with sandcrete blocks as the base category. All the other variables are as previously defined.

Table 8 reports the regression results for arrears, full arrears and partial arrears. Columns (1), (3) and (5) are the baseline regressions, where we additionally include information on the building type. We observe that the findings drawn previously continue to hold in the presence of these additional controls, whereby owner-and-tenant and tenant categories are significantly more noncompliant than the owner category. When examining the interactions between building types and ownership characteristics, we find that homeowners in the shared housing arrangement living in properties made of wattle and daub, which is the cheapest building type, are significantly more likely not to pay their property taxes (24%), and also to not pay in full (27%).[15] The results indicate that poorer households in the lower socio-economic bracket are additionally vulnerable to property tax arrears, which reflects the binding financial constraints they face.

[Insert Table 8 about here]

[15] In the partial arrears regression, one of the interaction coefficient is not estimated due to no observational data.

6. Conclusion

Property tax compliance is a topic of much research. The extant literature focuses on the pecuniary and nonpecuniary motives driving the decision-making of owners and renters. In recent years, multihabitation arrangements within dwelling units have become increasingly popular, where homeowners rent out part of their home, thus allowing homeowners to utilize the additional rental income to support their financial needs.

This paper examines property tax noncompliance 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 the unique constraints and motives of homeowners sharing their space with tenants lead to variations in compliance compared to pure owners and landlords. On the one hand, since homeowners are renting out parts of their home, 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 noncompliance than pure owners, and more sensitive to property tax rate increases.

Our empirical investigation draws on detailed administrative-level data on property tax arrears and occupancy characteristics of residential dwelling units in the Accra Metropolitan Assembly (AMA) in Ghana, for the period 2011–2018. We find that shared owner-and-tenant dwellings are more likely to renege on their property tax obligations compared to owner-occupied units, with the likelihood of nonpayment being about 2.2% higher for the former. Further, the property tax compliance outcomes of this occupancy category are associated with the affluence levels of the neighborhoods, with a greater likelihood of default in less affluent locations. The owner-and-tenant category is also more likely to become noncompliant when faced with property tax rate shocks. Moreover, the households living in this occupancy arrangement are influenced more strongly by nonpecuniary motives. In particular, owner-and-tenant-occupied dwellings that are distant from public amenities have a significantly greater probability of property tax delinquency. Finally, utilizing heterogeneity in building types as a proxy for socio-economic status, we observe that poorer homeowners in shared occupancy arrangements are additionally vulnerable to nonpayment.

These findings advance our understanding of how occupancy characteristics are related to residential property tax 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 dwellings, 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.

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Figure 1
Property rate imposts and minimum rates

This figure presents the first two pages of a sample bulletin (for the year 2017) showing the property rate impost ranges and distribution of minimum rates for locations within the Accra Metropolitan Assembly (AMA), as categorized under residential rating zones.

Republic of Ghana

LOCAL GOVERNMENT BULLETIN

Published by Authority

No. 1 WEDNESDAY, 4TH JANUARY 2017

SUMMARY OF CONTENTS

General

GENERAL

IMPOSITION OF RATES FOR THE YEAR 2017
ACCRA METROPOLITAN ASSEMBLY

BASIC RATE

Part VIII of the Local Government Act 1993 (Act 462)

The making and levying of the following rates for Financial Year 1st January, 2017 to 31st December, 2017 has been approved by the rating authority.

Under section 96 (3), (4) (6) and 99 (1) and (3)

A basic rate of 0.10p flat for both men and women payable by all persons of or above the age of 18 and up to 70 years who reside within or own immovable property within the area of authority of the Accra Metropolitan Assembly.

PROPERTY RATE

Rating Zones	*Rate Impost*	*Minimum Rate GH¢*	*Areas Affected*
RES. CLASS 1A	0.0020-0.0017	200.00	Achimota Forest Residential, Roman Ridge, Airport West Residential, Airport Residential, East Legon, Ambassadorial Enclave, Ridge.
RES. CLASS 1B	0.0016-0.0014	150.00	Zoti, Abelenkpe, Dzorwulu, North Dzorwulu, Nungua Newtown, East Legon Extension, West Legon, Ringway Estates, Nyaniba Ako Adjei Area, Airport Hills,Tesano 1, Golf Hill.
RES. CLASS 2A	0.0015-0.0013	100.00	South Odorkor, Dansoman SSNIT, New Dansoman Estates, Latebiokorshie, Candle Factory, Mamprobi, Dansoman Estate, Kanda Estates, Nima Akuffo Addo, Asylum Down, Naaflajo, Okpoi Gonno, Greda Estates, Beach Front, Regimanuel Grey, Adogon, New Achimota.

