

MANAGERIAL OPPORTUNISM,
US CONVEYANCING AND BLOCKCHAIN

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Abstract

This thesis is structured in three chapters. In chapter 1, I address managerial opportunism towards workers. I present a theoretical model and test it. Results suggest that outside opportunities are key to hinder or stimulate managerial opportunism towards the workforce. In chapter 2, I study price-setting practices in the US title insurance industry. I test both the presence of a bilateral monopoly, insurers and lawyers, and the increase in the title insurers' market concentration levels. Results suggest that the increased concentration led to an increase in prices. In chapter 3, I explore the application of blockchain technology to land property institutions. I develop an analytical framework acknowledging the customizable nature of blockchain and discuss diverse initiatives currently being developed in several countries. I conclude blockchain is bringing some changes but it has not been disruptive to existing systems.

Resumen

Esta tesis está estructurada en tres capítulos. En el capítulo 1, abordo el oportunismo gerencial hacia los trabajadores. Presento un modelo teórico y lo testeo. Los resultados sugieren que las oportunidades externas son clave para prevenir o estimular el oportunismo gerencial hacia los trabajadores. En el capítulo 2, estudio las prácticas de establecimiento de precio en la industria de seguro de título de EEUU. Testeo tanto la presencia de un monopolio bilateral, aseguradoras y abogados, como el incremento de los niveles de concentración en el mercado de las aseguradoras de títulos. Los resultados sugieren que el incremento de la concentración ha conllevado un incremento de los precios. En el capítulo 3, exploro la aplicación de la tecnología blockchain a las instituciones de título. Desarrollo un marco analítico en base a la naturaleza configurable del blockchain y discuto diversas iniciativas actualmente en desarrollo en varios países. Concluyo que blockchain está trayendo algunos cambios a los sistemas existentes pero no de forma disruptiva.

Foreword

This thesis analyses economic transactions and their effects in two fields.

Firstly, I study *labor transactions in firms*. In chapter 1, I address managerial opportunism towards workers. Managerial opportunism is defined as the capacity of managers to impose orders which, despite exceeding the previously agreed contractual limits and reducing their workers' welfare, do not need to be consulted. Based on this definition, I discuss the reasons why managers are prone to deceive their workers, explain when workers will accept such unilateral changes in their working conditions and clarify the extent to which they will accept a subsequent reduction in their welfare. I develop this through a theoretical model and test it with an empirical study using cross-sectional data at country level. Results suggest that managerial opportunism may arise even in the absence of information asymmetries. Moreover, outside opportunities (unemployment rates, economic dynamism, unemployment subsidies) are key for hindering or stimulating managerial opportunism towards the workforce. A relevant by-product of the paper is its questioning of the exclusive emphasis that Principal-Agent Theory has placed on workers' opportunism. This chapter is co-authored with E.L. Giménez and X.H. Vázquez.

Secondly, in regards to *land property transactions*, I study the economic effects of agents' relationships in the US title insurance industry and the impact of introducing blockchain technology in land property institutions.

In Chapter 2, I explore how title insurance is priced and, more specifically, who holds a greater say in that. Firstly, I analyse whether insurers or lawyers have a greater impact on title insurance premiums. Secondly, focusing on title insurers, I test whether an increase concentration levels in the title insurers' market increases title insurance premiums, using a natural experiment, the bankruptcy of Land America—a major title insurer—and its merger with Fidelity National in 2008.

Results confirm that increased concentration in title insurance led to an increase in premiums.

In Chapter 3, I examine the application of blockchain technology to the exchange of property rights in land, including its use as collateral for secured credit. After developing an analytical framework, which combines insights from legal, economic and technological perspectives, I analyze real initiatives under development in several countries. This empirical evaluation focuses on the real solutions' capacity to provide legal evidence of title.

It concludes that (1) blockchain is bringing some changes but it has not been disruptive to existing systems; (2) public registries retain their competences, ruling out the implementation of peer-to-peer registries; (3) there is an overriding emphasis on only tracking ownership on the blockchain, disregarding the rest of land property rights; (4) public registries depend on private firms to develop the technological solution, and misalignments between the interests of the public and the private firm can cause negative effects that might damage evidence quality and even weaken the nature of the institutions.

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Chapter 1

WHAT IF PRINCIPALS COULD BEHAVE OPPORTUNISTICALLY TOWARDS AGENTS? UNDERSTANDING (BETTER) THE EMPLOYMENT RELATIONSHIP

1.1 Introduction

Economics has built a powerful theory on the efficient properties of social exchanges by focusing on how principals can overcome their agents' opportunism. Thus, when principals delegate decisions to their agents, they simultaneously hand over informational rents that inevitably increase their chances of being deceived (Jensen and Meckling, 1992; Armstrong 1994; Gal-Or and Amit, 1998). Any possible gains from the use of expert knowledge must therefore compensate the incremental costs from loss of control. The particular case of labor transactions is no exception.

As with any type of asset specificity (Klein, Crawford and Alchian 1978), the standard approach to the employment relation suggests that human-specific investments in a labor relationship -often referred to as human capital- create a situation of bilateral monopoly. Workers fear that, in case of dismissal for any unpredictable reason, they can lose their firm-specific investment in human capital. Simultaneously, employers know that, as their workers' skills make them difficult to be replaced, they can use them opportunistically.

tically to their own benefit (Vázquez, 2004). The result is a long-term labor contract to avoid continuous renegotiations that one of the parties could exploit to take advantage of the other. Labor contracts are thus normally incomplete (Simon, 1951; Williamson, Watcher and Harris, 1975), because environmental uncertainty and humans' bounded rationality make the forecast of all future eventualities difficult and –mostly– too costly.

In return for stable remuneration, therefore, it is efficient for workers to concede discrete assignment capabilities to their managers so that they can fill in the blanks left by contracts (Menard 1997:36). The resulting relation of authority, which differentiates employment transactions –long-term labor contracts– from other market exchanges, thus becomes the main trait of formal organizations. Accordingly, the main challenge for economic analysis has been to guarantee that the incentives of the workforce are aligned with managerial goals. Otherwise, given that personal interests may not be compatible and that managers cannot exert a perfect control, workers would tend to shirk and fall in strategic non-disclosure, disguise, or distortion of information in the execution of their labor transactions (Williamson, 1985, 59).

Several authors (Willman, 1983; Dow, 1987, 1996: 179; Foss, Foss and Vázquez, 2006; Vázquez, 2004, 2006) have nevertheless warned about the exclusive emphasis on worker opportunism in economics. Grimshaw and Rubery (1998) explain, for instance, that a lack of alternative employment opportunities when labor markets do not clear boosts employers' bargaining power. Both authors interpret this as an explanation for human resource practices that do not seem to reflect long-term efficiency concerns. Stevens (1996) also argues that firms may be imperfect competitors for labor in the presence of market failures in training, thus gaining market power which prevents workers from leaving the firm even when their wages turn out to be less than their marginal products. Dow (1987, 21) cites additional casual evidence suggesting particular examples of employer opportunism: distortion or hoarding of information about the product market or about labor costs relative to other firms, and unilateral introduction of technical innovations which undercut worker's bargaining position. The fact is that managerial opportunism towards employees is an underdeveloped issue in economics that has, at best, been treated as a side argument in the analysis of workers' attitudes towards work (Akerlof, 1982; Nagin *et al.*, 2002; Minkler, 2004; Arocena *et al.*, 2010).

The reasons why economics has neglected managerial opportunism towards employees is unclear, especially considering the attention paid by corporate governance and corporate finance to managers' moral hazard towards

shareholders (Berle and Means, 1932; Noe and Rebello, 1996), or the increasing interest in the fairness of managerial intervention as perceived by the workforce among political economists (Bowles and Gintis, 1993), sociologists (Pfeffer, 1981) and psychologists (Argyris 1960; Rousseau 1989; Coyle-Shapiro and Kessler 2000; Tepper and Taylor 2003). Maybe the fact that all these approaches stemmed from alternative theoretical frameworks was the root cause of this lack of permeability. Since most of us view economic phenomena through mainstream eyes, their results are usually disregarded and minimized. As Dietrich (1994: 8) puts it, scientific progress is not simply a matter of letting facts “speak for themselves” because the questions we ask and interpretations of the facts offered are guided by the theoretical frameworks we use. The paper therefore harnesses the above-mentioned developments from other disciplines to explain in conventional economics language the conditions in which managers do actually exceed the previously agreed limits.

The next Section addresses theoretical and empirical studies on managerial opportunism towards employees. It should allow readers to accurately assess the originality and relevance of both our problem statement and our analytical approach. In the light of Section 1.2, Section 1.3.1 models the decision of managers to behave opportunistically or not when designing the labor contract and implementing it, and Section 1.3.2 addresses the subsequent decision of workers to accept or reject the contract when being hired, or the new conditions while already working. Section 1.3 closes with several testable hypotheses that are examined empirically in Section 1.4. Section 1.5 highlights the main results of the paper and summarizes its main theoretical and policy-making implications.

1.2 The employment relationship and managerial opportunism

It might be prudent to start this section with what might be a triviality: the fact that economics sees individuals as rational maximizers does not mean that all managers are opportunistic by nature. We could actually say that most managers are honest most of the time, but it is precisely because of certain circumstances that we will analyze here that this “most of the time” holds. It is under these circumstances that public policy and even firm’s internal procedures should organize labor relations “just in case.” Otherwise, managerial opportunism may raise transaction costs to limits where active reactions (conflict and sabotage) and passive attitudes (apathy and lack of

concern towards the firm goals and strategies) may offset any short term benefit from deception.

1.2.1 The need for an eclectic perspective of the employment relationship

The conceptualization of managerial opportunism towards employees should start by understanding how economics perceives the role of authority in the employment relationship. According to the dominant approach (Simon, 1951), authority reflects a situation in which a “boss” is permitted by a “worker” to select actions, $A_0 \in A$, where A is the set of the worker’s possible behaviors. For the worker to accept the assignment, it must lie within his “zone of acceptance”, which is generally delimited by legal, ethical and cultural norms.

On the base of Simon’s foundations, Alchian and Demsetz (1972), Jensen and Meckling (1976), Williamson (1975, 1985) and Aoki (1984) have emphasized the basically consensual character of the employment relationship. Authority would thus function on behalf of both workers and employers because, since environmental uncertainty and bounded rationality make labor contracts incomplete, a central unit must necessarily hold discrete assignment capabilities “to fill in the blanks left by contracts” (Menard, 1997). Notice that the consensual character of the employment relationship does not entail that decision making is made by consensus; it just refers to the nature of the relation. This efficiency driven perspective ran parallel, nevertheless, to other less conventional views of the employment relationship. Classics such as Braverman (1974), Marglin (1974), Edwards (1979), Bowles (1985) and Bowles and Gintis (1993) made major contributions highlighting the coercive nature of work. Hence, depending on the perspective adopted, one would tend to conclude that the organization of work is efficiency or power-driven.

To be sure, neither of the two sides of the debate neglects power or efficiency as variables that “exist” in the firm. It is more a question of which one is the ultimate force that makes organizations evolve. Pitelis (1993: 266) has sharply pointed out that at least Marglin and Williamson seem to agree in one specific issue: the strongest the hierarchy, the better the supervision, and therefore the higher the potential for an increase in labor’s productivity and –*ceteris paribus*– in the firm profits. The main difference is that, while the first author seems to rely on rent-seeking factors to explain the historical evolution of the firm, the second focuses on the transactional efficiency gains that stronger hierarchical forms have shown over weaker ones. For

Williamson it is even a question of scientific rigorousness, as he puts forward that “the problem with power is that the concept is so poorly defined that power can be and is invoked to explain virtually anything” (1985, 238).

We do not think it is appropriate, however, to counter coercion with consensus. As Marginson (1993) notes, both approaches fail to reflect the complex mix of organizational phenomena involved in the firm. To be sure, the consensual perspective has been useful to understand the firm as a nexus of consensual commitments by which, in return for a salary, workers allow employers to decide –within previously agreed limits– how to manage labor transactions when confronting unexpected eventualities. This consensual perspective may entail a naïve approach to organizations, however, when analysts try to explain from a positive perspective what is really happening on the shop floor, and therefore, starting from right there, what should be happening to make them more efficient (Vázquez, 2006). Hence, an exclusive emphasis on the consensual character of the firm reflects a biased perspective that only focuses on its economic nature as a resource allocation mechanism. It therefore neglects the influence of the institutional environment (particularly the external labor market) and the socio-political nature of intra-firm relations; that is, it underestimates the fact that the firm is composed of diverse agents who play organizational politics in order to materialize their diverse and often contradictory goals. Notice thus that some corporate governances affect the nature of the employment relationship by stimulating more than others the consensus nature of the relation (e.g., german codetermination system vs. anglosaxon shareholder primacy).

In the same sense, focusing only on the coercive side of the employment relationship necessarily entails again a partial interpretation of the organization of work: it not only misses the fact that employers have searched for new methods to guarantee the right effort from the workforce, but also what their reasons to do so are. Wood and Albanese (1995), Osterman (2000) and Green (2004), for instance, have showed that firms are increasingly changing their human resource practices to encourage employees to work harder and smarter, to use their knowledge and judgment, to share their ideas, to accept responsibilities and take initiative in an instrumental way. The emphasis in human resource practices has accordingly changed in many firms from guaranteeing commanded effort to the encouragement of discretionary effort: an extra performance that is given at will by employees in their jobs (Arocena *et al.*, 2010). New workplace systems have thus arisen where empowerment and horizontal decision-making structures have been intensified. Employees are not only in charge of a broader variety of tasks but also have greater responsibility and autonomy (Osterman, 2000), reducing the ease with which firms can monitor their workers and therefore raising the possibility that they will

shirk. Yet, this is the way managers have found to obtain the extra physical and mental energy from their employees that enable organizations to make the leap from satisfactory to outstanding results in hypercompetitive environments. To sum up, making these practices compatible with the coercive nature of work is not easy, so an eclectic perspective that mixes efficiency and power considerations seems then proper if we aim at analyzing the “world as we know it”.

1.2.2 What is managerial opportunism?

Transactions are affected by two sources of uncertainty: opportunistic conducts and environmental changes. As the existence of environmental uncertainty does not allow foreseeing all unexpected eventualities, opportunistic behavior of the contractors may make the transaction difficult to execute each time the need for adaptation appears. This is the reason why in the absence of exogenous disturbances, opportunistic conducts would not be a contractual problem (Williamson 1985, 59). We could perform complete contracts and, therefore, unilateral modifications would be solved by a court.

The concept of opportunistic behavior furthermore entails an extension of the orthodox consideration of “self interest” to address also strategic behaviors: this implies a conscious search for self interest with guile (Williamson 1985, 47-50, 64-67), such as in an incomplete, distorted or misleading revelation of an agent’s preferences or intentions, or in the strategic non-disclosure, disguise, or distortion of information ex-post (Williamson 1985: 59). Hence the two types of opportunism that we can find in the literature. *Ex-ante opportunism* or *adverse selection* refers to a deceit which, deliberately or not, has been carried out before the formalization of the contract. *Ex-post opportunism* or *moral hazard*, in turn, refers to a disloyal conduct happening during contract execution because one of the agents might decide not to respect a specific agreement (the other agent might not be able to check if he is executing accurately the terms of the contract or simply he is in a position to exploit the other).

Although there is nothing in this conceptualization of behavioral uncertainty against managerial opportunism, economics has basically addressed it as the result of a situation where a principal cannot fulfill a perfect control over her agent, both show personal interests that may not be compatible, and contracts between them cannot anticipate all future eventualities –so they need to be renegotiated. Some authors have realized the clear bias towards workers opportunism that this perspective has entailed (Willman 1983; Dow 1987, 1996: 179; McGuinness 1987; Pitelis 1993). Even Williamson must have reckon this neglect (1996: 23) when he asserts that “power has relati-

vely less to offer to the study of capital and intermediate product markets, [and] has more bearing on labor and final product markets”.

Managers could indeed behave opportunistically, however, if the labor exchange is not egalitarian (Pfeffer 1981; Bowles and Gintis 1993; Vázquez, 2006). In fact, conscious attempts by managers to extract surplus value through unilateral decisions that exceed the “previously agreed limits” can be frequent when employment alternatives are scarce. In this situation it might be reasonable for managers to raise transaction costs (derived from an increased workers’ opportunism or conflict between managers and workers) and even risk reputational losses if production costs decrease more in absolute terms.¹

Thus, if decision by fiat reflects a certain conception of the firm by which a central unit can impose orders — within certain ex-ante agreed limits — without consulting those who are expected to obey them, employer opportunism can be developed from the capacity of a central unit to impose orders which, despite decreasing workers’ welfare –and therefore exceeding the previously agreed limits– do not need to be consulted.

1.2.3 What drives managers to behave opportunistically?

There are three reasons for which managers may behave opportunistically. The first one could be linked to an adverse selection problem; the other two could be associated to a moral hazard problem.

Managers could be interested in lying from the very beginning (ex ante) to make workers materialize specific investments that later hold them to their posts. This relates to the familiar problem in political economy of time inconsistency (Kydland and Prescott 1977; Weingast and Marshall 1988). For example, governments have an incentive to initially promise not to confiscate (too much of) the wealth created by entrepreneurs in order to strengthen their incentives to actually undertake investments, and then, in some later period, deviate from this promise and confiscate substantial portions of the created

¹For instance, if an operator is asked to work overtime with no compensation at all, she has two options; either she stays or searches for a new job. If the unemployment rate is high, many will chose to stay, although they might show a lower productivity because they will tend to reciprocate by intensifying their level of opportunism or the general conflictive atmosphere within the firm. This can be a valuable strategy for managers, however, if the increased production of overtime more than offsets the negative consequences of raising transaction costs. Other examples of managerial opportunism have to do with restricting the vacation period, changing the remuneration conditions or undercutting labor’s bargaining position through technical or organizational innovations.

wealth. In the context of managerial opportunism, this kind of behavior may consist in, first, promising a particular mix of working conditions, including substantial discretion, a particular wage or a specific amount of hours of work per week. When later employees, enthused about their new extended discretion or better conditions, come up with profit-improving ideas about how to improve products, processes, etc., or just aim at leaving on time and requiring the agreed wage, managers may unilaterally decide that the conditions have changed. Workers are therefore told that costs need to be saved by reducing the level of delegated discretion and wages, or increasing the number of hours worked.

Secondly, there are two reasons for which managers may unilaterally change working conditions ex post beyond the ex ante agreed limits. The most obvious reason is that managerial opportunism may become cost-effective at some point in time, at least in the short term. Demanding workers, for instance, more hours of work for free or changing unilaterally wage conditions may indeed be profitable if the benefits more than offset (1) the subsequent rise in organizational transaction costs derived from increased conflict, sabotage or discouraging effects on workers' attitude, and (2) the reputational costs in terms of the firm capacity to hire new labor who may be acquainted with these irregular practices. Both transaction and reputational costs may often be irrelevant, however. The situation of the labor market may decrease the workforce capacity to reciprocate by lowering down outside opportunities. On the other hand, reputational effects are far from being perfect with respect to constraining opportunistic behaviors (Williamson 1996). Information on these practices is normally transmitted through word of mouth, which may not be credible for potential workers. Furthermore, managers change jobs and may or may not carry their reputation with them.

On the other hand, even if managerial opportunism destroys value for the firm (Foss, Foss and Vázquez, 2006), managers may derive a private benefit. For example, managers who are up for promotion may derive private benefits from imposing more hours of work or cutting costs through the deterioration of work conditions in general. For this to work as an equilibrium strategy, it is necessary that the manager is not punished for intervening in a value-destroying manner, for example, because his behavior is simply not noticed by those who are in a position to punish him. This may be the case when the organizational costs arrive after only a significant delay, or if it is very difficult to trace organizational costs to the managers' behavior.

1.2.4 When can a manager behave opportunistically? A matter of “outside opportunities” and “bargaining power”

It is in this complex organizational context where managerial opportunism needs to find a place as an operationalizable concept. In a world of perfectly competitive labor markets it would be difficult for managers to deceive workers; they would immediately find a different firm to work so, besides suffering the loss of productivity while searching for a new worker, managers would also suffer reputational costs that could harm their capacity to attract the best -or maybe any- worker.

There could indeed be particular niches in the labor market (top management in large firms, elite athletes and coaches, officers in fishing and merchant fleet, world class university professors, etc.) that could resemble the ideal functioning of a competitive labor market. Most workers do not belong to these labor market niches, however. There are several sources of “labor market imperfections” that may reduce the outside opportunities of employees. This reduces their bargaining power and hence their capacity to avoid opportunistic demands by their managers. With no purpose to be exhaustive, we offer below several reasons for which outside opportunities vary from country to another:

1. Labor regulation. Societies discuss what is politically acceptable in labor regulation beyond efficiency concerns, and this obviously affects geographical and functional mobility, for instance, which are at the base of a perfectly competitive labor market (Botero *et al.*, 2004).
2. Culture. Norms and values in many countries make individuals perform specific investments that are difficult to recover if workers quit their jobs and move. Closer family and friendship ties in Latin countries, for instance, may reduce workers geographical mobility (Hofstede, 2001). Even investments in real state may be more specific in some countries to the extent that their citizens may be more prone to buy their households than to rent them, making the move emotionally and economically more difficult (Green and Henderschott, 2001).²
3. Composition of the workforce. The type of worker may affect labor mobility: it has been found, for instance, that blue collar workers,

²To be sure, economic indicators (Chiuri and Japelli, 2003) and legal rules (Casas-Arce and Saiz, 2010) may also affect the willingness of individuals to buy or rent their households. The effect of this specific investment on “outside opportunities” is anyhow the same.

older workers, ethnic minorities and households with children show lower migration rates (McCormick 1997; Gregg, Machin and Manning 2004).

4. Economic conditions. Even in the most liberalized labor markets the economic conditions affect labor mobility across firms. Unemployment rates or the general dynamism of the economy influence the outside opportunities that workers need to find when deciding to confront managerial opportunism (Grimshaw and Rubbery, 1998).
5. The welfare system. The level of unemployment benefits that cover the risk of unemployment may obviously become an outside opportunity itself. In fact, the literature has found that higher unemployment benefits make workers more selective in accepting jobs, provoking a longer duration of unemployment and higher unemployment rates (Lalive 2007). The possibility that unemployment compensation helps to raise the wage by at least one-half the unemployment compensation benefit has also been suggested (Diamond 1981).

Furthermore, outside opportunities notwithstanding, the propensity of workers to accept opportunistic interventions in their working conditions will also depend on their bargaining power, which we mainly link to the collective bargaining power that is present in his firm through trade unions, and the individual **bargaining power** he may hold because of specific human investments. Both issues maintain a close relationship, however.

Williamson, Wachter and Harris (1975) linked the incentive to organize production workers within unions to the level of human specificity involved in the company. Their explanation is simple: specific investments entail lock in effects that make the continuity of the employment relationship be valued by both employers and workers. Bargaining individually, which could be preferred by each worker to exploit her monopoly position, would cause a waste of resources and inefficient and delayed adaptations. Accordingly, managers and workers can rely on the efficiency role of unions to guarantee that “investments of idiosyncratic types, which constitute a potential source of monopoly, are undertaken without risk of exploitation” (idem, 270).

The fact that unions represent all workers in a firm, however, does not entail that each one of them has a different individual bargaining power. Some employees or groups of employees may be particularly costly for management to overrule because they control critical resources, notably their own human capital. Overruling such employees means that they may cut back on the supply of their essential services and may refrain from augmenting their valuable human capital.

1.3 The model

We harness the arguments in Section 1.2 to build a four-step model describing a bilateral negotiation between a manager and a worker who aim at agreeing a labor contract under particular exogenous environmental economic conditions. This model will allow us to show why managers behave opportunistically, when this behavior is more likely, and at which extend they do so.

1.3.1 The economic agents

We initially characterize the two types of agents that interact: managers and workers.

The manager

The manager is in charge of a firm that produces an output x with worker's labor e as the required input, hired in exchange of a compensation W . The technology is described by a production function $x = x(e)$, where $x(\cdot)$ is a strictly monotone, strictly concave and twice-differentiable function.

The manager is *risk-neutral*. She designs, and then proposes, a labor contract that maximizes the firm's profits, $x(e) - W$. A labor contract is a triple (W, w, e) , where W is the firm's labor costs (i.e., the total compensation paid to the worker), w is the wage per unit of labor, and e is the labor required to the worker. Notice that the compensation is usually computed as the wage times the units of labor, $W(w, e) = we$, so denoting a labor contract as (W, w, e) might seem redundant. Yet, this triple will be useful to identify informal contracts when labor conditions are modified; for instance, when a higher number of hours (e) is required to the worker but without any additional monetary compensation (i.e., keeping W constant).

The worker

The worker receives a wage income W in exchange of the labor hired by the firm, so his budget constraint is $c = W$. He is characterized by the dupla $(U(c, e), \underline{U})$. The former stands for the worker's welfare, which is enhanced by higher consumption c and lowered by higher levels of labor e . Her preferences are assumed to be represented by a separable continuous utility function

$$U(c, e) = u(c) - v(e),$$

where u is a differentiable, strictly concave and strictly increasing function, while v is a differentiable, strictly convex and strictly increasing function.

The latter, \underline{U} , stands for the worker's welfare provided by his opportunity cost of signing the contract (W, w, e) , which sets a lower welfare threshold termed to as the *reservation utility*.³ Observe that the worker's opportunity cost depends on the worker's individual expectations and a number of environmental economic conditions. Individual expectations, whether correct or not, usually depend on his own experience and stock of human capital. Thus, expectations might stem from his subjective individual probability of either staying in the same job (i.e., being rehired each time as the contract deadline is met), finding a different job in the same firm (through promotion) or finding a job outside the firm (with at least similar features in terms of wage and effort). Regarding environmental economic conditions, we find among others the level of unemployment, the business dynamism of the economy, the magnitude of the unemployment benefits, the level of unionization, and the rule of law.

1.3.2 The rationale for managerial opportunism

Understanding the rationale for managerial opportunism requires to address the bargaining process between managers and workers, which can be basically characterized by four step decisions. At period $t = 0$ the manager designs a labor contract, so we are giving all bargaining power to the manager. The worker decides to sign the labor contract or not at period $t = 1$. At period $t = 2$, once the labor contract has been signed, an unexpected occurrence happens; then, the manager must decide whether to honor the contract or to propose the worker new labor conditions. Finally, at period $t = 3$ the

³We may conceptualize this worker's reservation utility in three illustrations. First, if the worker's opportunity cost is receiving unemployment benefits \underline{W} , then the reservation utility is $\underline{U} = U(\underline{W}, 0)$. Second, the worker's labor market (subjective) perception brings with his belief that he might sign labor contracts $(\check{W}, \check{w}, \check{e})$ outside the firm, a random variable extracted from a (subjective) probability density function $f(\check{W}, \check{w}, \check{e}; h, \mathcal{U})$, which depends on the worker's qualification h and the prevailing unemployment rate \mathcal{U} . In this case, his reservation utility is the future expected welfare $\underline{U} = \beta E[U(W, e)]$, where β is the intertemporal utility discount parameter and $E[\cdot]$ is the expectation operator. Finally, this weighted average might be difficult for the worker to compute, e.g. the probability density for every potential labor contract could not be known. Some authors (e.g., Miles *et al.* 2013) have reported that when individuals find computing the mean costly, they empirically tend to choose the mode as the statistic for the mean. Thus, for single peak density distributions, the worker might consider that his opportunity cost is to find the most probable labor contract, $(\check{W}, \check{w}, \check{e}) = \arg \max f(W, w, e; h, \mathcal{U})$; therefore, $\underline{U} = \beta f(\check{W}, \check{w}, \check{e}; h, \mathcal{U})U(\check{W}, \check{e})$.

worker has to accept or not the informal contract. Next, we describe each period in detail.

At period $t = 0$, the manager designs a labor contract (W^*, w^*, e^*) , with $W^* = w^*e^*$ being the total labor compensation. At period $t = 1$, the worker decides to sign the labor contract or not; he will accept it as long as his *participation constraint* is fulfilled, i.e. $U(W^*, e^*) \geq \underline{U}$.

At period $t = 2$, once the labor contract has been signed, an unexpected occurrence happens: for instance, market labor aggregates change. Then, the manager must decide whether to honor or to break unilaterally the previously agreed contractual conditions. Note that when designing the contract at period $t = 0$ the manager might be setting the basis for her future opportunism: she can lie from the very beginning about a particular mix of working conditions –including substantial discretion, a particular wage or a specific amount of working hours per week– before the contract is signed to make a worker materialize specific investments that later hold him to his posts. When later employees, enthused about their new extended discretion or better conditions, the manager comes up with profit-improving ideas about how to improve products, processes, etc., or just aim at leaving on time and requiring the agreed wage, and she may unilaterally decide that the conditions have changed. Workers are therefore told that costs need to be saved by reducing the level of delegated discretion and wages, or increasing the number of hours worked. This kind of manager behavior is related to the well-known *time inconsistency problem* in political economy,⁴

If the manager honors the contract, the worker works for e^* hours, receives a total compensation $W^* = w^*e^*$, and obtains a welfare $U(W^*, e^*)$; the firm's profits are $x(e^*) - w^*e^*$. The manager has nevertheless incentives to behave opportunistically at $t = 2$ because it may be cost-effective for the firm. Because labor costs reduce profits, and labor input increases output, we would expect one (or a combination) of the following practices: a decrease in compensation, a decrease in wages per unit of labor, or an increase in the level of labor required. That is, the manager might decide to break up the labor contract conditions by proposing a new *informal contract* (W^{**}, w^{**}, e^{**}) . Note that now the new compensation needs not be related to wages and working hours, i.e. $W^{**}(w, e) = W^{**}$.

