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Integrating Technology and Institutional Change

Toward the Design and Deployment of 21st Century Digital Property Rights Institutions

If you ask any economist what drives the development of human societies over the long term, you are likely to get one of two answers: technological change and innovation, or institutions, notably those that enable the definition and defense of formal property rights.[1] While the individual importance of each of these factors is largely uncontested, the interaction between the two is almost unstudied.

Granted, human societies existed for millennia before the development of formal property rights—deeds, titles, and the like. In some societies, the very concept of private property is still almost alien. Yet in the absence of both robust informal mechanisms to structure social relationships and formal mechanisms to establish clear ownership over goods, the incentive to engage in economic exchange is severely attenuated. After all, how is it possible to engage in exchange if the parties involved do not know who owns what, or what is implied by a trade? Moreover, without property rights, individuals have less of an incentive to engage in productive activities and invest their assets to create economic value.

Property rights also are crucial to the functioning of credit markets, where individuals and businesses pledge assets as collateral; credit markets in turn are a key to economy-wide growth.[2] For these reasons, wherever societies have grown and informal mechanisms for tracking reputations have become strained, the definition and enforcement of formal property rights have correspondingly increased in importance.

Over the past 25 years, economists and policymakers have increasingly recognized the role played by institutions in general, and property rights in particular,

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in the process of economic development. The impetus for this new emphasis has come from both the core and the edge of economic theory. Iconoclastic Peruvian economist Hernando DeSoto is one of the most prominent advocates of the importance of property rights in economic development and alleviating poverty. In his book *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else,* he states:

> Property, then, is not mere paper but a mediating device that captures and stores most of the stuff required to make a market economy run. Property seeds the system by making people accountable and assets fungible, by tracking transactions, and so providing all the mechanisms required for the monetary and banking system to work and for investment to function.[3]

Although organizations such as DeSoto's Institute for Liberty and Democracy have sought to persuade governments around the world to advance development by reforming their formal property rights institutions, the outcomes for which DeSoto and his allies have advocated have been slow to materialize, despite increased appreciation among development professionals of the importance of property rights. Cumbersome processes persist, making economic "formalization" more costly than it's worth for many impoverished households and small-scale entrepreneurs. Moreover, enforcement is often lacking, which results in expensive and time-consuming judicial processes that render formal property rights institutions of little use to individuals and businesses. More to the point is the fact that, in many places, incumbent elites who advance narrow interests have sought to obstruct rather than embrace systematic improvements to property rights systems.[4]

Why have reform efforts failed to yield more satisfactory outcomes? In this essay, we consider several of the challenges of formal institutional reform. We argue that the current environment of technological possibility provides opportunities for significant improvements to formal property rights institutions. We believe that appreciation for the manner in which technology sets the context for the documentation, validation, and enforcement of property rights has been lacking, both in theory and in practice. In this context, technology not only refers to the physical hardware required to maintain a formal property rights registry—paper filing systems, computers, mobile phones, etc.—but also to the specific organizational routines that enable the hardware to function. Furthermore, we note that a property rights system has multiple components, each of which may use a different technology. These include systems to communicate the existence of rights and to share instructions with potential users; the registry itself; a mechanism or set of mechanisms for validating claims and resolving disputes over claims; and, finally, a method for enforcing valid claims. Changes in the underlying technologies and institutional structures used in any of these subsystems can alter the effectiveness of a property rights system in the near term and affect development outcomes in the longer term.

Our objective, then, is to consider how technology interacts with the evolution of institutions, in particular those related to property rights. This is not just an academic question. Today the frontier of technology is reaching the majority of the world's population, notably but not exclusively in the form of mobile handsets. Increased connectivity in even the least developed countries, coupled with the proliferation of mobile phones, presents an opportunity to bring improvements to formal property rights processes in the developing world. This may create exceptional opportunities to accelerate institutional evolution and advance development through the purposive application of technological innovation.

