Monitoring of Bureaucracy as a Public Good

Shanks, Olga
ostaradu@gmu.edu
George Mason University

Stratmann, Thomas
tstratma@gmu.edu
George Mason University

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Abstract

We model and test the effects of citizen monitoring of services provided by bureaucrats. Monitoring by citizens is a public good. Because of collective action problems, monitoring is underprovided, allowing bureaucrats to reduce efforts in the provision of services. Our model shows that collective action problems in monitoring activities are associated with sub-optimal bureaucratic output. The model predicts that efficiency of bureaucratic output decreases with the number of citizens affected and the distribution of the bureaucracy-generated benefit. Utilizing income data from leases under the purview of the Bureau of Indian Affairs (BIA), we find broad support for our hypothesis that bureaucratic output is inversely related to the collective action challenges of bureaucrats' clients. These collective action problems vary with the number of owners, interests of the largest shareholder, and variations in monitoring costs due to private vs. institutional ownership.

Keywords: Indian allotted land, Indian trust land, bureaucracy

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1 Introduction

The purpose of bureaucracy is to implement laws passed by the legislature, thereby serving citizens. While Congress and the President provide broad oversight, the details of overseeing bureaucrats are often left to citizens. In the private sector, customers oversee or monitor their service providers by, for example, demanding remedies or reducing payment. In the public sector, citizens monitor their politicians by voting for or against them. However, citizens can monitor bureaucrats only indirectly by casting ballots, and in their day-to-day direct interactions with bureaucrats, citizen oversight takes the form of nagging bureaucrats or filing complaints.

We develop a simple theory whereby bureaucratic effort is a function of citizen monitoring and oversight. We model the latter as a public good. Citizens face collective action problems which allow bureaucrats to reduce effort and performance. The model predicts that citizen monitoring is underprovided compared to the socially optimal level and generates several testable hypotheses. First, if the distribution of the bureaucracy-generated benefit is equal, the contributions to the monitoring effort decline with the number of citizens. Second, with an unequal distribution of the bureaucracy-generated benefit, citizens with the highest stakes will be the only ones to monitor, while the others will free-ride. Third, lower monitoring costs increase citizen monitoring.

The model applies to many government agencies that provide services to citizen groups. We hypothesize that an agency will be overseen more effectively if it serves smaller citizen groups. This model predicts that bureaucracies are more efficient in serving smaller jurisdictions because with fewer citizens in these communities, citizen incentives to monitor increase. Our model provides an explanation for why agencies facing concentrated and less fractured interests are more responsive to those interests.

Seminal works in the literature on the role of oversight in restraining bureaucracy emphasize the influence of political principals, such as Congress (Fiorina, 1977; Kiewiet and McCubbins, 1991; Weingast, 1984) and the President (Moe, 1985; West and Cooper, 1989). The role of citizens was originally highlighted by Lipsky (1983), who coined the term "street-level bureaucracy." The more recent literature covering the influence of citizens on the bureaucracy is championed by Prendergast (2003, 2016).

The street-level bureaucracy model analyzes the behavior of bureaucrats that directly interact with citizens. It posits that bureaucrats face a high level of demand for their services, which they are unable to meet. Thus, bureaucrats create coping strategies such as imposing costs on the citizens (e.g. making access to services more difficult) and differentiating between citizens on multiple margins. One such margin is the level of oversight the bureaucrats expect from different categories of citizens.

Street-level bureaucrats prioritize those citizens that engage in more oversight.

The model by Prendergast (2003) analyzes the efficiency implications of citizen oversight under different incentive alignment conditions between bureaucracy's principles, i.e. politicians, bureaucrats, and bureaucrats' customers, i.e. citizens. Prendergast argues that bureaucrats try to avoid citizen oversight by giving in to their demands. This means that the citizens who pose higher threat of complaints or lawsuits receive preferential service.

Both Prendergast and street-level bureaucracy scholars explain why bureaucracies respond to monitoring. Our model addresses why citizens often fail to sufficiently monitor bureaucrats.

Measuring citizens' collective action problems is challenging as is measuring bureaucratic effort or how much the citizens value the services they receive. For example, although citizens of the United States may benefit from some EPA actions, citizens do not benefit equally. The distribution of benefits depends on a variety of factors: the distance from where the EPA activities take place, the resource most valued by the citizens, the citizens' health conditions, etc. It is difficult to determine how EPA benefits are distributed without observing the citizens' willingness to pay for services. Similar measurement challenges exist with services provided by numerous other government agencies. The case used in this paper is unique because it enabled us to bypass most such measurement challenges.

We examine the case of the Bureau of Indian Affairs (BIA) and its lease administration on behalf of Indian landowners. We focus on agricultural leases signed on Indian trust lands between 2002 and 2010. Typically, such lands have several or many owners and when this is the case the ownership form is tenancy in common, implying that no owners can point to a physical part of the land that they could claim as their own. Due to BIA's fiduciary responsibility, mandated by Congress, BIA employees negotiate and administer leases. The BIA negotiates a lease with all owners as beneficiaries, making the benefit from BIA's service non-excludable. The benefit is also non-rival because the share of the owners' interests in the land determines their lease incomes. The assumption that monitoring of BIA employees by the Indian land owners increases effort to negotiate leases implies that monitoring is a public good. Knowledge of the ownership distribution among the lease beneficiaries overcomes the challenge of measuring citizens' stakes in the bureaucracy-generated benefit. Therefore, the case and the data set are ideally suited to test our theory of bureaucracy oversight by the citizens.

When testing our theoretical model, we relate various land ownership characteristics to leasing income. To interpret our estimates as causal, the identifying assumption is that, for example, the number of joint owners, and the identity of the largest shareholder is exogenous. Many writings on the fractionation of Indian trust land support this assumption. For example, wills were not allowed until 1910, and even when the wills were technically allowed, they required an extensive BIA approval process (Shoemaker, 2014). The BIA probated the land dividing it equally between the heirs.

Our results show that lease income falls with the number of owners and increases with the interest of the person with the largest ownership share. We also find that lease income increases with the ownership share of institutional landowners.

2 Theory

The long-standing model of budget-maximizing bureaucrats pioneered by Niskanen (1971) has given way to modeling bureaucrats as driven by intrinsic motivations and ideological biases (Besley and Ghatak, 2005; Forand et al., 2022; Prendergast, 2007). In the more recent literature, in addition to the rewards from political principals and disutility of effort, the bureaucrats' objective function also includes utility from fulfilling the bureaucrats' own policy preferences (Gailmard and Patty, 2012).

In addition to intrinsic motivation, bureaucrats also strive to avoid punishment. For example, Prendergast (2003) develops a model whereby consumer complaints are the primary mechanism to monitor and punish bureaucratic malfeasance, positing that avoiding such complaints is the primary driver of bureaucratic agents. Lipsky (1983) writes that bureaucrats put in more effort serving those citizens that have a higher propensity to complain.

Both the arguments for intrinsic motivations and the desire to avoid punishment justify our assumption that the bureaucratic effort e is a monotonic non-decreasing function of monitoring. The bureaucracy-provided benefit R is in turn a monotonic non-decreasing function of the bureaucratic effort.

Treating citizen monitoring of the bureaucracy as a public good warrants a short discussion. Although most services provided by the bureaucracy are public goods, the literature on citizen engagement with bureaucrats provides many examples where services themselves and monitoring of them are private goods. An example frequently used by Prendergast (2001) and by authors within the street-level bureaucracy literature (e.g. Cohen and Hertz, 2020) is police. They focus on the interactions between the police and the criminals, where the criminals are viewed as the customers of the police. From that vantage point, the service provided by the police, such as lenient or harsh treatment of the criminal, is a private good or bad. Similarly, when a citizen successfully petitions the bureaucracy for welfare benefits, the remaining welfare budget for all the other applicants is reduced. Thus, individual welfare benefits are excludable and rivalrous, and hence private. Monitoring bureaucrats to secure higher individual benefits is therefore a private good. Unlike Prendergast and the street-level bureaucracy researchers, we explore the relationship between the citizens and the bureaucracy in cases where bureaucracy-provided services are public goods.

Let monitoring M be a public good equal to the sum of individual contributions by the citizens: $M = \sum_i^n m_i$. The utility of citizen i is then $u_i(R(e(\sum_i^n m_i)), w_i - c_i m_i))$, where w_i is the endowment of citizen i and c_i is the unit cost of monitoring. Since both R and e are monotonic transformations of the public good of monitoring, $R(e(\sum_i^n m_i)$ is a public good. Thus, the citizen's utility function has two arguments: public good R and private good $w_i - c_i m_i$.

Traditional public goods theory (Varian, 2004; Batina and Ihori, 2005) examines the case of perfect substitution between the public and private good as a special case. Yet, utility functions where public and private goods are perfectly substitutable abound, at least within the range of demand for the public good. States maintain public parks using tax revenues. A private arrangement is a viable alternative, whereby a citizen would pay a fee every time she goes to a park, and a park would operate as a revenue-generating business. At the margin, the citizen would want to contribute to the public good of park maintenance the same amount that she would spend on park visits in the privatized parks scenario. To her, the money she spends in taxes on the public good and the money she is left with to spend on private goods are perfect substitutes. Similar logic can be applied to many goods currently provided by the bureaucracy, including roads, education, and police. We limit our analysis to cases where the citizen's preferences between public and private goods can be expressed with a perfect substitutes utility function.

Public goods theory provides clear predictions if a utility function exhibits perfect substitutability between the public and private goods. This public goods game will have a unique Nash equilibrium, whereby only the agent that places the highest marginal value on the public good will contribute. In the case of identical tastes for the public good, at the margin, all the agents will contribute equally (Varian, 2004).