The contractual breach, however, may bring with monetary and productivity costs for the firm, such as (i) the expected costs of a potential negative

⁴See, e.g. Kydland and Prescott (1977) or Weingast and Marshall (1988). For instance, governments have incentives to initially promise not to confiscate (too much of) the wealth created by entrepreneurs, in order to strengthen manager incentives to actually undertake larger investments, and then later, once the production is sold and share among the factors, to dishonor the promise and confiscate substantial portions of the wealth created.

judicial sentence; (ii) the subsequent rise in organizational transaction costs derived from increased conflict, sabotage or discouraging effects on workers' attitude; and, (iii) the reputational costs in terms of the firm capacity to hire new labor who may be acquainted with these irregular practices. We characterize these costs in terms of the model. First, a consequence of being sued, because of a negative wage payment deviation from those signed at period $t = 1$, is that the firm has to pay out judicial costs $\lambda(W^* - W^{**}) \geq 0$. The non-negative parameter λ represents the managerial expectations of receiving an adverse sentence in due time, and may depend on the degree of workers unionism. Second, with respects the transaction costs to the firm, a lower worker's motivation and increasing conflict as the worker's reciprocation of unilaterally worsening conditions for employees, can be measured as a productivity penalty $\rho \geq 0$, a strictly positive parameter provided $e^{**} > e^*$. This non-negative parameter ρ can be attached again —clearly at least with respect to conflict and reputation in the labor market— to the degree of workers' unionism.

Third, concerning the reputational costs that spread rebargaining practices of the firm in the labor market, will not be considered in the model. It would be required a dynamic setting that considers a rehiring mechanism in the labor market as well as a rumor spreading process. Yet, although these costs cannot be neglected along time, the reputational effects are far from being perfect with respect to constraining opportunistic behaviors (Williamson 1996). Information on these practices is normally transmitted through word of mouth, which might not be credible for potential workers. Furthermore, managers change jobs and may carry their reputation with them.

Finally, at period $t = 3$ the worker has to accept or not the informal contract. His decision is based on the opportunity cost that other alternatives outside the firm offer him. If the manager breaks the labor contract conditions by proposing a new *informal contract* and the worker accepts it, he works for e^{**} hours, receives a total compensation W^{**} , and obtains a welfare $U(W^{**}, e^{**})$; the firm's profits are then $(1 - \rho)x(e^{**}) - W^{**} - \lambda[W^* - W^{**}]$. If the manager breaks the labor contract conditions and the worker rejects the new *informal contract*, he will receive his reservation utility \underline{U} , and the firm's profits are zero.⁵

Two comments are in order. First, as explained in Section 1.2, it is important to note here that changing labor conditions unilaterally does not necessarily entail managerial opportunism. Given the unpredictable event-

⁵In fact, the firm will receive the present value —discounted at the interest rate r — of the future profits if a new worker is hired at the labor contract (W^*, w^*, e^*) with probability π^f , i.e. $\pi^f[x(e^*) - w^*e^*]/(1 + r)$. Note that π^f likely depends on the environmental economic conditions, such as the unemployment rate \mathcal{U} .

alities that may affect labor transactions, it is efficient that workers concede managers the capacity to impose orders within certain ex-ante agreed limits (these limits are set by their own agreement, collective bargaining, labor laws, ethic values, etc.). Managerial opportunism is therefore about something else than changing working conditions unilaterally; it is about imposing orders that exceed the previously agreed limits and decrease workers' welfare. Thus, in terms of the model, we concretize it as follows:

Assumption 1. *Managerial opportunism arises whenever the manager unilaterally imposes new labor conditions that exceed the previously agreed limits and decrease the worker's welfare, i.e. $U(W^{**}, e^{**}) < U(W^*, e^*)$.*

Second, we have been implicitly assumed that the (long-run) incentives for the manager and the firm are fully aligned. However, this need not be the case, as managers can also be opportunistic with their workers because they may derive a private benefit at the expense of destroying value for the firm (Foss, Foss and Vázquez 2006). For instance, managers who are up for promotion may derive private benefits from imposing more hours of work or cutting costs through the deterioration of work conditions in general. For this practice to work as an equilibrium strategy, however, it is necessary that the manager is not punished for intervening in a value-destroying manner. This may happen because her behavior is simply not noticed by those who are in a position to punish him, as when the organizational costs arrive after only a significant delay, or when it is very difficult to trace organizational costs to the managers behavior. Thus, the informational delay in perceiving this destruction in the firm's value by the shareholders (or by higher management levels in the firm's hierarchy) may be represented in terms of our model by a reinterpretation of the cost parameters. Let π^s be the manager's (subjective) probability of being discovered in destroying value of the firm, through managerial opportunism, before being promoted. Shareholders perceive the "good" performance of the manager observing the firms profit $x(e^{**}) - W^{**}$ with probability $1 - \pi^s$; and, shareholders detect the destruction of firm's value by observing the firms profit $(1 - \rho)x(e^{**}) - W^{**} - \lambda[W^* - W^{**}]$ with probability π^s . By denoting $\tilde{\rho} = \pi^s \rho$ and $\tilde{\lambda} = \pi^s \lambda$, the model develops along our main setting. Observe that informational delay in the firm's hierarchy increases the incentives for those managers expecting a promotion based on good economic performance, to destroy long-term value of the firm, and thus to exert managerial opportunism.

To summarize, a manager will modify previously agreed labor conditions whenever it is profitable, even after discounting the costs of a negative judicial sentence (λ), the organizational transaction costs derived from lower motivation and higher conflict (ρ), and the reputational damage she may

provoke with her behavior in the labor market. A worker, in turn, will be more likely to accept the contractual breach provided his welfare is at least as higher as his participation constraint, i.e. $U(W^{**}, e^{**}) \geq \underline{U}$. Thus, we have identified those key variables that allows opportunistic behavior to become specially likely. Namely, the case that both transaction and reputational costs are irrelevant; and, the worsening of the labor market aggregates, which may deteriorate workforce capacity to reciprocate by lowering down outside opportunities. In the following section, we study the conditions that lead workers to accept a unilateral breach of the contract by the manager and, accordingly, when managerial opportunism arises.

1.3.3 When will a manager behave opportunistically?

In a world of perfectly competitive labor markets it would be difficult for managers to deceive workers; they would easily find a different firm to work in. There are indeed particular niches in the labor market (top management in large firms, elite athletes and coaches, officers in fishing and merchant fleet, world class university professors, etc.) that could resemble the ideal functioning of a competitive labor market. Most workers, however, do not belong to these niches. In fact, we posit that workers are more likely to be subject to managerial opportunism (i) whenever existing legal constraints push managers to initially propose better working conditions than workers would accept otherwise; and, (ii) whenever existing exogenous shocks reduce workers' outside opportunities. Although somehow connected, both situations cannot be confused.

To identify the conditions that make managerial opportunism plausible, we have previously addressed how managers design labor contracts. Our setting allows us to determine what would be a labor contract at $t = 0$ under different scenarios, specially those related to legal rules and trade unions. Specifically, we study labor contracts under two legal constraints: a maximum legal number of hours and a minimum wage. Under these legal restrictions, we find that it might be optimal for the manager to break up the contract and to propose an informal one that will be accepted by the worker, provided the transaction costs are not too high. The case that no legal constraint exists is not immune to managerial opportunism. Once the labor contract is accepted at $t = 1$, the deterioration of the worker's opportunity cost due to environmental shocks may cause changes in his participation constraint that makes him more vulnerable to contractual breaches. Next, we explore these alternative possibilities.

Labor contract design with no legal constraint

As in the literature of the economics of information (e.g., Salanié 1997, or Macho-Stadler *et al.* 2001), we assume that at period $t = 0$ the manager designs the labor contract that maximizes the firm's profits and providing to worker enough welfare to accept the job,

$$\begin{aligned} \max_{W,w,e} \quad & x(e) - W \\ \text{s.t.} \quad & u(W) - v(e) \geq \underline{U} . \\ & W = w e \end{aligned}$$

First order conditions are

$$x'(e) = \frac{v'(e)}{u'(we)} \quad (1.1)$$

$$u(we) - v(e) = \underline{U} \quad (1.2)$$

$$W = w e. \quad (1.3)$$

To find the labor contract, $(\widehat{W}, \widehat{w}, \widehat{e})$, we initially obtain wages as a function of working hours in (1.2), $w = \phi(e; \underline{U})$; then, substituting into (1.1) we find the labor hired, \widehat{e} . Wages are set at $\widehat{w} = \phi(\widehat{e}; \underline{U})$ and the total compensation is $\widehat{W} = \widehat{w}\widehat{e}$. If the contract is accepted at $t = 1$, the worker's welfare will become $U(\widehat{W}, \widehat{e}) = \underline{U}$ and the firm's profits will be $x(\widehat{e}) - \widehat{W}$.

This solution can be easily interpreted within a simple demand-supply diagram of the bilateral labor market. Three functions are drawn in Figure 1.1. First, the negative-sloped demand function for labor represents that the firm stops hiring additional units of labor whenever its marginal productivity equals its cost,⁶ $x'(e) = w$. Second, the positive-sloped supply function of labor is found at the worker's consumption-leisure problem and represents the marginal income received equals the marginal rate of substitution between the effort and consumption,⁷ $w = v'(e)/u'(we)$. Denote by \tilde{w} the wage rate that equalizes the demand function for labor and the supply function for labor. Finally, the participation constraint represents the combinations of effort and wages that makes the worker indifferent, in welfare terms, with his reservation utility. The participation constraint is thus represented by the indifference curve $\mathcal{I}_{\underline{U}} = \{(e, w) : u(we) - v(e) = \underline{U}\}$, any feasible contract will be placed at the upper contour set of $\mathcal{I}_{\underline{U}}$.⁸

⁶Recall that the demand function for labor is found from the first order conditions of the firm's profit maximization problem $\max_e x(e) - we$, taken wages w as given.

⁷Recall that the supply function of labor is found from the first order conditions of the worker's maximization problem $\max_{c,e} u(c) - v(e)$ subject to his budget constraint $c = we$, and taken wages w as given.

⁸To represent this indifferent curve, let us attach the opportunity cost \underline{U} to a particular

[Figure 1.1 here]

Five remarks are in order. First, it is important to realize here that it is the manager who designs the labor contract $(\widehat{W}, \widehat{w}, \widehat{e})$, which is offered to the worker to be accepted or not. This key feature has two consequences. One consequence is that the manager has full market power, and acts as a monopsonist when designing the contract. She determines the worker level of effort \widehat{e} when the marginal cost for the firm equals the marginal benefit for the worker; that is, at the intercept of the demand for labor and the supply of labor. Then, she determines the compensation to the worker, the wage \widehat{w} , at the threshold where the worker participates, equation (1.2); that is, on the indifference curve \mathcal{I}_U . The second consequence is that the worker do not decide the level of labor to be supplied at the wage \widehat{w} . He is offered a labor contract $(\widehat{W}, \widehat{w}, \widehat{e})$, and he has to accept it or not. This means that the worker does not face at all the textbook trade-off income-labor decision that shapes his supply of labor (see Robbins 1930). Instead, the worker only compares the indifference curve that belongs the labor contract $(\widehat{W}, \widehat{w}, \widehat{e})$ with that provided by his reservation utility, \mathcal{I}_U .

Second, observe that the set of feasible contracts, as well as the very design of the labor contract, crucially depends on the worker's reservation utility \underline{U} . For instance, if the opportunity cost equals the unemployment benefits, i.e. $\underline{U} = U(\underline{W}, 0)$, higher benefits shrinks the set of feasible contracts, and the manager will design a labor contract with higher wages; and vice versa for lower benefits. If the opportunity cost of signing a labor contract is extracted from a (subjective) probability function that depends on the worker's qualification h and the unemployment rate \mathcal{U} , i.e. $\underline{U} = \beta E[U(\underline{W}, w, e; h\mathcal{U})]$, lower human capital accumulation and larger unemployment rates enlarge the set of feasible contracts and reduce wages, and vice versa.

Third, the labor contract designed at period $t = 0$ –i.e., $(\widehat{W}, \widehat{w}, \widehat{e})$ with $\widehat{W} = \widehat{w}\widehat{e}$ –, if accepted by the worker at period $t = 1$, provides him a welfare $U(\widehat{W}, \widehat{e}) = \underline{U}$ that fulfills his participation constraint. Thus, once the labor contract “ $(\widehat{W}, \widehat{w}, \widehat{e})$ with $\widehat{W} = \widehat{w}\widehat{e}$ ” is accepted, all bargaining gains are exhausted, as there exists no other labor contract that can improve the welfare of some economic agent –the manager or the worker– without worsening off the other. We formally present this result.

labor contract $(\check{W}, \check{w}, \check{e})$, so that $\underline{U} = U(\check{w}\check{e}, \check{e})$, then the participation constraint implicitly is given by $w = \phi(e; U(\check{w}\check{e}, \check{e}))$. This is a convex function that displays a minimum at the crossing with the supply function at (\check{e}, \check{w}) . So, the participation constraint is a kind of *average cost function* of providing labor services by the worker, while the supply of labor is a kind of *marginal cost function* of providing labor services.

Lemma 1. *The labor contract $(\widehat{W}, \widehat{w}, \widehat{e})$ determined in (1.1)-(1.3) is efficient.*

Fourth, and related with the previous remark, once the labor contract “ $(\widehat{W}, \widehat{w}, \widehat{e})$ with $\widehat{W} = \widehat{w}\widehat{e}$ ” is accepted, there cannot exist managerial opportunism: either decreasing wages or increasing the hours required without increasing total compensation would lead the worker to leave the firm. This means that a necessary condition for managerial opportunism to exist is that the labor contract designed at period $t = 1$ must provide the worker a welfare that is higher than his reservation utility; i.e. the labor contract must be allocated at the strictly upper contour set of \mathcal{I}_U (see Figure 1.1).

Fifth, as a final remark, changes in the environmental economic conditions –such as those in the labor market or in the unemployment benefits– modify the worker’s opportunity cost, which may open opportunistic possibilities for managerial behavior. Concerning the labor market conditions, even in the most liberalized labor markets, the economic conditions affect labor mobility across firms. Unemployment rates or the general dynamism of the economy influence the outside opportunities that workers face when deciding to confront managerial opportunism (Grimshaw and Rubbery, 1998). In what respects the level of unemployment benefits that cover the risk of unemployment, it may obviously become an outside opportunity itself. In fact, the literature has found that higher unemployment benefits make workers more selective in accepting jobs, provoking a longer duration of unemployment and higher unemployment rates (Lalive, 2007). The possibility that unemployment compensation helps to raise the wage by at least one-half the unemployment compensation benefit has also been suggested (Diamond, 1981).

We conclude by characterizing how changes in the environmental economic conditions affect the non-constrained setting studied in this section. Exogenous economic changes in the unemployment level or the unemployment benefits modify the worker’s reservation utility. An increase in the unemployment rate, $\mathcal{U}' > \mathcal{U}$, or a cut on the unemployment benefits, $\underline{W}' < \underline{W}$, moves the participation constraint leftwards for the reservation utility decreases. The labor contract $(\widehat{W}, \widehat{w}, \widehat{e})$ is then allocated at the upper contour set of the new indifference curve $\mathcal{I}_{U'}$, opening opportunistic possibilities for managerial behavior. We can summarize this result, to be tested, as follows.

Proposition 1. *Managerial opportunism is possible if a shift on outside opportunities (unemployment, economic dynamism, unemployment benefits) makes the indifference curve \mathcal{I}_U move downwards.*

Proposition 2. *Managerial opportunism is possible if legal constraints push working conditions of the worker beyond what his opportunity cost would lead him to accept.*

Labor contract design with legal constraints

Individuals in any society have to reach consent agreements on what is politically acceptable in labor regulation beyond efficiency concerns, as legal rules enhance the working conditions of many workers above their participation constraint. These agreements obviously affect geographical and functional mobility, which are at the base of a perfectly competitive labor market (Botero *et al.* 2004). The set of norms and values that conform a country's culture make individuals perform specific investments that are difficult to recover if workers quit their jobs and move. For instance, closer family and friendship ties in Latin countries may reduce workers geographical mobility (Hofstede 2001); also, investments in real state may be more specific in some countries to the extent that their citizens may be more prone to buy their households than to rent them. As a consequence of the imperfections of the rent and the real state markets, the move emotionally and economically becomes more difficult (Green and Henderschott, 2001). On the other hand, legal rules are specially important for some types of workers when it comes to obtain better working conditions than they would accept otherwise: it has been found that blue collar workers, older workers, ethnic minorities and households with children show lower migration rates (McCormick, 1997; Gregg, Machin and Manning, 2004). Finally, besides legal rules, the bargaining power of workers through unions may allow them to obtain better working conditions above what the law and the competitive equilibrium would suggest.

With this background, we next study in our model the traits of labor contracts signed under two examples of legal constraints: a maximum legal number of hours \bar{e} , and a minimum wage \underline{w} .

1.3.3.1 Labor contracts under a maximum legal number of hours. Consider the case that the number of hours is upper bounded by a legal restriction, i.e. $e \leq \bar{e}$. In this case, the manager designs the labor contract by solving the problem,

$$\begin{aligned} \max_{W,w,e} \quad & x(e) - w e \\ \text{s.t.} \quad & u(we) - v(e) \geq \underline{U} \\ & W = w e \\ & e \leq \bar{e} \end{aligned} .$$

The labor contract designed at period $t = 0$ is straightforward. Whenever

the legal number of hours is higher than the hours that would be hired by the manager, i.e. $\bar{e} \geq \widehat{e}$, the labor contract is the efficient one computed in the previous section, $(\widehat{W}, \widehat{w}, \widehat{e})$. There exists a legal constraint, but it does not affect the labor conditions. Things are different whenever the legal number of hours is lower than the hours that would be hired by the manager if this legal constraint does not exist, i.e. $\bar{e} < \widehat{e}$ (see Figure 1.2). In this case the manager designs a labor contract (W^e, w^e, \bar{e}) by hiring the legal number of hours, $e^e = \bar{e}$, and then setting at (1.2) the wage per hour that makes the worker to accept the contract, i.e. $w^e = \phi(\bar{e}; \underline{U})$; thus, the total compensation is $W^e = w^e \bar{e}$. If the contract is accepted at period $t = 1$, the worker's welfare will become $U(W^e, \bar{e}) = \underline{U}$ and the firm's profits will be $x(\bar{e}) - W^e$.

Two remarks are in order. First, the labor contract designed by the manager, (W^e, w^e, \bar{e}) with $W^e = w^e \bar{e}$, do not open managerial opportunism opportunities. Either decreasing wages or increasing the level of effort (i.e. $w^{**} \leq w^e$ or $e^{**} \geq e^e$), would lead the worker to leave the firm.

Second, observe that the labor contract (W^e, w^e, \bar{e}) is not efficient. The manager could find it profitable to propose at period $t = 2$ a new informal labor contract, (W^{**}, w^{**}, e^{**}) with $W^{**} = w^{**} e^{**}$, with more hours worked, $e^{**} \in (\bar{e}, \widehat{e}]$, and a higher wage per hour, $w^{**} > w^e$, such that the worker verifies his participation constraint $U(W^{**}, e^{**}) = \underline{U}$. The worker is indifferent between both labor contracts, while the firm's profits are higher $(1 - \rho)x(e^{**}) - W^{**}$, provided the productivity penalty ρ is not very big. Yet, in this case there is no managerial opportunism, but a rebargaining of the labor contract in the quest for an efficiency improvement. In fact, although the employee works more hours, he also gets a higher compensation, so that $U(W^{**}, e^{**}) = U(W^e, \bar{e})$; thus, it is very likely that he will accept the new informal contract at period $t = 3$. Moreover, since there is no managerial opportunism, but a rebargaining without any Pareto efficient loss, there might not be a productivity penalty either, i.e. $\rho = 0$. Thus, the informal labor contract will therefore be (very likely) the efficient one found in the case that no legal constraint exists, $(\widehat{W}, \widehat{w}, \widehat{e})$.

[Figure 1.2 here]

1.3.3.2 Labor contracts under a minimum wage. Consider a case in which the wage is lower bounded by a legal restriction, i.e. $w \geq \underline{w}$. At period $t = 0$ the manager designs the labor contract that maximizes the firm's profits and

providing to worker enough welfare to accept the job,

$$\begin{aligned} \max_{W,w,e} \quad & x(e) - w e \\ \text{s.t.} \quad & u(we) - v(e) \geq \underline{U} \\ & W = w e \\ & w \geq \underline{w} \end{aligned} \quad (1.4)$$

First order conditions for the solution are (1.2)-(1.3) and

$$[\underline{w} - w] \left[x'(e) - \frac{v'(e)}{u'(we)} \right] = 0. \quad (1.5)$$

To find the optimal labor contract, we consider the case that the worker's opportunity cost –i.e., his reservation utility– is independent of the minimum wage,⁹ i.e. $\underline{U}(w) = \underline{U}$. That is, his participation constraint remains unchanged after the legal restriction is modified.¹⁰ To find the labor contract we identify three different cases.

- i) The legal minimum wage is **lower** than the wage the manager would be willing to pay, i.e. $\hat{w} \geq \underline{w}$. In this case, the labor contract is the efficient one found in the previous section: $(\widehat{W}, \hat{w}, \hat{e})$ with $\widehat{W} = \hat{w}\hat{e}$. There exists a legal constraint, but it does not affect the contract.
- ii) The legal minimum wage is **higher** than the wage that would be paid by the manager without this legal constraint, but **lower** than the wage that equalizes the demand for and the supply of labor, $\underline{w} \in [\hat{w}, \tilde{w}]$ (see Figure 1.3). To find the labor contract, first we obtain from (1.2) that wages are a function of the working hours, $w = \phi(e; \underline{U})$; then, substituting into (1.1) we find the labor hired, $e^w = \hat{e}$. Then, the proposed wage equals the minimum wage $w^w = \underline{w} > \hat{w} = \phi(\hat{e}; \underline{U})$. So the labor contract designed at $t = 0$ is $(W^w, \underline{w}, \hat{e})$ with $W^w = \underline{w}\hat{e} > \widehat{W}$. Note that the worker's compensation is higher than in the efficient contract despite working the same number of hours \hat{e} , as the existence of a minimum wage increases his bargaining power.
- iii) The legal minimum wage is **higher** than the wage that equalizes the demand for and the supply of labor, i.e. $\underline{w} > \tilde{w}$. In this case, the manager determines the level of effort at the level that the marginal

⁹For instance, the worker's opportunity cost is an unemployment subsidy, or coincides with the worker's most likely labor contract, such as the mode of the density function being a robust statistic (provided this mode is higher than the minimum wage).

¹⁰In Appendix A.1 we study the case that the reservation utility is affected by the level of the legal restriction.

productivity for the firm equals the minimum wage, $x'(e^w) = \underline{w}$. With regard to the labor contract under no legal constraint, the hours worked are lower, $e^w < \hat{e}$, and wages are higher $w^w = \underline{w} > \hat{w} = \phi(\hat{e}; \underline{U})$. So the contract is $(W^w, \underline{w}, e^w)$ with $W^w = \underline{w}e^w$.

Note that the labor contract designed in period $t = 0$ is accepted (or not) by the worker at period $t = 1$. Thus, once agreeing the labor contract, if $\underline{w} \geq \hat{w}$ the labor contract is at the strictly upper contour set (see Figure 1.3). Then, provided cases ii) and iii) apply, the manager can pay less or demand more effort without any fear that the worker leaves his job. Under these conditions, managerial opportunism could arise, as the following section explores.

[Figure 1.3 here]

Table 1.1: **Summary of labor contracts**, (W^*, w^*, e^*) . Labor contracts designed by the manager at $t = 0$, with and without legal constraints.

		Labor contract			Managerial Opportunism
		Contract	Labor income	Efficient	
No legal constraints		$(\widehat{W}, \hat{w}, \hat{e})$	$\widehat{W} = \hat{w}\hat{e}$	Yes	No
Legal constraints:					
Maximum number of hours: $e \leq \bar{e}$	$\bar{e} < \hat{e}$	(W^e, w^e, \bar{e})	$W^e = w^e\bar{e}$	No	Yes
Minimum wage: $w \geq \underline{w}$	ii) $\underline{w} \in [\hat{w}, \tilde{w}]$	$(W^w, \underline{w}, \hat{e})$	$W^w = \underline{w}\hat{e} > \widehat{W}$	No	Yes
	iii) $\underline{w} > \tilde{w}$	$(W^w, \underline{w}, e^w)$	$W^w = \underline{w}e^w$		

Managerial opportunism

We have so far modelled the “why” and the “when” questions. A manager behaves opportunistically because it may find it profitable, but she can only take this advantage when the existing labor contract results in a (far) better conditions for the worker that would lead him to accept the job. In terms of the model, his participation constraint is not fulfilled as the labor contract is at the strictly upper contour set of the participation constraint \mathcal{I}_U . In this section we will focus on the issue: what are the factors that explain differences in the level of managerial opportunism? In other words, to what extent can a manager behave opportunistically?

We have already suggested two type of scenarios that may explain the existence of some level of managerial opportunism (see Table 1.1). The first

type refers to changes in the environmental economic conditions after signing the labor contract. Once at work after agreeing a labor contract at step $t = 1$, a lower probability of finding a job (e.g., because of an increase in the unemployment rate) or the reduction of the unemployment benefits moves the participation constraint \underline{I}_U leftwards, reducing the worker's opportunity cost and increasing the bargaining power of the manager (see proposition 1). The second type deals with labor market restrictions may result in labor contracts at step $t = 1$ with better working conditions than those that would lead the worker to accept a job. In the previous section, we have explored this possibility under the existence of a minimum wage (cases ii and iii) (see proposition 2).

Both possibilities are at the root of managerial opportunism. To study the extent of managerial opportunism, in this section we focus on the step $t = 2$, where the manager may design a new labor contract. Thus, once the worker is on his job, the manager might consider to modify the labor conditions in two ways: (i) changing the whole contract and offer a new, but “informal,” contract (W^{**}, w^{**}, e^{**}) , so total compensation would turn out to be $W^{**} = w^{**}e^{**}$ (studied in Section 1.3.3.1); or, (ii) changing the effort required $e^{**} > e^*$ without further payment, so the contract becomes (W^*, w^*, e^{**}) with $W^* = w^*e^*$ (analyzed in Section 1.3.3.2). Which of them is finally implemented, if so, depends on the net profits for the firm.

1.3.3.1 Managerial opportunism: proposing a completely new informal contract. Once the labor contract (W^*, w^*, e^*) with $W^* = w^*e^*$ is signed at $t = 1$, the manager might consider the possibility to change it completely. The new *informal labor contract* is found by solving the problem,

$$\begin{aligned} \max_{W,w,e} \quad & (1 - \rho)x(e) - W - \lambda[W^* - w e] \\ \text{s.t.} \quad & u(W) - v(e) \geq \underline{U} \\ & W = w e \\ \text{given} \quad & W^* \end{aligned}$$

where $\rho \in [0, 1]$ measures the productivity loss from a decreased motivation, an increased conflict and/or worse quality of the new workers hired (because of reputational effects of managerial opportunism); and $\lambda \geq 0$ is a parameter representing the judicial costs that the firm may face for exerting opportunism (severance pay, trial costs, etc.). First order conditions for the interior solution are (1.2) and

$$\frac{1 - \rho}{1 - \lambda} x'(e) = \frac{v'(e)}{u'(we)}. \quad (1.6)$$

Note that the demand function for labor moves upwards as the judicial costs λ increase, and moves downwards the higher the costs from loss of motivation

and conflict ρ . To find the informal labor contract, wages are a function of effort at (1.2), $w = \phi(e; \underline{U})$, and then, substituting in (1.6) we find the *informal* level of hours required. The resulting informal contract is set on the indifference curve, i.e. $(W^{**}, w^{**}, e^{**}) \in \mathcal{I}_{\underline{U}}$ with $w^{**} \leq w^*$, $e^{**} \geq e^*$ and $W^{**} = w^{**}e^{**}$ (see Figure 1.4). If the informal contract is accepted at $t = 3$, the firm's profits will be $(1 - \rho)x(e^{**}) - W^{**} - \lambda[W^* - W^{**}]$, and the worker's welfare is lower than that obtained with the original labor contract, $U(W^{**}, w^{**}, e^{**}) = \underline{U} < U(W^*, w^*, e^*)$, so managerial opportunism exists.

Four comments are in order. First, note that, given the contract proposed at $t = 0$, (W^*, w^*, e^*) with $W^* = w^*e^*$, the manager would be initially interested in proposing the informal contract (W^{**}, \hat{w}, e^*) with $W^{**} = \hat{w}e^*$; that is, paying less to the worker. Provided no productivity penalty harm the firm ($\rho = 0$), this will be the new informal contract provided probability of judicial costs due to a lower compensation to the worker is zero, $\lambda = 0$. Otherwise, if $\lambda > 0$ the demand function for labor moves upwards then requiring higher number of hours $e^{**} > e^*$ and, consequently, the existence of a productivity penalty, $\rho > 0$, that moves the demand function downwards. Note that for a penalty ρ high enough, the manager will not change the labor conditions at $t = 2$. Thus, the informal contract depends on the ratio $(1 - \rho)/(1 - \lambda)$. The value of the parameters (ρ, λ) that allows managers to behave opportunistically is upper and a lower bounded. So this ratio must be higher than one; otherwise $e^{**} < e^*$. Furthermore, there exists an upper threshold for (ρ, λ) such that the informal labor contract is $(W^{**}, \hat{w}, e^{**})$, with $W^{**} = \hat{w}e^{**}$, verifying $u(\hat{w}e^{**}) - v(e^{**}) = \underline{U}$.

The second comment refers to the fact that the informal contract (W^{**}, w^{**}, e^{**}) with $W^{**} = w^{**}e^{**}$ might require to work more hours than those legally allowed, so that $e^{**} > \bar{e}$. Thus, the new informal contract could be illegal.

Third, observe that graphically, the set of possible informal contracts are placed at the arc belonging to the indifference curve $\mathcal{I}_{\underline{U}}$ (see Figure 1.4). The final location will depend on the strength of the workers and the rule of law, i.e. ρ and λ ; thus, in strict sensu, the informal labor contract is $(W^{**}(\rho, \lambda), w^{**}(\rho, \lambda), e^{**}(\rho, \lambda))$, with $W^{**} = w^{**}e^{**}$. Fourth, following the previous comment, note that the informal contract that only reduces the worker's compensation, i.e. (W^{**}, \hat{w}, e^*) with $W^{**} = \hat{w}e^*$, is dominated by the informal contract proposed in this section, unless $\rho = \lambda = 0$. That is, if no penalty exists, then the informal contract will resembles the efficient one. Note that worse (better) outside options result in a lower (higher) reservation utility \underline{U} , which expands the feasible contract set, thus increasing (reducing) managerial opportunism.