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In section one we outline the theoretical relationships between formal property rights and social development, and between technological innovation and social development, offering select empirical evidence to support this conjecture. In section two we discuss various obstacles to realizing the social benefits that can be derived from formal property rights—in essence, why we have not seen the "property rights dividend" shared equally around the world. In section three we get to the heart of the discussion, describing the interaction between technological innovation and property rights and the importance of that interaction for development. We conclude in section four by outlining the mechanisms through which the current generation of technological innovations might accelerate institutional evolution related to property rights, and thereby yield substantial development dividends.

PROPERTY RIGHTS AND TECHNOLOGY-BASED INNOVATION AS DRIVERS OF DEVELOPMENT

Property Rights and Development

To the extent that the development of a society is about the ability of people in that society to meet their aspirations and to live long, healthy lives, a system of property rights does not, in and of itself, represent development. However, property rights

enable exchange and encourage entrepreneurial initiative, which in turn advance substantive, human development.

In a useful survey of the relevant literature, Timothy Besley and Maitreesh Ghatak define four primary mechanisms through which property rights enable exchange and encourage entrepreneurial initiative: (1) decreased risk of expropriation; (2) lower cost, due to a reduced need to allocate resources to defend property; (3) facilitation of the gains from trade; and (4) the ability to use property to support other transactions, credit in particular:

- **Expropriation risk.** As the risk of expropriation increases, individuals are less likely to benefit from the increased output resulting from productive activities or investments. This in turn reduces the incentive to increase production inputs. By reducing the risk of appropriation, established individual property rights can lead to higher output and productivity. Reducing expropriation risk is particularly important for entrepreneurship. Entrepreneurial opportunity is arguably greatest where market failures are greatest, but a lack of appropriability of returns due to weak enforcement of property rights undermines incentives to engage in entrepreneurial activities.
- **Defensive labor.** When expropriation risk is high due to insecure property rights, producers may choose to allocate labor to defending property. This increases the cost of production and reduces the labor supply for productive activities.
- **Trade.** Classical economics also emphasizes the notion of specialization, wherein individuals focus their efforts in areas where they have an advantage in the marketplace. A requisite of this specialization in the marketplace is the presence of trade, which cannot take place without recognition of changes in ownership and agreed upon rights over property.
- **Credit markets.** The link between formal property rights and credit markets presents a particularly compelling narrative for the economic benefits of property rights. The logic is as follows: When individuals or businesses have formal title to their assets, those assets can be pledged as collateral. This in turn eases credit constraints and lowers interest rates for lenders. Formal titles can interact with credit markets via other mechanisms as well. For example, lenders may be more likely to extend credit where property rights are strong, because borrowers then can be expected to have higher future wealth due to a reduced risk of expropriation. Formal titles also may function as a useful signaling device.[5]

These theoretical links between property rights and economic development have been the subject of extensive research. With respect to expropriation risk, Besley, Abhijit Banerjee, Lakshmi Iyer, and others have found evidence of increased incentive to invest in rural settings.[6] Erica Field identifies a causal relationship between formal property rights and inputs, as well as defensive labor allocation, in urban Peru.[7]

Although there is some evidence of the link between credit supply and formal property rights, there is considerable debate about whether the relationship holds

for impoverished households, due to the modest value of their assets and the small size of the loans they seek.[8] In such contexts, securing loans through collateral may not be the binding factor in accessing credit. The high transaction costs associated with verifying ownership, collateral processing, and foreclosure may make it unviable to serve poor households, even in the presence of formal titling. Michael Carter and Pedro Olinto have found empirical evidence in Paraguay to support this claim.[9]

Besley and Ghatak conjecture that the logic of the link between property rights and the improved welfare of borrowers hinges on assumptions about the competitiveness of the credit market. To test that conjecture in principle, they built a model for contracting between borrowers and lenders and analyzed the implications of varying degrees of competitiveness in the credit market, as well as distribution of wealth within a society. While their model lends general support to the notion that the creation of collateral through property rights has positive implications for productivity, their analysis also finds that "in the presence of extreme poverty and little competition, increasing property rights registration can actually lead only to greater exploitation in the credit market because lenders can foreclose on defaulting borrowers more easily."[10] While these arguments are theory-based, not empirical, they nonetheless suggest that careful consideration is needed when seeking to address poverty via the effect of improved property rights institutions on credit markets.