We proceed to derive functional relationships that can be tested empirically by using a simple functional form for bureaucratic effort. We assume that there is some level of monitoring beyond which bureaucratic effort does not improve, so we define bureaucratic effort as $e(M)$, such that $e(M)$ is concave with domain $[0, \infty)$ and range $[0, 1)$. The functional form $e(M) = \dfrac{M}{\gamma + M}$ satisfies these conditions and is convenient for its simplicity. In this functional form, the constant γ determines how quickly $e(M)$ converges to 1, with $\dfrac{\partial e}{\partial \gamma} < 0$. The higher the gamma, the slower the convergence to the maximum possible effort and more monitoring is required to achieve higher levels of effort.

The benefit generated by the bureaucratic agency is assumed to have a limit at some value R_b (subscript b for "best"), which is determined by the factors independent of bureaucratic effort. For example, in the case of the police, the number of solved crimes is limited by the amount of criminal activity. Thus, realized benefit R is a function of monitoring and the highest possible benefit R_b:

$$R(M, R_b) = \frac{M}{\gamma + M} R_b \tag{1}$$

All citizens seek to maximize their net benefit, which is the benefit they get from the bureaucracy minus the cost they need to expend on monitoring the bureaucracy. A simple representation of a citizen's objective function is $\pi_i = r_i - c_i m_i$, where r_i is the citizen's portion of the benefit, m_i is the monitoring the citizen contributes, and c_i is the individual cost of monitoring.

When citizens are homogeneous, i.e., they share in the bureaucracy-generated benefit equally and have identical monitoring costs, we can normalize the per-unit cost of monitoring to 1, resulting in $\pi_i = r_i - m_i$. The Pareto efficient provision of monitoring maximizes the total net benefit for all the citizens $\Pi = R - M = \dfrac{M}{\gamma + M} R_b - M$.

$$\frac{\partial \Pi}{\partial M} = \frac{R_b \gamma}{(\gamma + M)^2} - 1 = 0 \tag{2}$$

This results in the following socially optimal amount of monitoring:

$$M^* = \sqrt{R_b \gamma} - \gamma \tag{3}$$

Equation (3) shows that optimal monitoring is independent of the number of citizens. The optimal benefit is then $R^* = R_b - \sqrt{R_b \gamma}$.

With private provision of monitoring, a citizen maximizes her net benefit $\pi_i = \dfrac{R}{n} - m_i$, subject to constraint $m_i \geq 0$, where n is the number of citizens. Substituting for R and M results in $\pi_i = \dfrac{m_i + \sum_{j \neq i}^{n} m_j}{\gamma + m_i + \sum_{j \neq i}^{n} m_j} \dfrac{R_b}{n} - m_i$. Deriving the first order condition and simplifying, we get:

$$\frac{\partial \pi_i}{\partial m_i} = \frac{\gamma}{(\gamma + m_i + \sum_{j \neq i}^{n} m_j)^2} \frac{R_b}{n} - 1 = 0 \tag{4}$$

$$m_i + \sum_{j \neq i}^{n} m_j = \sqrt{\frac{R_b \gamma}{n}} - \gamma \tag{5}$$

$$M = \sqrt{\frac{R_b \gamma}{n}} - \gamma \tag{6}$$

$M < M^*$ if $n > 1$, so when there are multiple beneficiaries, monitoring is underprovided relative to its optimal level, and it is decreasing in n. When $n = 1, M = M^*$. Calculating the realized total benefit results in:

$$R = \frac{M}{\gamma + M} R_b = \frac{\sqrt{\frac{R_b \gamma}{n}} - \gamma}{\gamma + \sqrt{\frac{R_b \gamma}{n}} - \gamma} R_b = R_b - \sqrt{R_b \gamma} \sqrt{n} \tag{7}$$

This expression implies that the number of citizens has a negative effect on the bureaucracy-generated benefit in the case of citizen homogeneity. We can also derive the gap between the actual income and the optimal income R^*:

$$R^* - R = R_b - \sqrt{R_b \gamma} - R_b + \sqrt{R_b \gamma n} = -\sqrt{R_b \gamma} + \sqrt{R_b \gamma} \sqrt{n} \tag{8}$$

We now examine a case where citizens hold unequal claims to the benefit, but their per-unit monitoring costs remain the same. The socially optimal amount of monitoring is identical to the case of equal distribution. In private provisioning, however, each citizen now maximizes net benefit $\pi_i = s_i R - m_i$, where s_i is the citizen's share of the bureaucracy-generated benefit. Calculations analogous to the ones shown above result in the following reaction function for the individual contributor to the public good:

$$m_i = \sqrt{s_i R_b \gamma} - \gamma - \sum_{j \neq i}^{n} m_j \tag{9}$$

Since the citizens maximize a linear function, the Nash equilibrium solution to this public goods game is that the citizen with the highest claim to the bureaucracy-generated benefit (henceforth referred to as the "largest shareholder"), s_{max}, is the only one contributing because her valuation of the public good is the highest. Everybody else will free ride. To show this, we note that $\sqrt{s_i R_b \gamma} - \gamma$ is the amount of public good that citizen i would contribute if nobody else contributed. Let us denote it as m_i^{only}. Then $m_i = m_i^{only} - \sum_{j \neq i}^{n} m_j$, and since we do not rule out $m_i = 0$, we re-write the above equation as $m_i = \max\{m_i^{only} - \sum_{j \neq i}^{n} m_j, 0\}$. Citizen i will contribute to the public good only if $m_i^{only} > \sum_{j \neq i}^{n} m_j$, while $\sum_{j \neq i}^{n} m_j$ is made up of contributions by individual citizens with the same strategy. Thus, in a simultaneous game with full information, citizen with the highest s_i will be the only contributor.

The total amount of monitoring provided and the benefit generated are:

$$M = \sqrt{s_{max} R_b \gamma} - \gamma \tag{10}$$

$$R = \frac{M}{\gamma + M} R_b = \frac{\sqrt{s_{max} R_b \gamma} - \gamma}{\gamma + \sqrt{s_{max} R_b \gamma} - \gamma} R_b = R_b - \sqrt{R_b \gamma} \left(\frac{1}{\sqrt{s_{max}}} \right) \tag{11}$$

and the income gap is:

$$R^* - R = R_b - \sqrt{R_b\gamma} - R_b + \sqrt{\frac{R_b\gamma}{s_{max}}} = -\sqrt{R_b\gamma} + \sqrt{R_b\gamma}\left(\frac{1}{\sqrt{s_{max}}}\right) \tag{12}$$

This model predicts that total benefit increases with the interest of the largest shareholder. The equal distribution case, $s_{max} = s_i = s_{j\neq i} = \frac{1}{n}$, is, therefore, a special limit case of the more general case described here.

Relaxing our assumptions of homogeneity further, we move on to analyze the amount of monitoring provided if citizens differ not only in their claims to the bureaucracy-generated benefit but also in their monitoring effectiveness. This heterogeneity is relevant since both individual citizens and organized interest groups monitor the bureaucratic performance. Interest groups often exude more influence on the bureaucracy due to the institutional channels they establish for interacting with it and the funding they may wield for such influence. The public goods game, in this case, can be modeled as having two players, an interest group and the largest shareholder among the individual citizens. We normalize the interest group's cost per unit of monitoring to equal 1, and we denote the individual owner's cost per unit of monitoring $c_i \geq 1$. The interest group's net benefit is then $\pi_g = s_g R - m_g$, where s_g is the benefit claim of the interest group and m_g is the amount of monitoring provided. The individual citizen's net benefit is $\pi_{imax} = s_{imax}R - c_i m_{imax}$, where s_{imax} is the interest claimed by the largest shareholder among the individual citizens and m_{imax} is the monitoring provided by that shareholder.

Maximizing their net benefit functions, the reaction functions for the individual citizen and for the interest group are:

$$m_{imax} = \sqrt{\frac{s_{imax}}{c_i}R_b\gamma} - \gamma - m_g \tag{13}$$

$$m_g = \sqrt{s_g R_b\gamma} - \gamma - m_{imax} \tag{14}$$

The Nash equilibrium of this game is found by comparing $\frac{s_{imax}}{c_i}$ and s_g. The sole contributor to monitoring will be the interest group if $s_g > \frac{s_{imax}}{c_i}$, in which case:

$$M = \sqrt{s_g R_b\gamma} - \gamma \tag{15}$$

$$R = R_b - \sqrt{\frac{R_b\gamma}{s_g}} \tag{16}$$

Note that the expression for optimal monitoring ($M^* = \sqrt{R_b\gamma} - \gamma$) does not change since the interest group is the lowest cost contributor with a cost of monitoring normalized to 1, and in the optimum, only the lowest cost contributor would contribute to monitoring. Thus, the income gap can be expressed as:

$$R^* - R = -\sqrt{R_b\gamma} + \sqrt{R_b\gamma}\left(\frac{1}{\sqrt{s_g}}\right) \tag{17}$$

Conversely, if $\frac{s_{imax}}{c_i} > s_g$, then:

$$M = \sqrt{\frac{s_{imax}}{c_i}R_b\gamma} - \gamma \tag{18}$$

$$R = R_b - \sqrt{\frac{c_i R_b\gamma}{s_{imax}}} \tag{19}$$

$$R^* - R = -\sqrt{R_b\gamma} + \sqrt{c_i R_b\gamma}\left(\frac{1}{\sqrt{s_{imax}}}\right) \tag{20}$$

Lastly, if $s_g = \frac{s_{imax}}{c_i}$, both the interest group and the individual citizen with the highest benefit claim will contribute to monitoring equally for a total

$$M = \sqrt{s_g R_b\gamma} - \gamma = \sqrt{\frac{s_{imax}}{c_i}R_b\gamma} - \gamma \tag{21}$$

Thus, with heterogeneity in monitoring effectiveness, since $c_i \geq 1$, having the highest claim to the bureaucracy-generated benefit is no longer sufficient to be the sole contributor to monitoring. With lower monitoring costs, the interest group may become the sole contributor without being the largest shareholder. However, suppose the interest group has the highest claim to the bureaucracy-generated benefit. In that case, the interest group will be the sole contributor, in which case its interest will have a positive effect on the total realized benefit.