[Figure 1.4 here]

1.3.3.2 Managerial opportunism: increasing the effort conditions without compensation. Once the labor contract (W^*, w^*, e^*) with $W^* = w^*e^*$ is signed at $t = 1$, the manager might consider the possibility to change it partially. To take some advantage the new *informal labor contract* must exhibit a lower compensation, a higher number of hours required or both. In the previous section we found that the informal labor contract that only reduces the worker's compensation is dominated by (or could be a particular case of) the informal labor contract found in the previous section. In this section we will focus on the *informal labor contract* for which the worker will receive the total compensation she agreed with the manager at period $t = 1$: $W^* = w^*e^*$, while the manager is requiring now from his more effort. That is, the new labor contract is (W^*, w^*, e^{**}) with $W^* = w^*e^*$. This case is analogous to a situation in which overtime work is not paid. Anyhow, the new effort is found by solving the problem,

$$\begin{aligned} \max_e \quad & (1 - \rho)x(e) - W^* \\ \text{s.t.} \quad & u(W^*) - v(e) \geq \underline{U} \\ \text{given} \quad & W^* \end{aligned}$$

where $\rho \in [0, 1]$ measures the productivity loss from decreased motivation, increased conflict and worse new workers (because of the reputational effects of managerial opportunism). It is then easy to show that the informal labor contract, (W^*, w^*, e^{**}) , is found at (1.2): $e^{**} = \phi^{-1}(w^*; \underline{U})$.

If the informal contract is accepted at $t = 3$, the firm's profits will be $(1 - \rho)x(e^{**}) - W^*$, and the worker's welfare is lower than that obtained with the original labor contract, $U(W^*, w^*, e^{**}) = \underline{U} < U(W^*, w^*, e^*)$, so managerial opportunism exists.

To conclude this section, we present a result that shows under what conditions the labor conditions are fully or partially changed.

Proposition 3. *The level of managerial opportunism depends on how much the judicial system supports the firm interests (e.g., what is an unfair dismissal?); that is, on the size of $\lambda(W^* - W^{**})$.*

Proposition 4. *The level of managerial opportunism depends on how weak trade unions are so the productivity penalty is minimized (conflict and reputation), represented by the parameter ρ .*

1.4 Empirical study

1.4.1 Data and variables

We built a panel for the period 1995 to 2013 of economic, labour and legal indicators for 30 OECD countries: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Japan, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States. Our database results from the integration of several indicators stemming from different databases. The main ones are made available by OECD (Labour Force Statistics, Social Expenditure Database, Employment Protection Legislation Indexes, and Factbook Statistics and Compendium of Productivity Indicators), UN (World Population Prospects), and ILO (Key Indicators of the Labour Market, and Working Conditions Laws Database, NATLEX database).

Our dependent variable is managerial opportunism, which we proxy as the share of the labor force in a given country working a number of hours that exceeds the maximum weekly limit. We therefore collected two different types of data: the percentage of persons working hours per hour's intervals, and the maximum weekly hours allowed by law in a given country. The percentage of persons working hours per hour's intervals comes from the Key Indicators of the Labour Market (KILM henceforth), drawn up by ILO. The maximum legal hours, including both regular hours and overtime, were collected mainly from the ILO Working Conditions Laws Database. When this second database did not offer a clear figure for a specific country, we resorted to NATLEX (a different ILO database). The level of managerial opportunism thus resulted from adding the proportion of the labor force in each country that works more than the legal limit.

Focusing now on the main reasons for managerial opportunism as described in the theoretical model, we measured a set of independent variables as explained below.

To measure the dynamism of economic conditions outside the firm reflecting "outside opportunities", we use two complementary variables: unemployment rate and unemployment benefits. Unemployment rate measures the share of the labour force that is without work but available for and seeking employment. The source is the Labour Force Statistics database from OECD.Stat. Unemployment benefits, on the other hand, refer to the public and mandatory private expenditure in unemployment benefits programs measured as a percentage of the GDP. These data are collected by OECD in the Social Expenditure Database (SOCX). We expect that higher unem-

ployment rates are related to lower levels of economic growth.

The market constraints that affect the labour contract are summarized in two variables: the maximum working hours a worker could work during one week, and whether there is a national statutory minimum wage. The value of the variable maximum weekly working hours, for countries that have a legal limit, is equal to the maximum weekly legal working hours, including both regular hours and overtime. For countries where there is no legal limit (Australia, Japan, New Zealand, United Kingdom and United States), we impute a value equal to total hours in a week minus the average weekly time people spend sleeping according to data collected by OECD's National Time Use Surveys. This is because, although a person could legally work 24/7, there are obvious biological limitations. In terms of interpreting the results, the value of the variable will be higher for countries with no maximum weekly legal limit on working hours than for those with one. Regarding the existence of a national statutory minimum wage, we use a dummy variable of 1 if it exists, and zero otherwise. The variable belongs to the data base "Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts, 1960-2014 (ICTWSS)", authored by Jelle Visser.

To measure the costs that firms incur from not complying with the law by exerting opportunism towards their workers, we use the OECD's EPL: how strict individual dismissal for regular workers is. This index was developed by the OECD to consider not only the level of severance pay but also procedural inconveniences that also raise costs. The use of this EPL index serves as a proxy to measure the level of enforceability of the initial labor contract. Higher values of this index are related to stricter labor regulations. The stricter the labor regulations are, the higher the costs if employers breach or conclude the contract. We expect that high levels of the EPL index raise non-compliance costs, as Belot *et al.* (2007) and Blanchard and Portugal (2001) have suggested, therefore leaving room for managerial opportunism.

As for workers' bargaining power, we measure trade union density, which is a ratio that divides the number of wage and salary earners that belong to a trade union organization by the total number of wage and salary earners in the economy. We expect higher trade union density to be related to higher bargaining power, as Rose and Chaison have proved (1996). The variable belongs to the OECD Labour Force Statistics dataset.

Finally, we add three control variables. Total population is linked to the size of the labor market and, therefore, to the number of potential workers with whom a firm can transact. We expect the higher competition of workers in the labor market to cause an increase in managerial opportunism. We also control for the technological strength of countries through the number of triadic patent families (patents registered in Japan, USA and Europe). The

higher the number of triadic patents, the higher the technological strength of the country (Sternitzke, 2009), which may be linked to a highly-educated work force with more bargaining power than low-cost countries. Lastly, GDP per capita controls for many potentially relevant factors in the macroeconomic and political environment that influence business climate quality and even the professional skills of managers. We anticipate that higher levels of GDP per capita are related to less managerial opportunism.

1.4.2 Results and Discussion

Our estimates correspond to the basic model,

$$ManOpp_{it} = \alpha + OutOpp_{it} \beta + MarketConst_{it} \gamma + NonCompl_{it} \delta + TradeUn_{it} \lambda + CVar_{it} \phi + \varepsilon_{it},$$

where i and t denote country and year, respectively; *ManOpp* is the percentage of employees working more hours than legally allowed; *OutOpp* represents the alternative measures for outside opportunities; *MarketConst* represents the alternative measures for market constrains; *NonCompl* is a proxy for measuring the costs a firm may face when dismissing a worker and unilaterally breaking the contract; *TradeUn* represents the percentage of workforce affiliated to unions; *CVar* are control variables for the model; and, ε is an error term.

Our dataset consists of a strongly balanced panel of data for 30 countries for 19 years. In order to select the best estimator, we test our panel data set for the possible presence of the following disturbances: i) heteroskedasticity, ii) autocorrelation, iii) cross-sectional dependency. We conducted the standard test for each one of these three possible sources of disturbances: the modified Wald statistic for groupwise heteroskedasticity (following Greene, 2000), the Wooldridge test for autocorrelation in panel data, and the Pesaran (2004) test for cross-sectional dependence implemented by Hoyos and Sarafidis (2006) in Stata. All three allowed us to reject their null hypothesis, confirming the need to control for them when estimating the model.

The best option to ensure valid statistical inference given the disturbances present in our panel data is the Driscoll-Kraay estimator developed for Stata by Hoechle (2007). This has the advantage of being a “nonparametric covariance matrix estimator that produces heteroskedasticity- and autocorrelation-consistent standard errors that are robust to general forms of spatial and temporal dependence” (p.282).

Regarding whether a random-effects model or a fixed-effects model should be applied, we rely on Mundlak’s (1978) test results. Mundlak (1978) developed a method of estimation where the heterogeneity bias is explicitly

modelled by adding an additional term that accounts for unobserved characteristics between groups (countries in our case). He showed that, when the model is properly specified, the RE is identical to the FE estimator. RE is “the preferred choice because of its greater flexibility and generalizability, and its ability to model context, including variables that are only measured at the higher level” (Bell and Jones, 2015, p.134). This consideration is also relevant in cases where panel data “contains more slowly changing, historically determined variables (such as GDP per capita)” (Bell and Jones, 2015, p. 133). This is the case here, to the extent that the variable population does not vary enough to be included when performing Mundlak’s test, and Stata drops the variable from the calculations. Other variables, like “Market Constraints” or “Non Compliance” did not change their values much over our timeframe analysis.

Reasons accounting for the variance between countries and slow changing variables in the model are applicable to our analysis. The legal aspects of the labor market included in our model barely changed over the timespan of our panel data. Thanks to Mundlak’s work, it can be tested whether the observed variables are correlated with the unobserved time-invariant variables. Results suggest that there is evidence of coefficients being jointly zero; therefore the observed variables are uncorrelated with the unobserved time-invariant variables. This means the random-effects model assumptions are satisfied and can therefore be applied. We carried out a pooled OLS regression of the Driscoll and Kraay estimator since “it yields consistent coefficient estimates when the random effects model is true” (Hoechle, 2007, p.305).

The “Managerial Opportunism” variable values go from zero to 68.36, with its mean being 21.43 and its standard deviation 15.77. As explained above, the managerial opportunism variable is defined as the share of the labor force in a given country working a number of hours that exceeds the maximum weekly limit. Therefore, if there is no legal limit, all workers are working within the legal limit no matter how many hours they work per week. Consequently, the variable value in this case is zero. Countries from our sample with no legal limit are Australia, Japan, New Zealand, United States and United Kingdom (although in 1998 UK changed the legislation, establishing a maximum weekly working time, including overtime, of 48 hours). Value imputations were made in four countries: Belgium, Ireland, Luxembourg and Turkey. All four, in specific years or all the years contemplated in our database, had a legal maximum weekly working time of 50 hours. Given that the KILM database only provides data for the share of people working 49 or more hours, we impute this value as the percentage of people working over the legal limit. We consider this to be reasonable given the conservative approach applied in calculating this variable: we computed the maximum

weekly working hours as both the legal maximum regular working hours plus the weekly legal maximum overtime. Working overtime is usually considered in the legislation an extraordinary circumstance and in some cases is limited to a small consecutive period of time.

On average, 21.4% of workers work over the maximum weekly working hours. The highest value, 68.36, belongs to Poland. Between 2001 and 2003 Poland had a limit of 40 hours per week and also the highest share of workers working hours over the legal limit (66-68%). In 2003 Poland amended its labor legislation, effective since 1 January 2004, to adjust it to the standards of the European Union employment law set out in Directive 2003/88/EC of the European Parliament and of the Council of 4 November 2003 and has not changed it since. The EU Directive established maximum weekly working hours, including overtime, of 48 hours, which was the limit adopted by Poland. Data suggest that in Poland there was not only legal adoption of the 48-hour limit but also real, effective adoption. There has been a constant decrease in the percentage of workers working over the 48-hour limit from 18.1% in 2004 to 12.6% in 2013. Another three countries that at some point in time had more than half of their workers working over the legal weekly working limit are Spain, Turkey and Hungary. Data from all three countries share a similar pattern: over the time span of this dataset the value of the managerial opportunism variable continuously decreased from around 50% to 36-39%. The legal weekly working limit remained constant over time in Spain and Turkey, whereas Hungary decreased by one hour, from 44 to 43. Among the countries with a legal weekly working limit, France has the lowest, set at 39 hours per week. In France in 1998 the weekly maximum was 42 hours and 27.4% of the workers were working over this limit, the same number as in 2013 but with a legal limit of 39 hours per week.

Average unemployment is 7.61, with the minimum being 1.80 and the maximum 27.47. The database comprises the time period from 1995 to 2013 when there were two severe economic crises—the global financial crisis of 2007 (Claessens, Dell’Ariccia, Igan, and Laeven, 2010), and the subsequent European sovereign debt crisis in 2009 (Fernández-Villaverde, Garicano, and Santos, 2013; Lane, 2012)—which deteriorated economic indicators. The highest values are for Greece and Spain where the unemployment rate reached 24-27% in the period 2012-2013. Both countries are among the most affected by the European sovereign debt crisis. Luxembourg had the lowest unemployment rate, 1.80% in 2001, sharing the bottom position with Iceland. These two countries are very small and have a population of approximately five and three hundred thousand people respectively.

The average percentage of GDP spent on unemployment benefits programs is 0.92. Denmark spent the lowest percentage of GDP on unemploy-

ment benefits, between 0.044 in 1995 and 0 in 2013, with an average unemployment rate of 5.6. At the other extreme is Finland which spent 3.8 per cent of its GDP and had an unemployment rate of 15.26 in 1995. Finland shows decreasing expenditure on unemployment benefits and a decreasing unemployment rate for the time period (it spent 1.9% of GDP on unemployment benefits and had an unemployment rate of 8.2 in 2013). There are three other countries that spend three times the average percentage of GDP on unemployment benefits—Belgium, Spain and Ireland. Their numbers show both the difference in the amount of resources the countries spend on unemployment benefits and the adjustments made to such programs following the European sovereign debt crisis. For example in 2010 Belgium spent 3.5 per cent of its GDP on unemployment benefits while it had an unemployment rate of 8.3 per cent, and Ireland and Spain spent 3.2 per cent of GDP on such programs while their unemployment rates were 13.9 and 19.8 per cent respectively. In 2013 data suggest there were cuts in unemployment benefits programs, as all three countries reduced the percentage of GDP spent on such programs even though their unemployment rates had increased: Belgium spent 3.2 per cent of its GDP with an 8.4 unemployment rate, Ireland spent 2.5 per cent of its GDP with a 13.8 unemployment rate, and Spain spent 3.1 per cent of its GDP with a 26.1 unemployment rate.

The average value for maximum working hours per week is 54.91 hours. To understand this variable we must differentiate between countries with and without a legal limit. This differentiation and the way the dependent variable, managerial opportunism, is calculated explain the high negative correlation between them, -0.65, since higher values of maximum working hours per week corresponds to the lowest values of managerial opportunism. As mentioned above, Australia, Japan, New Zealand, United States and United Kingdom have no legal limit. We imputed maximum weekly working hours as all the hours in a week minus the average time people in those countries sleep per week (and for all of them managerial opportunism was valued at zero). Among those four countries, Japan has the longest working week with 114 hours. Regarding those with a legal limit, France has the shortest working week with 38 (currently 39) hours; and Belgium and Turkey the longest with 50 hours.

There are seven countries with no statutory minimum wage: Austria, Denmark, Finland, Germany, Italy, Norway, and Sweden. Ireland and United Kingdom did not have one, but this changed in the 2000s.

The average value for individual dismissal is 2.14 on a scale of zero to six, with a minimum of 0.26 and a maximum of 4.58. The country with the strictest and, therefore, most costly individual dismissal of a regular worker is Portugal with 4.58 for the period 1995-2003. Given its economic situation,

Portugal undertook labor market reforms because, according to economic theory, high levels of labor market protection are linked with higher levels of unemployment and other rigidities in the labor market (Blanchard and Portugal, 2001). This trend towards reform became especially marked after the European sovereign-debt crisis, especially in Mediterranean countries (Gutiérrez, 2014). Portugal, after ten years of reforms, in 2013 had a variable value of 3.18 while its unemployment rate went from 7% in 1995 to 16% in 2013. The country with the lowest value for this index is United States, 0.26; it saw no changes over the dataset time span. Until 2003, Portugal and U.S. shared similar unemployment rates but opposite levels in the employment protection index, a situation explored by Blanchard and Portugal (2001) who concluded that although high levels of employment protection decrease economic activity, their effect on the unemployment rate is unclear. This relationship is confirmed by our data, since the correlation between these two variables is 0.11. The index for individual dismissal of regular workers shows a higher correlation with the variables of managerial opportunism, 0.51, and maximum weekly working hours, -0.58.

On average, 32% of workers are affiliated to a trade union. Extreme cases are Iceland, where workers affiliation to unions is on average 86%, and Estonia, where in 2013 only 5.6% of workers belonged to a trade union. Whereas in Iceland the level of unionization varies little, from 87% in 1995 to 86% in 2013; in Estonia the pattern is a decreasing one: 32 per cent of workers were affiliated to a trade union in 1995, while in 2013 only 5.6 per cent were. On average, Finland and Sweden, along with Iceland, have the highest levels of unionization among their workers, 73 and 75 per cent respectively; while France and United States have the lowest, 7.9 and 12.3 per cent respectively.

About control variables, the biggest countries in terms of population are United States, with an average population of 293 million, and Japan, with 126 million; the smallest are Iceland, with an average population of roughly 300,000, followed by Luxembourg (463,000), Estonia (1.3 million), and Slovenia (2 million). Regarding technological strength, Japan and United States top the ranking with an average triadic patent filing of 15,600 and 14,700 per year respectively; the weakest are Estonia, Slovenia and Iceland with an average of 3, 5 and 6 triadic patents per year respectively. Lastly, in terms of GDP per capita, Luxembourg the highest, 78 thousand US dollars, followed by Norway (55) and Switzerland (49); Turkey (15), Poland (17), and Estonia (19) have the lowest.

Table A2 shows the results of various model specifications. In column 1 we simply correlate the dependent variable, managerial opportunism, with the control variables and find that the coefficients are statistically signifi-

cant. Countries that are technologically stronger and have higher economic performance tend to have lower managerial opportunism, whereas a bigger population tends to increase managerial opportunism. In practical terms, however, we could consider the increase in value to be zero since, for a 0.03 unit increase in managerial opportunism, the population has to increase by one million.

In column 4 we can see the results from our baseline specification as modelled in the theoretical part. Columns 2 and 3 simply show the results when the model is regressed taking the market constraints variables of maximum working hours and national minimum wage separately. In general we can say that the coefficients obtained are significant and have the expected sign, aligned with the theoretical model depicted above.

Empirical results relate to the four propositions stated in section three as follows. Proposition 1 suggests that a shift in outside opportunities would make it possible for managerial opportunism to arise. Regarding the two variables of unemployment rate and unemployment benefit, analysed here as outside opportunities, we find that increasing unemployment rates drive an increase in managerial opportunism; while higher unemployment benefits reduce it. The positive sign of the unemployment rate in this relation is consistent in all specifications of the model, although statistical significance seems sensitive to market constraints variables. The negative sign of the unemployment benefits is reasonable since unemployment benefits allow workers receiving them to be more selective when considering possible jobs (Lalive, 2007) without seeing their reservation wage drop as significantly as if they had not access to them. The empirical study by Arni *et al.* (2013) analyses long-term effects of unemployment benefit systems. They conclude that making such systems more rigid will decrease the unemployment rate in the short run but will increase labor instability in the long run: workers would end up in lower-quality or temporary jobs, and would have lower earnings.

Proposition 2 considers that managerial opportunism is possible if market constraints push a worker's working conditions beyond what his opportunity cost would lead him to accept. We use two variables to measure market constraints, the number of maximum legal weekly working hours and a dummy for whether there is a national minimum wage. In the theoretical model we consider that the existence of a maximum legal number of hours would not bring managerial opportunism because, whenever the legal limit is lower than the number of hours the manager would have hired, there would have been adjustments through wages. However, empirical results suggest that this adjustment is not taking place. The existence of legal limits to the maximum number of working hours that can be legally contracted seems to be affecting

the presence of managerial opportunism; the lower the legal limit, the less managerial opportunism is reduced. This effect might be explained by the fact that countries with more restrictive maximum working hours are likely to have in place other legal constraints affecting salaries and, therefore, impeding the adjustment we consider in the theoretical part. Looking now at the minimum wage, a clarification is in order. Although in the theoretical model we discuss different scenarios related to the level of the minimum wage, the empirical work assumes that the very existence of such a wage in the labor market means it will be higher than the clearance wage, that is, higher than the wage the manager would have offered otherwise. Results suggest that the presence of a national minimum wage helps to reduce managerial opportunism. Both variables of maximum working hours and national minimum wage have the expected sign and their statistical significance is robust.

Columns 2, 3 and 4 show the results when market constraints, maximum legal number of hours and the presence of a national minimum wage are taken separately or both together. Results hint to a possible relationship between unemployment rate and maximum working hours that is not being captured by the model specification, since if maximum working hours is included in the model the significance of the unemployment rate disappears. To explore this, we include the interaction term of unemployment rate multiplied by maximum working hours. This allows us to clarify how managerial opportunism is affected by changes in unemployment rates given a higher/lower maximum number of weekly working hours in a given country. Columns 5, 6 and 7 show the results of the model when this interaction term is added.

A first issue to highlight from results in columns 5, 6 and 7 is that the coefficients show the expected sign and all are statistically significant. The inclusion of the interaction term improves both the significance and the R-squared. The global impact of the unemployment rate ($\text{UnRate} + \text{UnRate} * \text{MaxWkHrs}$) on managerial opportunism will be positive for low values of maximum working hours, but negative for high ones. However, given that 48 hours is the most common weekly legal limit, the global impact of the unemployment rate on managerial opportunism will be positive, and negative for countries with no legal limit on weekly working hours. The global impact of maximum working hours ($\text{MaxWkHrs} + \text{MaxWkHrs} * \text{UnRate}$) on managerial opportunism is always negative. Therefore, the lower the limit on the number of hours a worker can work per week, the higher managerial opportunism will be.

Lastly, we comment on propositions 3 and 4 about the level of managerial opportunism. These propositions hypothesize that the level of managerial opportunism depends on how much the judicial system supports firms' interests and on how weak trade unions are, minimizing the productivity

penalty. Empirical results confirm both propositions. The level of managerial opportunism depends on both bargaining power and legal protection of individual dismissal. In countries where labor legal protection is stricter, i.e. individual dismissal is more costly and/or requires more time and paperwork, the level of managerial opportunism increases. Conversely, where the bargaining power of workers is higher, countries tend to have a lower level of managerial opportunism. These results are statistically significant and robust, since they hold for all of the six different specifications of the model presented in Table A2. These results are consistent with previous studies about the EPL that explain why better protection of worker's rights increases managerial opportunism and thus decreases worker's welfare when, a priori, the goal of the legal setting is to improve worker's labor conditions and rights. According to Belot *et al.* (2007), the EPL and welfare are best depicted through an inverse U-shape function, concluding that "there is a strictly positive (but finite) optimal level of employment protection". They consider that other factors of the labor market and their interactions may influence what optimum level is set. These interactions among factors of a specific labor market may also account for differences between two countries with different employment rates but similar labor protection levels (case of Portugal vs. Spain) or similar employment rates but different levels of labor protection (case of US vs Portugal) (Blanchard and Portugal, 2001).

Our study provides further evidence on how managers, broadly speaking employers, consider their economic and legal environment when designing labor contracts and react to it. It therefore ties in with current literature about employers' increasing bargaining power when contracting labor. There are several reasons behind this increase in bargaining power. An increase in concentration levels in the labor market (Azar *et al.*, 2018); the spread of no-poaching agreements in certain sectors (Krueger and Ashenfelter, 2017); the implementation of adaptive strategies to market rigidities by, for example, changing hiring patterns or choosing temporary contracting options over permanent ones (Pierre and Scarpetta, 2004); or choosing countries with market regulations that better serve firms' innovative activities (Griffith and Macartney, 2013). The impact of these behaviours could be wage stagnation, a decrease in workers' employment opportunities and job insecurity, thus affecting workers' welfare; they could also impact firms' investment and productivity (Azar *et al.*, 2018; Krueger and Ashenfelter, 2017; Pierre and Scarpetta, 2004; Griffith and Macartney, 2013). Exploring these issues requires further research. We hope further empirical work will help explain the cost in the long run of managerial opportunism.

1.5 Conclusions

In this chapter we address managerial opportunism towards workers. We define managerial opportunism as the capacity of managers to impose orders which, despite exceeding the previously agreed contractual limits and reducing their workers' welfare, do not need to be consulted. Based on this definition, we discuss the reasons why managers are prone to deceive their workers, explaining when the latter will accept such unilateral changes in their working conditions and clarifying the extent to which they will accept a subsequent reduction in their welfare. We develop this through a theoretical model and test it with an empirical study. We use panel data from OECD countries and show that, if outside conditions are bad enough and market constraints tight enough, managerial opportunism may rise to a level that depends on the workers' collective bargaining power and the strictness of legal protection regarding workers' dismissal.

Our empirical findings confirm that managers and workers should not be seen as price-takers when labour markets are not competitive, which is often the case. During the bargaining of a labor contract, workers do not exchange labor for a salary alone; they are offered a full package of working conditions. This package is what the worker compares with their subjective opportunity cost function, which ultimately depends on their individual expectations and some economic conditions such as unemployment rates, unemployment benefits, business dynamism of the economy, strictness of labor legislation or the level of unionization. These economic conditions can be affected by policymakers, for instance, by dynamizing the economy, or establishing a mechanism to share productivity increases with workers (whose commitment is crucial for improving it); or by designing unemployment benefits that are neither high enough to discourage job searching, nor so low that they weaken worker's bargaining power. All these actions will increase worker's outside opportunities and reduce managerial opportunism.

Finally, shareholders should be aware of the long-term consequences of managerial actions and the associated rewards. Benefiting from short-term returns cannot hide long-term effects on workers' commitment and conflict proneness. Managers should also estimate the long-term costs of being opportunistic before even trying. Negative consequences such as internal conflicts, sabotage, workers' lack of motivation, problems with business reputation, or the costs of contract breaches may appear at some point. Managers should definitely not expect workers to be interested in productivity gains that are fully expropriated by shareholders. As for shareholders, they must consider the firm's managerial rotation rate; a high rate gives the manager the opportunity to reap private benefits at the expense of shareholders' long-term

productivity.

Appendix

A.1 Labor contracts under minimum wage. An extension.

In this section, we present an extension of Section 1.3.3.2 with the worker's opportunity cost depending on the minimum wage.

Consider a case in which the wage is lower bounded by a legal restriction, i.e. $w \geq \underline{w}$. At period $t = 0$ the manager designs the labor contract that maximizes the firm's profits (1.4). First order conditions for the solution are (1.2)-(1.3) and (1.5). To find the optimal labor contract, we consider that the worker's opportunity cost depends on the minimum wage, and accordingly his reservation utility, affecting the participation constraint, $\underline{U}(w)$.¹¹ This entails that the indifference curve moves downwards the higher the minimum wage. The labor contract is found again distinguishing the same three cases as before.

Unlike the analysis for the labor contract designed with an independent opportunity cost, there is an interesting difference here in case i): because the indifference curve $\mathcal{I}_{\underline{U}(w)}$ moves downwards the higher the minimum wage, the existence of the legal restriction affects the efficient labor contract $(\widehat{W}(w), \widehat{w}(w), \widehat{e})$ with $\widehat{W}(w) = \widehat{w}(w)\widehat{e}$. Thus, as any minimum wage reduces the bargaining power of the worker, and the agreed wage in the contract is reduced, i.e. $\widehat{w}'(w) < 0$. As a consequence as the minimum wage is increased, wages are decreasing –case i)–, until the wage matches the minimum wage –cases ii) and iii).

¹¹For instance, whenever the worker considers the average of the density function as his opportunity cost, i.e. $\underline{U}(w) = \beta E[U(W, w, e)]$. Note that, provided the density function does not depend on the minimum wage, the higher the legal minimum wage, the domain of the probability function shrinks, and then its average is reduced.

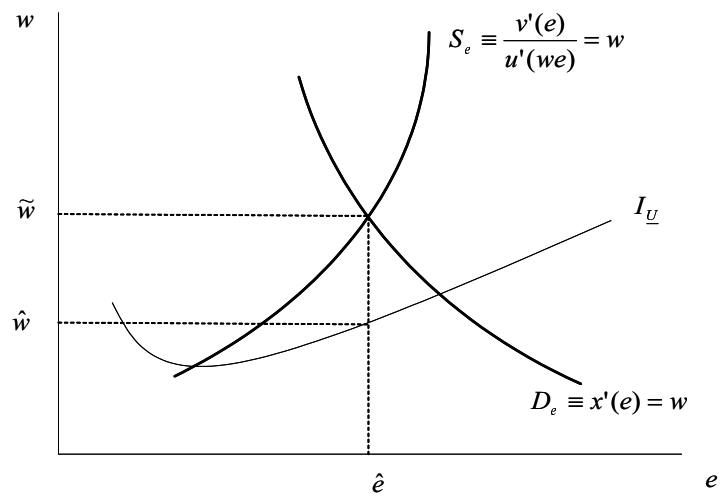


Figure 1.1: The bilateral labor contract $(\widehat{W}, \hat{w}, \hat{e})$ found at the labor market, with $\widehat{W} = \hat{w}\hat{e}$.

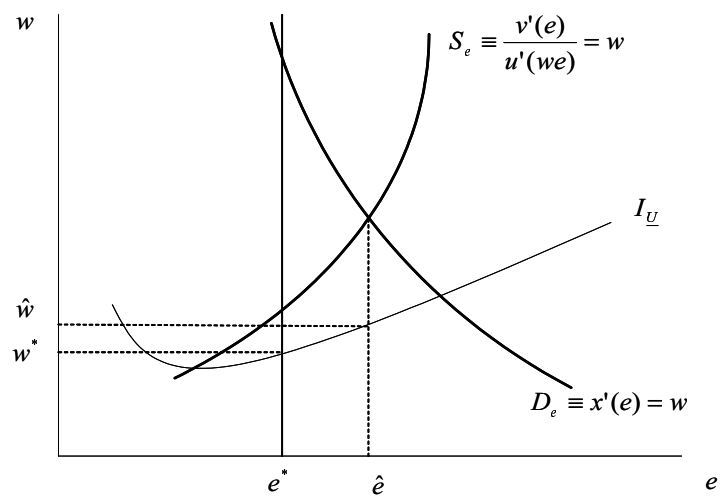


Figure 1.2: The (inefficient) labor contract with a legal upper limit of working hours and $\bar{e} \leq \hat{e}$.

