Property Rights and Urban Form

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Abstract

How do the different elements in the standard bundle of property rights, including those of possession and transfer, influence the shape of cities? This paper incorporates insecure property rights into a standard model of urban land prices and density and makes predictions about investment in land and property, informality, and the efficiency of land use. Our empirical analysis links data on institutions for land titling and transfer with multiple urban outcomes in 190 countries. The evidence is generally consistent with the model's predictions and more broadly with Harold Demsetz's approach to property rights institutions in "Towards a Theory of Property Rights." Indeed, we document worldwide improvements in the quality of institutions facilitating property transfer over time.

1. Introduction

Ownership can confer a bundle of property rights, including the right to possess, to transfer, and to alter (Ellickson 1993; Alchian 2008).[1] As stressed in the pioneering work Demsetz (1967), the protection of any of these rights is never free and varies greatly across jurisdictions. In the developing world, many of these

We are deeply grateful to Lawrence Jia and Eva (Yiwen) Zhang for outstanding assistance with this research and to Elodie Bataille, Marie Lily Delion, Egor Gornostay, Gary Hufbauer, Spencer Kwon, Nick Lore-Edwards, Robbie Minton, Rita Ramalho, Judith Trasancos, and Aigerim Zhanibekova for helpful comments. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the World Bank and its affiliated organizations or those of the executive directors of the World Bank or the governments they represent.

[1] The right to transfer includes the right to rent (temporary transfer) and the right to mortgage (conditional transfer). Ellickson (1993) describes a complete Blackstonian bundle of property rights, which include the right to exclude, in the sense that we use "possession," and use and abuse, which to us is synonymous with "alter." He defines transfers more thoroughly, but we intend our meaning to be the same. Ellickson (1993, p. 1363) also specifies the time frame of ownership (perpetual), its physical boundaries (limited in two dimensions but stretching "downward to the depths of the earth and upward to the heavens"), and its resting in a single proprietor.

[*Journal of Law and Economics,* vol. 65 (February 2022)]

rights are quite ephemeral, as possession is not guaranteed, sale is difficult, and alteration is highly regulated. Still, in a world of limited public capacity, one can ask, which rules and institutions matter for economic activity, and how? In this paper, we address these questions empirically using a cross section of 190 countries and focus on the consequences of the right of possession and the right of transfer in the context of urban land.

The most basic element in this Blackstonian bundle of property rights is possession—the right to exclude others from taking or invading the property. This right is typically secured by the government but occasionally by other means, such as self-defense. The state, of course, can also be the taker or invader of property. Works including Montesquieu (1748), Smith (1776), Olson (1965), North (1981), Barro (1991), De Long and Shleifer (1993), and Acemoglu, Johnson, and Robinson (2001) recognize entitlement to the undisturbed use of one's property as essential for protecting investment and economic development. In the context of urban development, the right of possession is central to the quality of the housing stock. When title is insecure, residents invest less in land and housing, and urban density rises.

The right to transfer is less central to classical economists than the logically prior right of possession, but more recently authors have stressed how transfer can enable property to be sold or rented to more efficient users or owners with access to capital (Barzel 1982; Ellickson 1993; Alchian 2008). De Soto (2000) stresses the role of urban land as potential collateral for entrepreneurs, and mortgages hinge on the conditional transfer of land in case of default. The right of transfer is logically secondary to the right of possession, but both may shape aspects of the urban form.

In a modern society, the protection of property rights, including possession and transfer, is typically delivered not only by courts and police but also by administrative institutions, such as deed registration offices. Empirically, much attention has been devoted to the effectiveness of courts and regulators in protecting private property, including in cross-country contexts (for example, Djankov et al. 2003; La Porta et al. 2004; Behrer et al. 2021). Less is known about the role of administrative institutions that keep track of ownership and its transfer.

Title is the central legal instrument that both secures possession and enables the transfer of property. Documenting formal title is usually a prerequisite for using legal authority to protect one's land and dwellings, and that is done through administrative tools, such as cadastres and deeds. Without formal title, residents must rely on self-protection to assure unhindered enjoyment of their residences and land (Field 2005, 2007) and have limited incentives to invest in such informally owned property (De Soto 1989; Besley 1995). Only secure title can in principle provide protection against expropriation by armed bandits, powerful neighbors, and the grabbing hand of the state (Olson 1993; Shleifer and Vishny 1998; De Soto 2000; Behrer et al. 2021).

The institutions that track and enable the transfer of title ensure the legal rec-

ognition and sanction of the permanent transfer of property ownership.[2] In many of the world's informal urban communities, residents are relatively safe against expropriation and eviction, but without legal sale they lack the means to trade their property for cash, move closer to work, or borrow money through a mortgage (De Soto 2000). Even with title, the time and money costs of a legal sale may stymie mobility and leave residents rooted in place. That stasis may explain the long commutes between informal communities and formal work in many developing-world cities such as Kigali (Collier and Venables 2014).[3]

In this paper, we investigate the distinction between the right of possession and the right of transfer and the distinctive effects that the institutions protecting these rights have on the urban form. To this end, we analyze a large cross-country data set assembled by the World Bank from 2004 to 2019. The data set contains information about institutions securing property title and institutions governing the transfer of ownership for 190 countries.

We seek to accomplish three goals. First, we describe the relevant data sets and show how property rights institutions covering the titling of property and its transfer can be objectively measured. Second, we present new evidence that these institutions have a substantial impact on economic outcomes, especially in the context of the allocation of urban land. Third, we present some evidence that, unlike many institutions that previous research has shown to be sticky, the institutions we describe here show dramatic improvement over the 16 years of the data.

Our first goal is to describe the institutions of titling and transferring property from the World Bank's Doing Business database. A large literature uses measures of security of property rights obtained in surveys of investors, experts, and households. La Porta et al. (1999) provide a summary of many of these measures; Chong et al. (2014) present related findings from the World Justice Project (WJP) database. These survey measures are outputs of a system of securing property rights and hence are extremely highly correlated with multiple inputs including not just legal and regulatory rules and infrastructure but also human capital. Here instead we use administrative rules governing titling and transfer of property and analyze their impact, holding constant the level of human capital. A further advantage of measuring specific rules rather than survey outcomes is that rules are subject to modification, reform, and improvement over horizons shorter than the general growth of public-sector capacity and human capital.

The Doing Business database contains two types of variables. First, it contains data on the titling process, including the reliability of title infrastructure, the transparency of title information, the geographic coverage of titling, and the mechanisms for resolving title disputes. These indicators are aggregated into a title index, which describes the quality of legal and regulatory infrastructure that

[2] We do not focus on the temporary transfer of property through rental arrangements, for these are typically limited more by rent control rules than by title. Glaeser and Luttmer (2003) empirically quantifies the misallocation of apartments due to rent control.

[3] A third element of the property rights bundle, on which we do not focus here, is the right to develop or improve one's land and property, which is often restricted by zoning.

administers the titling process. Second, the database contains data—over a period of 16 years—on rules governing the transfer of urban property, including the number of steps it takes to transfer a piece of property, the cost of doing so, and the time it takes in a typical case. We aggregate these indicators into a transfer index. In Section 2, we describe how these data are constructed from hard information on rules and procedures and from surveys of professionals involved in the titling and the transfer of property.

We also establish three preliminary findings. First, there is tremendous disparity in the quality of institutions of titling and transferring property across countries, but they are generally much better in more developed (or higher human capital) countries. The finding is not surprising, since the human capital of a country and its level of economic development are typically closely associated with all measures of government effectiveness (see La Porta et al. 1999; Glaeser et al. 2004). Second, perhaps more surprisingly, although the data on titling and transfer institutions are collected in very different ways, there is a high correlation between the quality of the two types of institutions, even controlling for the level of economic development. And third, several of the determinants of the quality of institutions identified in previous research, such as human capital, the level of development, and government effectiveness, matter here as well, while others, such as legal origin, do not.

In Section 3, we present a theoretical model of a city using the Alonso-Muth-Mills framework (Brueckner 1987) in which formal jobs are located in a city center, while residents live and work informally, if they do not have formal jobs, away from the center. The model allows us to study the size of the city, its residential density, commute times, and patterns of land ownership. We add to this standard framework a cost of protecting one's property and limitations on property transfer.

These alterations to the standard model yield several predictions, but we focus on two. First, limitations on the right of possession lead to reduced consumption of urban land. Residents must either invest in self-protection or risk losing their property, and both the costs and the risks scale up with investment. Consequently, residents invest less and consume lower-quality housing, and urban density levels are higher. Second, limits on the right to transfer imply that people remain stuck in place even if they have to commute far to work, which leads to greater traffic congestion. In Section 4, we test the key predictions of our model that weak possession rights lead to high density and poor structures and that weak transfer rights lead to a spatial mismatch between residences and workplaces. We use urban data on density, the presence of slums, and traffic congestion to evaluate our hypotheses.