The theory applies directly to the leases negotiated by the Bureau of Indian Affairs on behalf of Indian landowners. The BIA provides a service to the landowners by negotiating with potential renters and administering the leases. Monitoring the performance of this service at the lease level is a public good because it is non-excludable and non-rivalrous. If one owner's monitoring increases BIA's effort, the resulting increase in lease income will be distributed among the owners in their ownership proportion regardless of who did the monitoring, so the benefit is non-excludable. Monitoring is rivalrous between leases that compete for BIA's effort, but monitoring is non-rivalrous within any one lease. Moreover, we contend that more monitoring by the Indians leads to more effort by the BIA at the lease level. Thus, monitoring the BIA is a public good provided by Indian landowners.

3 The BIA and The Indian Trust Land

3.1 Historical Background

The history of the relationship between the U.S. and the Indian tribes includes the so-called Allotment era, a period of attempts by the U.S. government to assimilate Indians into white American society. The allotment policy, established by the General Allotment Act of 1887 (also known as the Dawes Act), authorized the government to survey Indian tribal land and divide it into plots of about 160 acres, which were then allotted to individual Indians. The allotment policy took the lands out of the control of Indian tribes and placed them in a trust managed by the federal government.

The goal of the allotment policy was to encourage the Indian population to adopt the values and practices of white American society, such as farming and private property ownership. Instead, the allotment policy led to strikingly different outcomes. It led to the loss of millions of acres of tribal land, as "surplus" land was taken from Indians and granted to American farmers. Additionally, allotments were often located in undesirable areas, such as rocky or arid land unsuitable for farming. Leonard et al. (2020), for example, argue that the allotted lands are of the lowest quality on Indian reservations. As a result, many allotment recipients could not make a living from their land. Difficulties with adjustment from traditional occupations such as fishing, hunting, and gathering to farming led many Indians to lease or sell their lands to American farmers leading to additional loss of Indian land.

The allotment policy was officially ended in 1934 with the Indian Reorganization Act, which aimed to reverse the negative effects of allotment and provide for more tribal control. The Indian Reorganization Act did not eliminate the federal trust over the Indian lands but further enforced it. While earlier allottees had the right to convert their land to fee simple ownership after owning the land for 25 years, the 1934 law made such conversion more difficult if not impossible.

Indian lands held in trust by the federal government are administered today by the Bureau of Indian Affairs. It is a federal agency within the Department of the Interior with a fiduciary responsibility to serve the interests of American Indians and Alaskan Natives (further referred to as "Indians"). One of the main reasons the federal trust responsibility over Indian lands persists to the present day is the goal supported by both the U.S. government and Indian tribes to keep Indian lands in the hands of Indians.

As a consequence of the allotment era, three forms of land ownership developed on Indian reservations: tribal trust, individual trust, and fee simple. Lands in tribal trust and individual trust are lands held in trust by the federal government and administered by the BIA. Fee simple ownership grants the owner unrestricted ownership with a full bundle of property rights over her land.

Tribal trust lands are owned by tribes. Tribes have governments that define the way tribal land can be used. For example, tribal governments can allocate sections of the land to households or lease the land and divide the earnings from the leases among the members of the tribe. Thus, a tribal owner, as a sovereign nation, has jurisdiction over its land. By contrast, individual trust lands are owned by individual Indians. Indian owners belong to a tribe, and their trust lands are subject to tribal rules and regulations as well as BIA regulations.

An important characteristic of individual trust land is fractionation. Fractionation is the division of land ownership into ever smaller shares as new generations inherit the land. Over time, fractionation on Indian reservations has resulted in tracts with hundreds and in some cases, thousands of owners. Federal restrictions on inheritance can be argued to be the primary cause of fractionation. Shoemaker (2014) describes the history and consequences of inheritance restrictions. Initially, allottees were not given any control over what happened to their land upon their death. Instead of using traditional tribal inheritance practices, the disposition of the allotments was governed by the state's laws of intestacy, which often resulted in the land being divided among the children and relatives of the deceased. If the land was not converted to fee and sold after the death of the landowner, which was a common practice, the land was either partitioned into smaller tracts for ownership by individual heirs or jointly owned by all the heirs in the form of tenancy in common. Congress recognized the right of Indian landowners to write wills in 1910. Although a significant step in lifting inheritance restrictions, the legislation required that wills undergo an extensive federal approval process, a practice that persists today.

In 1934, the Indian Reorganization Act prohibited the division of allotments into smaller tracts. This decision eliminated the partition option for the land inherited by multiple heirs and meant that unless there was a will in place, the land would pass to the heirs as undivided interests in an existing tract.

Rights to ownership of Indian lands held in federal trust are also curtailed by an alienation restriction that prevents Indians from selling their land interests to non-Indians. Even a sale to an Indian requires an extensive BIA approval process (Shoemaker, 2003). Similarly, owners of trust lands cannot mortgage their land. The alienation and mortgage restrictions impede the ability of owners of fractionated tracts to buy out their co-owners, which is a significant impediment to consolidation efforts by owners who want to make productive use of the land.

Property rights restrictions have been found by multiple authors to be a significant cause of poverty on Indian reservations (Anderson and Parker, 2009; Russ and Stratmann, 2014; Shoemaker, 2014). Anderson and Lueck (1992) document a large disparity between incomes on Indian trust tracts and Indian fee simple tracts, which they explain by the differences in property rights within these two ownership forms. (Monette, 1995) analyzes the issues of tribal nations being "subsumed into the U.S. federal system" without the right to the title of their lands. Research by McCulley (2005), Russ and Stratmann (2016), Shoemaker (2003) and others focus on the detrimental effects of ownership fractionation.

The type of ownership on fractionated tracts is tenancy in common, which means that owners cannot point to a specific section of a tract that belongs to them. Instead, they own "undivided" interests in the land, which creates large transaction costs for landowners. Unlike joint owners elsewhere in the U.S. off reservations, joint owners of Indian trust land are required to lease the land from the other co-owners or secure formal permission from them to farm the land (Shoemaker, 2014). This requirement creates two issues. The first issue is the transaction costs associated with reaching an agreement with multiple co-owners. Until the American Indian Agricultural Resource Management Act of 1993 (AIARMA), unanimous consent of the owners was required to sign an agricultural lease. As some co-owners may own a minuscule interest in the land, the cost they would incur from participating in lease negotiation may be larger than the income they can expect from leasing the land. Thus, it may be more efficient for a small interest holder to do nothing with the land. Anderson and Lueck (1992) find that much of Indian land lies fallow.

Procuring consent from multiple co-owners has been frequently cited as a major administrative challenge for the BIA Russ and Stratmann (2014). The AIARMA set the consent requirement for agricultural leases to a simple majority. And in 2004, the American Indian Probate Reform Act (AIPRA) lowered the consent requirement for non-agricultural leases. Yet, despite these changes, fractionation is a significant impediment to leasing (Shoemaker, 2020).

Shoemaker (2014) explains the second issue created by the requirement for an owner to procure a lease from her co-owners to farm the land. Since Indian owners cannot use their land as collateral due to mortgage restrictions, requiring an owner of an undivided interest to compensate all the co-owners for utilizing the land severely limits the pool of Indian landowners who can farm the land. By effectively restricting land use by the owners themselves, joint ownership on individual trust lands makes leasing to outside farmers a widely employed option for productive land use. The resulting arrangements whereby Indian landowners do not farm their land themselves go sharply against the goals of self-sustainable Indian farming ostensibly pursued by the Indian Reorganization Act of 1934 and subsequent legislation.

3.2 Leasing

All the Indian lands held in trust by the federal government can be split into two broad categories - tracts owned exclusively by the tribe and tracts owned by individual landowners. The latter tracts can have some undivided interest owned by the tribe, but these tracts are subject to the same regulations as individual trust lands without tribal ownership interest.

The BIA is heavily involved in the process of leasing Indian trust lands. Until 2012, when The Helping Expedite and Advance Responsible Tribal Home Ownership Act (HEARTH Act) was signed, virtually every lease had to go through BIA approval. The HEARTH Act enabled Indian tribes to create their own leasing regulations, which once approved by the BIA would allow the tribes to negotiate and sign leases on tribally-owned land without further BIA approvals. As evidenced by the 2019 GAO report, however, the implementation of the HEARTH Act is fraught with challenges, and the BIA still plays an active role in leasing even tribally-owned lands.

Tribal governments are sovereign nations, and unlike individual Indians, tribes have a government-to-government relationship with the BIA. Tribes have established institutional arrangements for working with the BIA and better access to BIA's employees. For example, from some of our interviews with tribal leaders, we learned that the tribal leader meets with the BIA superintendent on a weekly basis. Further, tribes are also subject to different regulations when it comes to land ownership and leasing. For example, one of the main differences is that the BIA does not have the authority to grant leases on behalf of the tribe, while it is allowed to grant leases on behalf of Indian landowners on individual trust lands (U.S. Department of the Interior, 2023). Another example is that even if federal regulations do not explicitly require tribal consent to sign a lease for an individually-owned tract, the BIA states that procuring tribal consent is "encouraged" (BIA, 2006). In a 2012 federal regulation concerning residential, business, wind, and solar resource leases, the BIA explicitly stated that it "treated tribal and individual Indian landowners differently, providing more deference to tribal landowners in the lease approval process" (Office of the Federal Register and Administration., 2012). The relative autonomy and self-governing ability separate tribal from individual owners. In dealing with tribal owners, the BIA must contend with the tribe's authority. By contrast, BIA's relationship with individual owners does not have the same balance of power.

The BIA is charged with aiding Indian landowners in leasing their lands, and this aid includes land appraisal services, public advertisements, negotiations with prospective lessees, and verification of lease compliance with federal and tribal regulations. Landowners may advertise their land themselves in search of lessees. The BIA will typically advertise Indian land for agricultural leasing either at the request of the landowners or when it starts the process of leasing the land on behalf of the owners.