Rating Zones	*Rate Impost*	*Minimum Rate*	*Areas Affected*
RES. CLASS 2B	0.0012	80.00	Kwashieman North, Sakaman-Busia, New Dansoman, Mateheko, West Abbosey Okai, Osofo Dadzie, Dansoman Exhibition, Dansoman Sahara, North Alajo, Adabraka, Kaneshie, Awudome Estates, North Kaneshie, North Kaneshie Estates – CFC, Abeka, Fadama, Tesano 2, Akweteman, Apenkwa, Abofu.
RES. CLASS 3A	0.00104-0.0009	70.00	Kwashiebu, Kwashieman, North Odorkor, Odorkor Old Town, Kwashieman Old Town, Odorkor, Stanley Owusu, Banana Inn, Korle Gonno, Mamprobi Sempey, Old Dansoman, Maamobi, Kotobabi Police Station, Kpehe, Aalajo, Kotobabi, James Town, Bubuashie/ Cable and Wireless, New Fadama, Abeka Lapaz, Alogboshie, Kisseman/Christian Village
RES. CLASS 3B	0.0009-00.0008	60.00	Abossey Okai, Sukura, Russia, Town Council Line, Sabon Zongo, Mamponse, Tunga, Nima, Accra New Town, Shiashie Village, Bawleshie Mempeasem, Old Town, Dakuman, Old Bubuashie, North Abeka, Nii Boyeman/Achimota, Anumle.
RES. CLASS 3C	0.0008-0.0007	50.00	Chorkor, Mpoase, Gbegbeise, Shiabu, Luga, Osu Amanfo/Alata

Figure 2
Yearly distribution of average minimum rate change

This figure shows the annual average percentage growth rate in the minimum rate amount that dwelling units were expected to pay. This commences from 2011 and ends in 2018 and is based on the minimum rate figures presented in Table 2.

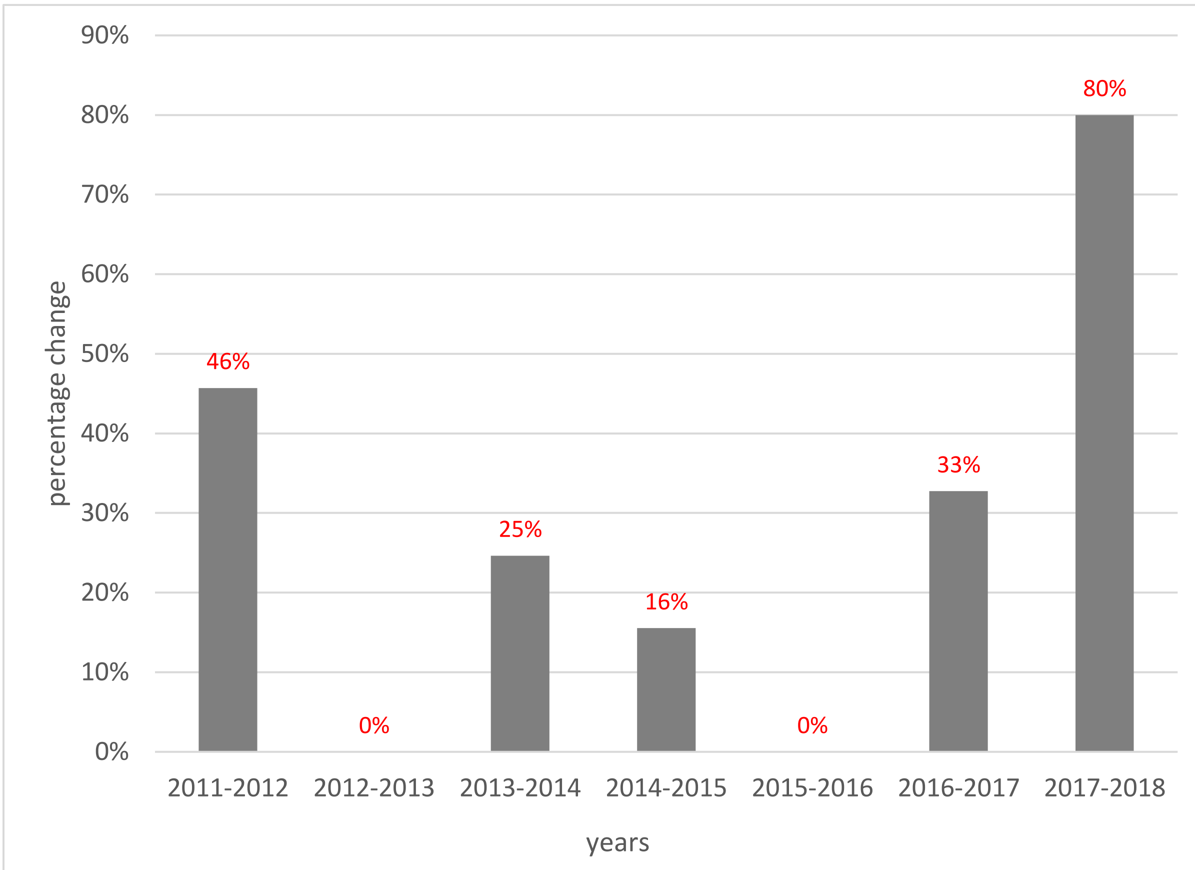

Table 1
Default Frequency and Odds: Owner vs. Owner-Tenant

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-Tenant dwelling unit. Columns (2) and (4) report the odds for the Owner dwelling unit being in default up to ten years versus not being in default. Columns (7) and (9) report the respective odds for the Owner-Tenant unit. The differences between columns (2) and (4) and the columns (7) and (9) are presented in columns (5) and (10), respectively.