For our housing structure and density outcomes, we use the percentage of urban population living in slums (which are typically informal), residential density, and the average size of formal and informal lot sizes. We use four aspects of titling quality to measure right of possession and the title index aggregating them. We typically control for the logarithm of per capita gross domestic product

(GDP). Three of the four measures and the overall title index show that stronger right of possession is associated with a smaller share of residents living in slums. The title index is also significantly negatively correlated with density and positively associated with informal lot size. Transfer rights are not correlated with any of these outcomes, just as the model predicts.

We then test whether weak transfer rights are associated with more traffic congestion, and we find that to be the case. Housing always has two critical qualities: location and physical structure. The model predicts that the right of possession is associated with better structure and that right of transfer is associated with better location. Both predictions find support in the data.

Finally, we examine the prevalence of home-related lending across countries, which should be influenced by both title and transfer institutions. A mortgage loan relies on a valid title and the ability to repossess and sell (transfer) the property if the borrower defaults. While both title and transfer measures correlate with the prevalence of mortgages, the number of transfer procedures influences the penetration of housing loans, even controlling for title and per capita income. This result shows the key role of the right of transfer for financial development.

In Section 5, we describe the evolution of institutions governing property transfer over the relatively short period of our sample. We have the transfer variables over 16 years, but we have the title variables for only a few years. For many institutions, particularly those tied to legal traditions of countries, the data show a great deal of persistence (La Porta, Lopez de Silanes, and Shleifer 2008), but here we find something different. Over a 16-year period, many countries sharply improved their institutions for transferring property. The time frame is too short to allow us to test whether these institutional changes translate to reduced commute lengths or other improvements in urban form.

The mechanisms behind such improvement largely result from the pervasive introduction of information technology. We find little evidence that suggests that these changes were politically motivated but rather find that they were efficiency driven. As cities grow, it becomes increasingly efficient to invest in better procedures for formalizing the transfer of property. Many cities have accommodated that demand. As Demsetz (1967) argues, the creation and improvement of property rights institutions follows, at least in part, the needs of economic efficiency.

2. Data and Initial Findings

We build two sets of variables pertaining to the measurement of property rights, using data from the World Bank: the title index, comprising four subindices of the quality of land administration index, and the transfer index, comprising three variables for the number of procedures, time, and cost of transferring property title between private parties (Table 1). These indices are constructed by unpacking the World Bank's Registering Property score, which consists (with equal weighting) of transfer procedures, transfer time, transfer cost, and the quality of land administration index.

Table 1

Variable Descriptions

Variable	Description	Level
Title	Index of 0–30 in 2015	City
Reliability of Infrastructure	Index of 0–8 in 2015	City
Transparency of Information	Index of 0–6 in 2015	City
Geographic Coverage	Index of 0–8 in 2015	City
Land Dispute Resolution	Index of 0–8 in 2015	City
Transfer	Property transfer efficiency index in 2019	City
Transfer Procedures	Number of procedures to transfer a property	City
Transfer Time	Time to transfer a property in days	City
Transfer Cost	Cost to transfer a property as the percentage of its value	City
UN Slum Share	Population living in slums as the percentage of the urban population in 2014 (UN-Habitat)	Country
Log(Built-Up Area Density)	Density of the built-up area in persons per hectare circa 2013 (Atlas of Urban Expansion)	City
Log(Formal Lot Size)	Average lot size in formal land subdivisions in 2015 (Atlas of Urban Expansion)	City
Log(Informal Lot Size)	Average lot size in informal land subdivisions in 2015 (Atlas of Urban Expansion)	City
Log(GDP)	Log of gross domestic product (World Development Indicators)	Country
Government Effectiveness	Government effectiveness scale of −2.5 to 2.5 (Worldwide Governance Indicators)	Country
Human Capital	Index of 0–1 in 2020	Country
TomTom Congestion Level	Congestion calculated as the percentage of excess travel time during rush hour beyond travel time in baseline traffic	City
Expropriation with Adequate Compensation	Dummy variable indicating that the government does not expropriate without lawful process and adequate compensation (World Justice Project)	Country
Housing Loan Penetration	Percentage of adult population with an outstanding loan to purchase a home (World Bank)	Country

The World Bank collected the data by reviewing the relevant laws and regulations and using surveys filled out by property lawyers, notaries, and administrators in land and cadastral registries. Data are for the main commercial city in 190 economies.[4] Online Appendix OA describes the variable construction procedures, including our institutional measures, in detail.

2.1. Title

In addition to police protection, several administrative processes make a title more secure. First, authorities can make transparent and easily accessible all the information pertaining to encumbrances on the property in question. Second, they can make this access universal: for any property and from anywhere. And third, they can establish a straightforward resolution process should challenges to the title arise. This resolution process can be court supervised or part of the administrative protection of title. Different countries approach the security of title differently. While France makes geographic access universal, Australia does not. While the United Kingdom has an expedient resolution process, Greece has a lengthy process to challenge title infringements.

The World Bank's quality of land administration index measures the security of title. It is composed of five subindices: Reliability of Infrastructure, Transparency of Information, Geographic Coverage, Land Dispute Resolution, and Equal Access to Property Rights. We do not use the gender equality subindex in this study, as it shows very limited variation across the sample. We use the remaining four equally weighted indices to construct the indexed variable Title. Data for the title index are available for 5 years, 2015–19. We use 2015 in the analysis.

The first subindex for the title index, Reliability of Infrastructure, captures the consistency and dependability of record-keeping systems in a country's property management system. This subindex records whether title and cadastral records are electronic, stored in a reliable database, and consistently maintained between governmental agencies. This index ranges from 0 to 8. In Turkey, for example, titles and cadastral maps are fully electronic, and databases of land ownership are linked. Turkey receives a perfect score of 8 on the subindex. Oman, where land title certificates are kept in paper format at the immovable property registry, receives a 5, while Afghanistan, with paper-based and separate databases at the immovable property registry and the cadastral agency, receives a 0.

The second subindex for the title index, Transparency of Information, captures the availability of property information to the general public. This subindex records whether cadastral plans, fee schedules, required documents, and complaint systems are made easily available to the public. This index ranges from 0 to 6. In the Netherlands, for example, an online title database, a required-document list, a fee schedule, and a complaint mechanism are all available using the Kadaster website, which results in a perfect score of 6. Montenegro, with neither public

[4] For details on the data collection process, see World Bank, Doing Business Archive: Registering Property Methodology (https://archive.doingbusiness.org/en/methodology/registering-property).

statistics for transactions nor an independent complaint mechanism, receives a 3; Sudan, where only intermediaries and interested parties can obtain title information—and fee schedules are available in person only—receives a 0.

The third subindex for the title index, Geographic Coverage, captures the completeness of titling information at the land registry and mapping agency. This subindex ranges from 0 to 8. For instance, in the Republic of Korea, all land plots are registered and mapped at the local and national levels, which gives Korea a perfect score of 8. Portugal, where all land plots are formally registered or mapped, but only at the local level, receives a 4, while Senegal, where land is not fully registered or mapped even in the main commercial city, receives a 0.

The fourth subindex for the title index, Land Dispute Resolution, captures the effectiveness and efficiency of the legal system for property disputes. It records whether there are formal compensation mechanisms, legal verification and guarantee systems, fair legal rules, and efficient court systems. The land dispute resolution subindex ranges from 0 to 8. In the United Kingdom, all property sales are guaranteed by the government, lawyers are required to verify legal documents with a national database, and the court system rules quickly, which gives it a perfect score of 8. Peru, where there is no out-of-court compensation mechanism and a land dispute can take 2–3 years to resolve, receives a 5 on the subindex, while Sri Lanka, where there are no guarantees for property registration and no databases for verifying identity documents, receives a 1.

2.2. Transfer of Title

The World Bank database contains three transfer variables measuring this process in the country's largest commercial city. These include the number of procedures and the time and cost to purchase and transfer a property title from a private seller to a private buyer. Transferring title begins with obtaining necessary documents, such as a copy of the seller's title, and is considered complete when the buyer can use the newly acquired property. Every procedure required by law or necessary in practice is included, whether it is the responsibility of the seller, the buyer, or a third party on their behalf. Data for the transfer variables are available for 16 years, from 2004 to 2019, and we use 2013 data for the analysis here.