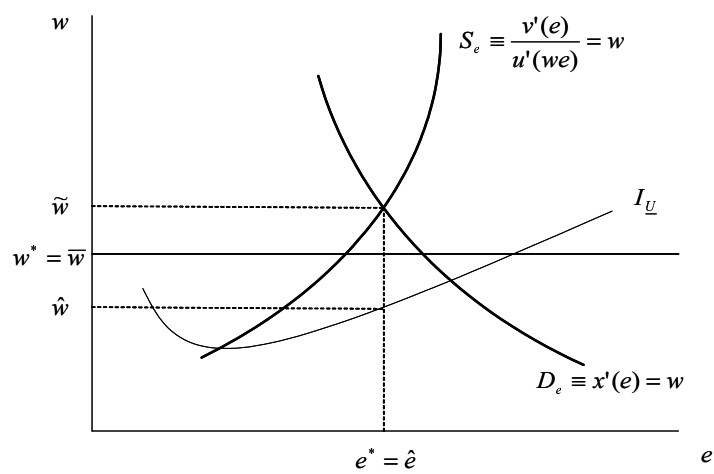


Figure 1.3: The (inefficient) labor contract with a legal minimum wage $\underline{w} \in [\hat{w}, \tilde{w}]$.

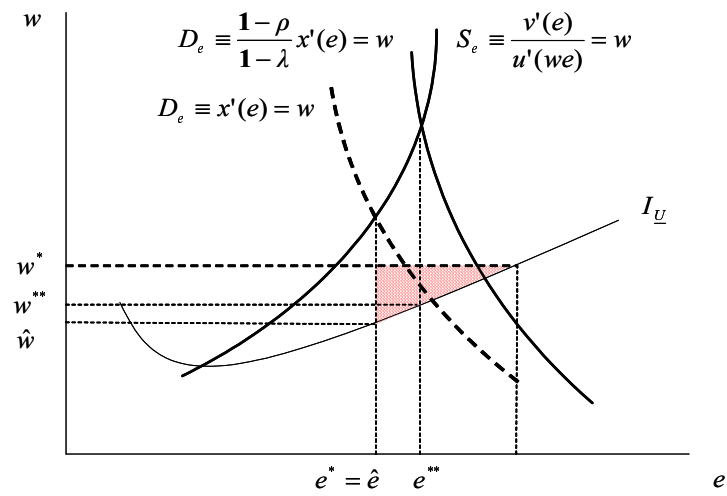


Figure 1.4: **Exerting managerial opportunism.** We depict the number of hours required in the new informal contract e^{**} in the case a new informal contract is designed (W^{**}, w^{**}, e^{**}) or in the case that additional hours are required without compensation (W^*, w^*, e^{**}) .

Table A1: Variable Descriptions.

Variable	Source	Description
Dependent variable		
Managerial Opportunism (<i>ManOpp</i>)		Construct
	% of employed persons by hours worked per week	Table 7a from Key Indicators of the Labour Market (KILM), 2015 Edition, produced by the International Labour Organization (ILO)
	Maximum weekly legal working time	ILO Working Conditions Laws Database, (complemented with other sources when needed such as ILO NATLEX, database of national labour, social security and related human rights legislation)
Independent variable		
Outside Opportunities		
	<i>Unemployment Rates</i>	OECD.Stat, Labour Force Statistics database (2016)
	<i>Unemployment Benefits</i>	OECD Social Expenditure Database (SOCX) (2016)
Market Constraints		
	<i>Maximum Working Hours</i>	ILO Working Conditions Laws & NATLEX databases OECD, Balancing paid work, unpaid work and leisure report - Time use across the world, 2016 database
	<i>National Minimum Wage</i>	J. Visser, ICTWSS Data base. Version 5.0. Amsterdam: Amsterdam Institute for Advanced Labour Studies (AIAS), University of Amsterdam. October 2015.
Non Compliance		
	<i>Individual Dismissal</i>	OECD Employment Protection Legislation (EPL) Indexes (2016)
Trade Union		
	<i>Trade Union Density</i>	OECD Labour Force Statistics -Trade Union Density dataset (2016)
Control Variables		
	<i>Total Population</i>	United Nations. World Population Prospects: The 2015 Revision
	<i>Triadic Patents</i>	OECD Factbook Statistics (database) (2016).
	<i>GDP per capita</i>	OECD Compendium of Productivity Indicators (2017)

Table A2: Managerial Opportunism. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

MODEL	VARIABLES	(1)		(2)		(3)		(4)		(5)		(6)		(7)		
		Control Vars		Max.Hours	Nat.Min.Wg	Max.Hours	Nat.Min.Wg	Max.Hours	Nat.Min.Wg	Max.Hours	Nat.Min.Wg	Max.Hours	Nat.Min.Wg	Max.Hours	Nat.Min.Wg	Max.Hours
<i>Outside Opportunities</i>	Unemployment Rate		0.250 (0.156)	0.784*** (0.155)	0.256 (0.159)	2.143*** (0.519)	3.088*** (0.199)	2.297*** (0.528)								
	Unemployment Benefits		-1.528*** (0.284)	-0.644 (0.543)	-1.329*** (0.334)	-1.354*** (0.320)	-0.957** (0.396)	-1.080** (0.409)								
<i>Market Constraints</i>	Max.Working Hours		-0.411*** (0.0235)		-0.400*** (0.0218)	-0.156** (0.0614)		-0.122* (0.0643)								
	National Min. Wage (dummy)			-6.444*** (0.853)	-2.124** (0.842)		-3.225*** (1.069)	-2.792** (1.094)								
<i>Interactive Variable:</i>																
<i>Non Compliance</i>	Unemp.Rate by MaxWorkingHours															
	Individual Dismissal (strictness of protection)		1.747* (0.884)	6.814*** (0.429)	1.684* (0.872)	1.728* (0.883)	1.843* (0.879)	1.643* (0.870)								
<i>Trade Union</i>	Trade Union Density		-0.139*** (0.00899)	-0.181*** (0.0163)	-0.167*** (0.0189)	-0.128*** (0.00814)	-0.164*** (0.0218)	-0.164*** (0.0208)								
			0.0233*** (0.00649)	0.0493*** (0.0153)	0.0231*** (0.00724)	0.0436*** (0.00721)	0.0541*** (0.00521)	0.0448*** (0.00730)								
<i>Control Variables</i>	Population		-0.185*** (0.0171)	-0.150*** (0.0179)	-0.0296*** (0.00729)	-0.0654*** (0.0121)	-0.0934*** (0.0142)	-0.0723*** (0.0140)								
	Traidic Patents		-0.576*** (0.0346)	-0.415*** (0.0800)	-0.535*** (0.0887)	-0.510*** (0.0763)	-0.532*** (0.0957)	-0.537*** (0.0933)								
	GDP per Capita		44.08*** (1.599)	26.44*** (4.457)	64.37*** (6.875)	49.73*** (5.476)	45.57*** (6.747)	51.87*** (5.863)								
	Constant															
	Observations		518	472	472	472	472	472								
	R-squared		0.395	0.537	0.684	0.692	0.694	0.695								
	Number of groups		30	30	30	30	30	30								

Table A3: Descriptive Statistics.

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
<i>Dependent variable</i>					
<i>Outside Opportunities</i>					
Managerial Opportunism	518	21.43	15.77	0.00	68.36
Unemployment Rate	566	7.73	3.95	1.80	27.47
Unemployment Benefits	562	0.95	0.77	0.00	3.81
<i>Market Constraints</i>					
Maximum Working Hours	555	54.84	22.31	38.00	113.99
National Minimum Wage	570	0.68	0.46	0.00	1.00
<i>Non Compliance</i>					
Individual Dismissal	518	2.14	0.79	0.26	4.58
<i>Trade Union</i>					
Trade Union Density	567	32.89	20.81	5.65	92.47
<i>Control Variables</i>					
Population	570	33.60	56.65	0.27	317.14
Triadic patents	570	15.97	38.74	0.00	187.02
GDP per capita	570	34.69	13.13	10.72	91.37

Table A4: Variable Correlations.

	1	2	3	4	5	6	7	8	9	10
1 Managerial Opportunism	1.000									
2 Unemployment Rate	0.4260	1.000								
3 Unemployment Benefits	0.0522	0.3718	1.000							
4 Maximum Working Hours	-0.6505	-0.2665	-0.2382	1.000						
5 National Minimum Wage	0.0557	0.2360	0.0001	0.2778	1.000					
6 Individual Dismissal	0.5141	0.1168	0.0951	-0.5809	-0.1084	1.000				
7 Trade Union Density	-0.1681	-0.1606	0.2038	-0.2296	-0.6309	0.0723	1.000			
8 Population	-0.3055	-0.0463	-0.1640	0.5243	0.1897	-0.4800	-0.3508	1.000		
9 Triadic patents	-0.4206	-0.2009	-0.1722	0.6133	0.1254	-0.4197	-0.2570	0.8580	1.000	
10 GDP per capita	-0.5075	-0.5084	0.0289	0.0748	-0.3770	-0.2632	0.2798	0.1132	0.1610	1.000

Chapter 2

EFFECTS OF MARKET CONCENTRATION ON U.S. TITLE INSURANCE PREMIUMS

2.1 Introduction

Real estate conveyancing in U.S. relies on a mixture of private and public intermediaries to clear land title and protect real estate buyers. On the one hand, private conveyancers produce information on land title by searching and examining available information about past events that might affect land title. They usually compile and store this information in title plants. On the other hand, public institutions give constructive notice of any recorded private agreement that may affect or burden the land—in most states in the U.S. this is usually done by the Recorder of deeds. However, despite conveyancers' professional due diligence, unknown risks may remain and still cloud land title.

Title insurance was born precisely to protect real estate buyers against these risks (Palomar, 2017 §1:3). It is a peculiar product among insurance lines in the industry. It has a preventive function—to indemnify an insured party subject to losses because of unknown or uncovered pre-existing title defects—is issued and

paid for only once —when the insured real estate transaction takes place—and its coverage extends to perpetuity. So it is unlike other insurance lines that cover against future events and provide coverage that is limited to a preset time-paid period (Arruñada, 2002).

Hence, title insurers can minimize risks and thus prevent future losses if efficient, good quality title search and examination is performed, allowing them to assess risks before they issue a policy. However, title search and examination is usually conducted by lawyers, especially wherever they hold exclusive competency by law. Consequently, not only are title insurers and lawyers the main players in the title insurance industry but they are also entangled in an interdependent relationship that may affect both the quality and the price of the title insurance (Arruñada, 2007; Palomar, 1998).

This paper studies if, and how, title insurance premiums are affected either by the interdependent relationship between title insurers and lawyers or by changes in concentration levels in the insurers' market. Firstly, I discuss whether insurers or lawyers have a greater effect on title insurance premiums and to what extent, in a context of a bilateral monopoly given the insurers' oligopolistic power over underwriting title insurance policies and lawyers' monopolistic competencies over title search and examination services. I also discuss the relevance of such services for assessing and purging title defects and estimating the residual risk remaining to be insured. Results suggest that premiums are higher in a situation of bilateral monopoly than in one of vertical integration, but are inconclusive as to whether a double markup problem could be at play. Further analysis suggests that, in a situation of bilateral monopoly, the title premium would be influenced by lawyers' monopolistic power when title insurers' market concentration levels are low. However, once such

concentration increases and reaches a certain level, the lawyers' monopoly is no longer relevant.

Secondly, I focus on title insurers and their market concentration levels. I analyze whether concentration and price are positively related as classic oligopoly theory states (Stigler, 1964; Weiss, 1989). Employing the methodology of natural experiments, I test whether an increase in concentration in the title insurers' market —due to the bankruptcy of Land America and its merger with Fidelity National in 2008—increases title insurance premiums. Results suggest that premiums have increased because of higher market concentration levels. This is supported by the most restrictive robustness checks.

Most previous work on title insurance is theoretical, consisting of discussions about its nature or configuration or its economic implications for conveyancing transactions. Nyce and Boyer (1998) provide a descriptive analysis of the structure, performance and problems of title insurance suppliers from an industrial organization approach. Arruñada (2002) analyzes the role of title insurance from a transaction cost viewpoint in the U.S and its applicability to other markets where a registry system, instead of a recording one, is in place.

Little empirical work has been done on the title insurance industry, mainly due to the lack of suitable data. Arruñada (2007) studies the involvement of legal specialists in land transactions under different land title regimes. Considering the shifts in characteristics produced over time in both the market and institutions, he concludes that the demand for legal specialists in conveyancing services has decreased. Results from the empirical study show that lawyers' involvement in the U.S. market adds little value. Nyce and Boyer (2010) combine a theoretical approach with an empirical one. They present four different competing industrial organization models (Cournot, Salop's circular city, Monopolistic competition and Blockaded entry) to see which one

fits the title insurance industry best. Their empirical results point to the Salop circular city model. This result implies that insurers compete in prices and consumers perceive differences in products as the distance between two firms located around a circle. Feinberg et al. (2015) develop empirical models to study how closing costs vary within five metropolitan areas using house, buyer and real estate broker characteristics as explanatory variables. Results suggest that variations in closing fees charged depend on the settlement agents and advise shopping around for a service provider and comparing rates. Lastly, Palomar (1998) discusses differences in quality of real estate conveyancing services based on whether they are provided by lay conveyancers or lawyers, considering the long-lasting battle between these two types of professional based on the concept of “unauthorized practice of law”. Results suggest differences in quality are not significant enough to determine that consumers actually face greater risk if they hire lay conveyancers and, therefore, do not constitute grounds for preventing other non-lawyer service providers from performing such services.

The main contribution of the paper is to provide a better understanding of how title insurance is priced and, more specifically, of who holds a greater say on such pricing. Its most relevant novelty is the empirical study on effects on premiums considering two different factors: the presence of a bilateral monopoly—consisting of an insurers’ oligopoly and lawyers’ monopolistic competencies; and the change in title insurers’ market concentration levels that took place because of Land America’s bankruptcy in 2008—due to exogenous circumstances. Moreover, it contributes to the heated debate on price setting practices in the title insurance industry and related closing costs in real estate conveyancing operations. Social concerns reached their peak in the years after the subprime crisis, 2006-07, to the point that the Federal and State Governments conducted a series of investigations into title insurers’ practices; resulting in changes in title insurance legislation and fines (DasGupta & Hernick, 2007).

Although results are inconclusive as to whether insurers or lawyers hold greater power over pricing, concentration levels in the title insurers' market seem to have increased prices. Title insurers seem not only to be profiting from oligopolistic rents but to have increased prices solely as a result of higher concentration in their market.

The remainder of the paper is organized as follows: section 2.2 reviews the U.S. title insurance industry, identifies and characterizes the existence of a bilateral monopoly between the two main agents, title insurers and lawyers, and states a testable hypothesis on how title insurance industrial organization may be affecting title premiums; section 2.3 discusses title insurers' market structure and states a testable hypothesis on how concentration levels of the industry may affect title premiums; sections 2.4 and 2.5 discuss empirical analysis and results for hypothesis from sections 2.2 and 2.3 respectively; section 2.6 concludes.

2.2 Land conveyancing and title insurance

Land conveyance transactions are formally carried out in a real estate closing ceremony. Regardless of the closing type used, two elements must always be present: a transfer of funds and a transfer of marketable title (Hopkins & Loeffler, 2012). Lack of proof of marketable title is reason enough for a buyer or a lender to legally breach the purchase agreement (Palomar, 2017, §1:2). In short, marketable title means that a title is free from other competing interests, such as liens, encumbrances, prior mortgages, etc. To produce marketable title, the U.S. land conveyance system relies on two intermediaries: a public institution, such as a public recording office, which provides constructive notice to private agreements; and a conveyance servicing industry to produce marketable title and protect buyers against future claims based on title defects. Title insurers are at the head of this industry's development (Szypszak, 2002).

The origins of title insurance date back to 1876 when the Real Estate Title Insurance Company was created as a reaction to the

Pennsylvania Supreme Court's opinion in *Watson v. Muirhead* (Palomar, 2017, §1:3). In it the court ruled that the conveyancer's liability is limited and he could not be asked to provide guaranty in case of a future real estate loss because of his past services. Title insurance became widely used due to the expansion of the national mortgage lending market in the 1930s (Palomar, 2017, §1:3; Szypszak, 2002), growing to a level at which title insurance policies were issued in 85 per cent of operations in the residential market at the end of the 20th century (Arruñada, 2002).

Title insurance is, by nature, a contract whereby a holder of a land property right (usually, an owner or a mortgage lender) is indemnified by the insurer if he endures a loss due to a defective property title (e.g., the land turns out to be owned by somebody else, its boundaries are redefined, etc.). Besides the specific characteristics of title insurance mentioned above—it is paid once, covers against past unknown or uncovered risks for any sort of defect affecting title—it is also independent from the insurer's professional liability when conducting title search and examination and is easier to enforce since the insurer is bound to pay the compensation without undertaking any further legal actions (Arruñada, 2002; Palomar, 2017, Chapter 1).

This distinctive nature of title insurance, compared to other types of insurance product, entails a strong need for insurers to perform—if in-house—or control for—if provided by an external supplier—good prior title search and examination to avoid future losses. Title search and examination allow insurers to better assess and cure risks affecting land title, thus reducing possible future losses. Insurers have therefore heavily invested in systematic production of information about land titles to the extent that title plants and joint title plants are their most relevant and expensive assets and are a great entry barrier to new incumbents (Arruñada, 2002; Boyer & Nyce, 2010; Palomar, 2017, §1:13-1:18).

The capability to reduce future losses has proven an effective economic incentive for title insurers. Numerical results (Annex II) show that title insurers' risk avoidance strategies have paid off since their total losses are a small proportion, around six per cent, of total revenues, whereas operating expenses stay at around ninety per cent. These are striking figures if compared to other insurance lines from the U.S.

market, such as property and casualty insurance, both stock and mutual, which dedicate a quarter of their revenues to pay for their operating expenses and three quarters to cover losses (Russo, DasGupta, & Korsmo, 2010, Exhibits 4 and 6). Thus, good title search and examination along with keeping updated and properly organized relevant information on real estate, although costly, are the cornerstone of the insurers' business, allowing them to minimize risks and prevent future losses.

When title insurers appeared and, later, expanded their business, lawyers seemed not to care and offered little resistance to insurers taking over some of their conveyancing services. But, presumably, when insurers started to prepare abstracts of title, draft conveyancing documents or carry out closings, lawyers realized that insurers were becoming a competitive force. Hence, they combated insurers' expansion by wielding the definition of "unauthorized practice of law" in the hopes of keeping their monopoly over conveyancing services (Brossman & Rosenberg, 1979). Results of this battle on "unauthorized practice of law" across the U.S. have been uneven. Insurers were able to hold monopoly over certain competencies of the conveyancing process in some states but not in all of them.

At state level, title insurers are either vertically integrated—or at least, are not banned from performing any task—or, along with the lawyers, are in a situation of bilateral monopoly for complementary services—i.e., by law, only title insurers can issue a title insurance policy, and only lawyers can conduct title search and examination processes, which are essential for issuing a title insurance policy (Palomar, 2017). Both issuing title insurance policies and conducting a title search and examination have no substitute products (Birnbaum, 2005). Consequently, the title insurance market structure has two main types of economic agents—title insurers and lawyers—and adopts the organizational form of either vertical integration or a bilateral monopoly in order to produce complementary services, perform title search and examination tasks and issue title insurance policies to final consumers. All this places this study within the theoretical framework of economic analysis of bilateral monopolies vs. vertical integration.

Literature in the field of bilateral monopoly and vertical integration has widely concurred that in a market the final output will be higher and the price consumers pay will be lower if firms are vertically integrated rather than structured in a bilateral monopoly (Machlup & Taber, 1960). However, in a bilateral monopoly situation an optimal solution can also be reached through bilateral bargaining over both quantity and price, as long as both parties have incentives to achieve “joint profit maximization” (Blair, Kaserman, & Romano, 1989).

I study how title insurance premiums are affected by the title insurance market structure regarding title search and examination services, taking into account the peculiarities shaping it. Firstly, the quality of output is similar in both vertical integration and bilateral monopoly since data suggest that, regardless of whether the service is conducted by lay conveyancers or by lawyers, their involvement in real estate transactions bears similar levels of risk for the public (Palomar, 1998). Secondly, the quantity of output is set by demand in the housing market, and an increase in real estate transactions raises demand for title insurance (Boyer & Nyce, 2010), therefore leaving outside the bargaining scope the quantity that would otherwise have maximized joint profit (Blair et al., 1989). Thirdly, demand is inelastic (Birnbaum, 2005; Boyer & Nyce, 2010; Hunter, 2006). And, lastly, regarding premium-split practices, it is insurers that set title insurance premiums and then pay lawyers for their involvement (Hopkins & Loeffler, 2012).

This premium-split is assumed to be negotiated between the two parties, insurers and lawyers. I assume there is a profit incentive for cooperation between insurers and lawyers to achieve “joint profit maximization”, especially considering that, although lawyers may hold monopolistic competencies that allow them to expropriate monopolistic rents from insurers, the number of legal firms in the market is large¹. Thus, whoever has better “bargaining skills” (Machlup & Taber, 1960) will receive a higher share when splitting the title premium. Hence,

¹ The number of “Title abstract and settlement offices” in U.S. was 8,878 in 2012 (Quarterly Census of Employment and Wages - BLS, 2012)

Hypothesis 1: Given the presence of a bilateral monopoly, title insurance premiums depend on whether title insurers or lawyers enjoy greater bargaining power.

2.3 Concentration and title insurance premiums

In parallel to the above mentioned relationship between insurers and lawyers and how it may impact title insurance premiums, there is another relevant factor to consider: the extent to which title insurers compete against each other and how this competition affects title insurance premiums. Since the degree of competition in a market is given by the number of firms and their size (Stigler, 1972), it is safe to say that title insurers are an oligopoly: there are only four big firms at national level which perform over 90 per cent of total sales in the U.S. market (ALTA 2016). Stigler (1972) argues that one way to measure competition in a market is through the extent that a firm can affect price. Hence, given title insurers' economic performance and evolution of their market structure over the past two decades, the fact that the third biggest title insurance firm went bankrupt in 2008 provides a unique opportunity to analyze how the oligopolistic industrial organization of title insurance may impact title insurance premiums.

Title insurers' economic performance is closely linked to economic evolution of the housing market (Davis & McCarthy, 2004). Between 1997 and 2012, the years covered in my study, the title insurance industry in the U.S. was marked by two opposing peaks of economic activity; the housing market bubble in the early 2000s followed by a severe subprime mortgage crisis along with high foreclosure rates which, in return, triggered a rise in title claims. These events tested both the capacity and the quality of the title insurers' production process.

After several years of consecutive profits after 1997, the title insurers' market reaches record results in 2003 due to the housing bubble (A.M. Best Company & American Land Title Association (ALTA), 2001; Davis & McCarthy, 2003). During this period of highly unusual activity, it is not unreasonable to consider that search and examination practices might have been relaxed. This could be a plausible

reason for the losses from 2005 on due to both title defects claims arising and increasing foreclosure activity. Every house foreclosed triggered a new title search and examination with the potential to reveal a prior lien or other title defect overlooked during the initial search (DasGupta & Hernick, 2007; DasGupta & McCarthy, 2005; Davis & McCarthy, 2004).

Adding to these difficulties, the Federal Government investigated title insurers between 2004 and 2006 (DasGupta & McCarthy, 2006), resulting in economic penalties and, in some states, reduction by law of maximum insurance rates. All these things combined led the title insurance industry to an unprofitable combined ratio in 2007 (DasGupta, Hernick, & Brown-Klinger, 2008). Title insurance activity did not improve until 2009 when modest increases were observed although the housing market continued to be slow due to unemployment rates and credit tightness (DasGupta & Korsmo, 2009; Russo & DasGupta, 2011; Russo et al., 2010). 2012 was the first year to show significant growth in the number of written premiums and marked a return to modestly profitable combined ratio for the title insurance industry (Russo, 2014).

The market structure of the title insurance industry in U.S. has five characteristics. First, title insurance firms are by law a monoline business in most states. Jaffee (2006) argues that this restriction is beneficial because of both the low probability of losses and the avoidance of insurers' insolvency in the event of running title insurance in a multiline firm along with higher-risk types of insurance. An example of the convenience of monoline firms comes from the Great Depression when banks and finance entities had their own title insurance divisions. The mortgage default crises led banks to fail and close, and along with them, their title insurance divisions (Palomar, 2017 §1:3).

Second, markets have a geographical scope, due to the geographical level at which the data needed to produce marketable title is collected. Title insurers have title plants that gather key information in order to purge title and minimize the residual risk covered by the policy. Traditionally title plants were organized at county level. Over time, thanks to technology, they have evolved into regional or even national title plants (Birnbaum, 2005)

Third, insurers are bound by state-level rate regulation when setting title insurance premiums. There are five main types: “competitive pricing (no regulation), use and file rates (moderate regulation), file and use rates (less moderate regulation), prior approval of rates (strict regulation) and commissioner promulgation (commissioner sets rates)” (Nyce & Boyer, 1998, p. 226). The widespread argument backing rate regulation is that it exists to protect consumers from inadequate, excessive or discriminatory rates. Notwithstanding, some authors consider price to be linked to the house purchase price or loan amount rather than to other aspects of the title insurance production process, stating that late price increases are due solely to increases in house market prices. “This can be interpreted as either price discrimination against buyers of higher-valued properties or subsidization of insurance for buyers of lower-valued properties” (Feinberg et al., 2015, p. 147; Hunter, 2006).

Fourth, all this, plus the absence of a substitute product and a highly inelastic demand (Birnbaum, 2005; Boyer & Nyce, 2010; Hunter, 2006), reduces bargaining power for homebuyers. The “large, well-organized institutional lender”, on the other hand, has greater bargaining power than homebuyers and is even in a position not only to negotiate better rates, but can also impose terms to be included in the policies (“Title Insurance,” 1962). Furthermore, homebuyers in need of a mortgage loan have no choice but to underwrite title insurance since no lender will approve a loan unless such a policy is underwritten, given its nature as the “lingua franca of the secondary mortgage market”: the title insurance guarantees a security standard and ensures reliable quality for mortgage trading in secondary markets (Nyce & Boyer, 1998, p. 215). Reducing homebuyers’ bargaining power even more, it is common practice for title insurers not to market their product directly to buyers but, rather, to real estate intermediaries looking for secure referrals. These practices are known as reverse competition and presumably drive prices up (Birnbaum, 2005; Hunter, 2006). However White (1984) considers that reverse competition is an improvement on insurers not wanting to compete based on prices.

Fifth, consequently, title insurance market is highly concentrated. It is highly concentrated according to the two main standards for

measuring concentration: the percentage of sales from the top national companies and the Herfindahl-Hirschmann Index (henceforth HHI). On average, the four (previously five) biggest national companies controlled 91% of the market sales between 1997 and 2012 (ALTA 2016). The HHI mean value at the national level in 2012 was 2,610, above the 2,500 points threshold set in the *Horizontal Merger Guidelines* by the Federal Trade Commission and the Department of Justice in 2010 to classify a market as highly concentrated. A similar conclusion is reached if HHI values are considered by state. This is a point that Nyce and Boyer (1998) emphasize given that insurance regulation is established at state level and, therefore, firms that are major competitors at state level may appear insignificant at national level.

All in all, the scenario depicted here leads to a situation where title insurers seem to find little incentive for establishing competition based on prices that might, in the long run, reduce title insurance premiums. The United States Government Accountability Office (henceforth GAO) shared these concerns and conducted an investigation into title insurance industry practices during the last years of the housing bubble, 2004-2006 (GAO, 2007). The report lists five factors questioning the doubtful existence of competition and the reasonableness of prices consumers pay for title insurance premiums: “1) consumers find it difficult to shop for title insurance, therefore, they put little pressure on insurers and agents to compete based on price; 2) title agents do not market to consumers, who pay for title insurance, but to those in the position to refer consumers to particular title agents, thus creating potential conflicts of interest; 3) a number of recent investigations by HUD and state regulatory officials have identified instances of alleged illegal activities within the title industry that appear to reduce price competition and could indicate excessive prices; 4) as property values or loan amounts increase, prices paid for title insurance by consumers appear to increase faster than insurers’ and agents’ costs; 5) in states where agents’ search and examination services are not included in the premium paid by consumers, it is not clear that additional amounts paid to title agents are fully supported by underlying costs” (GAO, 2007, p. 21).

This debate is not new. White (1984) already mentioned some of these issues. He considered that, given protective regulation and/or the

insurers' oligopolistic organization, price competition was replaced by other non-price competition strategies such as paying for referrals. He also pointed out that: 1) the industry at the time was highly concentrated; 2) there was price discrimination since basic costs for issuing title insurance do not increase in line with home value, hence high-value houses give insurers higher margins; 3) title insurers made no effort to market to consumers directly, connecting this behavior with insurers not being interested in price competition in that educating consumers is not difficult.

In 2008 Land America went bankrupt. It was the third biggest title insurance company at the time. Its bankruptcy left only four major players in the title insurance market at a national level. The causes of its bankruptcy were the mortgage crisis and the falling prices in the housing market that followed the housing bubble, which led to a two-year downward trend in the company's activity and a drop in revenue of more than forty per cent (Giannone, 2008). Fidelity National, the biggest title insurer at the time, and still so at the time of writing, bought Land America's title underwriting units. This merger brought with it an increase in both Fidelity National's market share and the title insurance market's concentration levels.

Land America's bankruptcy in 2008 and its impact on the insurers' market concentration levels allow for a unique analysis of the effects of concentration level changes on premiums in the title insurance industry within the oligopoly theory framework (Stigler, 1964, 1972; Weiss, 1989), applying the natural experiment methodology (Meyer, 1995). During the timespan of this study, the lawyers' monopolistic competencies variable remained constant, as did as other variables measuring legal features.

Classic oligopoly theory states that sellers' concentration levels and price levels are positively related (Weiss, 1989). In addition, Stigler (1964) supports the use of the Herfindahl Index as an appropriate proxy to measure a market's concentration levels and their positive relationship with prices. Thus,

Hypothesis 2: An increase in title insurers' market concentration will raise title insurance premiums.