	Owner					Owner-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
					Difference in default period					Difference in default period
Average default period	2.36		1.46		0.90	6.27		4.8		1.47

Table 2
Minimum rate distribution across rating zones and years

This table presents the annual minimum rates distributed across an eight-year period, 2011–2018, and the residential rating zone classes of the Accra Metropolitan Assembly (AMA). All amounts are in the local currency – Ghana Cedis (GHS). A, B and C are subdivisions within the rating zone classes, with 1A representing the most prime neighborhoods and 3C the least prime.

Rating zone class		Year							
		2011	2012	2013	2014	2015	2016	2017	2018
1	A	100.00	100.00	100.00	115.00	132.00	132.00	200.00	360.00
	B	50.00	80.00	80.00	90.00	104.00	104.00	150.00	270.00
2	A	40.00	60.00	60.00	70.00	81.00	81.00	100.00	180.00
	B	30.00	50.00	50.00	60.00	69.00	69.00	80.00	144.00
3	A	25.00	40.00	40.00	50.00	58.00	58.00	70.00	126.00
	B	20.00	30.00	30.00	40.00	46.00	46.00	60.00	108.00
	C	15.00	20.00	20.00	30.00	35.00	35.00	50.00	90.00

Table 3
Summary statistics

This table presents means, medians and standard deviations (SD) of the variables for the full sample and by dwelling unit type. Variable definitions are given in Appendix B.

	Full sample			Owner	Owner-Tenant	Tenant
	Mean	Median	SD	Mean	Mean	Mean
Continuous variables:						
Amount unpaid (GHS)	53.73	50.00	47.42	53.74	50.55	56.36
Property tax payable (GHS)	68.87	58.00	40.76	70.50	63.83	68.82
Arrears proportion	0.72	1.00	0.44	0.70	0.72	0.77
Building floor area (sq. m.)	157.08	138.55	111.38	155.34	161.02	158.34
Property value (GHS)	24,120.53	22,148.50	15,560.60	24,343.38	25,382.09	22,486.05
Indicator variables:						
Arrears	0.78			0.76	0.79	0.82
Full arrears	0.76			0.74	0.76	0.80
Partial arrears	0.20			0.19	0.23	0.20
Rating zone 1	0.06			0.07	0.02	0.07
Rating zone 2	0.31			0.35	0.25	0.27
Rating zone 3	0.62			0.58	0.73	0.66
Number of streets	2,966					
Number of observations	238,140			139,830	44,725	53,585

Table 4
Baseline regression results

This table reports estimates of the initial relationship between dwelling unit type and property tax arrears, as defined by equation (11). The dependent variable takes the value one if, for a given year, a household has any unpaid property taxes (column (1)), full nonpayment of property taxes (column (2)), or partial nonpayment of property taxes (column (3)); and zero if there is no property tax payment outstanding. For column (4), the dependent variable is, for a given year, the proportion of the property tax unpaid out of the property tax expected to be paid. The key explanatory variables are the occupancy type, with owner-occupiers as the base category. Variable definitions are given in Appendix B. Street and year fixed effects are included. Standard errors are clustered at the household level and given in parentheses. Statistical significance at the 10, 5, and 1 percent levels is denoted by *, **, and ***, respectively.

	Arrears (1)	Full arrears (2)	Partial arrears (3)	Arrears proportion (4)
Owner-Tenant	0.022***	0.023***	0.023***	0.024***
	(0.004)	(0.004)	(0.005)	(0.004)
Tenant	0.047***	0.052***	0.022***	0.059***
	(0.003)	(0.004)	(0.005)	(0.004)
Property value	-0.023***	-0.041***	0.111***	-0.060***
	(0.002)	(0.002)	(0.003)	(0.003)
Property tax payable	-0.047***	-0.004**	-0.004**	
	(0.011)	(0.002)	(0.002)	
Building floor area	-0.003**	-0.038***	-0.092***	-0.005**
	(0.002)	(0.012)	(0.017)	(0.002)
Street fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.093	0.106	0.103	0.119
Observations	238,140	216,789	65,922	238,140

Table 5
Heterogeneity across rating zones

This table reports linear probability regression estimates showing the likelihood of arrears across subsamples of the three rating zones. The dependent variable is indicated at the top of the columns, taking the value one if, for a given year, a household has any unpaid property taxes (columns (1)–(3)), full nonpayment of property taxes (columns (4)–(6)), or partial nonpayment of property taxes (columns (7)–(9)); and zero if there is no property tax payment outstanding. The key explanatory variables are the occupancy types, with owner-occupiers as the base category. Variable definitions are given in Appendix B. Street and year fixed effects are included. Standard errors clustered at the household level are given in parentheses. Statistical significance at the 10, 5, and 1 percent levels is denoted by *, **, and ***, respectively.