Technology-Based Innovation and Development

On the surface, the relationship between technological change, innovation, and development is quite direct. Technological change and innovation enable greater efficiencies in production, which allows for greater savings and investment, and in turn further technological change and innovation. Through this virtuous cycle, the aggregate resources available to a society increase and greater prosperity becomes attainable.[11] New products and knowledge created in the course of production only enhance this process, as consumers have greater options and producers have new spaces within which to learn.

There is truth to this standard tale. Investment does drive economic growth in the long term. Technological change and innovation are the primary mechanisms by which that happens. However, there is much more to the story.

To begin with, technological change cannot take place without organizational and behavioral change, as the two are intrinsically linked. The more disruptive the change, the greater the loss experienced within existing organizations. Practices that were effective in an earlier technological environment become ineffective, and the institutions that derive their power from those practices lose economic legitimacy. Consequently, as a general rule, incumbent institutions have a first-order interest in obstructing technological change and innovation whenever such change shifts economic power away from them, as will frequently be the case.[12]

Because of their fluidity, however, new ideas are difficult to suppress. Advantage-seeking individuals will always search for the best tools. If impeded in one place, ideas and technologies that have the potential to disrupt existing modes of economic activity will resurface elsewhere. In the long run, it is through this second pathway of economic disruption that technology-based innovation has its greatest impact on development.[13]

IMPEDIMENTS TO THE DESIGN AND IMPLEMENTATION OF SUCCESSFUL POLICY INNOVATIONS

While there is compelling evidence that formal systems of property rights, coupled with technology-based innovation, positively impact development, translating that evidence into policies that accelerate social development is not an easy task. The complexities of formal institutions operating at scale, weak capacity in developing countries, and low demand from citizens all hinder the attainment of desired social benefits.

Formal Institutional Complexity

Many researchers who provide empirical support for the theoretical links between property rights and economic development conducted their analysis in informal institutional settings. Therefore, while the studies provide compelling evidence of the need for formal property rights reform, it is critical to understand the increased complexity of formal institutional settings.

Informal institutions generally operate on a small scale, typically at the village level. They involve a limited number of individuals who often have direct personal relationships. These characteristics have profound implications for the dynamics of the system. Information is passed easily through such informal institutions, as individuals tend either to hold relevant information themselves or have knowledge of and access to those who do. This keeps the cost of verifying pertinent property rights information low. Since most actors know each other, the cost of dishonoring contracts is high. An informal setting also lends itself to low enforcements costs.

Contrast this with formal property rights systems, which typically operate at the national level. This creates problems of operation at scale that are less present in informal environments. Organizations are physically distributed, so personal relationships are unlikely to exist between those who enforce property rights and the citizens who enjoy their benefits.[14] The relevant information for the system is vast and far beyond what any single individual or set of individuals can know. Physical distance and the lack of personal relationships increase the cost of gathering and verifying information, which often is held in paper records. Because the system isn't dominated by a tight network of social connections, a breach of contract has a lower cost in terms of local reputation but potentially greater negative impact on the defaulting party if it the breach documented and accessible over an entire administrative domain. In addition to increasing the operational complexi-

ty of execution, operating at scale creates additional principal-agent relationships that invite corruption. Once a culture of corruption takes hold within formal institutions, it is difficult to revert to an efficiently functioning state.