2.4 Effect of bilateral monopoly on premiums

2.4.1 Data and Variables

I built a cross-sectional panel with no missing values for three years, 1997, 2003, and 2012, including price, market structure, legal and cost related features that the literature considers may be affecting title insurance premiums for 40 States: Alaska, Arizona, Arkansas, California, Connecticut, Delaware, Georgia, Idaho, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin, Wyoming. The main source for the database was the “Real Estate Closing Deskbook” (Boackle, 1997, 2003; Hopkins & Loeffler, 2012). It is a very complete state-by-state guide to real estate conveyance laws, costs and requirements for real estate closings. Unless indicated otherwise, data for the variables come from it.

The dependent variable is the average price charged for title insurance premiums in logs. These premiums are set by title insurance companies. The premium is meant to capture the extent of marginal risk left after purging any known defect affecting title or, if cure is not possible, including exceptions in the policy based on information collected through search and examination processes. Risk assessment and title purging are lawyers’ monopolistic competencies wherever the monopoly exists (Palomar, 2017)

The two main independent variables in this study are concentration in the title insurers’ market and whether there is a lawyers’ monopoly on certain conveyancing tasks. The former is measured through the Herfindahl-Hirschman Index² (HHI from now on); it is calculated based

² The Federal Trade Commission and the Department of Justice guidelines use the Herfindahl-Hirschmann Index to classify post-merger concentration levels in a market. According to § 1.5 from *Horizontal Merger Guidelines* (U.S. Department of Justice & FTC, 1997), a market was considered highly-concentrated if its HHI was over 1,800. These guidelines were revised in 2010 and the HHI intervals were modified. At the time

on market share data by family and state collected by the American Land Title Association (henceforth ALTA)³. The latter is measured through a dummy variable with a value of one if, by law, lawyers' involvement is required, and a value of zero otherwise. This dummy variable is obtained from two sources, ALTA (2000) and Docutech (2013). These documents inform at the state level about whether non-attorneys, title agents or insurers can prepare legal instruments for land conveyancing. A restrictive criterion has been applied: I consider there to be a lawyers' monopoly on preparing legal instruments for conveyancing real estate in a given state if, by law, non-lawyers cannot prepare them and/or if they can only fill in blanks in already-drafted official legal forms. This criterion is rooted in the ongoing debate about defining the practice of law and the effects of unauthorized practice on insurers. According to Palomar, in states where title insurers were authorized by courts to use blank legal forms, they could find themselves obliged to hold a higher standard of care: "The usual standard of care is that associated with a reasonably prudent person, but the higher standard is that of one trained in the law, that of an attorney" (2002, §16.07). In any case, the need for an attorney versus the freedom to hire a lay conveyancer comes at the cost of a more specialized professional. Thus, it is reasonable to consider there is a higher marginal cost for producing title insurance policies in those states where there is a lawyers' monopoly compared to those where there is not. This higher marginal cost will consequently be transferred to higher title insurance premiums.

Although the value of the lawyers' monopoly variable did not change between 1997 and 2012, the HHI increased both its mean value, from 0.207 to 0.261, and its minimum value, from 0.130 to 0.210, but decreased its maximum, from 0.468 to 0.375. As a result, the HHI

of writing, according to § 5.2 from *Horizontal Merger Guidelines* (U.S. Department of Justice & FTC, 2010), a market is considered moderately-concentrated if its HHI is between 1,500 and 2,500; and highly-concentrated if the HHI is above 2,500. For the purposes of the present analysis, I will apply market concentration criteria from 1997 since they were those in place when Land America went bankrupt and subsequently merged with Fidelity National.

³ Data was publicly available at the ALTA website from 2003 onwards when accessed in 2016. HHI data for 1997 is taken from Nyce and Boyer (1998).

interval value shrank while its mean kept increasing; therefore, the HHI shows that over time the title insurance industry increased its market concentration levels (summary statistics per year in table 4).

I include a group of independent variables to measure other important factors affecting title insurance premiums: some related to the policy itself, some about services included in the premium and, lastly, some regarding legal aspects.

Regarding the policy itself, two variables capture the two dimensions defining the product type of the title insurance policy: whether it is an owner's or a lender's policy (the dummy variable takes a value of one if it is an owner's policy; zero if it is a lender's); and the insured amount covered by the insurance policy (the quantity covered can be 100, 200, 500 or 1,000 thousand dollars). A distinction must be made between the coverage of an owner's policy and a lender's one: whereas the latter decreases as the loan is paid off and disappears once the loan is paid-up, the former covers both the buyer and his or her heirs in perpetuity "as long as they maintain a right or obligation over the property even after it has been sold" (Arruñada, 2002, p. 586).

There are some services that may, or may not, be included in the title insurance premium depending on legal or customary uses established at the state level. Title search and examination is the main distinctive activity that sets this type of insurance apart from the rest. The goal is to minimize risks and cure title defects before issuing a title policy but this activity is not mandatory in all states (Palomar, 2017, §1:13) and it does not necessarily need to be included in the premium. So I include variables to control for it: 1) whether premium fees include search and examination (it is a dummy variable that takes a value of one if included, and zero otherwise); and 2) the legal minimum for the length of the search, in years (computed as a ratio)⁴.

Also, I include two legal and institution-related variables: 1) Type of rate regulation applied in title insurance at the state level; and 2) estimated fees for recording transfers and mortgages when a transaction

⁴ For states that require a search all the way back to the original patent, the data source is Baker et al. (2002)

takes place, measured in hundreds of dollars. As explained above there are five types of rate regulation: competitive pricing, use and file rates, file and use rates, prior approval of rates and commissioner promulgation (Nyce & Boyer, 1998). I include only two dummy variables that take a value of one for states with “competitive pricing” (no regulation) and “file and use”. I follow Arruñada (2007) and consider the default regulatory regime to be “prior approval”; I also compute two states under “commissioner promulgation” as having “prior approval”; and, lastly, two states with “use and file” are computed as “file and use”. The variable for title insurance rates in place at state level is built using the following sources: Nyce and Boyer (1998), A.M. Best report (Davis & McCarthy, 2003), and NAIC (2010, 2015)⁵. The variable for estimated fees charged by the Recording Office serves as a proxy for the cost of producing quality information since title insurers use the Recording Office as their main source of title information.

Lastly, I add a variable to control for exogenous variation in economic value in the housing market. I use the annual increase in average sales price by region (US Census Bureau, n.d.). As Boyer and Nyce (2010) suggest, the average value of housing sales is a good proxy for estimating the total value of real estate transactions in a state. And including it helps to control for possible increases in title premiums that are due to increases in sales prices, as some authors argue (Feinberg et al., 2015; Hunter, 2006).

Table 4 provides a summary of statistics per year. Table 6 summarizes all variables and data sources.

2.4.2 Results and Discussion

My estimates correspond to the following basic model:

$$\begin{aligned} \text{Log of premiums}_{it} = & \alpha + \text{HHI}_{it} \beta + \text{Lawyers' Monopoly}_{it} \gamma + \\ \text{Product type}_{it} \delta + & \text{Services included}_{it} \lambda + \text{Rate regulation}_{it} \phi + \\ \text{Recording fees}_{it} \rho + & \text{CVar}_{it} \theta + \varepsilon_{it}, \end{aligned} \quad (1)$$

⁵ If a commitment fee is added to the premium, this might be another factor that could in principle affect title insurance price. However, including this variable in the model does not affect the results and its coefficient was never significant.

where i and t denote state and year, respectively; *Log of premiums* is the state average title insurance premium in logs; *HHI* is the Herfindahl-Hirschman Index which measures market concentration in the title insurance market at the state level; *Lawyers' Monopoly* indicates whether or not lawyers legally hold exclusive competencies over preparing conveyancing documents; *Product type* represents the type of title insurance policy: whether it is an owner's one or a lender's one, and the amount covered; *Services included* represents services that may, or may not, be included in the premium; *Rate regulation* represents the type of rate regulation applicable when setting the premium; *Recording fees* measures the fees for recording transfers and mortgage operations in dollars; *CVar* are control variables for the model; and ε is an error term.

Services included refers to two variables: *fees include search* indicates whether the price also covers the cost of title search and examination, and *search length*, a ratio that measures how far back in time the title search must go. As mentioned previously, rate regulation affecting policy prices is set by the state. *Rate regulation* is measured by two dummy variables: *unregulated pricing* indicates whether there is no price regulation, i.e., there is competitive pricing; and *file and use* indicates whether the state has a "file and use" rate regulation in place. I also control for two additional dimensions: *increase average sales price* measures the annual increase in the average sales price per state; and *year*.

The estimation sample is a cross-section without missing values for 40 states and at three different points in time, 1997, 2003 and 2012.

Table 1 reports OLS estimates of the effect that title insurance market concentration and lawyers' monopoly over certain tasks have on title insurance premiums. Column 1 focuses on the two main independent variables of the model: title insurers' market concentration levels and presence of a lawyers' monopoly. In columns 2-4, I simply regress the dependent variable, log of title insurance premiums, with the rest of the independent variables, i.e., product type, services included, rate regulation, recording fees and control variables, which allows the robustness of the estimates to be tested according to different specifications. Column 5 shows the main results for the baseline model. Column 6 expands it by adding an interaction term. This interaction

term tests the extent to which higher values for title insurance market concentration and for the presence of a lawyers' monopoly have a higher or lower impact on premiums.

Hypothesis 1 suggests that, given the presence of a bilateral monopoly, title insurance premiums depend on whether title insurers or lawyers enjoy greater bargaining power. Results from Column 5 in Table 1 indicate that the coefficients on title insurers' market concentration and lawyers' monopoly are both positive and statistically significant. This supports the idea that the higher the title insurers' market concentration, the higher the premiums. It also suggests that title insurance buyers will pay higher premiums in states where there is a lawyers' monopoly over conveyancing tasks which confirms previous findings reported by Arruñada (2007) . But the question as to who enjoys greater bargaining power, title insurers or lawyers, remains unanswered.

The model includes an interaction term (column 6) to test the extent of the bargaining relationship between insurers and lawyers. Results indicate that insurers' market concentration levels have a significant increasing effect on premiums when there is no lawyers' monopoly. However, from this information it is not possible to know how the presence of the lawyers' monopoly influences premiums considering that the HHI variable is continuous and never has a value of one in the sample. Figure 1 helps with this limitation by graphically representing the marginal effect of a lawyers' monopoly across the observed interval of title insurers' market concentration levels, i.e. HHI values in the sample. It makes it possible to determine statistically significant concentration levels in the title insurers' market up to which the presence of a lawyers' monopoly has a significant increasing impact on title premium. This limit seems to be set at an HHI of 2,900 points. Therefore, evidence suggests that, in a situation of bilateral monopoly the answer as to who enjoys greater bargaining power and influences premiums depends on who holds greater control over the production process. Lawyers enjoy advantages linked to monopolistic rents if insurers' market concentration is low, i.e., insurers cannot impose their conditions on the lawyers who are their service suppliers. On the other hand, the moment insurers' market concentration is high enough to

exceed lawyers' monopolistic power, it is the insurers that enjoy greater bargaining power and could affect premiums. Notwithstanding, these empirical results have been computed considering market concentration as endogenous; therefore, no causal relationship can be established yet between higher levels of concentration in the title insurers' market leading to higher premiums. This possible causal relationship is tested by hypothesis 2, and results from the empirical study are discussed in the next section.

In addition to answering the question posed by hypothesis 1, empirical results also provide some statistically significant evidence regarding the following variables. Owner's policy is significantly higher statistically speaking than the lender's policy, suggesting that lenders have higher bargaining power than homebuyers, as argued in 1962 by the article "Title Insurance: the Duty to Search Notes and Comments" (1962). If the premium includes the search and examination services, results seem to suggest that the cost is being transferred to the policyholder. However, lengthier searches decrease premiums. A possible explanation may be that, in states where title search has to go back over more years, there is an incentivizing effect for improving information collection and storage, allowing title insurers to improve the quality of title information, and for more efficient purging processes which, in return, minimize risks. Regarding the institutional influence on premiums through rate regulation, results indicate that a moderate level of regulation over rates has a decreasing effect on premiums compared to strict regulation –since "prior approval" is the default regulatory regime in the model, whereas unregulated pricing has no statistically significant effect. Lastly, an increase in recording fees is correlated with higher premiums. This could be explained by the fact that insurers pass on their cost of consulting title information in the Recording Offices to the consumer.

2.4.3 Background to the Analysis

Land America's bankruptcy in 2008 allows me to apply the methodology of natural experiments to test for a causal relationship between changes in title insurers' market concentration levels and title insurance premiums. Land America Co. was the third biggest title insurance company at the time. Three main factors were behind its

bankruptcy: a mortgage crisis, a low level of activity, and decreasing prices in the housing market, all of which are exogenous to this analysis (Giannone, 2008).

LandAmerica was acquired by Fidelity National Inc. (FN) in late 2008, increasing the market power of FN, which was already the biggest title insurance company on the market. This triggered an investigation by the Federal Trade Commission (FTC)⁶ on the grounds of anticompetitive practices, which resulted in FN's accepting to act upon the FTC's orders: (1) to sell several title plants and related assets in six different geographical areas in Oregon and Michigan; and (2) to notify the FTC before acquiring joint title plants in six States, California, Colorado, Nevada, New Mexico, Oregon and Texas.

When an exogenous event, such as this one, increases the market power of the biggest company on the market, the HHI will see a noticeable rise in its value. This allows me to perform a test of the differential before and after LandAmerica's bankruptcy in the insurers' market concentration level. To divide the sample into control and treated groups, I take ALTA (2016) to find the market share per state of LandAmerica in 2007—the last year for which there is available data before the bankruptcy in 2008 and the merger with FN. I then split states between those where Land America had the lowest market share values, considering them as the control group, since the post-merger market's HHI can be assumed to have seen little or no change, and those where LandAmerica had the highest market share values, considering them as a treatment group since HHI values would have increased significantly.

As expected, the table in Annex I shows that the average HHI value for states in the bottom 33% for LandAmerica's market share in 2007 did not experience any change, as in 2003 the average HHI was 2,639 points, and remained the same in 2012. Conversely, states in the top 33% for LandAmerica's market share in 2007 experienced an increase in their average HHI of 305 points, from 2,331 in 2003 to 2,636 points in

⁶ The proceedings of the Federal Trade Commission case are available at <https://www.ftc.gov/enforcement/cases-proceedings/091-0032/fidelity-national-financial-inc-matter-landamerica-financial> (accessed on November 2016)

2012. This amounted to an increase of 305 points in average HHI after a merger in an already highly concentrated market. This level of change — over 100 points in a market with an HHI over 1,800 points—is considered likely to damage market competition and is the one aspect that raises concerns from the governmental agency, according to the *Horizontal Merger Guidelines* from the U.S. Department of Justice and the Federal Trade Commission (1997), § 1.51.

Lastly, values for the lawyers’ monopoly variable did not change over time for the states in our sample.

2.4.4 Results, Robustness Checks and Discussion

To test the differential effect of market competition levels on title insurance premiums, I use a difference-in-difference estimator:

$$\text{Log of premiums}_{it} = \delta_1 \text{After}_{it} + \delta_2 \text{Treatment}_i + \delta_3 \text{After}_{it} * \text{Treatment}_i + \delta_4 \text{HHI}_{it} + \delta_5 \text{Lawyers' Monopoly}_{it} + \delta_6 \text{W}_{it} + \varepsilon_{it}, \quad (2)$$

As above, i and t denote state and year, respectively; *Log of premiums* is the state average title insurance premium in logs; *After* indicates observations in 2012 following the bankruptcy of Land America; *Treatment* is an indicator set equal to one when the state is among those where LandAmerica’s market share in 2007 is in the top 33%; *HHI* is the Herfindahl-Hirschman Index which measures market concentration in the title insurance market at state level; *Lawyers’ Monopoly* indicates whether or not lawyers legally hold exclusive competencies over preparing conveyancing documents. The term W_{it} represents observable time-state varying characteristics that could affect title insurance prices: *Coverage*, *Owner’s policy*, *Fees include search*, *Search length*, *Unregulated pricing*, *File and use*, *Recording fees*, and *Increase average sales price*; and ε is an error term.

The coefficient of interest, δ_3 , tests for differential changes in title insurance premiums for the states that saw a large increase in their market concentration levels versus those that did not after the LandAmerica bankruptcy and subsequent merger with FN. Assuming that changes in title insurance premiums would be comparable for all states had LandAmerica not gone into bankruptcy, equation (2) allows me to identify the causal effect of market concentration levels on title

insurance premiums, since the lawyers' monopoly variable remains constant throughout the whole time interval.

Table 2 reports the main results for the DiD estimator of changes. The DiD coefficient is positive and significant, with a value of 0.150. This means that title insurance premiums for states that saw increased market competition relative to those that did not increased by 16%.

This result might raise concerns as to whether both the treatment effect definition or the states kept in the sample would somehow help to give the foreseen results. Therefore, this main finding is complemented with some robustness checks in order to provide a more thorough analysis of the difference-in-difference estimator. Basically, I re-estimate the effects by applying alternative treatment sample splits and by dropping from the initial sample the states over which the Federal Trade Commission established asset-related constraints or burdens for FN by requiring it, for example, to sell key specific assets, and to send prior notification to the FTC of its intentions to acquire new assets. The main reason for dropping these states from the sample is that the FTC had found sufficient evidence of competition issues that could damage market competition because of the merger. By removing them, it can be tested whether an increase in market competition levels that was not large enough to damage competition would still prove the hypothesis.

There are two treatment sample splits, at 33% and at 50%. The 33% sample split means that *Treatment* variable takes a value of one if the state is among the top 33% states where LandAmerica had the highest market share, and zero if is among the bottom 33% (dropping from the analysis the 33% states in between). The 50% sample split does not drop any observation from the initial sample and splits it by half between the states where LandAmerica had the highest and the lowest market shares. Since the FTC intervention altered the initial landscape produced by the acquisition of LandAmerica by Fidelity National, the aftermath of FTC's intervention is also taken into account in the following manner: 1) labeled as -2Gov, Michigan and Oregon data are dropped, since Fidelity National had to sell several title plants and related assets in several counties; and 2) labeled as -6Gov, I add to the two previous states, California, Nevada, New Mexico and Texas, since

Fidelity National is bound by the FTC to notify it of any new acquisitions of any joint title plants in these states.

Firstly, I re-estimate the benchmark specification with the alternative sample split, the 50% treatment one. This addresses the possible concern that baseline positive results may be due to using the extreme values from both ends of the sample, for states that a priori had the greatest and smallest HHI values. However, results show that the estimated DiD coefficient remains positive and statistically significant but the effect is smaller, with prices increasing, on average, by 9%.

Secondly, I consider the situation of Oregon and Michigan. FTC found that FN's acquisition had damaged market competition enough in these two states to force them to sell title plants and their related assets, which are key in the title insurance industry. Results are shown in columns 3 and 4 in table 2. Coefficients for both treatments, 33% and 50%, are positive and statistically significant, and the confidence intervals of the coefficients overlap the benchmark results although the effect is smaller, 12% and 8% respectively.

Lastly, I add to the list of those left out the other four states which the FTC considered needed to be watched in case FN wanted to acquire new title plants: California, Nevada, New Mexico and Texas. In this case, only when the treatment variable is the 33% split does it give a positive and statistically significant coefficient; also the confidence intervals of the coefficients overlap the benchmark results. The magnitude of the effect, again, is smaller than the benchmark one, and the increase in the average premium is now 11%.

All in all, the evidence supports hypothesis 2. These results confirm that title insurers' market concentration levels are relevant and have a significant, increasing effect on title insurance premiums –possibly being the main factor behind rises in premiums. This concurs with classic oligopoly theory on prices being positively correlated to sellers' concentration levels (Stigler, 1964; Weiss, 1989).

2.5 Concluding remarks

The paper observes, first, the presence of a bilateral monopoly between title insurers and lawyers and, second, an increase in title insurers' market competition levels due to an exogenous circumstance – the bankruptcy of the third biggest title insurer. I use new data on title insurance premiums and a set of key defining features identified by previous literature on the title insurance industry, thus contributing to the small number of empirical works done in this field.

The evidence suggests that, in a situation of bilateral monopoly lawyers enjoy greater bargaining power and may enjoy monopolistic rents as long as title insurers have low levels of market concentration. Once title insurers' market concentration reaches a certain level, the fact that lawyers hold a monopoly over conveyancing tasks no longer influences title premiums. Results are consistent with those reported by Arruñada (2007) who suggests that the presence of lawyers' monopoly increases premiums assuming that, as argued by Palomar (1998), the quality of the output is unaffected by whether it is a lay conveyancer or a lawyer that provides the service. The main limitation to this part of the study is the lack of detailed data on the closing costs homebuyers are charged in the settlement agreement.

Results from the analysis, considering Land America's bankruptcy in 2008, support that an increase in title insurers' market concentration is the only reason behind the rise in premiums. This relationship is supported by strict robustness checks. Results align with what title insurers are already aware of about their consumers, namely, that it is costly to shop around and that the title premium, along with the other closing costs, is a small percentage compared to the house sale price, giving insurers room to enjoy oligopolistic rents⁷. These results also shed some light on the long-running complaints from consumers and gathered by public authorities —like the GAO report (2007)—about title insurers' price-setting practices, and are in line with Feinberg et al. (2015) who find a positive and statistically significant relationship between the

⁷ These conclusions come from a study by Fidelity National about the title insurance market in California and included in the GAO report (2007, pp. 21–22)

largest real estate agencies charging higher premiums and endorsement costs.

All in all, the paper enhances our understanding of how title insurance premiums are affected by the two main agents in the industry, title insurers and lawyers, and of the impact that increasing levels of concentration in the insurers' market have had on title premiums.

Table 1: Influence in Title Insurance Prices by Title Insurers' market concentration and Lawyers' Monopoly.
 Dependent variable: Log of state average title insurance premiums

MODEL	VARIABLES	(1) OLS	(2) OLS FE	(3) OLS FE	(4) OLS FE	(5) OLS FE	(6) OLS FE
HHI	Herfindahl-Hirschman Index (HHI)	0.569 (0.465)				0.443** (0.209)	1.381*** (0.428)
LawMon	Lawyers' Monopoly	0.102* (0.0616)				0.140*** (0.0245)	0.405*** (0.108)
	Interactive Variable HHI by Lawyers' Monop.						-1.143** (0.454)
Product Type	Owner's policy		0.216*** (0.0258)	0.216*** (0.0258)	0.216*** (0.0221)	0.216*** (0.0218)	0.216*** (0.0217)
	Coverage 100,000\$		0.561*** (0.0406)	0.561*** (0.0406)	0.561*** (0.0348)	0.561*** (0.0343)	0.561*** (0.0342)
	Coverage 200,000\$		1.072*** (0.0409)	1.072*** (0.0409)	1.068*** (0.0350)	1.065*** (0.0345)	1.065*** (0.0344)
	Coverage 500,000\$		1.823*** (0.0406)	1.823*** (0.0406)	1.823*** (0.0348)	1.823*** (0.0343)	1.823*** (0.0342)
	Coverage 1,000,000\$		2.381*** (0.0409)	2.381*** (0.0409)	2.372*** (0.0351)	2.373*** (0.0345)	2.372*** (0.0344)
Services Included	Fees include search				0.515*** (0.0281)	0.534*** (0.0278)	0.540*** (0.0279)
	Search lenght (ratio)				-0.202*** (0.0438)	-0.232*** (0.0438)	-0.227*** (0.0437)
Rate Regulation	Unregulated pricing				-0.0324 (0.0373)	0.00610 (0.0373)	0.0128 (0.0373)
	"File and use" regulation of prices				-0.0977*** (0.0251)	-0.106*** (0.0251)	-0.108*** (0.0251)
Institution	Recording fees (in hundreds of \$)				0.135*** (0.0292)	0.126*** (0.0289)	0.132*** (0.0289)
Control Variables	Increase average sales price				-0.00208 (0.00204)	-0.00251 (0.00207)	-0.00259 (0.00206)
	2003.year			0.0251 (0.0316)	0.0680** (0.0311)	0.0612** (0.0308)	0.0507 (0.0310)
	2012.year			0.0395 (0.0316)	0.0293 (0.0377)	0.0181 (0.0375)	-0.00315 (0.0384)
	Constant	6.390*** (0.118)	5.326*** (0.0315)	5.305*** (0.0364)	5.141*** (0.0440)	4.961*** (0.0581)	4.749*** (0.102)
	Observations	1,188	1,188	1,188	1,188	1,188	1,188
	R-squared	0.004	0.790	0.790	0.847	0.852	0.852
	Owner FE		YES	YES	YES	YES	YES
	Amount FE		YES	YES	YES	YES	YES
	Year FE			YES	YES	YES	YES

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 2: Difference-in-Difference (DiD) of Prices (in logs) before and after LandAmerica Title Insurance bankruptcy in 2008, when Fidelity National acquires it: Top (33% or 50 %) LandAmerica's market share States versus bottom ones.

Dependent variable: Log of state average title insurance premiums

MODEL	VARIABLES	Main Result	Robustness Checks				
		(1) DiD OLS 33%	(2) DiD OLS 50%	(3) DiD OLS -2Gov 33%	(4) DiD OLS -2Gov 50%	(5) DiD OLS -6Gov 33%	(6) DiD OLS -6Gov 50%
Diff-in-Diff Coefficient	1.After#1.Treatment	0.150*** (0.0581)	0.0881* (0.0464)	0.119** (0.0576)	0.0803* (0.0474)	0.106* (0.0580)	0.0673 (0.0479)
HHI	Herfindahl-Hirschman Index (HHI)	0.865*** (0.242)	0.586*** (0.208)	0.975*** (0.238)	0.712*** (0.212)	1.355*** (0.244)	1.015*** (0.216)
LawyMon	Lawyers' Monopoly	0.120*** (0.0354)	0.191*** (0.0262)	0.0542 (0.0358)	0.144*** (0.0276)	-0.0908** (0.0369)	0.0699** (0.0277)
Product Type	Owner's policy	0.271*** (0.0266)	0.216*** (0.0216)	0.252*** (0.0264)	0.207*** (0.0220)	0.246*** (0.0266)	0.198*** (0.0221)
	Coverage 100,000\$	0.531*** (0.0420)	0.561*** (0.0339)	0.536*** (0.0416)	0.569*** (0.0346)	0.555*** (0.0418)	0.586*** (0.0348)
	Coverage 200,000\$	1.036*** (0.0420)	1.064*** (0.0342)	1.042*** (0.0416)	1.075*** (0.0349)	1.075*** (0.0418)	1.103*** (0.0351)
	Coverage 500,000\$	1.797*** (0.0420)	1.823*** (0.0339)	1.808*** (0.0416)	1.840*** (0.0346)	1.844*** (0.0418)	1.868*** (0.0348)
	Coverage 1,000,000\$	2.349*** (0.0424)	2.372*** (0.0342)	2.363*** (0.0420)	2.394*** (0.0349)	2.394*** (0.0423)	2.418*** (0.0351)
Services Included	Fees include search	0.536*** (0.0329)	0.501*** (0.0281)	0.597*** (0.0333)	0.543*** (0.0290)	0.502*** (0.0347)	0.479*** (0.0298)
	Search lenght (ratio)	-0.112** (0.0539)	-0.223*** (0.0435)	-0.200*** (0.0543)	-0.272*** (0.0449)	-0.212*** (0.0589)	-0.310*** (0.0476)
Rate Regulation	Unregulated pricing	0.0814 (0.0518)	0.0561 (0.0382)	0.0585 (0.0506)	0.0367 (0.0382)	0.0242 (0.0475)	0.0239 (0.0367)
	"File and use" regulation of prices	-0.111*** (0.0303)	-0.0842*** (0.0245)	-0.119*** (0.0300)	-0.0913*** (0.0249)	-0.148*** (0.0307)	-0.0896*** (0.0253)
Institution	Recording fees (in hundreds of \$)	0.138*** (0.0345)	0.0982*** (0.0289)	0.123*** (0.0337)	0.0938*** (0.0290)	0.139*** (0.0327)	0.107*** (0.0284)
Control Variable	Increase average sales price	-0.00298 (0.00231)	-0.000379 (0.00190)	-0.00467** (0.00229)	-0.00155 (0.00196)	-0.000565 (0.00253)	0.00171 (0.00211)
	Constant	4.774*** (0.0838)	4.858*** (0.0641)	4.873*** (0.0830)	4.893*** (0.0651)	4.862*** (0.0812)	4.845*** (0.0646)
	Observations	834	1,188	804	1,128	684	1,008
	R-squared	0.850	0.855	0.859	0.859	0.876	0.870
	Owner FE	YES	YES	YES	YES	YES	YES
	Amount FE	YES	YES	YES	YES	YES	YES

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Summary Statistics.

<i>Variable</i>	<i>Full sample</i> ⁸					<i>33% bottom</i> ⁹					<i>33% top</i> ¹⁰				
	Obs.	Mean	SD	Min	Max	Obs.	Mean	SD	Min	Max	Obs.	Mean	SD	Min	Max
Log of premiums	1188	6.5964	0.9684	3.9120	8.8314	414	6.4756	0.9667	4.1744	8.2940	420	6.7543	0.9780	4.6347	8.8314
Herfindahl-Hirschman Index (HHI)	1188	0.2368	0.0606	0.1304	0.4681	414	0.2597	0.0727	0.1499	0.4681	420	0.2285	0.0516	0.1304	0.3748
Lawyers' Monopoly (stricter criteria)	1188	0.7020	0.4576	0	1	414	0.9275	0.2596	0	1	420	0.5714	0.4955	0	1
Log of coverage	1188	12.2881	1.0767	10.8197	13.8155	414	12.2733	1.0696	10.8198	13.8155	420	12.2953	1.0776	10.8198	13.8155
Owner's policy	1188	0.5000	0.5002	0	1	414	0.5000	0.5006	0	1	420	0.5	0.5006	0	1
Fees include search	1188	0.4461	0.4973	0	1	414	0.3865	0.4875	0	1	420	0.5476	0.4983	0	1
Search lenght (ratio)	1188	0.4364	0.3016	0.0957	1	414	0.5145	0.3490	0.1435	1	420	0.3983	0.2481	0.0957	.7990
Unregulated pricing	1188	0.1313	0.3378	0	1	414	0.1691	0.3753	0	1	420	0.0476	0.2132	0	1
"File and use" regulation of prices	1188	0.4259	0.4946	0	1	414	0.5024	0.5006	0	1	420	0.4286	0.4955	0	1
Recording fees (in hundreds of \$)	1188	0.6932	0.4399	0.1800	3	414	0.6958	0.5001	.18	3	420	0.6879	0.4091	0.18	2.1867
Increase average sales price	1188	16.5146	7.7817	7.3	30.3	414	17.05362	8.0694	7.3	30.3	420	16.3786	7.6922	7.3	30.3

⁸ States in the full sample are: Alaska, Arizona, Arkansas, California, Connecticut, Delaware, Georgia, Idaho, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin, Wyoming.