	Arrears			Full arrears			Partial arrears		
	Rating zone 1 (1)	Rating zone 2 (2)	Rating zone 3 (3)	Rating zone 1 (4)	Rating zone 2 (5)	Rating zone 3 (6)	Rating zone 1 (7)	Rating zone 2 (8)	Rating zone 3 (9)
Owner-Tenant	0.041	0.019***	0.021***	0.040	0.020***	0.023***	0.042	0.016	0.025***
	(0.029)	(0.007)	(0.004)	(0.031)	(0.007)	(0.005)	(0.032)	(0.010)	(0.006)
Tenant	0.059***	0.047***	0.046***	0.063***	0.052***	0.051***	0.024	0.007	0.029***
	(0.014)	(0.006)	(0.004)	(0.015)	(0.006)	(0.004)	(0.015)	(0.009)	(0.006)
Property value	-0.033***	-0.023***	-0.020***	-0.055***	-0.042***	-0.038***	0.075***	0.132***	0.109***
	(0.010)	(0.004)	(0.003)	(0.011)	(0.004)	(0.003)	(0.013)	(0.007)	(0.004)
Property tax payable	0.084	0.128*	-0.036*	0.088	0.129*	-0.029	0.071	0.161	-0.063*
	(0.159)	(0.073)	(0.021)	(0.167)	(0.078)	(0.022)	(0.167)	(0.156)	(0.037)
Building floor area	-0.019**	-0.003	-0.002	-0.021***	-0.002	-0.003	-0.011	-0.008*	-0.002
	(0.008)	(0.003)	(0.002)	(0.008)	(0.003)	(0.002)	(0.007)	(0.004)	(0.003)
Street fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.099	0.091	0.093	0.111	0.103	0.106	0.055	0.098	0.113
Observations	14,900	74,756	148,483	13,701	68,753	134,332	5,314	20,443	40,141

Table 6
Exogenous rate shock analysis

This table reports linear probability regression estimates showing the likelihood of arrears in the event of an exogenous property tax shock, as defined by equation (12). The dependent variable is indicated in the first row, taking the value one if, for a given year, a household has any unpaid property taxes (column (1)), full nonpayment of property taxes (column (2)), or partial nonpayment of property taxes (column (3)); and zero if there is no property tax payment outstanding. The key explanatory variables are the occupancy type, rate shock and their respective interaction terms. Variable definitions are given in Appendix B. Street fixed effects are included. Standard errors clustered at the household level are given in parentheses. Statistical significance at the 10, 5, and 1 percent levels is denoted by *, **, and ***, respectively.

	Arrears (1)	Full arrears (2)	Partial arrears (3)
Owner-Tenant	0.020***	0.021***	0.016**
	(0.005)	(0.006)	(0.008)
Tenant	0.054***	0.058***	0.025***
	(0.005)	(0.005)	(0.007)
Rate shock	0.049***	0.041***	0.111***
	(0.003)	(0.003)	(0.006)
Owner-Tenant*rate shock	0.010*	0.013**	0.035***
	(0.005)	(0.006)	(0.012)
Tenant*rate shock	-0.009*	-0.005	-0.001
	(0.005)	(0.005)	(0.011)
Property value	-0.024***	-0.042***	0.116***
	(0.002)	(0.002)	(0.005)
Property tax payable	0.107***	0.122***	0.109***
	(0.002)	(0.003)	(0.006)
Building floor area	-0.004**	-0.004**	-0.005*
	(0.002)	(0.002)	(0.003)
Street fixed effects	Yes	Yes	Yes
Adjusted R-squared	0.088	0.100	0.117
Observations	132,334	120,009	35,700

Table 7
Reciprocity analysis: Proximity to public amenities and arrears

This table reports linear probability regression estimates showing the relationship between the likelihood of arrears and proximity to public amenities, as defined by equation (13). Panel A presents the mean, median, standard deviation (SD), minimum, and maximum distance estimates from the location of each dwelling unit to the nearest hospital and police station. Panels B and C present results based on the distance to hospitals and police stations, respectively. The dependent variable is indicated in the first row of Panels B and C, taking the value one if, for a given year, a household has any unpaid property taxes (columns (1)–(2)), full nonpayment of property taxes (columns (3)–(4)), or partial nonpayment of property taxes (columns (5)–(6)); and zero if there is no property tax payment outstanding. The key explanatory variables are the occupancy type, the distance estimates to public amenities, and their respective interaction terms. Variable definitions are given in Appendix B. Street and year fixed effects are included. Standard errors clustered at the household level are given in parentheses. Statistical significance at the 10, 5, and 1 percent levels is denoted by *, **, and ***, respectively.