The BIA can grant leases on behalf of landowners of individual trust lands in cases where the land is owned by orphaned minors, people that have been determined to be legally incompetent, or heirs whose location is unknown. Besides these cases, BIA is also allowed to grant leases on the owners' behalf in more ambiguous circumstances. The BIA can take on the responsibility of leasing fractionated tracts "when necessary to protect the interests of the individual Indian landowners" (U.S. Department of the Interior, 2023). Additionally, if the lease is in the negotiation stage and the landowners cannot come to an agreement for more than three months, the BIA can grant a lease without procuring the owners' agreement. Agreement is defined as agreement by a simple majority.

The BIA uses various methods to advertise land leases depending on the circumstances and the type of lease. It can use tribal newspapers and newsletters, the Federal Register, tribal council meetings and community gatherings, BIA regional offices, and online resources. The advertisements will inform prospective tenants of tribal laws and leasing policies that apply to the land, as well as standard terms and conditions that must be included in the lease. The advertisements require sealed bids. BIA policy states that bidders will not be given preferential treatment, but tribal law or leasing policy can supersede this condition (U.S. Department of the Interior, 2023). Tribes may overturn the results of competitive bidding by allowing an Indian tenant of their choosing match the highest bid.

If the owners advertise a lease independent of the BIA, the lease will still need to be approved by the BIA. To give approval for a lease, the BIA evaluates whether the lease serves the best interest of the Indian landowners. In making this evaluation, the BIA determines whether the lease has the required majority consent, establishes if the lessee pays a fair market value, identifies any environmental impacts of the lease, and verifies its compliance with land use requirements and local laws and regulations.

The BIA establishes the fair market value for a tract through competitive bidding, appraisal, or similar evaluation method. However, land can be leased for a value lower than the fair market value in a number of circumstances. For example, the tribe has the authority to choose the tenant for tribally-owned land and can negotiate or accept a lease with a value lower than the fair market value. Additionally, the BIA will approve a nominal or low rental rate on individual trust lands if the tenant is a member of the Indian landowner's immediate family or a co-owner in the tract. This provision is an attempt by the BIA to rectify the detrimental effect of fractionation, which precludes Indian landowners from farming their own land. By allowing families to make arrangements for productive land use without burdening the farming owner with a high lease payment, the BIA seeks to encourage land use by Indians as opposed to outside farmers.

The BIA has a system of Individuals Indian Money (IIM) Accounts. They are used to hold and manage money that is distributed to Indians as a result of various federal programs including land leases. Thus, the BIA collects payments from lessees and distributes the money to individual owners using their IIM accounts. The owners in turn can use their IIM accounts as regular bank accounts.

Although the vast majority of Indians use IIM accounts, some owners have an option to receive their lease payments directly. From interviews we held with BIA officers and Indian landowners, we learned that if the owners advertised and negotiated the lease themselves and then brought it to the BIA for approval, the owners may be eligible for direct pay. The BIA has discretion and considers requests for direct pay on a case-by-case basis. One interview provided an example of the BIA revoking direct pay from an owner because he was addicted to drugs. Thus, it is possible to have a lease where some owners are paid via their IIM accounts and some owners are paid directly. It is also possible that a lease was negotiated by the owners yet nobody opted for or was approved to be paid directly. It follows then that the probability the lease was negotiated by the owners is much higher for leases with any level of direct pay than leases that are paid out solely into the IIM accounts.

3.3 BIA Performance

The BIA, an agency of the Department of the Interior, manages Indian lands held in trust. The mission of the BIA is "to enhance the quality of life, to promote economic opportunity, and to carry out the responsibility to protect and improve the trust assets of American Indians, Indian tribes, and Alaska Natives" (BIA, 2023). Yet, malfeasance has characterized BIA's performance over the decades (McCarthy, 2004). The most notorious example is the class-action lawsuit Cobell vs. Salazar (1996-2009), where the plaintiff accused the federal government of failing in its fiduciary responsibility. The case ended with a $3.4 billion settlement paid out to Indian tribes after the court ruled in favor of the plaintiff. Other examples of BIA's malfeasance include giving inappropriate discounts to mining companies (McCarthy, 2004) and timber companies Smith (2000) at the expense of Indian landowners, as well as corruption and misappropriation of federal funds (Kendall, 2011).

Besides malfeasance, the BIA has been notorious for being slow and inefficient. In 1999, the U.S. Governmnet Accountability Office (GAO) reported that the BIA did not have consistent processes to appraise the land for leasing. Since then, key GAO recommendations for improvement have been closed without implementation. In a 2015 report, GAO found that BIA's "complex regulatory framework ... hindered Indian energy development." Examples of inefficiency included lengthy reviews of energy-related documents, which took more than 3 years in some cases, and in one case almost 8 years. In a 2019 report, GAO found that tribes miss opportunities to lease their land because the BIA takes too long to review the tribes' leasing regulations.

The complex and painful history of the relationship between the U.S. government and Indian tribes has had far-reaching consequences for the tribes. Property rights limitations, fractionation, and mismanagement by the BIA are the realities of land tenure on Indian lands.

4 Data

We obtained data for 2010 from the Trust Asset and Accounting Management System (TAAMS) administered by the BIA. The first data set has information on interest claims in land tracts held by individual owners (identified by reference numbers stripped of any sensitive data) and land conveyance dates and types. In 2010 there were 4.6 million separate interest claims on the Indian trust lands, held by over 287 thousand owners. Interest claims range from 100% for a sole owner to the smallest claim of $1 \times 10 - 8\%$. The distribution of individual interest claims is heavily skewed to the right, with the fiftieth percentile being 0.44% and the ninetieth percentile being 13.3%.

The second data set has information on land tracts, such as location, reservation identifier, size in acres, whether the land has surface or sub-surface resources, and whether the land is held in tribal ownership, fee simple, or individual trust. In the data set, there are 209,956 tracts, of which 63,911 are under tribal ownership, 5,013 are fee simple, and 141,032 are individual trust lands. Lands controlled by a tribe are designated in TAAMS as held by one owner, and we refer to such owners as tribal owners. Besides having complete control over tribal lands, tribal owners can hold interest in individual trust lands, and their total holdings amount to 24.3% of the individual trust acreage.

The third data set has information on leases, such as the type of lease - agricultural, oil and gas, business, etc. - when the lease was signed, its duration, what tracts the lease covers, how much income it generates, and how that income is split between the covered land tracts. We focus on agricultural leases for several reasons. First, they are the most numerous, which allows for a large data set. The type of lease with the second-highest count of observations is the oil and gas lease. However, we do not have a metric to measure the value of oil and gas leases that would allow between-lease comparisons. With agricultural leases, income per acre after controlling for land quality provides such a metric. On the contrary, dividing income from an oil and gas lease by the number of acres does not result in a meaningful value. Oil is not distributed underground evenly, and the amount of total oil as well as the ease of extraction drive the value, making comparisons challenging. Additionally, a BIA employee we interviewed made a valuable observation that since oil and gas leases involve large oil companies, factors of interest group politics may be at play that we are not accounting for in our analysis.

There are 14,576 active agricultural leases on the individual trust lands as of October 2010. We only look at leases signed in or after 2002 to make sure that the regulations of the 2000 ILCA amendment are in effect for all the leases under examination. Interpreting lease income requires caution. A lease can be signed for the entire tract or include multiple tracts in their entirety, in which case we can simply divide the lease income by the number of acres on the tracts. However, a tract can also have multiple leases, and we do not have the data to know what acreage is covered by each lease. We do not have the denominator for calculating lease income per acre in such cases. This limitation forces us to narrow the data set to tracts covered by one lease. Additionally, to take advantage of data on land characteristics available at the tract level, we further narrow our sample to leases that cover only one tract. Because of this, we will use the words "tract" and "lease" somewhat interchangeably. The final data set contains 10,177 agricultural leases. Table 1 shows descriptive statistics on tract-level and lease-level variables.

The number of owners varies greatly, with a standard deviation almost double the mean and the maximum number of owners exceeding one thousand (Figure 1). About 7% of all agricultural leases on the individual trust lands are owned by one owner, 50% is owned by 2-20 owners, while the rest is owned by over 20 owners. As new generations inherit the land, existing ownership shares get split into smaller stakes, so the number of owners and the interest of the largest shareholder are inversely related. The correlation between the interest of the largest shareholder and the log of the number of owners is a strong -0.6.

Figure 2 shows the frequency distribution of the interest of the largest shareholder and provides a corollary to the narrative above. The high frequency of values 0.25, 0.33, and 0.5 as the holdings of the highest shareholder are not surprising, as most tracts get probated and divided evenly among the heirs after the passing of the previous owner, and the spikes on the graph reflect tracts owned by 4, 3, or 2 siblings respectively. Conversely, the tracts with only one owner are likely a result of deliberate efforts to avoid fractionation, such as estate planning and taking advantage of consolidation programs.

Leases have tribal owners 39% of the time, and 12% of the time, the tribe holds the highest share. Figure 3 shows the distribution of tribal interest on tracts where the tribe holds an ownership share. Tribes tend to have higher ownership shares in larger tracts (4), which explains how tribes can hold an average of 14.5% interest in agricultural leases on the individual trust land while owning 24.3% of such land. In Figure 4, we group leases into sets of 100 sorted by the tribe's ownership share and take averages of the values within each set, so each dot on the graph represents a mean of 100 observations.

3.3% of leases in our data set pay the full lease income directly to the owners. 9.8% pay at least some portion of the lease income directly to the owners.