Several assumptions are made for comparability across countries. These assumptions also simplify the case, as they eliminate the most likely ways in which the transfer of title can be complicated. The buyer and the seller are assumed to be limited-liability companies that are located in the periurban area of the economy's largest commercial city, are 100 percent domestically and privately owned, and perform general commercial activities. The property is assumed to have a value 50 times per capita income, be fully owned by the seller for the previous 10 years with no mortgage, be registered in the land registry, be free of title disputes, be located in a periurban commercial zone, not be subject to renovations after purchase, be used for general commercial purposes, have no occupants, and have no other party with a legal interest in it.

The variable Transfer Procedures captures the interactions between the buyer,

the seller, or their agents and external parties, including government agencies, inspectors, notaries, and surveyors. The fastest legal procedure required for transferring title is used when more than one procedure exists. There are significant differences in how many procedures are required by law to transfer title. For example, a transfer of title in Managua, Nicaragua, in 2013 legally required nine procedures, whereas it required five procedures in Riga, Latvia, and two in Manama, Bahrain.

The variable Transfer Time captures, in days, the median duration that property lawyers, notaries, or registry officials indicate is necessary to complete a title transfer. The fastest legal procedure required for transferring title is recorded. For instance, a transfer of property in Port-au-Prince, Haiti, in 2013 required 319 days to complete, whereas it required only 4 days in Toronto, Canada.

The variable Transfer Cost captures the official costs required by law as a percentage of the property's value (assumed to be 50 times income per capita). These costs include fees, transfer taxes, stamp duties, and other payments to the title registry, notaries, public agencies, or lawyers. For instance, a transfer of title in Douala, Cameroon, in 2013 cost 19.1 percent of the property's value, whereas in Quito, Ecuador, it cost 1.9 percent of the property's value.

We construct the transfer index as the sum of the *Z*-scores of the procedures, time, and cost variables. The higher the value of the index, the less efficient is the transfer of title.

2.3. Outcome Data

The United Nations Human Settlement Programme (UN-Habitat) provides the number of people living in slums as a percentage of the urban population for 83 economies in our sample. For instance, in 2018, 38 percent of the urban population in the Philippines and 23 percent of the urban population in South Africa lived in slums.

The Lincoln Institute of Land Policy's Atlas of Urban Expansion provides data on cross-country land outcomes using satellite imagery and comprises two data sets: (1) blocks and roads and (2) areas and densities. These data are available for up to 76 economies in our sample. The blocks and roads data set measures the configuration of cities. Image analysts divide individual city blocks into lots or individual parcels of land that would likely be identified as separate properties in a cadastre. The data set distinguishes between informal land subdivisions and formal land subdivisions. Informal land subdivisions are areas that are "subdivided for urban use, but that lack visible evidence of conformity to land subdivision regulations such as regular plot dimensions, paved roads, . . . or sidewalks." Formal land subdivisions are "similar in layout to informal layouts, but exhibit a higher level of regularity, a higher level of provision of infrastructure, and better connections to existing roads" (Angel et al. 2016, p. 30).

Variables in this data set include measures of average lot size in formal and informal land subdivisions. For instance, the average lot size in formal and informal land divisions in El Salvador were 157 and 77 square meters, respectively, in

2015. These variables are constructed from satellite imagery for areas developed between 1990 and 2015.

The areas and densities data set measures compactness of the urban area. Each pixel of satellite images is classified as a built-up area (human-constructed, impervious surfaces), open space, or water. The variable Log(Built-Up Area Density) is calculated by taking total population of the city and dividing by its built-up area. For example, the built-up area density in El Salvador is 100 people per hectare. These data are available for 1990, 2000, and circa 2013. We use values from circa 2013.

The TomTom public database measures city-level traffic congestion in 56 of the economies covered in our data. The index uses real traffic data from 600 million drivers to calculate the excess travel time during rush hour as a percentage of off-peak travel time. In 2019, an average trip during rush hour took 18 percent more time than in baseline traffic in Iceland but 60 percent longer in India.

Finally, the percentage of adult population with an outstanding loan to purchase a home, obtained from the World Bank's Global Findex database, is used as a measure of housing loan penetration. We use the data for 2017.

2.4. Control Variables

The World Development Indicators collection contains annual per capita GDP, which we use as a control for 185 economies. The World Governance Indicators project provides an index of government effectiveness, capturing perceptions of the quality of public services and quality of civil services for 189 economies. The indicator ranges from −2.5 (weak governance) to 2.5 (strong governance). The World Bank's Human Capital Index is constructed from measures of child survival rates, expected years of school, and childhood health factors and is available for 168 economies. The index ranges from 0 (low human capital) to 1 (high human capital).

2.5. Preliminary Findings

Values for Title are highly variable, with a mean of 14.26 and a standard deviation of 7.49 in our sample of countries. As a first step, we check whether this variable is correlated with a closely related survey measure of the quality of property rights protection from the WJP database, namely, a measure of the risk of expropriation of property by the government without due compensation. Figure 1 shows the correlation between Title and the WJP expropriation risk. Of course, Title generally has higher values in more developed countries. When we split the sample into quintiles by per capita income, countries in the top quintile score nearly three times higher than countries in the bottom quintile (Figure 2). Table 2 presents these results more formally, using continuous measures. We regress Title, its four subindices, and the four transfer variables, including the transfer index, on Log(GDP), Human Capital, and Government Effectiveness. We uniformly find significant correlations with the expected sign. This result is not sur-

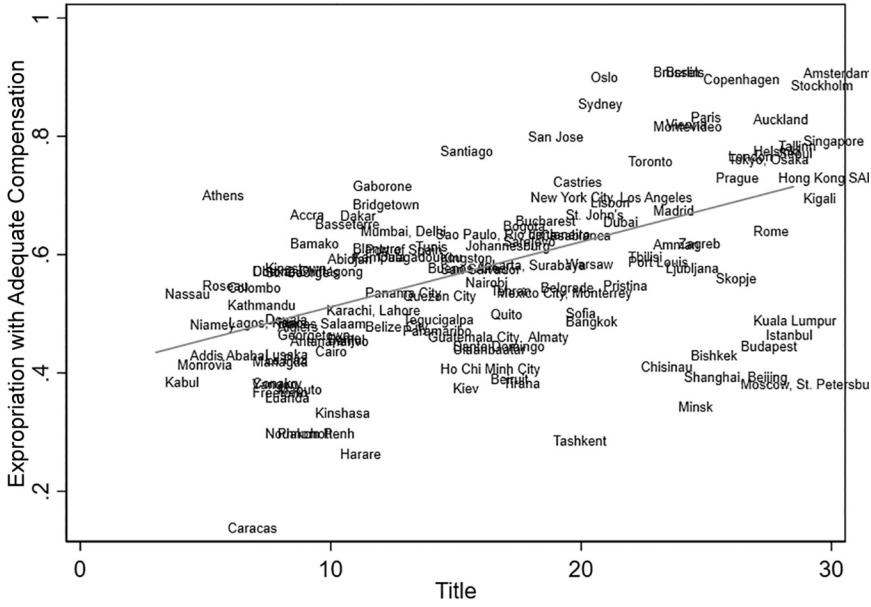

Figure 1. Correlation between the title index and World Justice Project expropriation risk

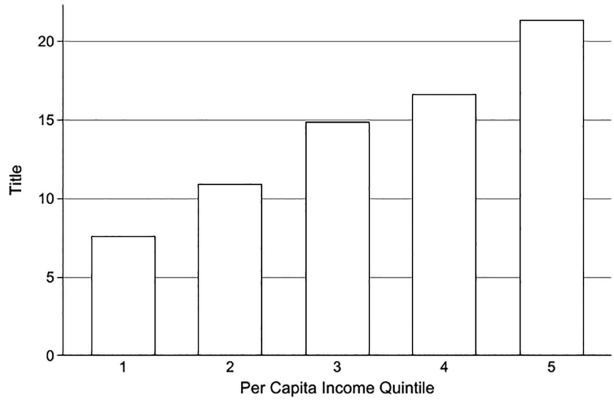

Figure 2. Title index by 2015 gross domestic product quintile

prising since the quality of government institutions across the board rises with human capital (La Porta et al. 1999; Chong et al. 2014).[5]

There is a strong correlation between the title index and subindices and the transfer variables. This is somewhat surprising because the title index is created

[5] We looked at several other determinants of the quality of government from previous research, such as legal origins and ethnic fractionalization, but did not find consistent results.