⁹ 33% of States where Land America had the lowest market share in 2007: Alaska, California, Connecticut, Maine, Massachusetts, Mississippi, Montana, North Carolina, North Dakota, Oklahoma, South Dakota, Vermont, Wisconsin, Wyoming

¹⁰ 33% of States where Land America had the biggest market share in 2007: Arizona, Delaware, Idaho, Louisiana, Maryland, Michigan, Minnesota, Nevada, New Mexico, New York, Pennsylvania, Rhode Island, Texas, Virginia

Table 4: Summary Statistics per year.

<i>Variable</i>	<i>1997</i>					<i>2003</i>					<i>2012</i>				
	Obs.	Mean	SD	Min	Max	Obs.	Mean	SD	Min	Max	Obs.	Mean	SD	Min	Max
Log of premiums	396	6.575	0.963	3.912	8.831	396	6.600	0.957	4.317	8.831	396	6.614	0.986	4.174	8.639
Herfindahl-Hirschman Index (HHI)	396	0.207	0.073	0.130	0.468	396	0.242	0.052	0.184	0.452	396	0.261	0.040	0.210	0.375
Lawyers' Monopoly (stricter criteria)	396	0.702	0.458	0.000	1.000	396	0.702	0.458	0.000	1.000	396	0.702	0.458	0.000	1.000
Log of coverage	396	12.288	1.078	10.820	13.816	396	12.288	1.078	10.820	13.816	396	12.288	1.078	10.820	13.816
Owner's policy	396	0.500	0.501	0.000	1.000	396	0.500	0.501	0.000	1.000	396	0.500	0.501	0.000	1.000
Fees include search	396	0.455	0.499	0.000	1.000	396	0.455	0.499	0.000	1.000	396	0.429	0.496	0.000	1.000
Search lenght (ratio)	396	0.442	0.296	0.155	1.000	396	0.436	0.301	0.150	1.000	396	0.431	0.308	0.096	1.000
Unregulated pricing	396	0.172	0.378	0.000	1.000	396	0.101	0.302	0.000	1.000	396	0.121	0.327	0.000	1.000
"File and use" regulation of prices	396	0.253	0.435	0.000	1.000	396	0.621	0.486	0.000	1.000	396	0.404	0.491	0.000	1.000
Recording fees (in hundreds of \$)	396	0.539	0.243	0.180	1.240	396	0.563	0.242	0.180	1.190	396	0.978	0.585	0.240	3.000
Increase average sales price	396	10.317	2.847	7.300	14.900	396	16.817	8.583	8.400	30.300	396	22.410	5.173	17.200	28.700

Table 5: Correlation Matrix.

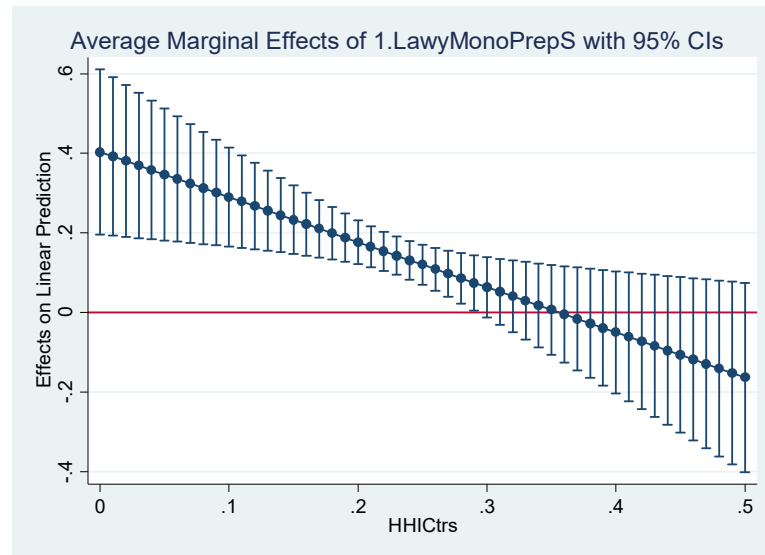
	Log of premiums	Herfindahl Index	Lawyers' Monopoly	Log of coverage	Owner's policy	Fees include search	Search lenght	Unregulated pricing	"File & use" reg. prices	Recording fees	Δ avge. sales price	iv_LMxHI
Log of premiums	1.0000											
Herfindahl-Hirschman Index	0.0394	1.0000										
Lawyers' Monopoly	0.0509	0.0788	1.0000									
Log of coverage	0.8815	-0.0011	-0.0053	1.0000								
Owner's policy	0.1116	0.0000	0.0000	0.0000	1.0000							
Fees include search	0.2257	0.1290	-0.0447	0.0060	0.0000	1.0000						
Search lenght (ratio)	0.0509	0.2182	0.0247	-0.0137	0.0000	0.5140	1.0000					
Unregulated pricing	-0.0666	-0.1468	-0.1608	0.0034	0.0000	-0.3489	-0.2475	1.0000				
"File & use" regulation of prices	-0.0126	0.2264	0.0476	0.0013	0.0000	0.0831	-0.0048	-0.3349	1.0000			
Recording fees	0.0344	0.0853	0.0663	0.0026	0.0000	-0.1135	-0.1538	0.0131	0.0663	1.0000		
Increase average sales price	0.0669	0.4319	-0.0282	-0.0009	0.0000	0.2874	0.2073	-0.1907	0.1626	0.3080	1.0000	
Interactive var: Lawyers'Mon x HI	0.0580	0.4546	0.8997	-0.0050	0.0000	0.0307	0.1246	-0.1860	0.1161	0.0785	0.1163	1.0000

Table 6: Main variables and Data Sources.

	Definition	Data Source
<i>Dependent Variable</i>		
Log of premiums	Log of state average title insurance premiums	Boackle 1997&2003; Hopkins &Loeffler 2012
<hr/>		
<i>Main Independent Variables</i>		
Herfindahl-Hirschman Index	<i>Herfindahl-Hirschman Index of the title insurance market (measures concentration level of the industry)</i>	Nyce and Boyer, 1998; ALTA, 2003 & 2012
Lawyers' Monopoly	<i>Lawyers' monopoly in the preparation of document: = 1, if monopoly; = 0, otherwise</i>	ALTA 2000; DocutechCorp. 2013
<hr/>		
<i>Control variables: Legal, Cost and market related</i>		
Log of coverage	<i>Log of insurance coverage (insured amount)</i>	Boackle 1997&2003; Hopkins &Loeffler 2012; question 31
Owner's policy	<i>Type of policy. If policy is an owner's policy = 1; = 0 otherwise</i>	Boackle 1997&2003; Hopkins &Loeffler 2012; question 31
Fees include search	<i>If fees include search and examination = 1; = 0 otherwise</i>	Boackle 1997&2003; Hopkins &Loeffler 2012; question 35
Search length (ratio)	<i>Ratio of legal minimum for the length of search, in years</i>	Boackle 1997&2003; Hopkins &Loeffler 2012; question 1; Baker et al., 2002
Unregulated pricing	<i>Unregulated pricing of title insurance</i>	Nyce and Boyer, 1998; A.M.Best 2003; NAIC, 2010; NAIC, 2015
"File and use" regulation of prices	<i>"File and use" regulation of title insurance prices</i>	Nyce and Boyer, 1998; A.M.Best 2003; NAIC, 2010; NAIC, 2015
Recording fees (in hundreds of \$)	<i>Estimated recording fees for transfer and mortgage, in \$</i>	Boackle 1997&2003; Hopkins &Loeffler 2012; questions 6 and 15
Increase average sales price	<i>Annual increase of Average Sales Price by region. It is a measure of level of activity in the housing market</i>	Census.gov, New Residential Sales Historical Database

Figure 2.1

The marginal effect of LMPS on HHI indicates that the differences given the presence or not of Lawyers' Monopoly is statistically significant for all values of HHI up to 0.29



ANNEX I

Summary Statistics of Variable HHI for the Diff-in-Diff Analysis

	Variable	Obs.	Mean	SD	Min	Max
33% Top	2003 HHICtrs	140	.23310	.02276	.19908	.28869
	2012 HHICtrs	140	.26361	.04196	.21165	.37483
33% Bottom	2003 HHICtrs	138	.26397	.07291	.18638	.45226
	2012 HHICtrs	138	.26395	.04442	.21398	.34652

ANNEX II: Compensation and operating expenses by insurance sector in the United States

Losses/operating revenue (%)						Operating expenses/operating revenue (%)				
Year	Title Industry	Surety (Stock)	Property & Casualty (Stock)	Property & Casualty (Mutual)	Boiler & Machinery (Stock)	Title Industry	Surety (Stock)	Property & Casualty (Stock)	Property & Casualty (Mutual)	Boiler & Machinery (Stock)
1997	4.6	25.6	72.3	74.7	45.2	93.7	43.2	28.3	24.3	43.0
1998	3.8	24.5	75.0	80.1	51.0	92.7	43.5	29.0	24.9	44.0
1999	4.1	25.0	77.3	81.7	60.6	92.9	42.6	29.1	25.5	48.9
2000	5.3	27.7	19.4	85.3	51.5	94.7	44.1	28.6	25.2	41.8
2001	4.8	47.2	87.3	90.8	50.2	92.7	40.8	27.4	24.9	41.9
2002	4.6	63.7	80.5	82.9	40.0	91.6	51.6	25.7	24.9	39.7
2003	4.0	72.1	74.4	75.4	28.4	89.8	49.1	25.0	24.4	39.7
2004	4.3	69.7	72.2	72.5	32.4	89.4	47.2	26.3	24.4	43.7
2005	5.3	53.4	74.9	74.7	22.8	89.0	47.4	26.3	24.6	40.0
2006	5.0	31.6	64.1	69.5	35.8	89.9	48.5	26.5	25.9	40.8
2007	8.6	22.9	66.6	71.5	32.5	90.9	46.6	27.5	26.3	38.5
2008	11.7	21.4	76.9	79.2	34.5	97.4	44.6	27.8	26.6	40.3
2009	9.7	31.8	71.8	77.1	34.5	93.1	46.6	28.2	27.5	40.9
Average										
1997-2009	5.8	39.7	70.2	78.1	40.0	92.1	45.8	27.4	25.3	41.8
past 10 years	6.3	44.2	74.8	77.9	36.3	91.8	46.7	26.9	25.5	40.7
past 20 years	6.3	36.8	76.9	79.7	43.7	92.2	46.1	27.6	24.3	43.6
all years	6.6	41.9	75.1	78.0	39.8	89.5	46.2	27.2	22.8	47.3

Source: (Russo et al., 2010, Exhibits 4 and 6)

Chapter 3

ASSESSING BLOCKCHAIN SOLUTIONS FOR LAND TITLE INSTITUTIONS

3.1 Introduction

Blockchain technology –also known as Distributed Ledger Technology (DLT)– has been labeled as a ‘truth machine’ capable, among other things, of ‘protecting land titles’.¹ Nick Szabo already contemplated the possibility of securing and transferring land titles and property rights through a ‘distributed title database’ a decade before Bitcoin was a reality.² The launch of Bitcoin and its increasing adoption raise interest in blockchain technology. The hype surrounding blockchain technology along with Szabo’s theory have fueled the appearance of numerous blockchain applications in the field of land governance and property rights. Efforts have been made from both public and private

¹ ‘The Great Chain of Being Sure about Things’ [2015] *The Economist* <<https://www.economist.com/briefing/2015/10/31/the-great-chain-of-being-sure-about-things>> accessed 15 August 2018.

² Nick Szabo, ‘Secure Property Titles with Owner Authority | Satoshi Nakamoto Institute’ (1998) <<https://nakamotoinstitute.org/secure-property-titles/>> accessed 14 August 2018.

initiatives, although only a few are implemented or at a pilot stage, which accounts for the difficulties that such initiatives are encountering.³

This paper studies the blockchain-based solutions under development by real initiatives in land title institutions and assesses their feasibility to provide valuable evidence of title that a court can rely on in case disputes arise between parties. It will do so acknowledging the customizable nature of the blockchain technology. It will therefore discuss key factors influencing the design of blockchain-based systems providing an analytical framework for assessing such solutions.

The analysis combines economic, legal and technological perspectives. From an economic perspective, it considers agents' relationships when conveyancing land through contract (personal or *in personam*) rights or through property (real or *in rem*) rights. From a legal perspective, it delves into the requirements and conditions set by the law, without which land title institutions would not effectively afford protection. Lastly, from a technological point of view—blockchain can adopt diverse configurations—it studies the relation between the

³ One of the first projects announced was the partnership between the startup Factom and the government of Honduras, but so far it has not come to fruition. Pete Rizzo, 'Blockchain Land Title Project "Stalls" in Honduras' (*CoinDesk*, 26 December 2015) <<https://www.coindesk.com/debate-factom-land-title-honduras/>> accessed 14 August 2018. Besides the four initiatives discussed in this paper there are announcements, among others, from countries such as Brazil (Trevor Hill, 'Ubitquity Used to Test Pilot Blockchain Land Registry in Brazil' (*Bitsonline*, 27 January 2018) <<https://bitsonline.com/ubitquity-test-blockchain-land/>> accessed 16 August 2018.), Ghana (Melanie Kramer, 'Ghana Looks To IBM For Blockchain-Based Land Administration' (*ETHNews.com*, 12 July 2018) <<https://www.ethnews.com/ghana-looks-to-ibm-for-blockchain-based-land-administration>> accessed 16 August 2018.), Dubai (Lara Abdul Malak, 'Dubai Land Department to Implement Four Blockchain Projects in 2018' (*Unlock Blockchain*, 24 May 2018) <<https://www.unlock-bc.com/news/2018-05-24/dubai-land-department-to-implement-four-blockchain-projects-in-2018>> accessed 15 August 2018.), United Kingdom (Stan Higgins, 'UK Land Registry Plans to Test Blockchain in Digital Push' (*CoinDesk*, 12 May 2017) <<https://www.coindesk.com/uk-land-registry-plans-test-blockchain-digital-push/>> accessed 15 August 2018.) or Japan (Samburaj Das, 'Japan Could Place Its Entire Property Registry on a Blockchain' (*CCN*, 22 June 2017) <<https://www.ccn.com/japan-place-entire-property-registry-blockchain/>> accessed 16 August 2018.)

technological elements, the characteristics that define the institutions, and any new players the blockchain technology brings along.

This paper is grounded on the assumption that land title institutions are required in land conveyancing in order for real property rights to be traded and land used as collateral. Land institutions are seen as mechanisms that provide constructive notice as well as enable gathering the parties' consent that is inherent in property (real or *in rem*) effects. As functioning institutions, they are capable of lowering transaction costs, decreasing parties' information asymmetries, guaranteeing third party impartiality, and providing evidentiary documents under the strict requirement of territorial monopoly.⁴ The focus of the paper is understanding ongoing initiatives. Therefore, it sidelines the question whether land title institutions could be entirely replaced by blockchain technology.

The paper adds to the growing recent literature about blockchain, property rights and land governance and institutions. Arruñada studies if blockchain technology is capable of handling transactions of property rights (*in rem* rights).⁵ He concludes that the technology could at best facilitate personal exchange (*in personam* rights) but not convey impersonal exchange (*in rem* rights). Thomas discusses the suitability of blockchain technology to transfer real property rights.⁶ He tests the use of this technology within a setting characterized by the use of the

⁴ This perspective mainly follows the theoretical framework on impersonal exchange of property rights developed by Arruñada: Benito Arruñada, 'Property Enforcement as Organized Consent' (2003) 19 *The Journal of Law, Economics, and Organization* 401; Benito Arruñada, *Institutional Foundations of Impersonal Exchange: Theory and Policy of Contractual Registries* (University of Chicago Press 2012); Benito Arruñada, 'Registries' (2014) 1 *Man and the Economy* 209; Benito Arruñada, 'Property as Sequential Exchange: The Forgotten Limits of Private Contract' [2017] *Journal of Institutional Economics* 1.

⁵ Benito Arruñada, 'Blockchain's Struggle to Deliver Impersonal Exchange' (2018) 19 *Minn. J.L. Sci. & Tech.* 55. See a revised and updated version of the paper in 'Prospects of Blockchain in Contract and Property', *International Conference on Disruptive Technology, Legal Innovation and the Future of Real Estate* (Gazit-Globe Real Estate Institute 2019).

⁶ Rod Thomas, 'Blockchain's Incompatibility for Use as a Land Registry: Issues of Definition, Feasibility and Risk' (2017) 6 *European Property Law Journal* 361.

Bitcoin colored coins solution to handle and guarantee land title transactions in a Torrens-type institution. He concludes that Bitcoin's colored coins are unsuited to this setting, especially because this technological solution does not allow for control or verification of data from the registry, an independent third party to the operation. Gallego conducts a similar discussion but comparing public (such as Bitcoin) vs. private blockchain solutions had they been implemented in the Spanish Land Registry.⁷ He concludes that it would be the private blockchain solution that should be implemented but, if so, it would be very similar to the technical solution already in place. He also highlights that the technology is merely an instrument. Should it be used, it must be adapted to the rule of law and not the other way around, to avoid the risk of weakening the nature and the legal safeguards the existing registry provides. Griggs et al. test the validity of blockchain technology by discussing what would have been the outcome in four common fraud scenarios in the Australasian Land Registry if a colored coin solution running on a public blockchain had been in place.⁸ They conclude that this application of the technology to land title registration at this point is uncertain. Nogueroles and Martínez consider whether blockchain, as it operates in Bitcoin, would replace land registry systems by itself or would just be a tool for existing land title systems.⁹ They conclude that blockchain can be a useful tool that may improve the organizations but will not replace the land title institutions themselves; since the latter are more than databases, they entail legal consequences for parties involved in land conveyancing, such as the priority rule or title indefeasibility, that are only possible if third party enforcement stays in place.

In more general terms, Vos addresses the functioning of blockchain technology and the impact its use may have on existing Land Registry systems, and also considers the situation if a cross-border land registry

⁷ Luis A Gallego, 'Blockchains and Title Registration' [2017] *IPRA-CINDER International Review* 26; Luis A Gallego, 'Cadenas de bloques y Registros de derechos' (2018) 765 *Revista Crítica de Derecho Inmobiliario* 97.

⁸ LD Griggs and others, 'Blockchains, Trust and Land Administration: The Return of Historical Provenance' (2017) 6 *Property Law Review* 179.

⁹ Nicolás Nogueroles Peiró and Eduardo J Martínez García, 'Blockchain and Land Registration Systems' (2017) 6 *European Property Law Journal* 296.

were introduced.¹⁰ He concludes that at this point the technology does not seem suitable, that not enough testing has been done, and that the risk would be high if traditional land registries were replaced by a blockchain-based system. Verheye discusses whether blockchain for land registries can provide the same level of trust as existing land registries, considering four pairs of legal traits and using as benchmarks the German, Belgian and French systems. He concludes that, as long as certain conditions are observed –there cannot be anonymity or the use of a public blockchain, and there should be measures in place to guarantee the ‘mirror principle’– blockchain can bring modernization to public registries rather than disruptive change.¹¹ Lemmen et al. consider how the standardization of property rights and their transactions can contribute to the application of blockchain to land administration systems. They conclude that once the three elements kept in a land administration system –object, right and subject– are standardized, these data can be stored on a blockchain. However, they advise flexibility regarding its use and design and point out that the replacement of existing trusted third parties by a blockchain –or other computerized system– remains to be seen.¹² Graglia and Mellon argue that the implementation of blockchain in land governance relies on the society and its willingness to adopt decentralized governance systems.¹³ They present a set of requisites for a registry to be running with blockchain technology which would decrease transaction costs to the extent that underwriting title insurance in recording systems would be unnecessary. They consider that blockchain-based registries can be a reality and will allow peer-to-peer transactions.

¹⁰ Jacques Vos, ‘Blockchain-Based Land Registry: Panacea, Illusion or Something in Between?’ [2017] European Land Registry Association 26.<www.elra.eu/publications/elra-annual-publication/> accessed 2 August 2017

¹¹ Benjamin Verheye, ‘Real Estate Publicity in a Blockchain World: A Critical Assessment’ (2017) 6 European Property Law Journal 441.

¹² Christiaan Lemmen, Jacques Vos and Bert Beentjes, ‘Ongoing Development of Land Administration Standards’ (2017) 6 European Property Law Journal 478.

¹³ J Michael Graglia and Christopher Mellon, ‘Blockchain and Property in 2018: At the End of the Beginning’ (2018) 12 Innovations: Technology, Governance, Globalization 90.

The paper contributes in two ways. One, it presents a novel approach to the debate by considering that blockchain technology is a sum of elements that can adopt diverse configurations. Because not all blockchain-based systems are created equally, distinguishing between them and analyzing the specific design being developed for each land title institution improves the understanding of the legal and economic effects of their implementation. Two, it discusses the extent to which the outcome of a blockchain-based system safeguards the public interest and keeps third parties protected given the relevance of land as a key economic asset, by itself and as collateral. Its conclusions complement and are aligned with previous studies about computerization, internet and land title institutions, showing that the way blockchain-based systems are being designed for land title institutions leads to steady integration of the new technology in the institution rather than disruptive change to the status quo.¹⁴

The remainder of the paper is organized as follows. Section 3.2 explains the customizable nature of the blockchain technology and its implications for land systems. Section 3.3 develops an analytical framework for assessing blockchain solutions for land institutions presenting key factors that affect their design, and describes the impact such factors have on land title institutions. The empirical cases are analyzed in sections 3.4 and 3.5. They cover most of the possibilities with respect to land titling, recording vs. registration; public vs. private initiative, and public vs. private blockchain (Figure 1). Section 3.6 concludes.

¹⁴ Whitman considers that the introduction of digital computing technology had little impact on the recording system itself, which essentially keeps working in the same way it did in 1620. Hence, the technology brought some changes, from paper to digital records, but not to the essence of the recording system (Dale A Whitman, 'Digital Recording of Real Estate Conveyances' (1999) 32 J. Marshall L. Rev. 227.) On land title institutions and their computerization and online services see: Emily Bayer-Pacht, 'The Computerization of Land Records: How Advances in Recording Systems Affect the Rationale behind Some Existing Chain of Title Doctrine' (2010) 32 Cardozo L. Rev. 337; David A Thomas, 'Accessing U.S. Land Title Records through the Internet' (1997) 8 J.L. & Inf. Sci. 200; Ben France-Hudson, 'Living in Interesting Times: Landonline, Leader in Its Field at What Cost' (2006) 12 Canterbury L. Rev. 121.

3.2 Blockchain as customizable technology and its implications for land

Authors reach contradictory conclusions on whether blockchain technology could be suitable for land title institutions. For example, regarding registries of rights, Thomas concludes blockchain could not be suitable;¹⁵ as opposed to Gallego.¹⁶ Notwithstanding both authors agree that Bitcoin, a public blockchain, does not provide the adequate technical solution to guarantee that registrars can verify and control changes to the ledger's content before they enter into the blockchain, i.e. registrars cannot perform their duties of "purging" title. Gallego argues that only a private blockchain solution could allow this.¹⁷

Why do they agree about Bitcoin but disagree about blockchain? The answer lies in the customizable nature of the blockchain technology itself which can ground very different systems. The configuration of the different technical components of a blockchain system is influenced by the agents with interests at stake –the system developers, users, miners, and service providers among others. Each blockchain-based system is unique even if it shares some traits with another one. For example, Bitcoin and Ethereum are both public blockchain systems; however Bitcoin is a token system –it allows the transfer of cryptocurrency– while Ethereum is a smart contract system –also known as 'decentralized applications'–.¹⁸ Thus, given this customizable nature of the technology, blockchain-based systems are, in essence, complex socio-technical systems: they are not merely a combo of hardware and software components but are also the socially-accepted protocols running the network and the consensus algorithm validating the blocks.¹⁹

¹⁵ Thomas (n 6).

¹⁶ Gallego, 'Blockchains and Title Registration' (n 7).

¹⁷ *ibid.*

¹⁸ See *infra* Section 3.3.2.A, on the type of transaction logic.

¹⁹ Odysseas Sclavounis describes this complexity as follows:

The protocol that defines a blockchain, the software in which it is instantiated and the hardware on which it ultimately runs are all

Consequently, the analysis of blockchain solutions cannot be done in a vacuum nor simply referring in general to blockchain technology. It is paramount to distinguish between the specific customizable configurations the blockchain solutions have adopted. Otherwise, the analysis may render incomplete or even contradictory conclusions. With respect to the authors I am using as examples Thomas analyzes the suitability of blockchain for a registry of rights equalizing Bitcoin to blockchain technology; whereas Gallego distinguishes between blockchain systems relying on a public –the case of Bitcoin–, or private network of computers to operate.

Similarly, in the context of property law, property rights and property institutions are customizable in nature. The configuration of the property rights regime is made by law in a society and could be influenced by those with interests at stake.²⁰ Property law scholars point out the difference between property rights and contract rights, the relevance of this distinction for the effects carried on over subsequent transfers of an asset, especially in terms of third-parties' binding enforceable rights, and the role of public property registries, in terms of information asymmetries, transaction costs and enforceability of property rights.²¹

inputs that are produced by diverse groups of people. Moreover, these components are constantly changing to integrate better technology, render the network more efficient or patch vulnerabilities. This process of development is both a necessary part of a blockchain's growth and a fundamentally social process.

'Understanding Public Blockchain Governance — Oxford Internet Institute' (17 November 2017) <<https://www.oii.ox.ac.uk/blog/understanding-public-blockchain-governance/>> accessed 23 August 2018.

²⁰ Henry Hansmann and Reinier Kraakman, 'Property, Contract, and Verification: The Numerus Clausus Problem and the Divisibility of Rights' (2002) 31 *The Journal of Legal Studies* S373.

²¹ *ibid*; Thomas W Merrill and Henry E Smith, 'Optimal Standardization in the Law of Property: The Numerus Clausus Principle' (2000) 110 *Yale Law Journal* 1; Thomas W Merrill and Henry E Smith, 'The Property/Contract Interface' (2001) 101 *Columbia Law Review* 773; Henry E Smith, 'Property as the Law of Things Symposium: The New Private Law' (2011) 125 *Harvard Law Review* 1691.

Contractual rights oblige parties to the contract –personal or *in personam* rights– whereas property rights are also binding for third parties to the original agreement since the established rights run with the asset –real or *in rem* rights–. In order to facilitate cost-efficient transaction of property rights, i.e., help third parties to acquire knowledge of any property rights burdening an asset, the legal systems establish either (1) standardization of property rights (*numerus clausus*); or (2) verification rules so that the legal system lowers environmental uncertainty and third parties have higher availability of information at lower costs.

From this perspective of sequential exchange of property rights, property registries serve as reliable facilitators to verify which property rights are burdening an asset, for example a piece of land, and who is the right holder, not only for third parties interested in entering in a conveyancing agreement, but also for third parties in charge of solving disputes and enforcing property rights when claims between right holders arise, such as judges and courts. In essence these institutions are complex socio-legal systems: ‘they do not mainly contain magnitudes (values) but the socially-accepted legal evidence supporting claims (recording) or even establishing rights (registration)’.²²

Land title institutions have been considered to have potential for benefitting from the introduction of blockchain technology which could contribute to the record-keeping process thanks to its enhanced technical capabilities of traceability, provenance, transparency and immutability. It could even help to automate transactions because it can perform automatic balance-checks on peoples’ assets.²³ However, at the time of writing, the potential benefits of adopting blockchain technology are still

²² Arruñada, ‘Blockchain’s Struggle to Deliver Impersonal Exchange’ (n 5), footnote 142.

²³ Victoria Lemieux, ‘Evaluating the Use of Blockchain in Land Transactions: An Archival Science Perspective’ (2017) 6 *European Property Law Journal* 392; Victoria Lemieux, ‘A Typology of Blockchain Recordkeeping Solutions and Some Reflections on Their Implications for the Future of Archival Preservation’, *2017 IEEE International Conference on Big Data (Big Data)* (2017).

unclear. Technology enthusiasts seem to overestimate its usefulness while underestimating the viability of its implementation.²⁴

From an economic point of view, some consider that the capacity of blockchain technology to reduce or eliminate intermediaries, the middlemen, will allow for disintermediation of the economy, improving efficiencies and reducing transaction costs.²⁵ Conversely, others consider that these claims are overlooking ‘the inefficiencies associated with the incentive and governance systems and the likely costs associated with regulation of these platforms and [other] complementary service providers’ as well as the technological complexity introduced.^{26, 27} What is more, studies analyzing the need for record-keeping as well as the enforceability of blockchain agreements on off-line assets –which is the case of land property registries–, suggest that centralization would be more efficient.²⁸

In short, the research question is not only if, but how, blockchain can exchange *in rem* property rights while best serving the requirements for this once it is considered a customizable technology, once the complexity of both the technology and the land property institutions is acknowledged, and once the unknown cost-efficiency trade-off of implementing a blockchain-based solution is assumed.

Hence, the assessment of blockchain-based solutions for land title institutions can benefit from a case-by-case approach. This should take

²⁴ Michael Pisa, ‘Reassessing Expectations for Blockchain and Development’ (2018) 12 *Innovations: Technology, Governance, Globalization* 80.

²⁵ Aaron Wright and Primavera De Filippi, ‘Decentralized Blockchain Technology and the Rise of Lex Cryptographia’ [2015] *Soc.Sci.Res.Network* <<https://papers.ssrn.com/abstract=2580664>> accessed 21 August 2018.

²⁶ David Evans, ‘Economic Aspects of Bitcoin and Other Decentralized Public-Ledger Currency Platforms’ (2014) Working Paper No. 685 Coase-Sandor Institute for Law & Economics <http://chicagounbound.uchicago.edu/law_and_economics/680> accessed 8 March 2016.

²⁷ Pisa (n 24).