5 Econometric Models

The theory laid out in Section 2 has several testable hypotheses. The first is the positive relationship between the interest of the largest shareholder and the annual lease income per acre. Figure 5 shows a scatter plot of this relationship. As in a previous scatter plot, observations are grouped in sets of 100. To test that the interest of the largest shareholder has a positive effect on income per acre, we can estimate an Ordinary Least Squares (OLS) model by following equation (11). This requires the transformation of the interest of the largest shareholder into the inverse of its square root. We recognize, however, that the exact equation for income depends on the functional form we choose for bureaucratic effort. A different functional form compliant with our assumptions about bureaucratic effort would result in a different expression for income. Yet, the positive relationship between income and the interest of the largest shareholder would remain. Therefore, in addition to running the model dictated by the theory, we also run a more straightforward model where income is expressed in logs, and the interest of the largest shareholder is not transformed. The first approach results in econometric model (22), and the second approach results in an econometric model (23):

$$income_{ijt} = \beta_0 + \beta_1 \left(\frac{1}{\sqrt{maxshare_{ij2010}}} \right) + \beta_2 leasechar_{ij2010} + \beta_3 year_t + \beta_4 reservation_j + \varepsilon_i \quad (22)$$

$$log(income_{ijt}) = \beta_0 + \beta_1 maxshare_{ij2010} + \beta_2 leasechar_{ij2010} + \beta_3 year_t + \beta_4 reservation_j + \varepsilon_i \quad (23)$$

where $income_{ijt}$ is the annual income per acre for lease i signed in year t on reservation j, $maxshare_{ij2010}$ is the interest of the largest shareholder as of 2010, $leasechar_{ij2010}$ is a vector of lease and tract characteristics as of 2010, $year_t$ is the year the lease was signed, $reservation_j$ is the reservation fixed effects for reservation j, and ε_i is the error term. The reservation fixed effects are intended to control for heterogeneity of land quality, the regulatory climate for agricultural leases in different jurisdictions, the economic conditions of the reservations and the surrounding areas, and cultural differences.

Controlling for reservation heterogeneity is our way of controlling for land quality, among other characteristics. Apart from an indicator of whether the land has only surface resources or both surface and subsurface resources, our data do not enable us to distinguish differences in land quality between tracts within a reservation. It is possible that some tracts have access to water, for example, or be relatively more fertile, and we acknowledge that not controlling for those factors may impact the accuracy of our results. But it is not unreasonable to assume that within the physical bounds of a reservation, characteristics of the soil are not as varied as to warrant a large discrepancy in land value.

The data set is cross-sectional with a time component. By including the year the lease was signed, we control for variations in economic conditions affecting rental rates for land and any changes in BIA lease policies.

Next, we test the effect of the number of owners on lease income. The correlation between the number of owners and the annual income per acre is not apparent (Figure 6), which is not surprising because the driving force behind the monitoring provided by the landowners is not their number but the concentration of ownership. The special case of equal distribution of ownership where n enters the equation for bureaucratic effort directly represents only about 5% of the leases in our data. Therefore, it is the negative correlation between the number of owners and the interest of the largest shareholder that leads to the effect of the number of owners on income to be negative. To estimate this effect, we use the following models:

$$income_{ijt} = \beta_0 + \beta_1 \sqrt{owners_{ij2010}} + \beta_2 leasechar_{ij2010} + \beta_3 year_t + \beta_4 reservation_j + \varepsilon_i \tag{24}$$

$$log(income_{ijt}) = \beta_0 + \beta_1 log(owners_{ij2010}) + \beta_2 leasechar_{ij2010} + \beta_3 year_t + \beta_4 reservation_j + \varepsilon_i \tag{25}$$

where $owners_{ij2010}$ is the number of owners on the lease as of 2010.

When discussing the number of owners, we must address potential confounding factors associated with one-owner tracts. All Indian landowners face the decision whether to lease the land or farm it themselves. When multiple owners are on a tract, establishing and enforcing who farms which piece of the tract and how proceeds are distributed is costly. Conversely, when there is only one owner on a tract, the owner's decision to farm does not entail such costs, which suggests that one-owner tracts will be leased relatively less frequently than tracts with multiple owners. However, if our assumptions hold, whereby lease value is determined by BIA's effort and the underlying land quality, then the collective-action costs absent on one-owner tracts do not produce a confounding effect.

Another potential endogeneity issue with one-owner tracts is harder to resolve. The type of personality that undertakes the effort of keeping sole ownership of a tract through estate planning and strategic purchasing may also be more involved in negotiating a favorable lease and monitoring the BIA. Thus, it is prudent to test our results with and without one-owner leases, which we do in the Appendix.

Given the government-to-government relationship between the BIA and the tribes, we assume that the marginal cost of eliciting effort from the BIA is lower for tribal landowners than individual landowners. Thus, if the tribe is the largest shareholder, the lease income will be higher on average than if the largest shareholder is an individual owner. Furthermore, a tribal owner without the largest interest can still be the sole contributor to monitoring because the tribe's monitoring costs are lower. Thus, we can assume a positive probability that a tribal owner can be the sole contributor to the public good of monitoring without being the largest shareholder. Given these assumptions, our model predicts that lease income increases in the interest held by the tribe regardless of whether the tribe holds the largest ownership interest or not.

Figure 7 shows a weak positive relationship between tribe interest and lease income. Figure 8 demonstrates a positive effect of the tribe's presence on the lease by contrasting leases with tribal ownership to those owned exclusively by individual owners. The OLS regressions with tribe interest $tribeint_{ij2010}$ serve as a test for the effect of the share held by the tribe. Since the tribe is present on 39% of the tracts, 61% of the time, the theory-guided transformation of the variable $tribeint_{ij2010}$ following equation (16) would yield a missing value. Thus, we only use the econometric model where lease income is transformed into logs, as in equation (26).

$$log(income_{ijt}) = \beta_0 + \beta_1 tribeint_{ij2010} + \beta_2 leasechar_{ij2010} + \beta_3 year_t + \beta_4 reservation_j + \varepsilon_i \quad (26)$$

The theory tells us that when the tribe is the largest shareholder on the lease, it will be the sole contributor to monitoring the BIA. Then, the higher the tribe' interest, the more monitoring, and hence the more lease income will be produced. However, we cannot observe the relative monitoring costs for tribal and individual owners. When the tribe is not the largest shareholder, it is not guaranteed that its ownership share will impact the lease income. This premise is conducive to using an interaction variable between the share owned by the tribe and the binary variable $tribemax_{ij2010}$ for whether the tribe is the largest shareholder. We expect to see a positive coefficient on that interaction variable. To test this hypothesis, we run the following econometric model:

$$\begin{aligned} log(income_{ijt}) = \beta_0 + \beta_1 tribeint_{ij2010} + \beta_2 tribemax_{ij2010} \times tribeint_{ij2010} \\ + \beta_3 leasechar_{ij2010} + \beta_4 year_t + \beta_5 reservation_j + \varepsilon_i \end{aligned} \quad (27)$$

In all model specifications, errors are clustered at the reservation level.

6 Results

Tables 2-4 show the regression results from testing several predictions of our theoretical model. In columns (1) - (3) of Tables 2 and 3, the dependent variable is annual lease income per acre. In all other specifications, the dependent variable is the log transformation of the annual lease income per acre. All specifications include year fixed effects for the signing of the lease and reservation fixed effects. All reported standard errors are clustered at the reservation level.

Table 2 tests the hypothesis that as the interest of the largest shareholder increases, collective action problems decrease as that shareholder has increased incentives to monitor the BIA. We find the sign on the variables of interest to be consistent with our hypothesis. In columns (1) - (3), the negative sign on the transformed variable of the interest of the largest shareholder implies a positive effect of the interest of the largest shareholder on lease income. The point estimates in columns (1) - (3) are highly significant. The magnitude of the point estimate in column (3) implies that an increase in the interest of the largest shareholder from 10% to 20% leads to a $2.8 increase in the annual lease income per acre, which constitutes 3.3% of the mean income across all agricultural leases. The effect is diminishing. An increase in ownership share from 50% to 60% increases lease income by 0.38%, and from 90% to 100% by 0.16%.

Point estimates in columns (4)-(6) represent semi-elasticities, and the estimate in column (4) implies that a ten-percentage point increase in ownership share of the largest shareholder increases lease income by 0.78%.

Table 3 tests the hypothesis that lease income falls as the number of owners increases. The point estimates on the square root of the number of owners in specifications (1) - (3) and the log of the number of owners in specifications (4)-(6) have the hypothesized negative sign. They are statistically significant at the 5% level in 4 out of 6 specifications. The point estimate in column (3) implies that increasing the number of owners from 1 to 5 decreases lease income by 1%, while increasing the number of owners from 1 to 10 decreases lease income by 1.8%. Point estimates in columns (4)-(6) represent elasticities, and using column (4), we can interpret the estimate as implying that doubling the number of owners decreases income by 2.6%.

Table 4 tests the hypothesis that when the cost of monitoring falls, monitoring increases, and bureaucrats are more responsive to their clients. Here, we measure lower costs by who is the owner of the land, a private person or the tribe, and where we hypothesize, as described above, that tribes have lower monitoring costs. Consistent with our predictions, the point estimates on tribal interest and its interaction with the binary variable of whether the tribe holds the largest ownership share have positive signs, and both are statistically significant. The point estimates on tribal interest in columns (1)-(3) imply that increasing the share owned by the tribe by ten percentage points increases lease income by $1.1\% - 1.9\%$ depending on model specification. The point estimates in columns (4)-(6) imply that if the tribe is the largest shareholder, then an increase in the tribe's interest by ten percentage points increases lease income by $1.6\% - 2.3\%$ depending on model specification.

Table 5 performs an additional robustness check on our theory. It tries to account for the reality on Indian reservations whereby several family members, often siblings, have ownership interests in the same tract of land. For example, when a parent dies without a will, each of the children typically receives an equal share of their deceased parent's ownership interest. Having a blood relation to another owner will likely alleviate collective action problems, generating a prediction similar to when one person has the largest ownership interest. Figure 9 shows box plots of the ownership interest owned by the top shareholder, top two, top five, and top ten shareholders.

In Table 5, we use the model specification with log-transformation of income, lease-level controls, and reservation and year fixed effects. We choose this specification due to ease of interpretation. The other specifications produce similar results. Columns (1) to (3) show the effect of cumulative ownership share of the top two, five, and ten owners on lease income respectively. In each case, the point estimate has the hypothesized positive sign although only the effect of the top ten owners' share is statistically significant. The sum of these findings points to the fact that bureaucrats provide more effort, measured as higher lease incomes, when ownership interests are concentrated among a few owners, and thus the chance of overcoming collective action problems associated with monitoring is higher.