Low Capacity

The complexities of executing at scale within a formal institutional construct are further stressed when capacity is limited, as typically is the case in developing countries. In this context, this system not only faces inherent complexities at scale, it attempts to execute with far fewer resources and far less human capacity than is optimal. As a result, service to the end user is weak, and the system opens itself up to corruption. We see this in developing countries, for example, when it takes an excessive amount of time to register property. In such circumstances, ancillary services often take hold, where a case can be prioritized for an additional fee.

Low Demand

Despite the existence of formal property rights institutions, many property owners may choose to remain extralegal. This can be attributed to ignorance about the benefits of formality or to the costs of formality outweighing the benefits.

Low demand is indeed a significant issue, as evidenced in a recent study of the urban titling program in Peru. The study reveals that, despite the granting of formal titles, subsequent transactions are rarely registered, which compromises the benefits of formal property rights. Of the plot transactions studied that involved a change in ownership, only 21 percent were registered.[15] Molina finds that when simplified procedures and reduced fees are not in place, the likelihood of registering a transaction falls significantly.[16]

OPPORTUNITIES TO IMPROVE FORMAL PROPERTY RIGHTS INSTITUTIONS

Any formal system of property rights is based on some technology—whether the technology of paper records and file cabinets or of digital records and computer storage. For property rights systems, technology-based innovation has the potential to improve social outcomes by lowering costs, increasing reliability, and expanding access.

There are numerous pathways within formal property rights institutions through which information and communications technologies can achieve these goals. These include improved efficiency of titling and registration processes, lower enforcement costs, reduced discretion between principals and agents within the system, and lower transaction costs in credit markets.

Improved Efficiency of Titling and Registration Processes

As demonstrated by Molina's research in Peru, the cost of the registration process is strongly and negatively correlated with the probability that property transactions

Mobilizing Property Rights

What could a technology-enabled 21st-century property rights institution look like? One possibility is a global network of property registries hosted on secure systems that can be accessed and updated via mobile phone from any village, town, or city in the world. The creation of a cloud-based platform for the digitization of national property rights registries could pick up where the institutional reform initiatives undertaken by Hernando DeSoto's Institute for Liberty and Democracy left off: unlocking investment and entrepreneurial initiative in places where informal property claims currently are the rule rather than the exception. In places where governments are interested in economic inclusion, the availability of such a platform would provide a powerful new inducement to upgrade existing property rights systems. In places where governments are not interested in economic inclusion, such systems could provide an extranational substitute for national, paper-based systems when such systems are unreliable or corrupt.

Could a network of property rights registries in the cloud really substitute for national, paper-based systems? The question may be less "if" than "when." Innovations such as Wikipedia, Ushahidi, and OpenStreetMap have demonstrated the power of open cloud-based systems to generate large-scale, authoritative databases. The creation and maintenance of such databases is no longer the exclusive domain of governments and large corporations, nor is it an activity restricted to rich countries. Thanks to the near ubiquity of mobile phones and cloud computing, citizen-based creation and validation of large-scale databases may be on the way to becoming an everyday global reality.

will be registered. Paper-based systems persist in many parts of the developing world today, resulting in cumbersome and expensive processes; in Senegal, for example, registering a property takes an average of six procedures, 122 days, and costs 20.3 percent of the property's value.[17]

The efficiency of titling and registration processes can be greatly improved by the use of information and communications technologies. For example, the information required for titling and registration can be stored in a single directory and accessed easily by the relevant government agencies engaged in the process. Citizens also can use technology to update records virtually, greatly reducing the cost of doing so.

The government of Rwanda recently digitized its National Land Centre. As a result, the number of days it takes to register a property fell from 371 to 55, and the cost of registration fell from 10 percent to 0.4 percent of the property's value.[18]

Decreased Cost of Enforcement

The benefits of formal property rights are limited in many places, due to the inability of the state to enforce contracts and adjudicate contract disputes. According to

the World Bank Doing Business Report, which measures contract enforcement broadly, it takes 1,420 days, 46 procedures, and 39.6 percent of the cost of a claim to formally enforce a contract in India.[19] Such realities render formal property rights institutions essentially useless.