Panel A: Summary statistics of distance estimates to public amenities (in km)

	Mean	Median	SD
Hospital	4.42	4.23	2.03
Police station	1.18	1.12	0.57

Panel B: Distance to hospitals

	Arrears		Full arrears		Partial arrears	
	(1)	(2)	(3)	(4)	(5)	(6)
Distance to hospital	0.030***		0.032***		0.032***	
	(0.003)		(0.004)		(0.005)	
Distance to hospital*Owner		0.032***		0.034***		0.031***
		(0.004)		(0.004)		(0.005)
Distance to hospital*Owner-Tenant		0.029***		0.031***		0.031***
		(0.004)		(0.004)		(0.005)
Distance to hospital*Tenant		0.026***		0.028***		0.028***
		(0.004)		(0.004)		(0.005)
Owner-Tenant		0.036***		0.036***		0.022**
		(0.009)		(0.010)		(0.011)
Tenant		0.071***		0.077***		0.030***
		(0.009)		(0.010)		(0.011)
Property value		-0.023***		-0.041***		0.111***
		(0.002)		(0.002)		(0.003)
Property tax payable		-0.049***		-0.041***		-0.091***
		(0.011)		(0.012)		(0.017)
Building floor area		-0.003**		-0.004**		-0.004**
		(0.002)		(0.002)		(0.002)
Street fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.091	0.094	0.101	0.107	0.085	0.104
Observations	238,140	238,140	216,789	216,789	65,922	65,922

Panel C: Distance to police

	Arrears		Full arrears		Partial arrears	
	(1)	(2)	(3)	(4)	(5)	(6)
Distance to police	0.039***		0.041***		0.049***	
	(0.007)		(0.008)		(0.012)	
Distance to police*Owner		0.038***		0.038***		0.043***
		(0.008)		(0.008)		(0.012)
Distance to police*Owner-Tenant		0.030***		0.032***		0.054***
		(0.008)		(0.009)		(0.014)
Distance to police*Tenant		0.022***		0.021**		0.046***
		(0.008)		(0.008)		(0.014)
Owner-Tenant		0.031***		0.030***		0.012
		(0.008)		(0.008)		(0.012)
Tenant		0.067***		0.073***		0.018
		(0.007)		(0.008)		(0.012)
Property value		-0.023***		-0.041***		0.111***
		(0.002)		(0.002)		(0.003)
Property tax payable		-0.040***		-0.031***		-0.084***
		(0.011)		(0.012)		(0.017)
Building floor area		-0.003**		-0.004**		-0.004**
		(0.002)		(0.002)		(0.002)
Street fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.090	0.093	0.101	0.106	0.084	0.103
Observations	238,140	238,140	216,789	216,789	65,922	65,922

Table 8
Assessment of socio-economic status proxied by building type

This table reports linear probability regression estimates showing the relationship between the likelihood of arrears and the type of building materials used for dwelling units, as defined by equation (14). The dependent variable is indicated at the top of the columns, taking the value one if, for a given year, a household has any unpaid property taxes (columns (1)–(2)), full nonpayment of property taxes (columns (3)–(4)), or partial nonpayment of property taxes (columns (5)–(6)); and zero if there is no property tax payment outstanding. The key explanatory variables are the occupancy type, building material type, and their respective interaction terms. Variable definitions are given in Appendix B. Street and year fixed effects are included. Standard errors clustered at the household level are given in parentheses. Statistical significance at the 10, 5, and 1 percent levels is denoted by *, **, and ***, respectively.

	Arrears		Full arrears		Partial arrears	
	(1)	(2)	(3)	(4)	(5)	(6)
Owner-Tenant	0.030***	0.028***	0.031***	0.029***	0.028***	0.028***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.007)	(0.007)
Tenant	0.052***	0.053***	0.058***	0.060***	0.021***	0.023***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.007)
Property value	-0.027***	-0.027***	-0.045***	-0.045***	0.116***	0.116***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)
Property tax payable	-0.051***	-0.051***	-0.044***	-0.045***	-0.090***	-0.090***
	(0.012)	(0.012)	(0.013)	(0.013)	(0.021)	(0.021)
Building floor area	-0.005**	-0.005**	-0.005**	-0.005**	-0.007**	-0.007**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Wattle and daub	-0.084	-0.169*	-0.104*	-0.198**	0.185***	0.180***
	(0.053)	(0.086)	(0.057)	(0.095)	(0.047)	(0.062)
Mass swish	-0.053***	-0.054***	-0.053***	-0.052***	-0.007	-0.001
	(0.009)	(0.015)	(0.009)	(0.015)	(0.010)	(0.014)
Wattle and daub*Owner-Tenant		0.237**		0.270**		-
		(0.098)		(0.107)		-
Wattle and daub*Tenant		0.142		0.156		0.013
		(0.109)		(0.118)		(0.094)
Mass swish*Owner-Tenant		0.012		0.010		-0.005
		(0.019)		(0.020)		(0.017)
Mass swish*Tenant		-0.007		-0.012		-0.015
		(0.019)		(0.019)		(0.017)
Street fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.103	0.103	0.116	0.116	0.118	0.118
Observations	141,015	141,015	128,554	128,554	37,230	37,230

Appendix A Theoretical proofs

Proof of Proposition 1: Let dwelling unit i be an owner-occupier with an average labor income of μ_i, and dwelling unit j be an owner-and-tenant-occupier with an average labor income of μ_j and an 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 G_i as the distribution of $x_i = y^i$ and G_j as the distribution of $x_j = y^j + k(H-h^*)$, the above inequality can be represented as:

$$\int u'(x_t^i)dG_i(x_t^i) < \int u'(x_t^j)dG_j(x_t^i). \tag{A1}$$

As $u'(x_t^i)$ is decreasing, from the above inequality and equation (1) it follows that G_i first-order 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:

$$E_0 \sum_{t=0}^{\infty} \beta^t \big[p(x_t^i)\big] < E_0 \sum_{t=0}^{\infty} \beta^t \big[p(x_t^j)\big]. \tag{A2}$$