Table 2

The Improvement of Title and Transfer Rules with Economic Development

	Title	Reliability of Infrastructure	Transparency of Information	Geographic Coverage	Land Dispute Resolution	Transfer Procedures	Transfer Time	Transfer Cost	Transfer
Log(GDP)	3.393**	1.255**	.389**	1.313**	.400**	−.234*	−10.64**	−.790**	−.538**
	(.286)	(.114)	(.0658)	(.129)	(.0688)	(.110)	(2.576)	(.216)	(.100)
Human Capital	41.72**	15.33**	5.513**	14.95**	5.482**	−3.740**	−131.3**	−12.51**	−7.698**
	(2.532)	(1.071)	(.650)	(1.329)	(.670)	(1.183)	(27.46)	(2.176)	(1.013)
Government Effectiveness	5.511**	1.953**	.767**	2.094**	.626**	−.613**	−17.15**	−1.349**	−1.015**
	(.394)	(.163)	(.0918)	(.181)	(.103)	(.161)	(3.798)	(.342)	(.145)

Note. All models are univariate regressions. Standard errors are in parentheses.

* $p < .05$.

** $p < .01$.

with a different methodology than the transfer variables (procedures, time, and cost). Even when controlling for per capita income, the partial correlation between Title and Transfer is −.493 (Table 3 and Figure 3). This result suggests that the security of title is associated with the efficiency of title transfer, and we should be careful in disentangling the effects of the two sets of rules and institutions.

3. A Model of Urban Land Allocation

We consider a simple Alonso-Muth-Mills model (Brueckner 1987). A mass M of consumers or residents locate along a line. A fraction of consumers q works in the city center, denoted 0, and the remainder work from home. We can think of city center employment as formal and employment at home as informal. All individuals earn incomes of W in the city center but only δW working from home, where δ is sufficiently low that anyone who has an opportunity to work in the city center will do so. Individuals who work in the center pay commuting costs of t times d, where d is the distance of daily commute. The only housing consumed is land, and utility is given by $\alpha \ln(L) + C$, where L represents land and C reflects consumption of a composite commodity with a price normalized to 1. A consumer's income minus commuting costs must be equal to the sum of consumption C and rent, so absent any expenditure on protecting one's property, $W - td = C + p(i)L$, where $p(i)$ represents the rent on land at location i. Those who work from home have an arbitrarily small preference to be closer to the city center, which ensures that they live on the urban edge instead of in the middle of the countryside. Land has a rental value of r_A when it is not occupied by city residents.

We assume that the density of land is 1 at every location and that in the urbanized areas all of that land is used by residents. In the land market equilibrium, land supply equals land demand. This means that for any segment of a line of length s, the total supply of land s must equal the number of consumers who live along that land times the average amount of land demanded by each of them. If $D(i)$ is the density of consumers living at location i and $L(i)$ is the land demanded by the average consumer at that location, then for any two locations x and y where $x > y$,

$$x - y = \int_{i=y}^{x} L(i)D(i)di.$$

The optimization decisions of consumers in this model deliver two choices that shape the city. Consumers must choose their location optimally, which implies that $p'(i)L(i) = -t$ for $i > 0$, because commuting costs rise with distance from the city center and must be exactly offset by declining rents. Consumers must also choose their land consumption optimally, which implies that $p(i) = \alpha/L(i)$, so rent times land consumption is constant. The last equation is a product of our functional form (which the spatial optimization equation is not), but land consumption always increases as rents fall, because in a spatial equilibrium declines in rent are compensated changes.

Table 3

Partial Correlations between Title and Transfer Indices

	Title	Transfer Procedures	Transfer Time	Transfer Cost	Reliability of Infrastructure	Transparency of Information	Geographic Coverage	Land Dispute Resolution
Transfer Procedures	−.296**							
Transfer Time	−.319**	.206**						
Transfer Cost	−.377**	.130+	.157*					
Reliability of Infrastructure	.849**	−.280**	−.317**	−.412**				
Transparency of Information	.581**	−.144+	−.271**	−.243**	.473**			
Geographic Coverage	.770**	−.192**	−.114	−.189*	.453**	.167*		
Land Dispute Resolution	.706**	−.286**	−.308**	−.238*	.520**	.328**	.405**	
Transfer	−.493**	.743**	.502**	.638**	−.501**	−.349**	−.244**	−.396**

Note. Results are partial correlations after controlling for per capita income. The *p*-values indicate the level of statistical significance of the amount that R^2 decreases by removing a variable from the regression.

+ $p < .1$.

* $p < .05$.

** $p < .01$.

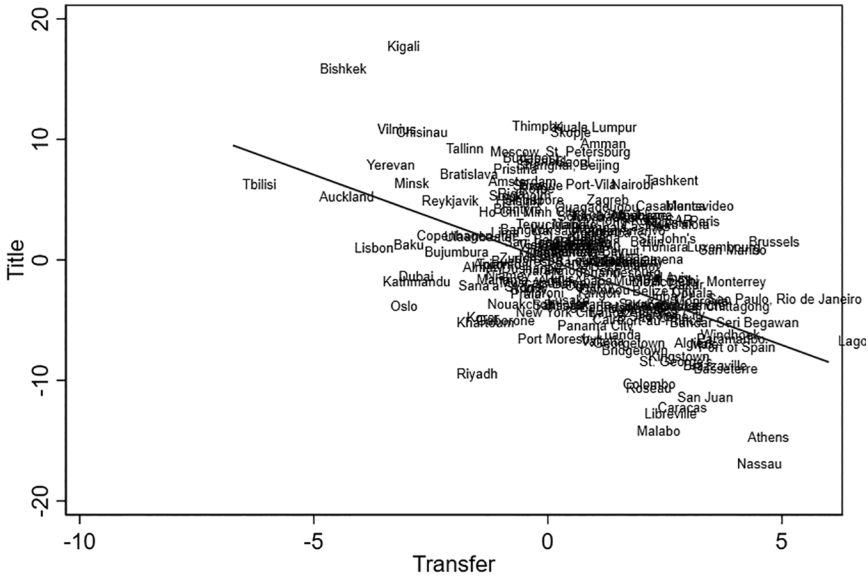

Figure 3. Partial correlation between the title and transfer indices

We next introduce insecure title into this standard model. To do so, we assume that after the property is bought or rented, it must be protected from expropriation or invasion. For simplicity, we assume that the cost of protecting one's land is k times its value. We also assume that both commuters and people working from home must pay this cost, so we do not model the Field (2005) effect of families staying at home and not going to work or school in order to protect it.

We are particularly interested in the link between security of title and urban density and land rents, and in how security of title differs from the ease of transferring title. In proposition 1 we focus entirely on the security of title. Comparing these results with proposition 2, which focuses on the cost of transfer, shows how the title and its transfer exert different impacts of urban form. Proposition 1 describes an equilibrium in which individuals buy and consume land after they know their workplace location and have imperfect security of tenure (all proofs are in Online Appendix OB).

Proposition 1: Insecurity of Title. If $|i| < (\alpha/t)\ln\{1 + [qMt/2(1 + k)r_A]\}$, then rent equals $p(i) = e^{-(t/\alpha)|i|}\{[qMt/2(1 + k)] + r_A\}$, and density is given by $e^{-(t/\alpha)|i|}\{qMt/2\alpha + [(1 + k)r_A/\alpha]\}$. If $(\alpha/t)\ln\{1 + [qMt/2(1 + k)r_A]\} + [\alpha(1 - q)M/2r_A(1 + k)] > |i| > (\alpha/t)\ln\{1 + [qMt/2(1 + k)r_A]\}$, then rent equals r_A, and density is given by $(1 + k)r_A/\alpha$. Over the entire city, density equals $(2\alpha/tM)\ln\{1 + [qMt/2(1 + k)r_A]\} + [\alpha(1 - q)/r_A(1 + k)]$, which is declining with k, and the distance of the average commute equals $(\alpha q/t) - [2r_A(1 + k)\alpha/t^2M]\ln[1 + [qMt/2r_A(1 + k)]]$, which is also declining with k.

Proposition 1 pairs the most canonical of all urban models with the need to protect one's property. The split of the population into commuters and noncommuters leads to a two-sector urban model. Land close to the city center is occupied by commuters, who live at particularly high density levels close to formal work and pay proportionately higher rents. Rents decline exponentially with distance from the city, and density falls along with the rent.

Insecure property fits naturally into this model of urban equilibrium. In the noncommuting zone, rent is tied down by the value of land in agricultural use. The cost of city living then scales up with the cost of protecting one's title. As a consequence, larger properties become more expensive to maintain when title protection is weak. Higher effective housing costs then lead city dwellers to consume less land, which leads to higher density levels and lower welfare. A simple extension of the model would allow residents to invest in physical structures. If these structures were also subject to expropriation, they would be smaller and cheaper when the right to possession is weak.

Within the commuting zone, rents always fall when title is less secure. Density also rises, and the city's overall footprint shrinks. Commuting distances fall when title is insecure because the city as a whole gets smaller. Proposition 1 implies that the shape of the city depends on the property title regime. With weak property rights, people crowd more and consume less land.