As with titling and registration processes, information and communications technologies have the potential to greatly reduce the cost of enforcing contracts. For example, a technical solution would create the ability to centralize all relevant property claim documentation in a single place, making it easier to resolve disputes. Sophisticated analysis of claims and supporting data could yield the segmenting of claims, which could then inform operational efficiency improvements within the courts.

Thanks to the near ubiquity of mobile phones and cloud computing, citizen-based creation and validation of large-scale databases may be on the way to becoming an everyday global reality.

Reduced Discretion

The cumbersome processes for titling, registration, and enforcement that are the norm in many developing countries also create opportunities for corruption, as property owners are willing to pay bribes to accelerate what would otherwise be prohibitively costly processes. Each face-to-face interaction between citizens and bureaucrats provides an opportunity for public officials to exact payments. The use of technology can eliminate steps that otherwise would require person-to-person interactions, such as updating records. In doing so, corruption may be inhibited.

Reduced Transaction Costs in Credit and Other Markets

As some of the empirical evidence summarized above demonstrates, the ability to secure loans via collateral sometimes is not the primary path to credit. This is particularly true for impoverished rural and urban households, where landholdings are modest and transactions costs for serving loans are high.

Information and communications technologies lower transaction costs for lenders. For example, a single property rights registry made accessible to third parties would enable banks to verify ownership documentation at a very low cost. Such technologies could address the high costs of collateral processing, foreclosure, and resale, issues that make lending to the poor unviable. New technological opportunities could also enable radically low-cost forms of operation, much like M-PESA in Kenya. Moreover, any third party could potentially access official information without needing to interact with a person.

INTEGRATING TECHNOLOGICAL AND INSTITUTIONAL EVOLUTION FOR PROPERTY RIGHTS

We noted at the outset that economists who study economic growth and social development tend to be divided between those who emphasize institutions[20] and those who emphasize technology.[21] As a result, the best studies of long-term development by economists end up looking a lot like institutional determinism or technological determinism. Similarly, development strategies overwhelming emphasize either technology-centric "projects" or institution-centric "reforms." Few studies or strategies elucidate the complex processes by which technology, institutions, and societies co-evolve.

Nevertheless, pathways for making progress in development almost inevitably involve both institution- and technology-based innovation. Absent institutional disruption, technology projects are unlikely to effect lasting change. Absent technological disruption, institutional reform will fall short of its potential. In the long run, development depends on the regular creation of disruptive, technology-based institutions.

The design and deployment of 21st-century digital property rights institutions are well within the boundaries of technical feasibility. The foregoing suggests that the creation of such institutions would be greatly beneficial, if not transformative, if and when accomplished on a global scale.

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1. A third answer, prominent in early development and resurrected at the end of the 1990s by Jeffrey Sachs, asserts that geography is a central determinant of development outcomes. See, for example, John Luke Gallup, Jeffrey D. Sachs, and Andrew D. Mellinger, "Geography and Economic Development," Harvard Center for International Development working paper no. 1, March 1999.
2. Although classical economists such as Adam Smith recognized the fundamental role of property rights in a market economy, the welfare theorems that are at the core of neoclassical theory assume that private property rights are not just well defined but also enforced without cost. That is not to say that property rights were ignored by 20th-century economists. Coase famously described how property rights constituted a precondition for efficiency in privately negotiated outcomes, including those involving economic externalities; Ronald H. Coase, "The Problem of Social Cost," *Journal of Law and Economics* 3 (1960): 1-44. Demsetz went further, exploring the manner in which a transaction in the marketplace can be interpreted simply through the exchange of bundles of property rights; Harold Demsetz, "Toward a Theory of Property Rights," *The American Economic Review* 57, no. 2 (May 1967): 347-359. Other significant contributors to the literature on property rights and economic development include Steven Cheung and Armen Alchian.
3. Hernando DeSoto, *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else.* New York: Basic Books, 2000, p. 63.
4. For the generalization of this point, see Mancur Olson, *Power and Prosperity: Outgrowing Communist and Capitalist Dictatorships.* New York: Basic Books, 2000.
5. Timothy Besley and Maitreesh Ghatak, "Property Rights and Economic Development," LSE STICERD research paper no. EOPP006, February 2009, p. 5.