We proceed by contradiction. Assume that $\mu^i < \mu^j + k(H-h^*)$ and thus dwelling unit i is more likely to be noncompliant. 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 $G_t^i(x_t^i)$. Since $p(x_t)$ is monotonically decreasing, it follows that for each period t

$$\int p(x_t^i)dG_t^i(x_t^i) > \int p(x_t^j)dG_t^j(x_t^i). \tag{A3}$$

Hence,

$$\sum_{t=0}^{\infty} \beta^t E\big[p(x_t^i)\big] < \sum_{t=0}^{\infty} \beta^t E\big[p(x_t^j)\big], \tag{A4}$$

a contradiction to (A2). □

Proof of Proposition 2: 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 $\frac{\partial \overline{x}(\tau,\alpha)}{\partial \alpha} > 0$. □

Appendix B Variable definitions

Variable	Definition
Panel A: Property tax and dwelling unit attributes	
Amount unpaid	Denotes the annual unpaid property tax amount in Ghanaian Cedis (GHS).
Arrears	Equal to one if a dwelling unit has an amount unpaid, and zero if it has no amount unpaid.
Full arrears	Equal to one if a dwelling unit has a full amount unpaid, and zero if it has no amount unpaid.
Partial arrears	Equal to one if a dwelling unit has a partial amount unpaid, and zero if it has no amount unpaid.
Arrears proportion	Denotes the quotient when amount unpaid is divided by property tax payable.
Property value	Denotes the ratable value (valuation-based) of a property, in Ghanaian Cedis (GHS). The variable is normalized by using a natural log transformation.
Property tax payable	Denotes the annual monetary property tax bill, in Ghanaian Cedis (GHS), for a dwelling unit. The variable is normalized by using a natural log transformation.
Building floor area	Denotes the total land area, in square meters (sq. m.), taken up by the external walls of a building.
Owner	Equal to one if a dwelling unit is completely occupied by the homeowner, and zero otherwise.
Owner-Tenant	Equal to one if a dwelling unit is jointly occupied by the homeowner and tenant(s), and zero otherwise.
Tenant	Equal to one if a dwelling unit is completely occupied by tenants, and zero otherwise.
Wattle and daub	Equal to one if a building is made of wattle and daub, and zero otherwise.
Mass swish	Equal to one if a building is made of mass swish, and zero otherwise.
Sandcrete	Equal to one if a building is made of sandcrete blocks, and zero otherwise.
Panel B: Location attributes	
Rating zone 1	Equal to one if a dwelling unit is in an area designated by the Accra Metropolitan Assembly (AMA) as a residential class 1 rating zone, and zero otherwise. There are two subdivisions, 1A and 1B, which are jointly considered for the purposes of our analyses.
Rating zone 2	Equal to one if a dwelling unit is in an area designated by the Accra Metropolitan Assembly (AMA) as a residential class 2 rating zone, and zero otherwise. There are two subdivisions, 2A and 2B, which are jointly considered for the purposes of our analyses.
Rating zone 3	Equal to one if a dwelling unit is in an area designated by the Accra Metropolitan Assembly (AMA) as a residential class 3 rating zone, and zero otherwise. There are three subdivisions, 3A, 3B, and 3C, which are jointly considered for the purposes of our analyses.
Rate shock	Equal to one if year is either 2012 or 2018, and zero if year is either 2013 or 2016. This is based on the annual average percentage changes in the rating zone–based minimum rates, as shown in Figure 2.
Distance to hospitals	Denotes the shortest distance in kilometers from a dwelling unit to the nearest of three public hospitals: Korle-bu Teaching Hospital, Greater Accra Regional Hospital, and 37 Military Hospital. All distances are calculated using Stata's geodist function, which geographically measures the length of the shortest path between two points along the surface of a mathematical model of the earth (see Picard, 2010).
Distance to police	Denotes the shortest distance in kilometers from a dwelling unit to the nearest police station. All distances are calculated using Stata's geodist function, which geographically measures the length of the shortest path between two points along the surface of a mathematical model of the earth (see Picard, 2010).

Shared Occupancy and Property Tax Arrears

Online Appendix

September 2023

Figure A1
Structure of the Local Governance System in Ghana

This figure displays the structure of the local governance in Ghana. It shows a 4-tier setup for Metropolitan Assemblies, and a 3-tier setup for both Municipal and District Assemblies.

Source: Adapted from Institute of Local Government Studies (ILGS), Ghana, 2008.