7 Conclusion

The performance of bureaucrats has been a topic of interest to social scientists since the seminal contribution of Max Weber. Since then, a dominant theme in this literature has been the view of bureaucrats being unresponsive to the citizens they are assigned to serve, a view summarized by Prendergast, 2007, pg. 180, "...the defining characteristic of many bureaucracies seems to be indifference, in some cases hostility, toward their clients' wishes."

In this paper, we analyze bureaucratic behavior through the lens of public goods theory. We posit that users of bureaucratic services face collective action problems in monitoring the activity of bureaucrats, while bureaucratic efforts are increasing in the watching, scrutiny, and complaints of their clients. Free riding in monitoring among clients provides bureaucrats with disincentives to deliver the effort and client services.

While our model has applicability to many bureaucracies, we focus on the BIA bureaucracy and lease income of owners on Indian reservations generated by land held in federal trust. This application is particularly suitable, as many tracts of land in federal trust on Indian reservations are held by several, sometimes many owners. The ownership form on federal trust land is tenancy in common where each co-owner owns a distinct share of the land. The BIA has fiduciary responsibility and either leases land on behalf of the owners or must approve the terms of the lease.

The significant negative effect of the number of owners on lease income is noteworthy due to the claims regarding the detrimental effect of fractionation on Indian lands. Much of the literature explaining the reasons for poverty on Indian reservations lists fractionation as the key culprit. While fractionation increases coordination problems and is thus likely to impede the Indians' ability to put their land to productive use, it is less obvious why fractionation would negatively affect incomes derived from leasing the fractionated land. The difficulty of acquiring owners' consent to lease explains why land may lie fallow, but conditional on the lease being signed, there is little theory to explain the negative effect of fractionation on lease incomes. We believe that our model of monitoring as a public good explains how fractionation impacts lease values by reducing the share of the largest shareholder.

Testing the hypotheses from our theoretical model, we find results that are inconsistent with the claim that the BIA upholds its fiduciary responsibility. Instead, the findings support the theoretical prediction that bureaucratic output is below its optimal level when clients face collective action problems in monitoring activities. Lease income falls with the number of owners and increases as the ownership share of the largest shareholder increases. Plots of land with landowners facing low monitoring costs have higher lease incomes, providing additional evidence that bureaucratic efforts in provision of services fall with less monitoring by their clients.

These results support our theory of bureaucracy whereby the oversight provided by the citizens is less than the socially optimal level, and it diminishes with the size of the population serviced by a bureaucratic agency. By organizing, citizens can achieve higher oversight over the bureaucracy via two channels: concentrating their interests and reducing monitoring costs.

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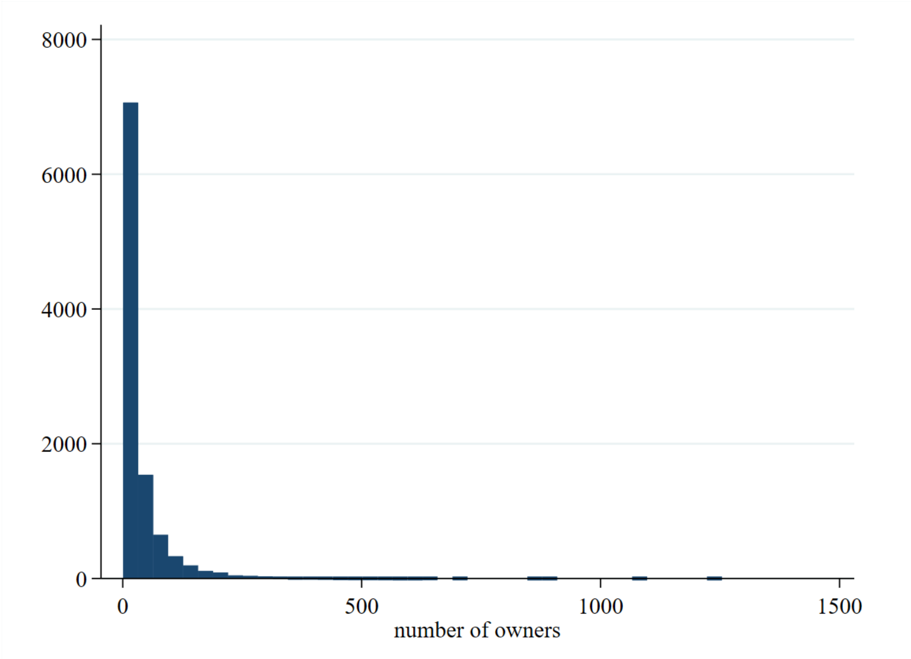
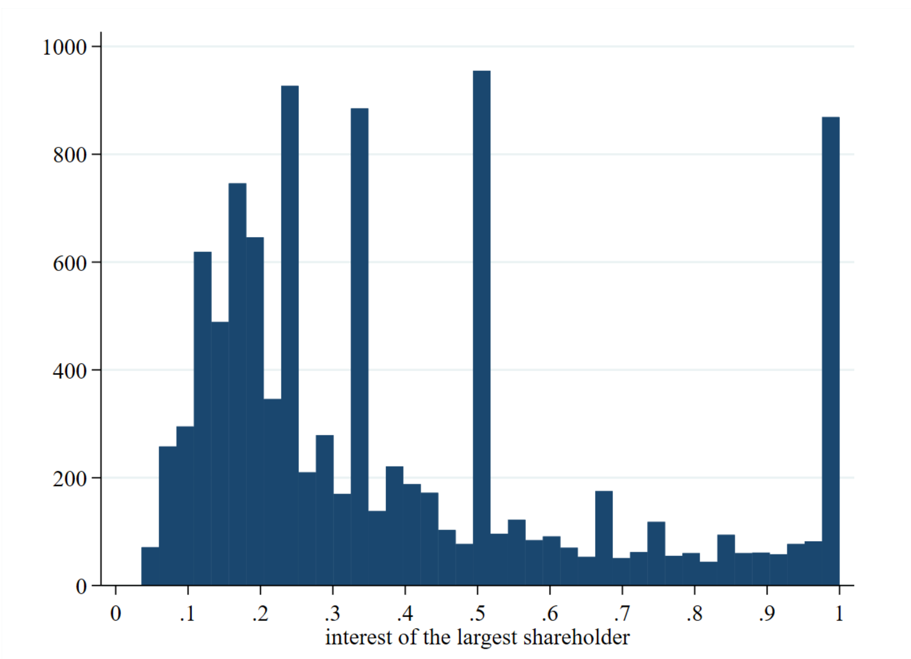
Figure 1: Frequency distribution of the number of owners



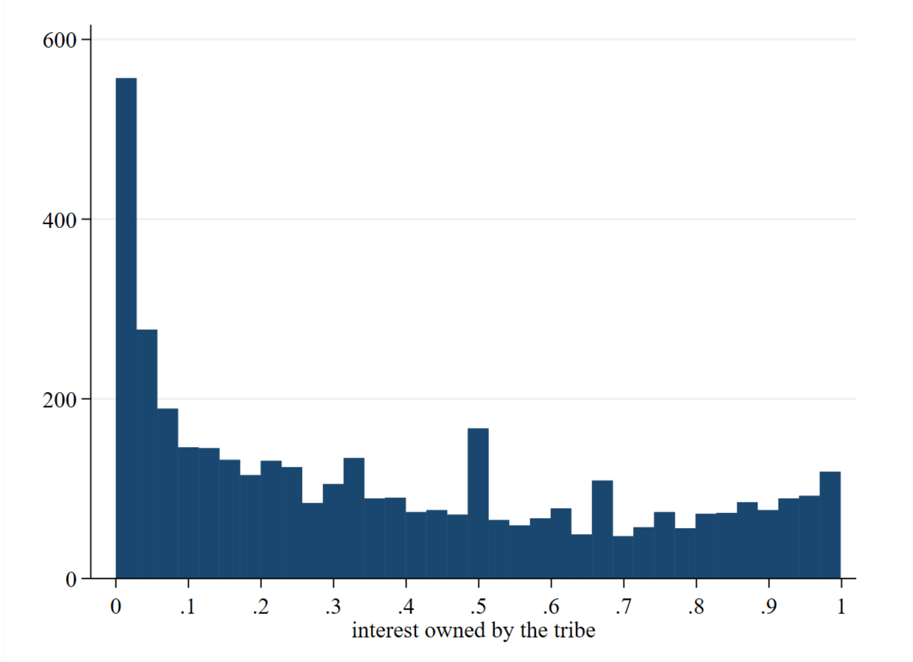
Note: The unit of observation is a lease.

Figure 2: Frequency distribution of the interest of the largest shareholder on a lease



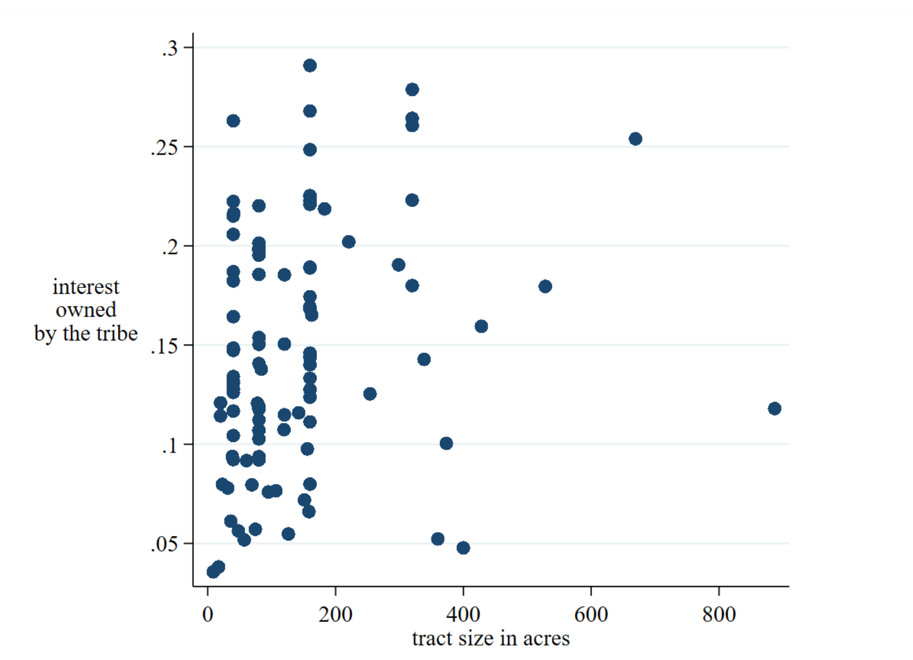
Note: The unit of observation is a lease.