Figure 4 shows a calibration of the model when $k = 0$ and $k = .25$. We assume that the city population (M) is fixed at 100,000, $q = .5$, $\alpha = 20$, $r_A = 100{,}000$, and $t = 4$, which implies that when title is secure ($k = 0$), 50,000 people work in the city center, and the price of land in the city center is twice the price at the edge of the city. The two curves show how density levels peak in the city center and then decline. At the urban edge, the land price equals the price of agricultural land, and density is flat because those residents are not commuting into the city center. The high curve shows the impact of insecure property rights, which raise density levels and make the city more compact. As the cost of defending property rises, the amount of property consumed falls, and the city becomes more crowded.

Our cross-sectional data provide information about the share of the urban population living in a slum. In our model, we define "slum conditions" as living at a density level greater than a threshold d_S. We recognize that there are millions of densely populated apartments that are not slums and provide living space with significant physical capital investment. As our model has no investment in physical capital, we identify slum living—in the model—with high density.

Corollary 1. If $(\alpha d_S - r_A)/r_A > k > (\alpha d_S - .5qMt - r_A)/r_A$, then the urbanites who live less than the distance $(\alpha/t)\ln[qMt + 2r_A(1 + k)/2\alpha d_S]$ from the city center live in slums, and the share of the population living in slums increases from 0 to q as the protection of property rights gets weaker (k rises). If $k > (\alpha d_S - r_A)/r_A$, then all of the urbanites live in slums, and if $k < (\alpha d_S - .5qMt - r_A)/r_A$, then none of the urbanites live in slums.

Corollary 1 describes the connection between property rights and the prevalence of slums in our model. At the intermediate level of property rights, people

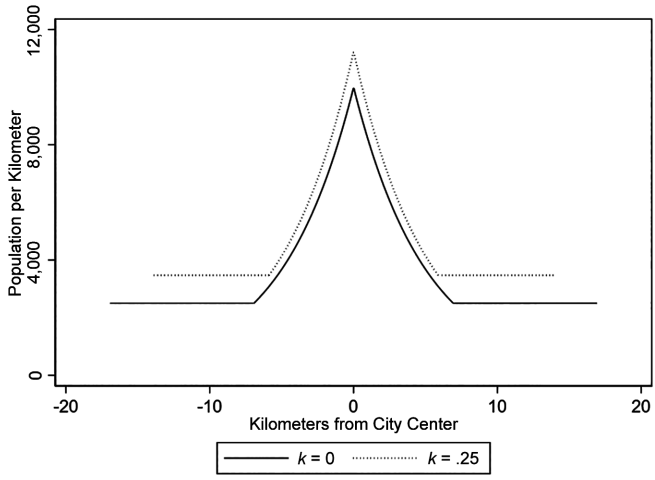

Figure 4. Title, population density, and distance from city center

living close to the city center live at densities that are higher than slum level. As property rights become weaker, density levels increase, and the physical footprint of slums also increases. The share of the population living in slums falls as the protection of property rights improves, because urbanites invest in more housing consumption.

This model predicts that slums are more prevalent near the city center, but that might not be the case if we extend the model to include income heterogeneity. If we allow for rich and poor urbanites, then those who can afford it will live closer to the city center, but not in slums, to avoid commuting costs. This pattern of income sorting can explain why developing-world cities often have slums on the urban edge. A second explanation for slums far from the city center is that property rights are more poorly protected on the urban edge, which makes squatting easier.

Our core results are unchanged if we assume the population of the city to be endogenous. To endogenize city population, we assume that migration to the city occurs until a resident's utility in the city equals utility in a reservation locale, denoted $\underline{U}$, and we assume that the city is attractive enough to lure some people. We define Z as the constant that satisfies the equation $-\alpha + \alpha\ln(\alpha) - \alpha\ln(Z) = \underline{U}$, and then proposition 1′ follows:

Proposition 1′: Insecurity of Title, Open City. City population equals $\{2[Z - (1 + k)r_A]\}/qt$ and is declining with k. If $|i| < (\alpha/t)\ln[Z/(1 + k)r_A]$, then rent equals $p(i) = e^{-(t/\alpha)|i|}[Z/(1 + k)]$, and density is given by $e^{-(t/\alpha)|i|}(Z/\alpha)$. If $(\alpha/t)\ln[Z/(1 + k)r_A] + \{\alpha(1 - q)[Z - (1 + k)r_A]/r_A(1 + k)qt\} > |i| > (\alpha/t)\ln[Z/(1 + k)r_A]$, then rent equals r_A, and density is given by $(1 + k)r_A/\alpha$. The average commute distance equals $(\alpha q/t) - \{r_A(1 + k)\alpha q/t[Z - (1 + k)r_A]\}\ln[Z/(1 + k)r_A]$, which is decreasing with k. Overall density is also rising with k.

Holding the quality of legal regimes elsewhere constant, we see that more insecure title in the city leads to a smaller population and a smaller physical footprint. Yet despite the city's shrinking population, overall density levels, or crowding, still rise. When population is endogenous, lot sizes become independent of title security in the inner commuting zone of the city, although the size of that zone shrinks as title security deteriorates. In the outer, noncommuting zone, crowding increases as title security falls.

Crowding could cause traffic to get better when title becomes less secure. In contrast, the inability to transfer property—perhaps because the institutions of transfer are ineffective—causes commuting distances to rise, which presumably makes traffic worse. To capture this cost, we assume that people must choose their location before they learn whether they will work in the city center or from home. The current model can be interpreted as one in which people buy housing at time 0, before they have learned their employment location, and then move, at zero moving cost, after they learn where they will work. Limits on the right to transfer make this cost positive.

At the extreme, we now consider what happens when people cannot move after learning their employment status at time 0. This implies that some people who live far from the city center end up with a long commute, and others live close to the city center without a formal job and work from home. Everyone is assumed to have a probability q of receiving a job at the city center but then being stuck in place. Consumers are risk neutral over consumption, as suggested by our functional forms. With these assumptions, proposition 2 follows:

Proposition 2: Inability to Transfer. If $|i| < (\alpha/tq)\ln\{1 + [qMT/2(1 + k)r_A]\}$, rent equals $p(i) = e^{-(tq/\alpha)|i|}[qMT/2(1 + k) + r_A]$, and density equals $e^{-(tq/\alpha)|i|}\{qMT/2\alpha + [(1 + k)r_A)/\alpha]\}$. The city ends where $|i| = (\alpha/tq)\ln\{1 + [qMT/2(1 + k)r_A]\}$ and density is 0. Over the entire city, density equals $(2\alpha/tqM)\ln\{[2(1 + k)r_A + qMT]/2(1 + k)r_A\}$, which is declining with k, and the average commuting distance equals $(\alpha/t) - [2r_A(1 + k)\alpha/t^2Mq]\ln\{1 + [qMt/2r_A(1 + k)]\}$, which is higher than $(\alpha q/t) - [2r_A(1 + k)\alpha/t^2M]\ln\{1 + [qMt/2r_A(1 + k)]\}$.

Proposition 2 tells us that rents and density at the city center are the same regardless of the possibility of land transfer, but both decline more slowly with distance to the city center when there is no ability to transfer property. The city as a whole becomes larger, and density becomes lower, because the willingness to pay declines more slowly. The rent and density at the city center are not impacted because the flatter slope of rents and densities is offset by the greater distance to the city's edge.

Figure 5 shows the impact of inability to transfer on density levels. The two curves use the same parameter values as Figure 4, and $k = 0$ for both. The lower curve is identical to the curve with strong title protection in Figure 4; the upper curve shows the equilibrium density levels when there is no ability to transfer title. The city's boundaries shrink. With a more compact city, density is also

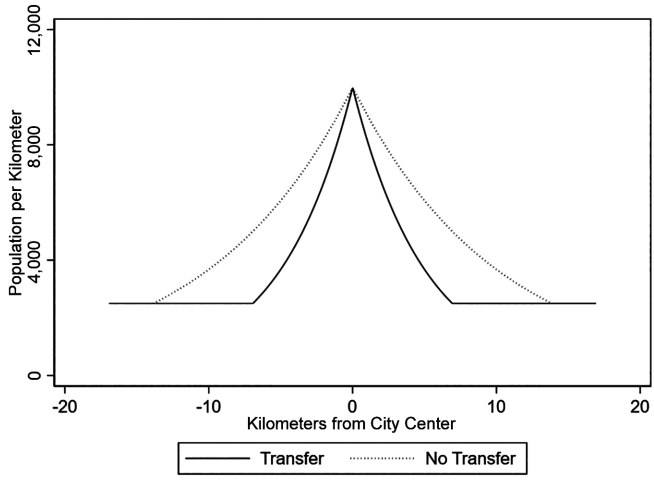

Figure 5. Transfer, population density, and distance from city center

higher everywhere the city is inhabited. This densification works to reduce, but not to eliminate, the longer average commutes created by the spatial mismatch.