²⁸ Joseph Abadi and Markus Brunnermeier, *Blockchain Economics* (Nat’l Bureau of Econ Research, Working Paper No 25407, 2018) <<http://www.nber.org/papers/w25407.pdf>> accessed 10 February 2019.

into account the different key elements of both the technological and the institutional systems to discuss the extent to which specific blockchain-based solutions impact the capacity of the land title institution to provide valuable legal evidence of title according to the existing rules of evidence, and should also consider how the structure of transaction costs is affected.

3.3 Key factors to design a blockchain-based system for land

I will analyze here two key dimensions for land systems, given the customizable nature of the blockchain technology. (1) Specific difficulties for handling land property rights digitally: I discuss the limitations and consequences of fitting land property rights as conceived by the rule of law into their digital representations while keeping their legal nature and the institutions' legal safeguards. Six design decisions and their effects are presented. (2) The system architecture:²⁹ I discuss the different

²⁹ Garlan, Monroe, and Wile state the relevance of system architecture which plays 'a strong role determining the success of complex software-based systems': if appropriate, the architecture not only satisfies the requirements of the product but can also be adapted to future products; if inappropriate, the 'architecture can be disastrous' (*Foundations of Component-Based Systems* (Gary T Leavens and Murali Sitaraman eds, Cambridge University Press 2000) 49). They consider that architectural design has four elements:

'First is *structure* –the organization of a system into its constituent parts. Second is *properties of interest* –information about a system or its parts that allow one to reason abstractly about overall behavior (both functional and nonfunctional). Third is *constraints* –guidelines for how the architecture can change over time. Fourth is *types and styles* –defining classes and families of architecture'.

ibid 52, emphasis added. Regarding initiatives to identify key aspects when designing and/or classifying blockchain-based systems, the Japanese Government, Ministry of Economy, Trade and Industry from Japan (METI) is conducting a benchmark survey comparing not only technical characteristics but also measuring related costs, 'Evaluation Forms for Blockchain-Based System Ver. 1.0' (Information Economy Division Commerce and Information Policy Bureau 2017) <http://www.meti.go.jp/english/press/2017/pdf/0329_004a.pdf> accessed 24 July

elements and the possible internal technical configuration of the blockchain technology, focusing mainly on the configurations implemented by the blockchain solutions studied in the empirical section of the paper.

3.3.1 Specific difficulties for handling land property rights digitally

Land property rights and currency are very different types of assets. This holds important consequences for blockchain solutions for land. Bitcoins are an alternative to fiat currency which is issued automatically by the software governing the blockchain network instead of by a central state-backed bank.³⁰ Secondly, the total number of coins is capped and they come into circulation once the requirements coded in the software are met.³¹ Thirdly, bitcoins are tradable assets in themselves; there is no need for an intermediary to link the asset from the digital world (they are a native digital cryptocurrency) to its representation from the non-digital world. The software automatically creates all coins equal and interchangeable.³²

Conversely, land property rights entail a degree of complexity that cryptocurrencies do not have.³³ At least three elements are required to identify a land property right: the piece of land object of the right, the right itself –including content (ownership, right of way, mortgage, etc.) and type of enforcement (*in personam* or *in rem*)–, and the person

2018. Also, Nintin Gaur, ‘7 Principles for Designing a Blockchain Network to Power and Sustain Your Business’ (*IBM Blockchain Dev Center*, 1 January 2017) <<https://developer.ibm.com/blockchain/2017/01/01/7-principles-for-designing-a-blockchain-network-to-power-and-sustain-your-business/>> accessed 17 August 2017.

³⁰ Thomas (n 6).

³¹ Bitcoins are the economic incentive that miners have for processing transactions in the network. Once all bitcoins are mined, miners are awarded transaction fees for their services, (Nakamoto n 25).

³² When created, all bitcoins are nothing more than currency. However, over-layers of software, such as Colored Coins, were developed and now allow for ‘representing and managing real world assets on top of the Bitcoin Blockchain’ ‘Colored Coins - Bitcoin Wiki’ <https://en.bitcoin.it/wiki/Colored_Coins> accessed 6 May 2017.

³³ Nogueroles Peiró and Martínez García (n 9).

entitled to it.³⁴ Moreover, the initial allocation of land property rights may be altered by subsequent operations.³⁵

3.3.1.A *Design decisions*

Therefore, six design decisions about land property rights as digital assets are in order:

- (1) the managing authority that exerts managing power over the digital assets;
- (2) first registration, the input taken to set up the blockchain;
- (3) the lodging authority that is entitled to submit transactions to the blockchain;
- (4) digital format, the legal nature of the instrument representing the digital assets stored on the blockchain;
- (5) which property rights are kept on the blockchain (the *numerus clausus* of rights);
- (6) what types of transaction involving property rights are to be conducted on the blockchain (the *numerus clausus* of transactions).

³⁴ Vos refers to the triple Object – Right – Subject as the basic structure behind land registration systems:

[T]he key principles of the conceptual model for Land Administration, the Social Tenure Domain Model (STMD), for building a legal and regulatory framework are a *continuum of land rights* (rights, restrictions and responsibilities), a *continuum of land use right claimants* (persons and groups or entities) and a *continuum of spatial units* (land, objects and units).

(n 10) 1–2, emphasis in the original.

³⁵ Some authors question the ability of computerized, automated land property rights systems to handle over time either initially non-existent land property rights or their new holders. For example, they question whether an automated system would manage a sub-division of a registered head-title, or the creation of new easements or covenants (France-Hudson, n 13); or if it would be capable of dealing with the existence of competing claims if affected parties were not willing or interested in having them introduced in the land title system (Thomas n 15).

(1) *Managing authority.* The entity *that exerts managing power over the digital assets* acts as an intermediary between the real world and its digital representation on the blockchain. From a sequential exchange perspective, long-term sustainability of a blockchain-based land property system would advise for public agencies to not only exert this managing power when the system is initially set up but also to retain it over time.³⁶ However, so far, land property blockchain applications seem to have an overriding concern for identifying the title owner and the link with the title's piece of land to introduce this pairing on the blockchain. This leaves out the consideration that ownership of land might be encumbered affecting its value;³⁷ or that third parties might hold legal title on different grounds, for example a judicial sentence, which gives a third party a better claim over ownership and forces reallocation of ownership.

(2) *First registration.* Regarding *what input is taken to set up the blockchain*, the debate is open as to whether the information introduced in the first block of the blockchain system –usually referred as the ‘genesis block’– can be equated to “first registration” of rights. “First registration” is a special procedure that requires a higher level of evidence than, for example, purging title due to a regular transaction of

³⁶ Property transactions follow a “sequential exchange” which

[I]nvolves at least three parties entering two non-simultaneous contracts, so that one of the parties would not be represented in the other two's choice of enforcement mechanism. Understandably, this unrepresented party would fear losing enforceability *in rem*—that is, she would have to rely on *in personam* rights against the other parties (...) [S]equential exchange advises (...) improving interaction between public agencies and private facilitators, while preserving the independence of the agencies and exploiting the strengths and specialization advantages of public and private operators

Arruñada, ‘Property as Sequential Exchange’ (n 4) 11 and 21.

³⁷ Encumbrances on land decrease the value of the owner's title and, thus, the collateral value of the land (Joyce D Palomar, *Patton and Palomar on Land Titles* (3rd. ed., Thomson West 2017) <<https://legalsolutions.thomsonreuters.com/law-products/Treatises/Patton-and-Palomar-on-Land-Titles-3d/p/100028784>> accessed 7 June 2018.)

property rights.³⁸ Another option is to consider that the operation is merely a transcription of the data already in the possession of the land title institution.³⁹ But, in any case, the key issue here is that that information must be reliable, i.e. the information on property rights used as input for the blockchain must first undergo a purging process to ensure that no contradictory claims are registered.⁴⁰

(3) *Lodging authority.* Once the available information in the land title institution is uploaded onto the blockchain, the next concern to address is *who is entitled to submit transactions to the blockchain* that alter the ledger's content. This decision is relevant in at least two dimensions: in terms of the information integrity of the title system in the long run; and in terms of any disparity transaction costs consumers may face. The case of New Zealand's Landonline illustrates this point. Landonline has been configured as an online automated registry where,

³⁸ Nogueroles Peiró and Martínez García (n 9).

³⁹ Victoria Lemieux, Daniel Flores and Claudia Lacombe, 'Real Estate Transaction Recording in the Blockchain in Brazil (RCPLAC-01)-Case Study 1 (v. 1.4)' 31.

⁴⁰ Arruñada, 'Blockchain's Struggle to Deliver Impersonal Exchange' (n 5). The importance of this comment relates to claims considering blockchain as a guarantee of information accuracy and its use as a remedial technology for corrupted land registries. Both the original registry and the blockchain-based one are linked and, therefore, if there are corrupted entries in the registry—unless purged by other means—they will be carried over to the blockchain-based one,

[T]here is *nothing inherent in the blockchain that fundamentally alters the accuracy of recording*. Rather, accuracy is dependent upon the procedural and technical controls over entry of data into these systems. If the data are derived *ex postfacto* from a land registry's registration database, as in the case of the current Ubitquity pilot in Brazil, accuracy of land transaction records depends upon the accuracy of the entries recorded in the original registry of land ownership as well as upon what is transcribed into the new blockchain-based land transaction recording system.

Lemieux, Flores and Lacombe (n 39) 18, emphasis in the original.

Moreover, as Lapointe and Fishbane warn, 'false land title data recorded in an immutable blockchain could exacerbate the effects on disenfranchised owners' ('The Blockchain Ethical Design Framework' 18 <<https://repository.library.georgetown.edu/handle/10822/1051505>> accessed 9 September 2018).

by law, lawyers are ‘personally responsible for all instruments registered that have been certified and signed using that lawyer’s digital certificate’.⁴¹ This configuration, in which it is conveyancers that are entitled to submit information of land transactions, has brought two consequences: one, the system now ‘relies on the integrity and competence of the users’;⁴² and two, there has been a shift in liabilities. Since conveyancers are now managing the registration of new transactions, they now also bear the burden of compensating for damages derived from their acts. Thus, lawyers are now not only liable for their mistakes when acting in their professional capacity but may also be required to pay for any damages their actions have caused to the integrity of the land registry.⁴³

(4) *Digital format.* Defining the *type of record kept on the blockchain* is critical for determining its legal nature as a valid instrument with evidentiary value. Land title institutions serve to keep records on land property rights which, for the blockchain to be implemented, need to be represented somehow. Therefore, besides the need for a trusted party to create the link between the real world asset (real property rights) and the digital world –already discussed above–, it is necessary to establish what digital form that link adopts to put it on the blockchain. Options range from just introducing descriptive information of the asset in an archive –the parcel of land, ownership and/or other claims susceptible of being recorded or registered in the land title system–to asset tokenization–the asset is linked to a cryptocurrency; transferring the cryptocurrency implies that ownership over the asset is also transferred–⁴⁴ Hence, the broad range available for digitally representing an asset

⁴¹ France-Hudson (n 14) 136.

⁴² *ibid* 144.

⁴³ *ibid*.

⁴⁴ On the asset representation solutions on blockchain, see Lemieux, ‘A Typology of Blockchain Recordkeeping Solutions and Some Reflections on Their Implications for the Future of Archival Preservation’ (n 21), who proposes a typology distinguishing, from the least to the most innovative, three types: the *mirror type* (‘the blockchain serves as a repository of “digital fingerprints”, or hashes, of the records in an originating system’, *ibid* 2273), the *digital record type* (‘records are actively created on chain in the form of “smart contracts”’, *ibid* 2274) and the *tokenized type* (‘not only are records

will impact the resulting blockchain system which in its most extreme link form, asset tokenization, would allow for a peer-to-peer asset transaction.

(5) *Numerus clausus of rights*, that is, defining *which property rights are kept on the blockchain*. Whether all or a specific number of real property rights recognized by the legal system are to be kept on the blockchain needs to be considered. If the latter, the proposal to have some real property rights on the blockchain while the others remain recorded or registered through the off-chain system, might end up creating duplicities and increasing both information asymmetries and transaction costs. For example, if only ownership is kept on the blockchain system, a prospective buyer relying only on the information from the blockchain system could be acquiring ownership from the rightful owner but with an encumbrance that leaves him/her with a naked property if the property is encumbered by a usufruct.

(6) *Numerus clausus of transactions*, that is, defining the *types of transaction conducted on the blockchain*. Apart from basic and routine transactions –for example, conveyancing land title from one seller to one buyer– there are others that either are not performed as often or involve altering the asset itself, entitling different people to different easements or covenants over the same piece of land –for example subdividing a head-title or creating a new right of way–. The extent of transactional complexity the blockchain is able to deal with would influence the extent to which those responsible for submitting transactions on the blockchain are liable, or the effects of badly recorded encumbrances or covenants, for example.⁴⁵

captured on chain, but assets are represented and captured on chain via linking them to an underlying cryptocurrency’, *ibid* 2275.)

⁴⁵ Although at the time of France-Hudson’s analysis only routine operations were allowed to be performed through the automated system, eventually it should handle all types of transactions. However, it was unclear how the more complex transactions would impact the constitution of property rights and agents’ liability (n 14).

3.3.1.B *Effects of the design decisions*

These design decisions are consequential in terms of legal safeguards, economic costs and instruments transacted and recorded on the blockchain. Ultimately, the designed blockchain-based land title system may carry, at least, three effects when handling land property rights digitally:⁴⁶

(1) *Role shifting*. It could reassign roles among the agents involved in the land title system. The introduction of the Landonline automated land registry has reduced the responsibilities of the Registrar and increased those of the conveyancers.⁴⁷ If a similar strategy were to be followed when implementing an automated blockchain system, this could lead to an extreme situation where, once the land title institution has been set up on the blockchain, it could run without the Recorder's or Registrar's intervention. In the long run, this might weaken the institutional foundations and dilute the nature of the institution from a public land system to a land conveyancing market.

(2) *Risk shifting*. It could shift the risk in case of claims. As was the case in New Zealand with Landonline, conveyancers end up shouldering higher risks than with the previous land registry system. They may therefore face higher professional liability insurance premiums which would be transferred to the consumer who would face higher transaction costs.⁴⁸

(3) *Evidence quality*. It could affect the value of the output produced by the new system as evidentiary proof of real property rights. The evidentiary value of an instrument is established by law. Even if it is argued that the law could be changed and adapted to the outputs generated by a blockchain-based system, the various considerations

⁴⁶ I foretell these effects considering, as a benchmark, the research done on the introduction of computerization and automation of land registries. See *ibid*; Rod Thomas, Rouhshi Low and Lynden Griggs, 'Designing an Automated Torrens System - Baseline Criteria, Risks and Possible Outcomes' (2015) 2015 New Zealand Law Review 425.

⁴⁷ France-Hudson (n 14).

⁴⁸ *ibid*; Thomas, Low and Griggs (n 46).

discussed here about managing property rights as digital assets would, in some cases, prevent the blockchain-based system from achieve this: ‘Centralization and monopoly in registries are not rooted mainly in economies of scale but in the enhanced neutrality (not only with respect to parties to the contract but also with respect to strangers to it) required to reach universal legal effects’.⁴⁹

3.3.2 Alternative system architecture of blockchain solutions for land

Any computer system rests on its system architecture.⁵⁰ To design it, the architect has to define the technical structural properties of the system and consider customer’s requirements: ‘the user of an automated system is in the hands of the architect or designer of the program. The programmer sets the nature of the discourse’.⁵¹

3.3.2.A Architectural elements

Regarding blockchain system architecture, I will distinguish four elements:

- (1) governance, considering agents’ decision-making power;
- (2) the type of blockchain, considering its network setting and permissions;
- (3) the type of transaction logic the consensus system follows, considering data stored on the ledger; and
- (4) the consensus algorithm, considering its reliability issues and cost effects on the system.

(1) *Governance*. Because of their decentralized nature, blockchain-based systems are considered by some as capable of replacing centralized third parties and intermediaries so that they become ‘alternative governance institutions, alongside firms, markets and relational

⁴⁹ Arruñada, ‘Blockchain’s Struggle to Deliver Impersonal Exchange’ (n 5) 95.

⁵⁰ *See supra* note 29

⁵¹ Thomas, Low and Griggs (n 46) 438.

contracting’.⁵² However, others consider that blockchain does not fulfill these expectations because, even if a blockchain-based system can enforce rules without the need of a third party, it is still necessary to enroll humans because they are ‘still very much in charge of setting the rules that the network enforces’.⁵³ Some even state that trust issues and the agency problem remain if the blockchain-based system is set up to impact the real off-line world.⁵⁴

Therefore, blockchain-based systems are still affected by the problem of governance: ‘how the actors come together to produce, maintain, or change inputs that make up a blockchain’.⁵⁵ Moreover, governance issues may be discussed and settled beyond the blockchain platform, as events like Ethereum’s DAO incident and Bitcoin’s SegWit debate attested.⁵⁶ Consequently, governance of the blockchain is not privy only to blockchain solutions for land, so further discussion is beyond the scope of the paper.⁵⁷

⁵² Sinclair Davidson, Primavera De Filippi and Jason Potts, ‘Economics of Blockchain’ [2016] Soc.Sci.Res.Network 11 <<https://papers.ssrn.com/abstract=2744751>> accessed 9 March 2016; Wright and De Filippi (n 25).

⁵³ Vili Lehdonvirta, ‘The Blockchain Paradox: Why Distributed Ledger Technologies May Do Little to Transform the Economy’ (*Oxford Internet Institute*, 21 November 2016) <<https://www.oii.ox.ac.uk/blog/the-blockchain-paradox-why-distributed-ledger-technologies-may-do-little-to-transform-the-economy/>> accessed 15 February 2018.

⁵⁴ Pisa (n 24).

⁵⁵ Slavounis (n 50) referring to public blockchains. Gaur refers to it in a similar way, although he discusses governance of private blockchains (Nitin Gaur, ‘Blockchain Business Series: Understanding Governance in Business Networks Powered by Blockchain’ (24 February 2018) <<https://www.linkedin.com/pulse/blockchain-business-series-understanding-governance-networks-gaur>> accessed 24 July 2018.)

⁵⁶ See on Ethereum’s DAO incident ‘The DAO, The Hack, The Soft Fork and The Hard Fork’ (*CryptoCompare*) <<https://www.cryptocompare.com/coins/guides/the-dao-the-hack-the-soft-fork-and-the-hard-fork>> accessed 15 July 2017; on Bitcoin’s Segwit debate: Aaron van Wirdum, ‘The Long Road to SegWit: How Bitcoin’s Biggest Protocol Upgrade Became Reality’ (*Bitcoin Magazine*, 23 August 2017) <<https://bitcoinformagazine.com/articles/long-road-segwit-how-bitcoins-biggest-protocol-upgrade-became-reality/>> accessed 25 August 2017.

⁵⁷ Recent studies try to analyze how off-chain behaviour by blockchain platform players shapes the governance of blockchains. Vidan and Lehdonvirta, using

(2) *Type of blockchain.* Blockchains can be public or private.⁵⁸ In a public blockchain anyone can have access and participate in the network. They are usually permissionless, i.e., anyone can join the blockchain, perform transactions, read information and be part of the consensus mechanism. The consensus mechanisms of a public permissionless blockchain are secured by a cryptocurrency ensuring that participants receive an economic incentive to reward their investment. Conversely, permissioned blockchains require participants to previously obtain permission from whoever controls the blockchain system; i.e., nodes are identified and authorized to participate in the blockchain and the extent of their access is defined beforehand. Private and consortium blockchains are usually permissioned. Reading, writing, and control over consensus mechanism permits may be restricted to a set of nodes.⁵⁹

breakdowns in public blockchain systems such as the two mentioned above, conclude that power is highly concentrated and that there is a gap between Bitcoin's promise and reality (Gili Vidan and Vili Lehdonvirta, 'Mine the Gap: Bitcoin and the Maintenance of Trustlessness' [2018] *New Media & Society* 1461444818786220.) Arruñada and Garicano study the differences in governance between centralized vs. decentralized platforms (Benito Arruñada, Miguel Espinosa and Luis Garicano, 'Blockchain: The Birth of Decentralized Governance' [2018] Pompeu Fabra University, Economics and Business Working Paper Series, 1608 <<https://papers.ssrn.com/abstract=3160070>> accessed 1 July 2018.)

On the blockchain governance debate by blockchain developers see, for example, Vitalik Buterin, 'Notes on Blockchain Governance' (17 December 2017) <<https://vitalik.ca/general/2017/12/17/voting.html>> accessed 21 August 2018; Fred Ehrsam, 'Blockchain Governance: Programming Our Future' (*Fred Ehrsam*, 27 November 2017) <<https://medium.com/@FEhsam/blockchain-governance-programming-our-future-c3bfe30f2d74>> accessed 25 July 2018; Vlad Zamfir, 'Against On-Chain Governance' (*Vlad Zamfir*, 1 December 2017) <https://medium.com/@Vlad_Zamfir/against-on-chain-governance-a4ceacd040ca> accessed 23 August 2018.

⁵⁸ There are also consortium blockchains, which consist of a consortium of entities sharing an interest in setting up a private shared blockchain, hence they will be considered here as private.

⁵⁹ Vitalik Buterin, 'On Public and Private Blockchains' (*Ethereum Blog*, 7 August 2015) <<https://blog.ethereum.org/2015/08/07/on-public-and-private-blockchains/>> accessed 1 July 2017; Lemieux, 'A Typology of Blockchain Recordkeeping Solutions and Some Reflections on Their Implications for the Future of Archival Preservation' (n 23); Gideon Greenspan, 'Where Blockchains Add Real Value' (2018) 12 *Innovations*:

In terms of designing a solution for land institutions, a public blockchain, such as Bitcoin or Ethereum, presents some drawbacks. The institution has no control whatsoever over events affecting the development of the blockchain: situations like the DAO incident pose a risk to the immutability of the recorded transactions.⁶⁰ Identity authentication is not possible, only the nodes' public key is identifiable.⁶¹ Recorders or registrars cannot impose lawful reallocation of rights. Costs are linked to the evolution of the underlying cryptocurrency which, so far, shows more volatile behavior than state-backed currency.⁶² Private blockchains solve or mitigate some of these problems, but most importantly it is a configuration that would allow recorders and registrars to perform their lawful duties. To abide by the legal requirements is what protects the parties, not how records are kept—in books, in digital databases or on blockchain ledgers—.⁶³

(3) *Type of transaction logic.* Blockchain systems rely on one of two types of transaction logic: token systems or smart contracts.⁶⁴ The token system uses cryptocurrencies to transfer value or tokenized assets between two parties—the token acts as the digital representation of an asset—. It checks balances and serves to track title over the cryptocurrency and transfers on the blockchain. This is the case of Bitcoin—Bitcoins

Technology, Governance, Globalization 58; Zibin Zheng and others, 'An Overview of Blockchain Technology: Architecture, Consensus, and Future Trends' (2017).

⁶⁰ 'The DAO, The Hack, The Soft Fork and The Hard Fork' (n 56).

⁶¹ Identification and verification of the parties involved in land transactions needs to be guaranteed if a blockchain-based system is set up. The complexity involved, especially if they are done through electronic means, exceeds the scope of this paper. On this topic, see Nicholas Bohm and Stephen Mason, 'Identity and Its Verification' (2010) 26 *Computer Law & Security Review* 43.

⁶² Bitcoin value was an all-time high in December 2017, close to \$20,000. In September 2018 it is around \$6,000.

⁶³ Dale A Whitman, 'Are We There Yet - The Case for a Uniform Electronic Recording Act' (2002) 24 *Western New England Law Review* 245.

⁶⁴ Symbiont, 'Smart Contract vs "Token"-Based Systems' (*Symbiont.io*, 24 April 2017) <<https://symbiont.io/blog/2017/4/24/smart-contract-vs-token-based-systems>> accessed 28 November 2018; Monax Industries, 'Smart Contracts v. Tokenized Approaches' <https://monax.io/learn/contracts_v_tokens/> accessed 8 December 2018.

represent value in themselves or value of an asset thanks to the colored coin protocol layer—.⁶⁵

A smart contracts solution adds to the token system the capability of implementing self-enforcing and self-executing software that runs over a blockchain platform. Allen defines it as ‘(i) a written instrument embodying and recording contracting parties’ mutual promises with (ii) code that performs and/or enforces those promises on a digital computer’.⁶⁶ This solution not only allows the workflow and content of parties’ agreements and consents to be tracked but also makes it possible to embed more information and functionality in the transaction.⁶⁷

(4) *Consensus algorithm.* At their core, blockchains have a consensus algorithm, which is a programmatic execution of the set of rules governing the activity in the network. Participants trust the consensus algorithm embedded in the code to act as promised.⁶⁸ Besides this primary function, the consensus algorithm affects other aspects of the system. Two considerations are in order: reliability and costs.

(a) *Reliability of the system:* The consensus algorithm automatically validates transactions if the requirements for validation are met. The number of consensus algorithms is growing;⁶⁹ and they show differences,

⁶⁵ See *supra* note 32

⁶⁶ JG Allen, ‘Wrapped and Stacked: “Smart Contracts” and the Interaction of Natural and Formal Language’ (2018) 14 *European Review of Contract Law* 307, 319.

⁶⁷ Example: the difference between employing a token or a smart contract solution for trading a bond is that, whereas a token solution requires two systems in place to manage the bond—the token keeps information and tracks ownership while the outside system manages the other operations—, a smart contract would not only allow full information on the bond to be kept and tracked on the blockchain but also other operations related to bonds, such as ‘coupon payments, puts, calls, conversions, etc.’, could be managed and self-executed Symbiont (n 64).

⁶⁸ Sclavounis calls this ‘governance by the network’ as opposed to ‘governance of the network’, already discussed above (Sclavounis n 54).

⁶⁹ For information about consensus algorithms, definition, pros and cons, see Vaibhav Saini, ‘ConsensusPedia: An Encyclopedia of 30 Consensus Algorithms’ (*Hacker Noon*, 2 July 2018) <<https://hackernoon.com/consensuspedia-an-encyclopedia-of-29-consensus-algorithms-e9c4b4b7d08f>> accessed 15 September 2018; Zane Witherspoon, ‘A

for example, in the way they work to achieve consensus from the nodes of the network, or what it is that they record. The choice of a specific consensus algorithm requires assessment regarding its adequacy and its performance. On the one hand, the adequacy of the consensus algorithm relates to how it handles validation of transactions on the blockchain and the content of the ledger. For example, ‘Proof of Work’ is a better choice if the blockchain is public than if it is a private one because it is designed to reward miners for their work, which a private blockchain is not. However, in terms of recorded information, one can only assume that the two parties involved in the transaction agreed to it. This is insufficient for a land institution if real property rights are transacted on blockchain. All parties’ consents must be gathered, including those of third parties holding rights over the land that is the object of the transaction. Ideally, a land registry should use a consensus algorithm capable of both gathering all parties’ consents to the real property rights transaction and handling any property rights that are subject to registration. This would not only maintain the nature of the registry as a cost-efficient institution for transacting real property rights, but might also allow for automation of certain operations and improved detection of contradictory claims.⁷⁰ On the other hand, the way the algorithm is designed affects its performance. For example, although Bitcoin and Ethereum both use ‘Proof of Work’, they have it designed differently, causing observable dissimilar behavior of the nodes. Consequently, it is advisable to benchmark ‘the performance of consensus algorithms to ensure reliable validation of transactions’.⁷¹

Hitchhiker’s Guide to Consensus Algorithms’ (*Hacker Noon*, 13 February 2018) <<https://hackernoon.com/a-hitchhikers-guide-to-consensus-algorithms-d81aae3eb0e3>> accessed 15 September 2018.

⁷⁰ In this vein, for example, Stratum has developed “Proof of Process”: ‘the who, what, when, where and why are all captured in a single cryptographic proof to represent the actors, the data, the time, the order of the step and the legal reasoning behind every single action in the network’ (‘Stratum’s Vision for Building Trust Networks for Economies’ (*Stratum Blog*, 21 July 2017) <<http://blog.stratum.com/stratumns-vision-for-building-trust-networks-for-economies/>> accessed 19 September 2018).

⁷¹ Lemieux, Flores and Lacombe (n 39) 25.

(b) *Cost derived from the operating consensus algorithm*: aside from the fixed cost derived from implementing a blockchain solution, choosing one consensus algorithm or another has a direct impact on the marginal cost. For example, the Proof-of-Work algorithm incurs higher marginal costs than others because of the computer power needed to solve the cryptographic problems involved in validating a transaction.⁷²

3.3.2.B *Effects of the architectural elements*

If the technical structural properties of the blockchain solution are not aligned with the legal and land title institutions' requirements, at least three effects may be observed. These effects are likely to be more observable in the long term once disputes over land transactions are settled before courts using title evidence provided by land institutions based on information produced on the blockchain solution.

(1) *Control shifting*. If control over the architectural design of the blockchain solution shifts from the recorders or registrars to the technology developers or to other agents involved—especially apropos of decision-making power—who can then design, govern or change the architectural elements, this may impact the solution's stability and fitness for the land title institution.⁷³ Agency and monitoring costs are likely to be higher given the novelty and the higher socio-technical complexity a blockchain solution entails in comparison with other available computerized-based solutions.⁷⁴

⁷² METI (n 29); Saini (n 69).

⁷³ *See supra* note 57

⁷⁴ Sclavounis (n 19). labels blockchain-based systems as complex socio-technical ones because:

The protocol that defines a blockchain, the software in which it is instantiated and the hardware on which it ultimately runs are all inputs that are produced by diverse groups of people. Moreover, these components are constantly changing to integrate better technology, render the network more efficient, or patch vulnerabilities. This process of development is both a necessary part of a blockchain's growth and a fundamentally social process.

(2) *Process shifting.* The recording or registering process could shift. Following the process established by the rule of law is what guarantees that land title institutions produce legal safeguards and provide title evidence. Choosing a combination of architectural elements that alters the nature of that process, the required checks or the gathered transactional information may not only weaken the legal safeguards but also the nature of the land institution. As Thomas points out, a bitcoin-based system does not suit the requirements of the due process for transferring real property rights in a Torrens-type institution.⁷⁵

(3) *Information quality.* How information is produced may be affected. Assuming all configurations are equally capable of keeping information, the question is how land title institutions produce it. As Arruñada argues, ‘producing reliable information’ is the main concern that land title institutions need to address.⁷⁶ A blockchain solution that does not allow for purging property rights and checking for contradictions would not only weaken the institution’s nature but render its information useless.