Figure 3: Frequency distribution of the interest owned by the tribe on leases with tribal ownership



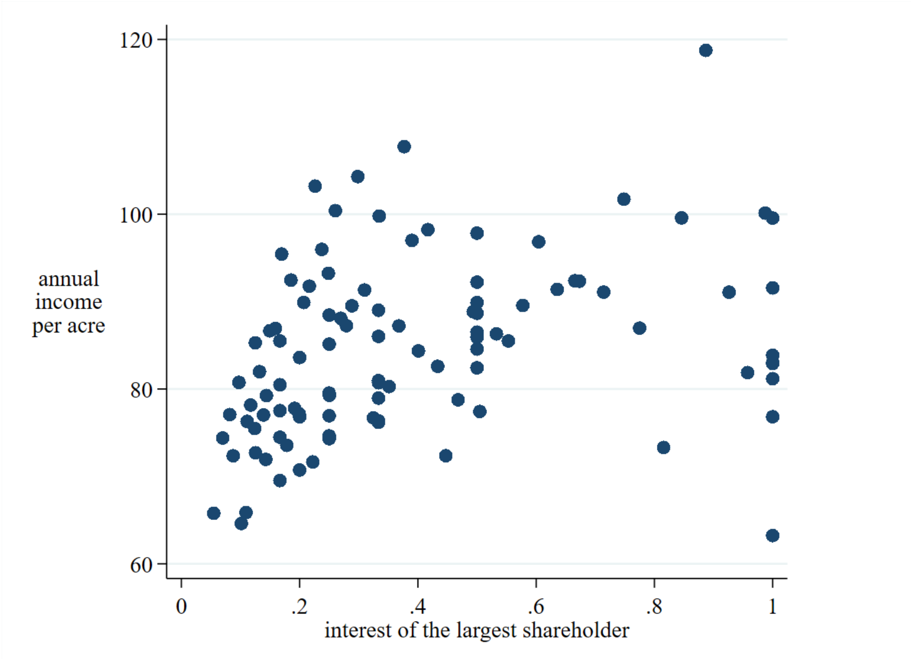
Note: The unit of observation is a lease.

Figure 4: Scatter plot of share owned by the tribe and tract size



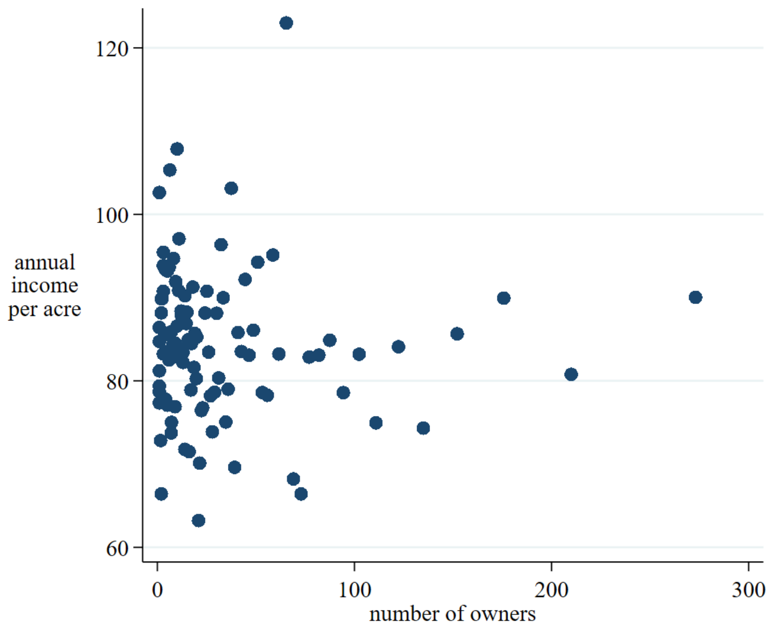
Notes: The unit of observation is a lease. The leases were sorted by the tract size and grouped in sets of 100 leases. Each dot represents an average of 100 observations. Thus, the first dot on the left is an average tract size in acres and an average interest owned by the tribe on the first 100 leases sorted by the tract size.

Figure 5: Scatter plot of lease income per acre and interest of the largest shareholder



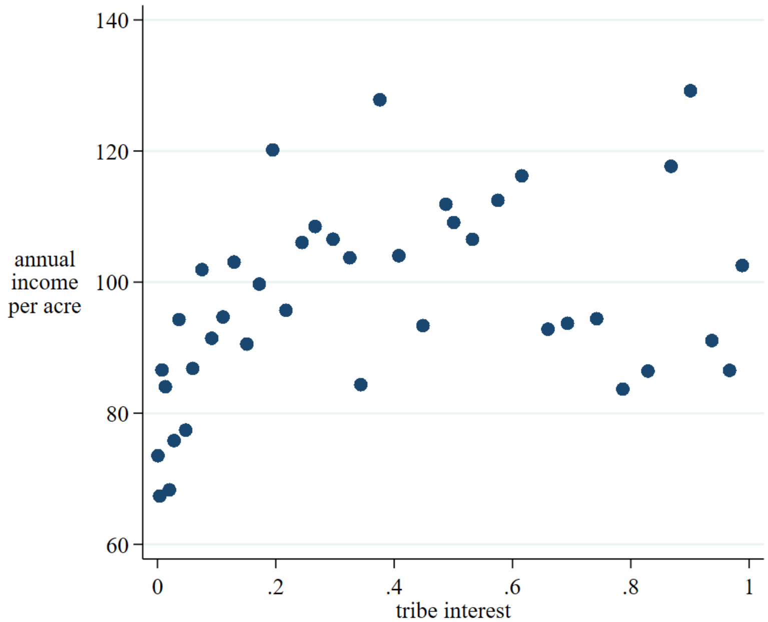
Notes: The unit of observation is a lease. The leases were sorted by the interest of the largest shareholder and grouped in sets of 100 leases. Each dot represents an average of 100 observations. Thus, the first dot on the left is an average interest of the largest shareholder and an average income per acre on the first 100 leases sorted by the interest of the largest shareholder.

Figure 6: Scatter plot of lease income per acre and number of owners



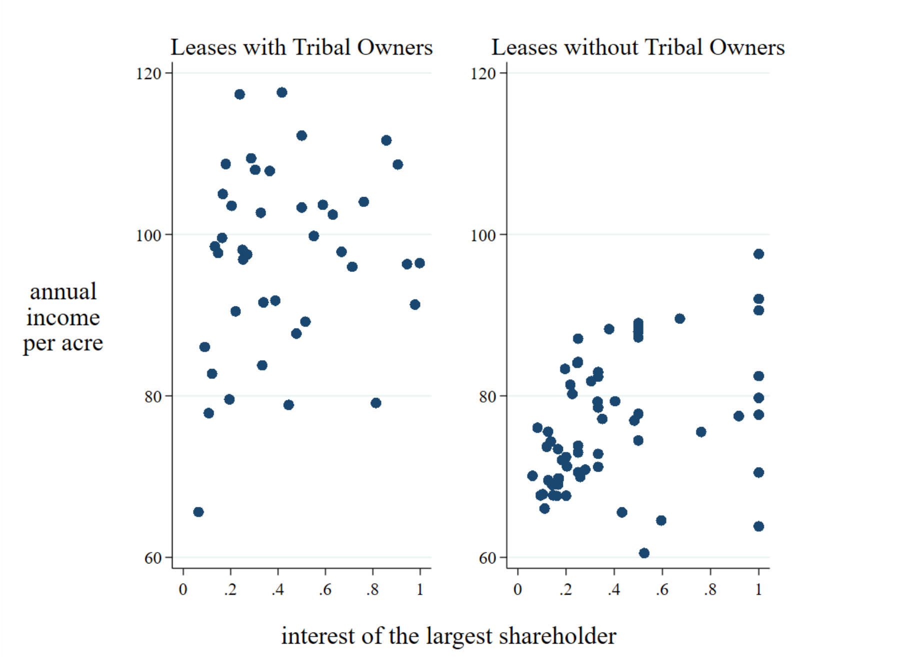
Notes: The unit of observation is a lease. The leases were sorted by the number of owners and grouped in sets of 100 leases. Each dot represents an average of 100 observations. Thus, the first dot on the left is an average number of owners and an average income per acre on the first 100 leases sorted by the number of owners.