Commuting distances become longer because of two related effects. First, there are people who live close to the city center but are still working at home because they cannot move farther out. They are pushing out people who would love to live closer but cannot readjust their location after getting jobs in the city center. Second, the city gets larger because willingness to pay declines more slowly with distance from the city center.

Propositions 1 and 2 shape our empirical work on property title, property transfer, and urban form. Proposition 1 generates the prediction that insecurity of title should lead to higher density levels or, equivalently, smaller lot sizes.

We also identify this prediction with the proportion of people living in slum dwellings, which are defined by the United Nations as residences that lack "sufficient living space" or "durable housing of a permanent nature."[6] In our model, lot size determines living space, and the weak possession right therefore implies that living space may be insufficient. If we enrich the model to allow structures that are also subject to expropriation, then a limited right to possession would also imply less durable housing.[7] Weak title protection may also deter the building of apartments, because developers fear to lose their property.

Insecure title does not lead to longer commutes or more congestion. Proposition 2 generates the prediction that inability to transfer property leads to a greater

[6] United Nations Human Settlements Program, Slums: Some Definitions, p. 1 (https://mirror.unhabitat.org/documents/media_centre/sowcr2006/SOWCR%205.pdf).

[7] If it costs $f(H)$ to provide housing that delivers the utility equivalent of H units of the consumption good, where $f(H)$ is increasing and convex, and if it costs kH to defend that housing, then the first-order condition for housing would be $1 - k = f'(H)$. The convex costs imply that the optimal level of H is falling with the need for self-protection.

mismatch between people and jobs. Because we do not have consistent data on commuting time and distance, we measure excess driving with the level of congestion, which should be greater if spatial mismatch is more severe.

4. Title, Transfer, and Urban Form

We next turn to the correlations between our property rights measures and urban outcomes. As discussed above, security of title and ease of transfer—or title and transfer for short—should have different impacts on two vital aspects of urban life. Security of title should impact the incentive to invest in housing quality. Ease of transfer should impact the allocation of space to its most efficient users. We begin with our measures of housing quality and then turn to the allocation of space in cities.

4.1. Residential Quality, Title, and Transfer

According to proposition 1, insecurity of title leads to higher urban density and more slums. We start with our preferred measure of housing quality: the share of the population living in a slum as measured by the United Nations. The United Nations "defines a slum household as a group of individuals living under the same roof in an urban area who lack one or more of the following: 1. Durable housing of a permanent nature that protects against extreme climate conditions. 2. Sufficient living space which means not more than three people sharing the same room. 3. Easy access to safe water in sufficient amounts at an affordable price. 4. Access to adequate sanitation in the form of a private or public toilet shared by a reasonable number of people. 5. Security of tenure that prevents forced evictions."[8] The first four conditions relate to the physical nature of the structure. The fifth condition echoes the title security measures that we use as dependent variables, and for this reason we also use other outcomes that are not potentially biased by this overlap.

Table 4 first relates UN Slum Share to our measures of title security; the five regressions all control for the logarithm of per capita GDP. The coefficient on Log(GDP) is always strongly negative, ranging from about −12 to −15. A value of −13 implies that as its level increases by 1 log point (or approximately 170 percent), the share of the population living in a slum falls by 13 percentage points.

The coefficient on the title index is −1.45. As the standard deviation of this variable is 7.5, a 1-standard-deviation improvement in Title is associated with a 10.88-percentage-point reduction in the share of the population living in slums. If we use the −12.26 coefficient on Log(GDP) in this regression, the coefficients imply that a 1-standard-deviation improvement in Title is associated with the same improvement in housing conditions as a 143 percent increase in income. The *t*-statistic on this coefficient is 3.83, which suggests that its magnitude is both statistically and economically meaningful.

[8] United Nations Human Settlements Program, Slums: Some Definitions, p. 1 (https://mirror.unhabitat.org/documents/media_centre/sowcr2006/SOWCR%205.pdf).

Table 4
Urban Form Outcomes and Title

	UN Slum Share	Log(Built-Up Area Density)	Log(Formal Lot Size)	Log(Informal Lot Size)
Title	−1.449**	−.0304**	.0207	.0402+
	(.378)	(.0114)	(.0170)	(.0222)
Log(GDP)	−12.26**	−.144*	.116	.0537
	(1.937)	(.0612)	(.0931)	(.127)
Reliability of Infrastructure	−2.640**	−.104**	.0229	.128*
	(.884)	(.0281)	(.0441)	(.0514)
Log(GDP)	−12.92**	−.117*	.171+	.0157
	(2.012)	(.0564)	(.0906)	(.119)
Transparency of Information	−5.272**	−.0572	.0190	−.0384
	(1.395)	(.0550)	(.0682)	(.104)
Log(GDP)	−13.79**	−.237**	.201**	.236*
	(1.777)	(.0502)	(.0609)	(.111)
Geographic Coverage	−2.119*	−.0219	.0341	.0196
	(1.042)	(.0268)	(.0377)	(.0528)
Log(GDP)	−14.80**	−.227**	.143	.189
	(1.875)	(.0612)	(.0906)	(.118)
Land Dispute Resolution	−2.006	−.101*	.112+	.171*
	(1.626)	(.0456)	(.0620)	(.0754)
Log(GDP)	−15.10**	−.214**	.153*	.125
	(1.946)	(.0482)	(.0613)	(.0973)
N	80	65	52	40

Note. Results are from multivariate regressions controlling for per capita income. Standard errors are in parentheses.
+ $p < .1$.
* $p < .05$.
** $p < .01$.

We next consider the subindices. The variable Reliability of Infrastructure captures the accessibility of property titles, including electronic access and centralized location. The coefficient is −2.64, and the standard error is .88, and so again it is statistically different from 0. The statistical relationship between our measure of the transparency of information about property title and slums is even stronger: the coefficient is −5.272, with a *t*-statistic of 3.78. A 1-standard-deviation increase in this variable is associated with a 7.48-percentage-point decrease in the share of people living in slums.

The measure focusing on the geographic coverage of land-titling information indicates the share of land that is formally registered and mapped. This variable is less strongly correlated with the slum share outcome: the coefficient is −2.12, and the *t*-statistic is just slightly over 2. The regression looking at the dispute-resolution subindex indicates that, while effective dispute resolution looms large in the desiderata for any property title system, the components in this index may not determine the quality of dispute resolution on the ground. For example, the availability of the number of title disputes may not matter for a slum dweller who

is trying to protect his home against expropriation. The coefficient is negative, but it is statistically indistinct from 0 and small.

Overall, the title variables correlate strongly with slum share even when controlling for income. These correlations do not prove a causal link but are consistent with the predictions of proposition 1.

Table 4 also looks at density and average property size. Overall population density is negatively correlated with the overall title index and the four subindices, as predicted by proposition 1. In three cases, the correlation is statistically significant at conventional levels. A 1-standard-deviation increase in the title index is associated with a .23-log-point (or about 25 percent) decrease in urban density, which is quite meaningful. A 1-standard-deviation increase in the reliability of title infrastructure is associated with a decrease in density of about 30 percent.

We then turn to average lot size from the Atlas of Urban Expansion. The atlas presents the lot size variables for formal and informal lots in the city. The titling system would presumably be irrelevant for informal settlements if these areas had no formal title whatsoever. However, informal settlements often have formal title, but the occupants are squatting, or they are "unplanned settlements and areas where housing is not in compliance with current planning and building regulations."[9] To the extent that the owners of informal housing are also protected by the titling system, the model's implication that weak title leads to smaller lot size stands. The poorer owners of these lots are particularly vulnerable to expropriation, so weaker title reduces their willingness to invest the most.[10]

The variable Title is positively associated with both formal and informal lot size, and the coefficient is statistically significant in the regression with informal lot size at the 10 percent level. The component of the index with the strongest relationship with lot size is the quality of dispute resolution. This measure is statistically significant in both regressions. Overall, these results provide some evidence, in line with proposition 1, connecting housing quality (our measure of investment) with the strength of the title.

Table 5 shows the same basic patterns with our measures of transfer, including the number of procedures involved in transferring property, time costs, financial costs, and the transfer index. Our model predicts that these variables should not be helpful in predicting housing quality, and that is indeed what we find. Only Transfer Cost is associated with UN Slum Share, as shown in the first column. All three variables and the transfer index are correlated with the density of the built-up area, but as we show in the last column, these correlations turn weaker or disappear when we control for the title index. The regressions controlling for the title index show that Title is significantly correlated with UN Slum Share in all

[9] Organisation for Economic Co-operation and Development, Glossary of Statistical Terms (https://stats.oecd.org/glossary/detail.asp?ID=1351).