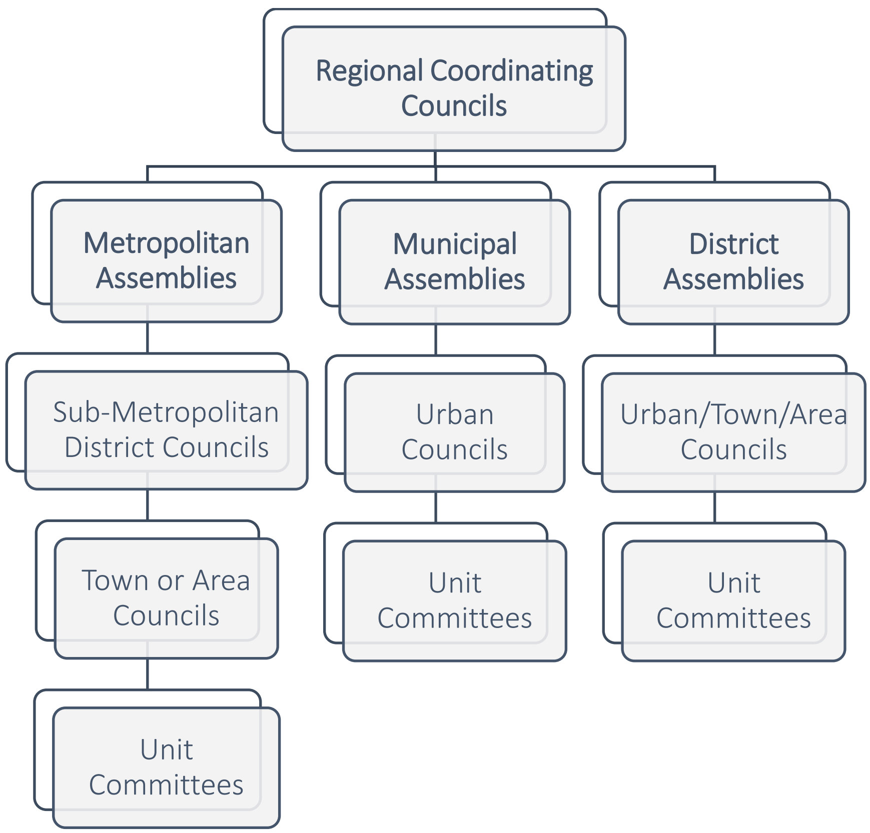

Figure A2
Residential Rating Zones

The figures show examples of areas in the three residential rating zones of the Accra Metropolitan Assembly (AMA). The AMA's residential rating zones are: 1A, 1B, 2A, 2B, 3A, 3B, and 3C, with 1A representing the most prime areas and 3C the least prime. To simplify the analysis, the A, B, and C sub-categories are jointly considered. Image Credit: (a) https://www.flickr.com/photos/sweggs/534895571; (b)https://www.flickr.com/photos/sweggs/510700598; (c) https://www.flickr.com/photos/caetie/9035079273 [Accessed November 19, 2020].

(a) East Legon (Zone 1)

(b) Adabraka (Zone 2)

(c) Nima (Zone 3)

Table A1
Minimum rate distribution across rating zones and years (USD)

The table presents the hand-collected annual minimum rates (in monetary terms) distributed across an eight-year period, 2011–2018, and the residential rating zone classes of the Accra Metropolitan Assembly (AMA). A, B and C are subdivisions within the rating zone classes, with 1A representing the most prime neighborhoods and 3C the least prime. All amounts are converted from the local currency, Ghana Cedis (GHS), into US dollars (USD), using annual USD/GHS exchange rates listed on the World Bank website: https://data.worldbank.org/indicator/PA.NUS.FCRF?locations=GH [Accessed 20 December 2022].

Rating zone class		Year							
		2011	2012	2013	2014	2015	2016	2017	2018
1	A	65.76	54.80	50.47	39.70	35.54	33.76	45.97	78.51
	B	32.88	43.84	40.38	31.07	28.00	26.60	34.48	58.88
2	A	26.30	32.88	30.28	24.17	21.81	20.72	22.99	39.26
	B	19.73	27.40	25.24	20.71	18.58	17.65	18.39	31.40
3	A	16.44	21.92	20.19	17.26	15.61	14.83	16.09	27.48
	B	13.15	16.44	15.14	13.81	12.38	11.77	13.79	23.55
	C	9.86	10.96	10.09	10.36	9.42	8.95	11.49	19.63

Table A2
Baseline regression robustness check with street-year fixed effects

This table reports linear probability regression estimates showing the likelihood of arrears between dwelling unit types and property tax arrears, with street-year fixed effects. The dependent variable takes the value one if, for a given year, a household has any unpaid property taxes (column (1)), full nonpayment of property taxes (column (2)), or partial nonpayment of property taxes (column (3)); and zero if there is no property tax payment outstanding. For column (4), the dependent variable is, for a given year, the ratio of the property tax amount unpaid to the property tax amount expected to be paid. The key explanatory variables are the occupancy type, with owner-occupiers as the base category. Variable definitions are given in Appendix B of the paper. Standard errors clustered at the household level are given in parentheses. Statistical significance at the 10, 5, and 1 percent levels is denoted by *, **, and ***, respectively.