Figure 7: Scatter plot of lease income per acre and share owned by the tribe



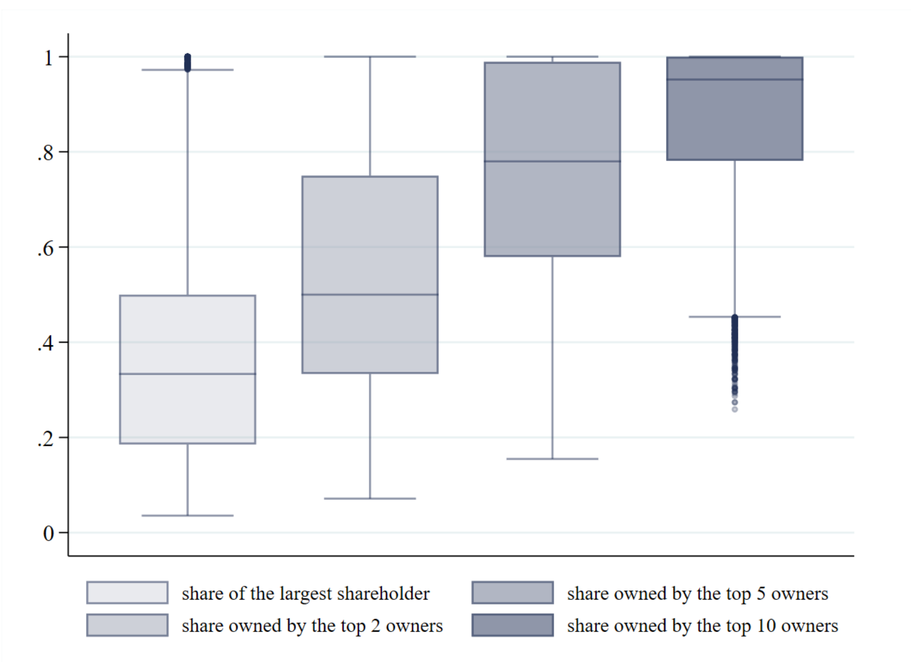
Notes: The unit of observation is a lease. The leases were sorted by the share owned by the tribe and grouped in sets of 100 leases. Each dot represents an average of 100 observations. Thus, the first dot on the left is an average share owned by the tribe and an average income per acre on the first 100 leases sorted by the share owned by the tribe.

Figure 8: Scatter plots of lease income per acre with and without tribal owners



Notes: The unit of observation is a lease. The leases were sorted by the interest of the largest shareholder and grouped in sets of 100 leases. Each dot represents an average of 100 observations. Thus, the first dot on the left is an average interest of the largest shareholder and an average income per acre on the first 100 leases sorted by the interest of the largest shareholder.

Figure 9: Box plots of ownership share of top 1, 2, 5, and 10 owners



Note: The unit of observation is a lease.

Table 1: Summary statistics for lease-level variables

	Mean	SD	Min	Max
annual income per acre	84.51	87.24	3.03	581.41
number of owners	36.28	60.53	1.00	1,254.00
share of the largest shareholder	0.40	0.27	0.04	1.00
share held by tribal owners	0.15	0.27	0.00	1.00
binary for tribal owner = top shareholder	0.12	0.33	0.00	1.00
lease term in years	5.09	1.45	1.00	25.00
size of land under lease	139.02	132.90	2.50	1,041.73
binary for presence of direct pay	0.10	0.30	0.00	1.00

N = 10,177

Table 2: Regression results: effect of the interest of the largest shareholder on lease income

	income per acre			log of income per acre		
	(1)	(2)	(3)	(4)	(5)	(6)
$\frac{1}{\sqrt{\text{interest of largest shareholder}}}$	-3.926***	-3.672***	-3.045**			
	(1.398)	(1.177)	(1.260)			
interest of largest shareholder				0.0784*	0.0494	0.0242
				(0.0408)	(0.0363)	(0.0419)
lease term in years		1.506	1.521		0.0179	0.0180
		(1.173)	(1.172)		(0.0122)	(0.0120)
surface resources only		-2.031	-1.864		-0.00392	-0.00120
		(2.547)	(2.549)		(0.0499)	(0.0500)
log of land size		-11.01***	-11.07***		-0.227***	-0.228***
		(1.987)	(1.947)		(0.0530)	(0.0526)
binary for direct pay			10.78*			0.158**
			(5.625)			(0.0646)
year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
reservation fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.513	0.522	0.523	0.443	0.473	0.475
Observations	10177	10177	10177	10177	10177	10177

Notes: Standard errors clustered at the reservation level in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01.

Table 3: Regression results: effect of number of owners on lease income

	income per acre			log of income per acre		
	(1)	(2)	(3)	(4)	(5)	(6)
$\sqrt{\text{number of owners}}$	-1.011**	-0.849**	-0.715**			
	(0.383)	(0.328)	(0.322)			
log of number of owners				-0.0263**	-0.0159*	-0.00949
				(0.0113)	(0.00811)	(0.00737)
lease term in years		1.381	1.399		0.0179	0.0180
		(1.125)	(1.123)		(0.0126)	(0.0125)
surface resources only		-1.057	-1.074		-0.00309	-0.00350
		(2.590)	(2.537)		(0.0485)	(0.0477)
log of land size		-10.81***	-10.90***		-0.231***	-0.232***
		(2.028)	(1.967)		(0.0528)	(0.0520)
binary for direct pay			11.74**			0.174***
			(5.423)			(0.0640)
year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
reservation fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.511	0.520	0.522	0.440	0.470	0.472
Observations	10177	10177	10177	10177	10177	10177

Notes: Standard errors clustered at the reservation level in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01.

Table 4: Regression results: effect of tribal ownership on lease income

	log of income per acre					
	(1)	(2)	(3)	(4)	(5)	(6)
share owned by the tribe	0.112***	0.175***	0.193***	0.0175	0.0966*	0.118**
	(0.0409)	(0.0564)	(0.0540)	(0.0419)	(0.0524)	(0.0522)
tribe interest X binary for tribe=top				0.141***	0.117**	0.112**
				(0.0440)	(0.0494)	(0.0516)
lease term in years		0.0169	0.0174		0.0170	0.0174
		(0.0127)	(0.0125)		(0.0127)	(0.0125)
surface resources only		-0.0305	-0.0311		-0.0302	-0.0308
		(0.0498)	(0.0492)		(0.0493)	(0.0488)
log of land size		-0.235***	-0.236***		-0.235***	-0.236***
		(0.0514)	(0.0509)		(0.0514)	(0.0510)
binary for direct pay			0.193***			0.192***
			(0.0631)			(0.0631)
year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
reservation fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.439	0.471	0.474	0.439	0.471	0.474
Observations	10177	10177	10177	10177	10177	10177

Notes: Standard errors clustered at the reservation level in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01.

Table 5: Regression results: effect of ownership concentration on lease income

	log of income per acre		
	(1)	(2)	(3)
share owned by top 2 owners	0.0387		
	(0.0377)		
share owned by top 5 owners		0.0462	
		(0.0383)	
share owned by top 10 owners			0.103**
			(0.0475)
lease-level controls	Yes	Yes	Yes
year fixed effects	Yes	Yes	Yes
reservation fixed effects	Yes	Yes	Yes
R^2	0.472	0.472	0.472
Observations	10177	10177	10177

Notes: Standard errors clustered at the reservation level in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01. Lease-level controls include lease term in years, presence of sub-surface resources, log of land size, proportion of tract in fee simple, and presence of direct pay.

Appendix

Table A1: Regression results: effect of the interest of the largest shareholder on lease income after excluding one-owner leases

	income per acre			log of income per acre		
	(1)	(2)	(3)	(4)	(5)	(6)
$\frac{1}{\sqrt{\text{interest of largest shareholder}}}$	-3.964***	-4.185***	-3.714***			
	(1.207)	(0.979)	(1.089)			
interest of largest shareholder				0.112**	0.129***	0.110**
				(0.0434)	(0.0395)	(0.0440)
lease term in years		1.089	1.085		0.0150	0.0149
		(1.225)	(1.224)		(0.0135)	(0.0133)
surface resources only		-1.993	-1.858		-0.00665	-0.00421
		(2.515)	(2.518)		(0.0464)	(0.0466)
log of land size		-11.49***	-11.58***		-0.236***	-0.237***
		(2.130)	(2.072)		(0.0565)	(0.0560)
binary for direct pay			10.73			0.158**
			(6.682)			(0.0739)
year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
reservation fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.515	0.525	0.526	0.449	0.481	0.483
Observations	9442	9442	9442	9442	9442	9442

Notes: Standard errors clustered at the reservation level in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01.

Table A2: Regression results: effect of the number of owners on lease income after excluding one-owner leases

	income per acre			log of income per acre		
	(1)	(2)	(3)	(4)	(5)	(6)
$\sqrt{\text{number of owners}}$	-0.920**	-0.819***	-0.713**			
	(0.364)	(0.304)	(0.301)			
log of number of owners				-0.0269**	-0.0216**	-0.0161**
				(0.0125)	(0.00864)	(0.00750)
lease term in years		1.006	1.002		0.0159	0.0158
		(1.152)	(1.150)		(0.0140)	(0.0138)
surface resources only		-0.810	-0.831		0.00315	0.00293
		(2.606)	(2.555)		(0.0471)	(0.0463)
log of land size		-11.15***	-11.26***		-0.239***	-0.240***
		(2.156)	(2.075)		(0.0558)	(0.0549)
binary for direct pay			11.65*			0.176**
			(6.436)			(0.0739)
year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
reservation fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.513	0.523	0.524	0.445	0.476	0.479
Observations	9442	9442	9442	9442	9442	9442

Notes: Standard errors clustered at the reservation level in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01.

Table A3: Regression results: effect of tribal ownership on lease income after excluding one-owner leases

	log of income per acre					
	(1)	(2)	(3)	(4)	(5)	(6)
share owned by the tribe	0.133***	0.185***	0.200***	0.0469	0.112**	0.128***
	(0.0374)	(0.0530)	(0.0511)	(0.0398)	(0.0481)	(0.0476)
tribe interest X binary for tribe=top				0.126***	0.107**	0.106**
				(0.0434)	(0.0490)	(0.0508)
lease term in years		0.0154	0.0154		0.0154	0.0154
		(0.0141)	(0.0139)		(0.0141)	(0.0139)
surface resources only		-0.0259	-0.0268		-0.0255	-0.0264
		(0.0478)	(0.0471)		(0.0473)	(0.0467)
log of land size		-0.241***	-0.243***		-0.241***	-0.243***
		(0.0546)	(0.0538)		(0.0546)	(0.0538)
binary for direct pay			0.196***			0.196***
			(0.0730)			(0.0729)
year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
reservation fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.445	0.477	0.480	0.445	0.478	0.480
Observations	9442	9442	9442	9442	9442	9442

Notes: Standard errors clustered at the reservation level in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01.