[10] The largest informal lot sizes in our data are in cities of former socialist countries, such as Warsaw and Kiev. The informal lots there are not the lawless slums of poor countries but former public housing that is not yet fully formalized.

Table 5

Urban Form Outcomes and Transfer

					With Title Control	
	UN Slum Share	Log(Built-Up Area Density)	Log(Formal Lot Size)	Log(Informal Lot Size)	UN Slum Share	Log(Built-Up Area Density)
Transfer Procedures	−.199	.0599*	−.00328	.00536	−.640	.0415
	(1.005)	(.0281)	(.0368)	(.0491)	(.931)	(.0286)
Title					−1.481**	−.0252*
					(.382)	(.0119)
Log(GDP)	−15.93**	−.236**	.206**	.217*	−11.99**	−.147*
	(1.852)	(.0449)	(.0596)	(.0972)	(.931)	(.0607)
Log(Transfer Time)	−.4839	.1323*	.0267	−.0964	−5.638*	.0830
	(2.467)	(.0645)	(.0846)	(.1330)	(2.477)	(.0673)
Title					−1.881**	−.0250*
					(.414)	(.0122)
Log(GDP)	−16.110**	−.2104**	.219**	.1881+	−12.623**	−.133*
	(1.939)	(.0500)	(.0651)	(.101)	(1.894)	(.0616)
Transfer Cost	1.036*	.0330+	−.00106	−.0495	.4861	.0234
	(.413)	(.0190)	(.0222)	(.0321)	(.433)	(.0188)
Title					−1.252**	−.027*
					(.416)	(.0117)
Log(GDP)	−15.22**	−.246**	.208**	.171+	−12.40**	−.145*
	(1.785)	(.0448)	(.0554)	(.0962)	(1.938)	(.061)
Transfer	1.3516	.0827*	.00286	−.045	−.896	.0598+
	(1.157)	(.0311)	(.0398)	(.0582)	(1.235)	(.0331)
Title					−1.605**	−.0219+
					(.4361)	(.0122)
Log(GDP)	−15.64**	−.2093**	.2102**	.1866+	−12.081**	−.139*
	(1.836)	(.0468)	(.0621)	(.101)	(1.958)	(.0602)
N	80	65	52	40	80	65

Note. Results are from multivariate regressions controlling for per capita income. Standard errors are in parentheses.

+ $p < .1$.

* $p < .05$.

** $p < .01$.

specifications, but the transfer variables generally do not predict UN Slum Share once we control for Title.

Our model predicts that the right to possess and the right to transfer should have different implications for lot size and the physical quality of housing. Just as the model predicts, weak title protection is associated with higher density and greater prevalence of slums. Stronger transfer rights are not associated with any of these outcomes once we control for Title.

4.2. Spatial Mismatch, Title, and Transfer

We next turn to our spatial mismatch variable, which according to proposition 2 is more likely to be correlated with transfer costs than with the security of title. The inability to buy and sell homes means that as people's economic conditions change, they find it difficult to relocate. We should expect to see longer commutes when the transfer of property becomes more difficult. Ideally, we would identify longer commutes with the physical distance between work and home. Unfortunately, we do not have those data for a sufficiently large sample of our cities and instead use the TomTom data on congestion. The extra driving that comes from an inability to move to a new location leads to more congestion when road infrastructure does not improve to match new travel demands.

The outcome in Table 6 is the measure of traffic congestion defined as the extra travel time resulting from traffic congestion during a basic car trip from the TomTom data. We show that there is a significant correlation between the number of procedures needed to transfer property and the congestion index. We also show that neither the logarithm of time to transfer property nor the financial cost of transferring property is statistically significant at conventional levels, but both coefficients are positive and more than 1 standard error greater than 0. Finally, we show the results using Transfer, which sums the Z-scores of our three measures of barriers. Again, inefficient transfer is associated with increased travel time.

In all specifications, the coefficient on Title is 0. In our model, better title could reduce travel times because density increases. We do not find that negative impact, but we do find support for the prediction in proposition 2 that difficulty of transfer, but not the security of title, increases the spatial mismatch between work and home. Travel congestion falls with log GDP, which may be because richer countries are building high-rises close to city centers or spending more on infrastructure, which can reduce travel times.

Our final test, which falls outside the predictions of the model, considers the penetration of housing loans in a country. Theoretically, mortgage lending relies on both reliable title, since the lender requires valid collateral, and reliable transfer procedures, since the lender must be able to repossess and sell collateral should the borrower default. Figures 6 and 7 present the relationships between Title and Transfer Procedures, respectively, and housing loan penetration. The results are consistent with the theoretical prediction, namely, that both possession and transfer rights are associated with greater penetration of housing loans.

Table 6
Spatial Mismatch and Transfer: TomTom Congestion Level

	(1)	(2)	(3)	(4)
Transfer Procedures	.0133*			
	(.00587)			
Log(Transfer Time)		.0151		
		(.0127)		
Transfer Cost			.00559	
			(.00418)	
Transfer				.0149*
				(.00669)
Title	.000445	−.00125	−.00119	.000276
	(.00268)	(.00262)	(.00261)	(.00266)
Log(GDP)	−.0668**	−.0697**	−.0748**	−.0685**
	(.0153)	(.0158)	(.0156)	(.0152)
Constant	.953**	1.048**	1.118**	1.067**
	(.149)	(.149)	(.131)	(.130)
R^2	.478	.441	.445	.476

Note. Results are from multivariate regressions controlling for per capita income and the title index. Standard errors are in parentheses. $N = 56$.

* $p < .05$.

** $p < .01$.

At the same time, the graphs do not control for per capita income, and housing loan penetration is extremely low in poor countries across the quality of property rights institutions. In the regressions, we take these concerns into account.

Table 7 presents the regressions controlling for log GDP per capita. Results for the full sample controlling for per capita income show that housing loan penetration is significantly affected by both Title and Transfer, although only the latter variable survives when both are included in the regression. This result also holds if we focus on the subsample of upper-income countries, where we see the most variation in housing loan penetration. Table 7 also shows interestingly that the result on the central role of transfer institutions holds for rural housing loan penetration, which has not been the focus of our analysis.

Tables 5, 6, and 7 together illustrate how different elements in the bundle of property rights have different impacts on urban form. As the model predicts, stronger protection of possession is correlated with more land per person and better quality of physical housing. Easier land transfer is not correlated with these outcomes but is negatively correlated with commuting times. These findings suggest that the efficiency of land allocation depends on the ability to transfer property, but the quality of living space depends on the ability to possess it. In addition, Table 7 shows that the penetration of housing loans depends on both the security of title and the number of transfer procedures, but especially on the latter. This is a significant result since, as we noted, most economic research focuses on the benefits of title rather than transfer institutions for economic outcomes.