6. Abhijit Banerjee and Lakshmi Iyer, "History, Institutions, and Economic Performance: The Legacy of Colonial Land Tenure Systems in India," MIT Department of Economics working paper no. 02-27 (June 2002); Timothy Besley, "Property Rights and Investment Incentives: Theory and Evidence from Ghana," *The Journal of Political Economy* 103, no. 5 (October 1995): 903-937.
7. Erica Field, "Property Rights and Investment in Urban Slums," *Journal of the European Economic Association* 2, no. 3 (2005): 279-290; "Entitled to Work: Urban Property Rights and Labor Supply in Peru," *The Quarterly Journal of Economics* 122, no. 4 (2007): 1561-1602.
8. See, for example, Erica Field and Maximo Torero, "Do Property Titles Increase Credit Access among the Urban Poor?" unpublished manuscript, 2006.
9. Michael R. Carter and Pedro Olinto, "Getting Institutions 'Right' for Whom? Credit Constraints and the Impact of Property Rights on the Quality and Composition of Investment," *American Journal of Agricultural Economics* 85, no. 1 (2003): 173-186.
10. Timothy Besley and Maitreesh Ghatak, "The DeSoto Effect," unpublished manuscript, April 2009.
11. The original articulation of this idea is found in Keynes "Economic Possibilities for our Grandchildren," p. 30, published in John Maynard Keynes, *Essays in Persuasion*, New York: W. W. Norton & Co., 1963, pp. 358-373. Ramsey presented the first formal model of economic growth, though it lacked an explicit technological dimension; Frank P. Ramsey, "A Mathematical Theory of Saving," *The Economic Journal*, 38, 152 (1928): pp. 543-559. Solow and his contemporaries were the first to explicitly study the role of technological change in economic growth; Robert Solow, "A Contribution to the Theory of Economic Growth," *Quarterly Journal of Economics* 70, no. 1 (1956): 65-94; "Technical Change and the Aggregate Production Function," *Review of Economics and Statistics* 39 no. 3 (1957): 312-320.
12. Joseph Schumpeter, *Capitalism, Socialism, and Democracy*, New York: Harper & Row, 1942.
13. Philip Auerswald, T*he Coming Prosperity: How Entrepreneurs Are Transforming the Global Economy*. New York: Oxford University Press, 2012.
14. This is not to say that personal relationships are not relevant or significant in the functioning of formal, bureaucratically administered systems. Personal relationships do indeed hold between administrators within a bureaucracy, but not throughout the entire organization. Civil servants almost never have connections with constituents outside of transactions related to property rights.
15. Oswaldo Molina, "Titling without Registration: Quietly Undermining the Property Rights Reform," unpublished manuscript, 2012, p. 3.
16. Molina, "Titling without Registration," p. 18.
17. World Bank, "Registering Property," June 20, 2012. Available at http://www.doingbusiness.org/data/exploretopics/registering-property.
18. IFC, "Rwanda Land Registration," June 20, 2012. Available at http://www.icfafrica.org/news/1145/rwanda-land-registration/?cid=47.
19. World Bank, "Enforcing Contracts," June 20, 2012. Available at http://www.doingbusiness.org/data/exploretopics/enforcing-contracts.
20. See, for example, Daron Acemoglu and James Robinson, *Why Nations Fail: The Origins of Power, Prosperity, and Poverty.* New York: Crown Books, 2012.
21. Paul Romer, "Increasing Returns and Long Run Growth," *Journal of Political Economy* 94, no. 5 (October 1986): 1002-1037; "Endogenous Technological Change," *Journal of Political Economy* 98, no. 5 (October 1990): S71-102.