	Arrears (1)	Full arrears (2)	Partial arrears (3)	Arrears proportion (4)
Owner-Tenant	0.022***	0.023***	0.021***	0.024***
	(0.004)	(0.004)	(0.005)	(0.005)
Tenant	0.047***	0.052***	0.017***	0.059***
	(0.003)	(0.004)	(0.005)	(0.004)
Property value	-0.023***	-0.041***	0.100***	-0.060***
	(0.002)	(0.002)	(0.004)	(0.003)
Property tax payable	-0.048***	-0.039***	-0.104***	
	(0.013)	(0.014)	(0.020)	
Building floor area	-0.003**	-0.004**	-0.005**	-0.005**
	(0.002)	(0.002)	(0.002)	(0.002)
Street*year fixed effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.104	0.118	0.119	0.122
Observations	235,788	214,346	61,441	235,788

Table A3
Baseline regression robustness check with double clustering of standard errors

This table reports linear probability regression estimates showing the likelihood of arrears according to dwelling unit type and extent of property tax arrears, with standard errors clustered by both household and year. The dependent variable takes the value one if, for a given year, a household has any unpaid property taxes (column (1)), full nonpayment of property taxes (column (2)), partial nonpayment of property taxes (column (3)); and zero if there is no property tax payment outstanding. For column (4), the dependent variable is, for a given year, the ratio of the property tax amount unpaid to the property tax amount expected to be paid. The key explanatory variables are the occupancy types, with owner-occupiers as the base category. Variable definitions are given in Appendix B of the paper. Street and year fixed effects are included. Statistical significance at the 10, 5, and 1 percent levels are denoted by *, **, and ***, respectively.

	Arrears (1)	Full arrears (2)	Partial arrears (3)	Arrears proportion (4)
Owner-Tenant	0.022***	0.023***	0.023***	0.024***
	(0.002)	(0.003)	(0.005)	(0.003)
Tenant	0.047***	0.052***	0.022***	0.059***
	(0.002)	(0.002)	(0.005)	(0.002)
Property value	-0.023***	-0.041***	0.111***	-0.060***
	(0.001)	(0.002)	(0.003)	(0.001)
Property tax payable	-0.047***	-0.038***	-0.092***	
	(0.008)	(0.008)	(0.016)	
Building floor area	-0.003***	-0.004***	-0.004**	-0.005***
	(0.001)	(0.001)	(0.002)	(0.001)
Street fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.093	0.106	0.103	0.119
Observations	238,140	216,789	65,922	238,140

Table A4
Heterogeneity across rating zones with arrears proportion as dependent variable

This table reports linear probability regression estimates showing the likelihood of arrears across subsamples of the three rating zones. The dependent variable Arrears proportion is, for a given year, the proportion of the property tax unpaid out of the property tax expected to be paid. The key explanatory variables are the occupancy type, with owner-occupiers as the base category. Variable definitions are given in Appendix B of the paper. Street and year fixed effects are included. Standard errors clustered at the household level are given in parentheses. Statistical significance at the 10, 5, and 1 percent levels is denoted by *, **, and ***, respectively.

	Arrears proportion		
	Rating zone 1 (1)	Rating zone 2 (2)	Rating zone 3 (3)
Owner-Tenant	0.055	0.026***	0.021***
	(0.034)	(0.008)	(0.005)
Tenant	0.073***	0.061***	0.056***
	(0.016)	(0.007)	(0.005)
Property value	-0.073***	-0.062***	-0.056***
	(0.012)	(0.005)	(0.003)
Building floor area	-0.020**	-0.004	-0.004
	(0.009)	(0.004)	(0.002)
Street fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Adjusted R-squared	0.124	0.111	0.123
Observations	14,900	74,756	148,483

Table A5
Reciprocity analysis with arrears proportion as dependent variable

This table reports linear probability regression estimates showing the relationship between the likelihood of arrears and proximity to hospitals and police stations. The Arrears proportion dependent variable is, for a given year, the proportion of the property tax amount unpaid out of the property tax expected to be paid. Columns (1)–(2) (Columns (3)–(4)) present results based on the distance to hospitals and police stations, respectively. The key explanatory variables are the occupancy type, the distance estimates to public amenities, and their respective interaction terms. Variable definitions are given in Appendix B of the paper. Street and year fixed effects are included. Statistical significance at the 10, 5, and 1 percent levels is denoted by *, **, and ***, respectively.

	Arrears proportion			
	Distance to hospitals		Distance to police stations	
	(1)	(2)	(3)	(4)
Distance to hospitals	0.036***			
	(0.004)			
Distance to police stations			0.049***	
			(0.009)	
Distance to hospitals*Owner		0.037***		
		(0.004)		
Distance to police stations*Owner				0.046***
				(0.009)
Distance to hospitals*Owner-Tenant		0.036***		
		(0.004)		
Distance to police stations*Owner-Tenant				0.047***
				(0.010)
Distance to hospitals*Tenant		0.031***		
		(0.004)		
Distance to police stations*Tenant				0.031***
				(0.010)
Owner-Tenant		0.030***		0.024**
		(0.011)		(0.010)
Tenant		0.084***		0.077***
		(0.011)		(0.009)
Property value		-0.060***		-0.060***
		(0.003)		(0.003)
Building floor area		-0.005**		-0.005**
		(0.002)		(0.002)
Street fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.112	0.120	0.111	0.120
Observations	238,140	238,140	238,140	238,140