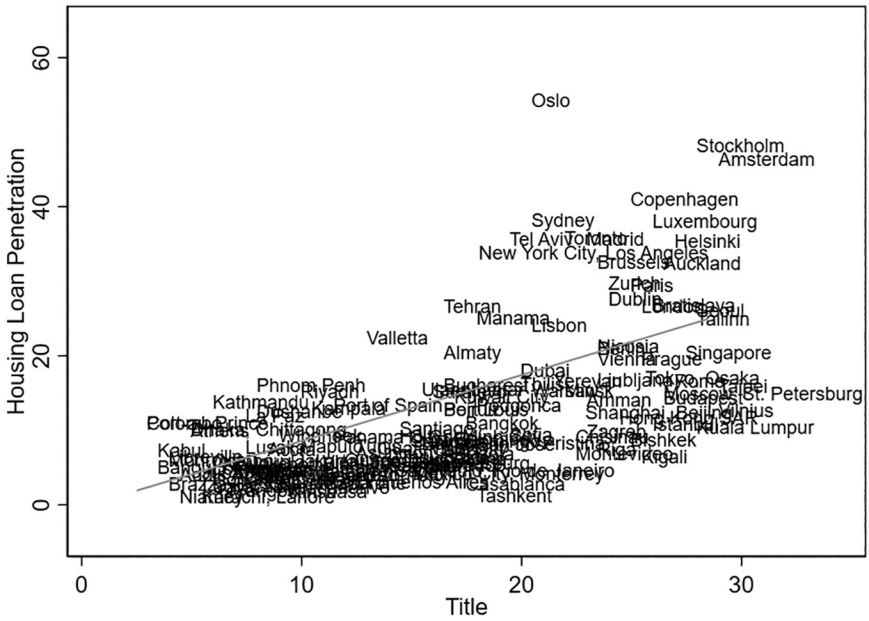

Figure 6. Housing loan penetration and title

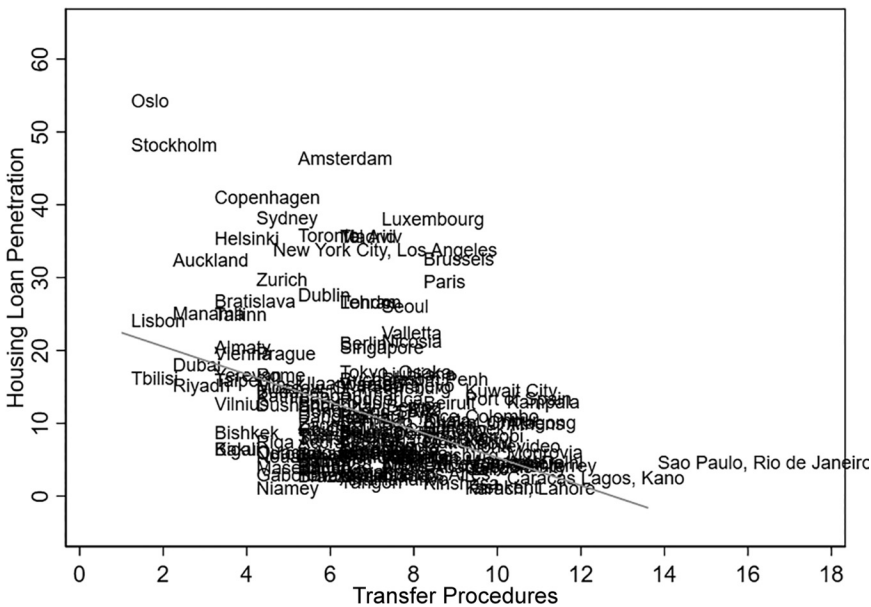

Figure 7. Housing loan penetration and transfer procedures

Table 7
Housing Loan Penetration, Title, and Transfer

	Full Sample			Upper-Income Countries	Rural Areas
	(1)	(2)	(3)	(4)	(5)
Title	.259*		.114	.152	.0573
	(.122)		(.135)	(.176)	(.157)
Transfer	4.403**	4.766**	4.429**	10.08**	4.377**
	(.613)	(.453)	(.603)	(1.238)	(.701)
Log(GDP)		−.946**	−.811*	−.916*	−.994*
		(.309)	(.348)	(.435)	(.404)
Constant	−28.95**	−28.76**	−27.49**	−84.76**	−26.68**
	(4.207)	(3.904)	(4.187)	(10.96)	(4.863)
N	138	138	138	73	138
R^2	.556	.571	.574	.637	.489

Note. Upper-income countries are countries with above-average per capita gross domestic product in 2017. Standard errors are in parentheses.

* $p < .05$.

** $p < .01$.

5. The Evolution of Title and Transfer

We have focused on the effect of title and transfer rules on urban form and show that poor property rights protection is often associated with inefficient urban outcomes, such as slums and traffic congestion, and with stunted mortgage markets. These findings raise the question of whether these rules are getting better or worse over time. Many legal institutions in the world, including the inefficient ones, persist for decades and even centuries and can be driven by their intimate connection to a country's legal tradition (La Porta, Lopez-de-Silanes, and Shleifer 2008; Balas et al. 2009). But there are other institutions, such as the regulation of entry, that have been improving dramatically over time (Djankov 2009).

The rules of title and transfer are not related to legal traditions, but do they change? Increased urban growth is likely to increase the costs of weak possession rights and of inefficient property transfers. An optimistic hypothesis, inspired by Demsetz (1967), is that these increased costs will lead polities to invest in the fixed costs needed to reform their institutions. A related view holds that technological change makes it easier to register and transfer title electronically and thus effectively lowers the cost of securing property rights. A pessimistic view would maintain, in contrast, that economic and political changes empower interest groups to impose new limitations on transfer or create more risk of expropriation.

Figure 8 supports the more optimistic view. We have only limited time-series data on title institutions between 2015 and 2019, but the evidence in Figure 8*A* shows that our composite measure Title has been improving in countries in all income groups. In contrast, we have 16 years of data on transfer rules and find for procedures, time, and cost an improvement for countries of all income levels. Figure 8*B* shows a decline in the number of transfer procedures, particularly in

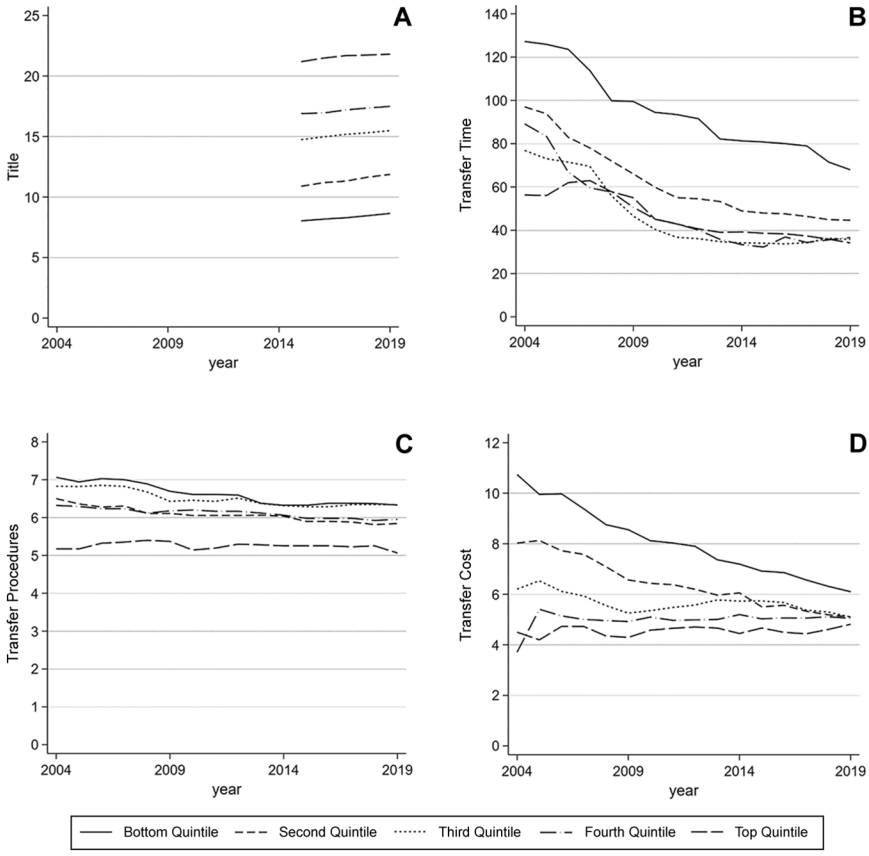

Figure 8. Evolution of title and transfer. *A,* Title; *B,* transfer procedures; *C,* transfer time; *D,* transfer cost.

countries in the bottom two income quintiles. Figure 8*C* and *D* show large reductions for transfer time and transfer cost; these are again present at all income levels but are particularly dramatic for poor countries.

We examined a number of country-specific case studies of reform and found that much of this improvement is apolitical and technocratic. In many cases, new technologies, especially electronic record keeping, drive the reductions in time and cost. In other cases, the number of procedures decreased because of a bureaucratic push toward simplification. These findings support the observation of Demsetz (1967) that—at least some—institutions evolve toward lower transaction costs and a more efficient form.

6. Conclusion

The Blackstonian bundle of property rights is not merely a theoretical construct. The strength of the various rights associated with land ownership can be measured. They can be analyzed as distinct but related forces that shape economic development and urban form.

We have focused on rights related to possession of title and those related to ease of transfer in 190 countries. These institutions differ significantly across cities and countries. Institutions in some countries make it extremely difficult to transfer property, while others offer limited protection of possession. As policy reformers have limited capacity to reform institutions, scholars must develop a richer understanding of the value of the different types of property rights.

This paper suggests that, both theoretically and empirically, the right to possession and the right to transfer have different impacts on urban form. Weak possession rights reduce the incentives to build better housing and own more land. The empirical link between limited title and urban slums is in line with our theory. Limited ability to transfer property makes it difficult to match workplace with home location. The empirical link between the number of procedures needed to transfer property and traffic congestion is also consistent with our model. Finally, we also showed that the development of housing loan finance relies on both title and transfer institutions, but especially the latter.

While many countries provide only weak protection of title and pose many barriers to transfer, the good news is that these institutions are improving in most countries and particularly in the developing world. In line with Demsetz (1967), protection of property rights is costly, but over time the world appears to be moving toward more efficient outcomes. As Demsetz (1967) predicts, as technology lowers the cost of improving property rights, those rights eventually improve.

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