3.4 Empirical analysis: application in recording of deeds

There are two basic types of land title systems: recording of deeds and registry of rights. The main function of recording of deeds is to give public notice to the private contracts –deeds, mortgages and other instruments– by which persons transfer real property rights. The recorder must enter the submitted instrument as long as it complies with formal requirements established by the law, then timestamp a copy. This recorded copy of the instrument can be used as evidence of title before a court in case of a dispute. More importantly, courts, instead of “first in time, first in right”, will enforce the priority rule “first in filing for recording, first in right” to adjudicate property rights to the party holding the recorded instrument with prior date.

⁷⁵ Thomas (n 6).

⁷⁶ Arruñada, ‘Blockchain’s Struggle to Deliver Impersonal Exchange’ (n 5) 88.

In most states in the U.S., the law establishes that proof of title is done based on records kept by the designated government office; therefore, the law not only recognizes the Recorder of Deeds offices as the valid source of proof of title but also their territorial monopoly to do so. However, the recorder does not examine *ex-ante* the legality of the instruments; therefore, records provide useful information to trace the chain of recorded transfers but not its quality. This fact led to the development of the conveyancing and title insurance servicing industries which conduct title search and examination processes in order to cure title defects and provides title insurance to cover title holders against unknown past risks.⁷⁷

Some consider that a land title institution that provides evidence of title by keeping records of title transfers –“chain of title”– seems, *a priori*, a hospitable environment for doing so on a blockchain –“chain of blocks”–.⁷⁸ Such an initiative could improve traceability of transactions, increase processing efficiency and reduce costs and fraud.⁷⁹

In the U.S. two initiatives have been tested. The first is a public initiative from the Cook County Recorder of Deeds partnered with technology developer Velox.RE.⁸⁰ The second is a private initiative from

⁷⁷ Palomar (n 41); Arruñada, ‘Property Enforcement as Organized Consent’ (n 5); Joyce D Palomar, *Title Insurance Law* (2017–2018 edn, Clark Boardman Callaghan 2017) <<https://legalsolutions.thomsonreuters.com/law-products/Practice-Materials/Title-Insurance-Law-2017-2018-ed/p/104885844>> accessed 7 June 2018; Benito Arruñada, ‘A Transaction Cost View of Title Insurance and Its Role in Different Legal Systems’ (2002) 27 Geneva Papers on Risk and Insurance - Issues and Practice 582.

⁷⁸ Graglia and Mellon (n 13); Propy Team, ‘Propy. Global Property Store with Decentralized Title Registry.’ (2017) White Paper <<https://tokensale.propy.com/Propy-White-Paper-17-Jul-2017.pdf>> accessed 2 August 2017.

⁷⁹ Peter Drucker, ‘Blockchain Applications in the Public Sector’ (Deloitte LLP 2016) <<https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/Innovation/deloitt-e-uk-blockchain-app-in-public-sector.pdf>>.

⁸⁰ John Mirkovic, ‘Blockchain Pilot Program Final Report’ (Karen A Yarbrough, Cook County Recorder of Deeds, Illinois 2017) <<http://cookrecorder.com/wp-content/uploads/2016/11/Final-Report-CCRD-Blockchain-Pilot-Program-for-web.pdf>> accessed 5 July 2018; Ragnar Lifthrasir, ‘Permissionless Real Estate Title Transfers on

Propy, a technology developer, which has been testing its blockchain solution in South Burlington, Vermont, at the City Clerk’s Office.⁸¹ These initiatives have similarities: the technology developers are in charge of designing the blockchain-based technical solution; both aim to combine real estate conveyancing with land title recording; and in both cases the recorders show some scepticism as to the benefits of replacing their existing land records software manager system with a blockchain-based one or of replacing the institution altogether with the blockchain technology.

I also analyze two initiatives designed for registries of rights in section 3.5, the cases of Georgia and Sweden. Thus the empirical cases cover most of the possibilities considering the type of land title institution and the type of initiative and blockchain, as *Figure 1* shows:

		<i>Land Title System</i>			
		Recording of Deeds	Registry of Rights		
<i>Type of Initiative</i>	Public	Cook County	Georgia	Public	<i>Type of Blockchain</i>
	Private	Propy	Sweden		

Figure 1 Empirical cases analyzed, classified by type of land title system, initiative and blockchain.

3.4.1 Cook County Recorder of Deeds

The Cook County Recorder of Deeds (henceforth CCRD) partnered with technology developer Velox.RE and other participants to study the

the Bitcoin Blockchain in the USA!’ (*Medium*, 28 June 2017) <<https://medium.com/@RagnarLifthrasir/permissionless-real-estate-title-transfers-on-the-bitcoin-blockchain-in-the-usa-5d9c39139292>> accessed 5 July 2018.

⁸¹ Ben Miller, ‘Vermont City, Real Estate Startup Try Out Blockchain for Recording Property Transactions’ (5 February 2018) <<http://www.govtech.com/biz/Vermont-City-Real-Estate-Startup-Try-Out-Blockchain-for-Recording-Property-Transactions.html>> accessed 5 July 2018.

applicability of blockchain technology to land conveyancing and its consequences for land title recording.

Participants approached the pilot acknowledging their own roles and distinctive working spheres: Velox.RE as a conveyancing intermediary, and CCRD as a public institution with monopolistic competencies. The possibility of linking the processes of conveyancing and recording land transactions was explored but based on the understanding that both Velox.RE and the CCRD would perform their own tasks and would be liable for their own professional responsibilities, unlike Propy which aims to unify both under its service.

On the one hand, the pilot allowed the CCRD to explore the potential of the blockchain technology and what it could bring to a recording of deeds system if the ledger of records was to be kept on a blockchain. On the other hand, the pilot addressed how to comply with existing legal standards for conveyancing land on the blockchain.

The pilot (1) defined a workflow for conveyancing land on the blockchain; (2) determined the elements required for proving that a land conveyancing transaction took place; and (3) established which type of instrument—of all the legal instruments available at that time—would be considered as a valid instrument by the Recorder’s office for recording the transaction.⁸²

Velox.RE opted for a system architecture based on asset tokenization using the colored coin protocol running over Bitcoin—a public permissionless blockchain—which places control and governance of the blockchain out of Velox.RE’s reach.

In terms of managing land property as digital assets, Velox.RE acts as a mere intermediary creating the digital token. The digital token contains information on the title deed, i.e., it contains information about ownership of the real asset and description of property rights. It must, at

⁸² Mirkovic (n 80); Lifthrasir (n 80). In Illinois, unlike Vermont, at the moment the pilot was taking place, there was no bill recognizing land transactions conducted on the blockchain as legally valid or binding. It was therefore necessary for the CCRD to consider and determine out of all the available legal instruments the one that could best serve as a valid instrument considering that recording rules require the instrument to be in writing and to comply with a specific format.

least, ‘identify who the parties are (grantor and grantee), provide a description of the property, have some explicit language “warranting” and/or “conveying” the property, identify a consideration amount, and be signed and dated’.⁸³

However, the CCRD considers that the token transfer only implies transferring ownership of the real asset if it follows the rules in place for land conveyancing.⁸⁴ This remark from the CCRD comes close to considering the token a title deed in digital form rather than a tokenized title deed. The former would still be a title deed that, according to the law, is produced by a title examiner once title has been searched and examined; whereas the latter, a tokenized title deed, would be a security. Thus its legal transfer should abide by securities rules not land conveyancing ones.⁸⁵

A human notary was also involved. The notary’s role was to witness on screen and in real time the seller’s and buyer’s actions when performing the transaction on the blockchain and how this information was compiled in a Confirmation Deed. Afterwards, he/she would print the Confirmation Deed, inkstamp and sign it. Then, the Confirmation Deed could be submitted for recording in the CCRD.⁸⁶

Velox.RE’s blockchain solution is designed for conveyancing real estate only. In principle, it is a solution that allows parties to give some degree of public notice to their private contract in a way that prevents them from tampering with the date and the content of the deed stored in the token. Anyone can read and track transactions on the Bitcoin

⁸³ Mirkovic (n 80) 23.

⁸⁴ *ibid.*

⁸⁵ In the U.S., the security trading market is regulated by the United States Securities and Exchange Commission (SEC). For an overview on regulatory issues on digital tokens, see Token Alliance, ‘Understanding Digital Tokens: Market Overviews and Proposed Guidelines for Policymakers and Practitioners’ (Chamber of Digital Commerce 2018) <<https://digitalchamber.org/token-alliance-whitepaper/>> accessed 27 November 2018.

⁸⁶ During the pilot, no Confirmation Deed was ever filed by Velox.RE at the CCRD (Mirkovic n 78).

platform at the cost of knowing how to use blockchain explorers.⁸⁷ Therefore, it does not alter the existing recording and legal safeguards system.

The CCRD retains its role as sole producer of evidence of title after the title deed is recorded. There are only two novelties: one, the CCRD has determined that the Confirmation of Deed would be the valid instrument for submitting to the Recorder's Office if land conveyancing were to be conducted on the blockchain; two, the content of the Confirmation of Deed includes identifiers of the blockchain transaction.

The Confirmation of Deed is already in place in Illinois but is barely used because it 'is an instrument designed to be recorded with respect to a prior conveyance (the blockchain conveyance, in this case) with the purpose of clearing up any potential ambiguities in the prior deed'.⁸⁸ Thus it gives legal coverage to the transaction on the blockchain allowing it to be recorded as long as bills establishing otherwise are not passed. It also allows for *anchoring* information of the blockchain transaction on the public institution.

From a sequential exchange perspective, Velox.RE's deed tokenization is focused on the initial allocation of rights. Velox.RE does not manage the updating of title information about covenants, liens or easements that may affect the piece of land after the token is created and first transferred. That will be up to the token holder. This situation is likely to introduce negative externalities to the sequential exchange of the tokens because disclosing new private information affecting the asset—for example, a new lien on the land, or a judicial sentence mandating reallocation of ownership to a third party—is at the token holder's discretion. Hence, this solution makes it possible for the initial representation of the real property rights embedded in the token to no longer represent the real situation.

⁸⁷ Jamie Redman, '10+ Monitoring Websites That Help Track the Bitcoin Network' (*Bitcoin News*, 17 April 2017) <<https://news.bitcoin.com/10-monitoring-websites-track-bitcoin-network/>> accessed 3 December 2018.

⁸⁸ Mirkovic (n 80) 23.

From a legal perspective, the nature of the tokenized title deed is unclear. In principle it could be considered as a *digital version of a title deed*, or a *security* representing *title ownership*. If the token is just a *digital version of a title deed* –as it seems to be understood by the CCRD⁸⁹, the conveyancing process, the recording and its evidentiary effects are the same as if the deed was a paper-based written one. Consequently, the Velox.RE solution is merely a new way of providing conveyancing services using a blockchain platform instead of the other digital or non-digital channels already in place in the conveyancing service market.

The use of the token as a *security of title ownership* entails entering into regulatory considerations that are yet to be clarified.⁹⁰ Whether the tokenization of the deed of title as proposed by Velox.RE falls or not into the commodity category is beyond the scope of this paper.

Assuming the token is a tradable security of title ownership and there are no legal changes on land property rights evidentiary rules, the use of the security of title ownership as a means of conveyancing ownership over a piece of land would pose several risks, mainly for the buyer and the subsequent chain of transfers, which could facilitate fraud. Firstly, its use may mislead buyers by giving a false sense of reliability. Velox.RE does not update the token on possible changes affecting title information, thus negative externalities are introduced and the accuracy of the information embedded in the trading instrument is reduced, as mentioned above. Secondly, the security of title ownership cannot be recorded: trade in securities follows different legal rules to those for the conveyance of land, the latter seemingly being CCRD's criterion for allowing the private instrument to be entered in the Records' Office.

⁸⁹ See *supra* note 84

⁹⁰ According to U.S. regulators, tokens could be commodities, tokenized securities or neither. In any case, the creation and transaction of tokens should follow the regulation established under the Commission in charge of each regulatory category. Apart from the SEC (see footnote 85), in the U.S. there is also the United States Commodity Futures Trading Commission (CFTC) that regulates the trade of commodities. Tokens that are neither a security nor a commodity would probably be under the regulation of the Federal Trade Commission (FTC). For a detailed review on the U.S. debate on regulatory issues on digital tokens see Token Alliance (n 85), at 16-29.

Thus, thirdly, if the buyer wants to record the conveyancing, he/she needs to incur in duplicity of operations. Besides holding the security of title ownership, the buyer must perform title search and examination prior to the transaction to acquire legal evidence of title because, although title deeds are instruments for transferring land interest, it is a title examiner who ‘can determine who does have title or rights in the land’ after examining the chain of transfers.⁹¹ This solution simply increases costs since the buyer’s protection against third party claims comes from recording the deed of title.

Lastly, without being awarded recording, the holder of the security of title ownership bears the risk of any existing contradictory chain of title derived from its trading. Courts will decide allocation of real property (*in rem*) rights based on proof of title produced by the Recorder’s Office. Therefore, any other good-faith third party holding a registered deed of title has better and higher-priority valid evidence in a court of law.

Nevertheless, any consequences that tokenization of the title deed may bring have no effects on third parties since the pilot contemplated no legal changes affecting either the Recorder or the public recording system. Therefore, in case of a dispute, by law, still only recorded deeds or liens can be used as proof against a claiming party.

This analysis coincides with some remarks from the CCRD’s final report. The CCRD highlights that:

- a) the legal monopoly of the recorder of deeds offices as the one source of evidence of title;
- b) tokenization of deeds introduces legal and economic risks that require further study;
- c) a permissioned blockchain solution would be better if a blockchain system were to be implemented;
- d) the Bitcoin-based solution is not efficient in terms of power consumption and economic investment. More efficient

⁹¹ Palomar (n 37), §2.

consensus mechanisms should therefore be sought in terms of both economic costs and processing capacity.

At the time of writing, the CCRD has announced the implementation of ‘paperless Certified Digital Files’ backed-up by the Bitcoin blockchain.⁹² The service consists of providing online a certified copy of a deed—in a PDF file—and embedding the hash uniquely associated with that digital file in the Bitcoin blockchain. This setup employs the blockchain merely as a repository for verifying the authentic provenance of the digital file –this use, blockchain as a back-up repository, is similar to the Georgian case.

3.3.2 Propy

Propy is a private initiative whose end goal is to deploy the Propy Registry DApp as the only valid decentralized ledger for registering peer-to-peer (henceforth P2P) real estate conveyancing with binding effects for all parties, including third parties, and legally enforceable title changes in ownership.⁹³ It would allow parties to directly get in touch with one another –reducing the need for intermediaries– and, thanks to the blockchain technology, to transact real estate with enhanced transparency and security at, presumably, lower transaction costs.⁹⁴

Propy sustains that it could even become capable of unifying standards among jurisdictions and provide legally valid universal land title evidence as long as the legal environment is changed, conferring it monopolistic competencies detrimental to public registers already in place.

Propy’s blockchain solution adopts the system architecture of a decentralized application (DApp) which contains a set of decentralized

⁹² ‘New Service! Paperless Record Certification with Blockchain’ (*Cook County Recorder of Deeds - Edward Moody*, 30 November 2018) <<https://cookrecorder.com/new-service-paperless-record-certification-with-blockchain/>> accessed 12 February 2019.

⁹³ ‘The Propy Registry, (...) will achieve its full promise if and when land registries are modernized to (...) recognize the Propy Registry as effectuating a binding and legally enforceable change in title’ Propy Team (n 78) 23.

⁹⁴ See Propy Team (n 78).

smart contracts (agreement, payment, title, deed, and identity smart contracts) and runs over Ethereum, a public permissionless blockchain. Propy controls the development and configuration of the DApp, but not of the underlying blockchain platform, Ethereum.

Propy's P2P blockchain-based solution consists of (1) a conveyancing platform and (2) a registry ledger. First, in the conveyancing platform, the seller and buyer would contact each other and agree to transact. The smart contract solution controls for parties' opportunistic behavior as well as ensuring the legal compliance of the transaction. Second, once all the conditions set by the parties in the smart contract for land conveyancing have been met, payment would be released to the seller and the system would immediately change title of ownership in favor of the buyer on the blockchain-based ledger, named the Propy Registry. The information stored in this registry ledger would make it possible to track chain of title of subsequent ownership right-holders and to provide legally valid and enforceable evidence of prior title, which implies a previous adaptation of evidentiary rules.

Propy has designed a four-stage gradual deployment to achieve a fully workable implementation of its blockchain-based P2P registry system:

Stage one: land conveyancing is conducted on Propy's blockchain-based platform combining on-line with off-line conveyancing services to perform the closing. At the closing ceremony a title deed is produced. The novelty here is that information regarding the location of the land conveyancing transaction on the blockchain is included in the title deed. This title deed needs to be submitted in the Recorder's office if public notice and the attached legal safeguard are desired.

Stage two: same as stage one, but, now, the Recorder acknowledges, by entering the information on Propy's platform, that the deed has been submitted and the corresponding fees have been collected.

Stage three: the Recorder's office links its land records software manager system with Propy's, allowing the latter to electronically submit title deeds for recording.

Stage four: the Recorder's office replaces its land records software manager system with Propy's and the Propy Registry DApp becomes the sole official land records software manager system.⁹⁵

At the time of writing, Propy has deployed step one. It is organized in three interconnected platforms: Propy Listing Platform, Propy Transaction Platform, and the Propy Blockchain Registry. These three platforms allow Propy to cover from beginning to end the required contractual process for legally conveyancing land; and to coordinate parties and conveyancing professionals involved by organizing and tracking a combo of on-line and off-line steps:

(1) The *Propy listing platform* provides a listing service. The listed property is introduced in the Propy platform by either Propy itself or the seller. Once seller and buyer agree to perform a transaction, the contractual process is handled on the Propy transaction platform.

(2) The *Propy transaction platform* provides escrow and closing services. Firstly, Propy generates the purchase and sale *agreement smart contract*. Then, Propy organizes off-line services like title search and examination to clear ownership conducted by title agents, setting up an escrow account to handle payment at the closing ceremony by escrow agents, and even, if requested, other services such as property inspection. The off-line service providers upload their reports on-line to Propy's platform. When the payment money is in the escrow account, Propy records proof of the wire transfer in the *payment smart contract*. At this point, Propy prepares the *title smart contract* for the closing ceremony for the parties and their escrow and title agents to sign it electronically. The closing team will include the hash –the contract's public address on the blockchain– in the traditional (paper-based) deed of title which is then submitted to the Recorder's Office for recording.

(3) Once the Recorder's Office returns to the buyer a time-stamped copy of the deed of title, Propy itself registers this information in the *deed smart contract* at the *Propy Blockchain Registry*.⁹⁶

⁹⁵ Miller (n 81).

⁹⁶ Propy Team (n 78); Alexander Voloshyn, 'First Government Sanctioned Blockchain Recorded Real Estate Deal in the US' (*Propy*, 21 March 2018)

Analysis of the workflow of smart contracts from step one suggest that it is conducive to exclusive recording of the personal (*in personam*) contractual process on the blockchain but priority is not gained relative to the blockchain date—the priority rule in place for courts to enforce adjudication of real (*in rem*) property rights. Acquiring priority is left to the off-line, traditional public system: parties will gain priority according to the date of filing the request of recordation at the Recorder’s Office.

In this regard, and working towards deploying a truly blockchain-based P2P recording system—stage four of the Propy Registry DApp—Propy has taken two actions: one, it is campaigning to raise awareness about blockchain technology and pushing for a more blockchain-friendly legal framework. As a consequence, two, it tested stage one of its blockchain-based solution in South Burlington, Vermont.⁹⁷

Propy’s lobbying activities have been fruitful in Vermont. The General Assembly has enacted new legislation supporting blockchain technology. So far, two acts in particular affect land conveyancing and property rights: firstly, Act 157 modified legislation regarding rule of evidence in order to include blockchain records as admissible to prove ‘(1) contractual parties, provisions, execution, effective dates, and status; (2) the ownership, assignment, negotiation, and transfer of money, property, contracts, instruments, and other legal rights and duties’.⁹⁸ Secondly, Act 205 mandates public services –including the Vermont Municipal Clerks’ and Treasurers’ Association– to assess and report to the General Assembly on the use of blockchain technology for managing and storing land records by January 15th, 2019.⁹⁹

<<https://blog.propy.com/first-government-sanctioned-blockchain-recorded-real-estate-deal-in-the-us-bb83e8292a7f>> accessed 5 July 2018.

⁹⁷ Mauricio Guitron, ‘New Blockchain Law Passed in Vermont Following Propy’s Successful Title Registry Project’ (28 August 2018) <<https://www.businesswire.com/news/home/20180828005249/en/New-Blockchain-Law-Passed-Vermont-Propy%E2%80%99s-Successful>> accessed 2 October 2018; Propy Team (n 78).

⁹⁸ House Committee on Commerce and Economic Development, An Act Relating to Miscellaneous Economic Development 2016 [H.868 (Act 157)] 119.

⁹⁹ Sen. Alison Clarkson, An Act relating to Blockchain Business Development 2018 [S.269 (Act 205)].

Consequently, Propy’s blockchain-based solution within such a legal framework makes the land conveyancing contractual process stored on blockchain records legally binding for parties, and those records can be used as evidence in a court of law, i.e., personal contract (*in personam*) rights exchanged on the blockchain are now legally safeguarded in Vermont. In Cook County, however, the law did not cover real estate conveyancing on the blockchain, so the CCRD considered that, if this type of conveyancing were to be performed, the Confirmation Deed was to be used as the valid legal instrument to be submitted to the Recorder’s Office for recording the transaction. Nevertheless, and as in the Cook County case, real property (*in rem*) rights in case of dispute are still determined and allocated by courts based on the priority rule and the Recorder’s Office is still the only valid source of proof of title...at the time of writing.

These arguments are consistent with the facts. Propy, given Vermont’s blockchain-friendly legal environment, conducted a pilot with the cooperation of a register, the City Clerk’s Office in South Burlington. The pilot consisted of submitting a title deed of a real estate transaction conducted on the Propy transaction platform for recording at the City Clerk’s office—this corresponds to the abovementioned stage one in Propy’s deployment strategy.

From the perspective of the register, the novelty resided on the written content of the submitted paper-based deed of title: it included the conveyancing contract’s public address on the blockchain, and the City Clerk’s office considered it a valid deed and proceeded to timestamp it, *anchoring* information produced on the blockchain system in the public recording system.¹⁰⁰ South Burlington’s City Clerk, Donna Kinville, considers that implementing the other three stages in Propy’s deployment strategy, especially stages three and four, may face some problems. She highlights two reasons: one, it is still unclear that implementing Propy’s blockchain-based software would reduce costs; and two, the law does not yet allow the acceptance of electronically filed deeds.¹⁰¹ The official report from Vermont State concurs on questioning

¹⁰⁰ Voloshyn (n 96).

¹⁰¹ Miller (n 81).

the benefits of implementing blockchain for managing land records not only for economic reasons—whether such a big investment in the new technology would pay off—but also for the risks it may pose for the long-term survival of the land record public system. The report points out some unsolved questions regarding the adoption of blockchain technology: whether access to and use of stored records is granted if the blockchain-based solution is removed or switched to another type of solution or technology; whether the blockchain technology can produce valid evidence; what impact will remain for the land record public system in the event blockchain technology becomes obsolete.¹⁰²

At the time of writing, Propy is simply a private real estate conveyancing solution—not a public institution. It may add some degree of publicity to the conveyancing transaction due to its underlying blockchain technology—the cost of accessing it is knowing how to use a blockchain explorer as in the Velox.RE solution. But it does not confer the status of evidence of title. Proof of title is still the Recorder’s Office competency.¹⁰³

Conversely to the title deed tokenization solution from Cook County’s pilot, Propy’s smart contract solution records on the blockchain information about the parties, the transacted land, and all the steps parties have undertaken during the contracting process.¹⁰⁴ Consequently, this solution makes it possible to track parties’ actions

¹⁰² Vermont State Archives and Records Administration Office and others, ‘Blockchains for Public Recordkeeping and for Recording Land Records’ (Vermont Secretary of State 2019) White Paper <https://www.sec.state.vt.us/media/914631/blockchains_for_public_recordkeeping_white_paper_v1.pdf> accessed 16 May 2019.

¹⁰³ For an example of a Recorder’s Office involvement for granting title deed after a real estate transfer closed through Propy’s blockchain platform, see Vtblockchainlawblog, ‘Gravel & Shea Completes Vermont’s First 100% Cryptocurrency Real Estate Transaction on the Blockchain’ (*Vermont Blockchain Law*, 30 January 2019) <<https://vtblockchainlawblog.com/2019/01/30/gravel-shea-completes-vermonts-first-100-cryptocurrency-real-estate-transaction-on-the-blockchain/>> accessed 6 May 2019.

¹⁰⁴ For an explanation of the difference between the token system and smart contracts, see *supra* 3.3.2.A point (3) *Type of transaction logic*. For an example of the difference see *supra* footnote 67

and agreements –parties’ consent– throughout the whole contractual process. This means that, in case of a contractual dispute, as long as it can be proven that records have not been subject to manipulation, and legislation confers them legal value (as in Vermont), some within-parties leverage might be gained for the party that has a prior, time-stamped conveyancing contract on the blockchain.¹⁰⁵

However, even between parties, it is still only the court that, when solving a dispute, can ultimately decide on the value of such blockchain records as proof of contractual agreement and as long as the law recognizes such records and contracts conducted on the blockchain as legally binding. In any case a third party is only affected by the public registry’s records.

In summary, *Propy’s real estate conveyancing solution* merely shifts trust on the identification of the traded asset, the parties and ensuring parties’ commitment from traditional closing agents to a blockchain-based one. So,

(1) Propy’s real estate conveyancing solution does not eliminate intermediaries, but just adds one more to the land conveyancing services industry. This, at best, allows for increased coordination and traceability of the land conveyancing process and, at worst, if network economies are exploited, shifts monopolistic power to Propy, the newcomer.¹⁰⁶

¹⁰⁵ The robustness of Ethereum’s solution –and smart contracts and any other type of entity running on it– is in question after several hacks. Evidence points to smart contracts being the weak point in Ethereum’s blockchain solution, making it vulnerable to tampering: ‘it has become clear that smart contracts are prone to errors, bugs and other catastrophic mistakes—to the tune of more than a billion dollars stolen in smart contract hacks to-date’ Rachel Wolfson, ‘Smart Contracts on Steroids: Solving the Problems Facing Ethereum’s Solidity’ (30 July 2018) <<https://hackernoon.com/smart-contracts-on-steroids-solving-the-problems-facing-ethereums-solidity-a1f71cc260ce>> accessed 14 September 2018. Also see New Alchemy, ‘A Short History of Smart Contract Hacks on Ethereum’ (*Medium*, 8 February 2018) <<https://medium.com/new-alchemy/a-short-history-of-smart-contract-hacks-on-ethereum-1a30020b5fd>> accessed 14 September 2018.

¹⁰⁶ Michael L Katz and Carl Shapiro, ‘Systems Competition and Network Effects’ (1994) 8 *Journal of Economic Perspectives* 93.

(2) Although transparency may be increased, it is unclear whether total transaction costs are reduced. Propy charges a percentage of the final purchase price for its services.¹⁰⁷

(3) It is not clear that this type of blockchain-based solution is reliable. Ethereum and smart contracts technology show coding weakness. Hacking or taking advantages of bugs in the smart contract code have been the most common ways of committing fraud in this type of blockchain solution, so transactional risks and costs are pushed up.¹⁰⁸

As for *Propy's P2P blockchain-based registry*, from a sequential exchange perspective, four comments need to be made.

First, in addition to needing a monopoly to be granted, Propy's solution would still pose a problem. Of all property rights a legal system may recognize, it deals exclusively with transfers of ownership. It reduces the range of property rights a register usually handles, leaving the rest of land property rights either uncovered or creating the need to keep two registries instead of one to maintain the same level of protection. Nonetheless, Propy aims to provide the *in rem* type of enforcement.

Second, it puts the emphasis on determining title ownership the first time a piece of land is conveyed and registered on Propy. The first land conveyancing transaction would combine on-line and off-line conveyancing services, as already explained for stage one of the blockchain-based recording system implementation, but assumes that, once the Propy Registry DApp recognizes someone as the owner, that person holds title ownership impervious to third parties acquiring title through rightful claims based on other real property rights that do not require title owner's consent or property conveyancing.

This assumption, ingrained in the design of the P2P system, may lead—as in the Cook County case—to a situation where, according to the P2P system's stored records, a person is the title owner and is allowed to convey the property on the blockchain but in reality, in the non-digital world, that person has lost ownership and someone else is the

¹⁰⁷ Propy Team (n 78).

¹⁰⁸ See *supra* note 105 and accompanying text, on Ethereum's and smart contracts' robustness problems.

rightful owner. Therefore, information asymmetries regarding land title will increase, as well as market risks and transaction costs. In the long run, it is possible that information on the blockchain do not match reality at all.

Third, the need for monopolistic competencies for full deployment of Propy's P2P solution poses the issue of under which system land property rights other than ownership can be exchanged while awarding them *in rem* effects. If Propy is the sole land title institution in place, the value of land as collateral is damaged. For example, lenders' *in rem* enforcement in case of mortgage default would be non-existent.

If Propy coexists with a public register, assuming Propy keeps the monopoly over registering ownership rights, there could be contradictory chains of titles. This is because, as already mentioned, ownership can be acquired by legal means other than conveyancing but updating information on changes in ownership depends on the willingness of the party that loses ownership rights. This situation increases transaction costs as, for example, it requires the buyer to check two land registries in order to compile all public information on land property rights that may burden his/her title.

Fourth, Propy's goal is for a legal environment that allows public registries presently entitled to manage land records and provide title evidence for third parties' protection to be replaced by its P2P blockchain-based system.¹⁰⁹ If this replacement were to occur, it would mean changing a public entity for a private one.

This change involves trading the guarantee of an impartial third party to the transaction provided by the public institution for services provided by a private intermediary with vested interests in the transaction. The latter would not only have its own private agenda but also a stake in the transaction itself because its income depends on closing and recording land transactions. Therefore, the land title system would be weakened, creating negative externalities for third parties holding property rights to the transacted piece of land, and, in general, for the society by increasing uncertainty and information asymmetries.

¹⁰⁹ Propy Team (n 78) 10.

If such negative externalities are so big enough that the collective fiat is placed at risk, it may be advisable and cost-efficient to grant entitlement inalienability to public institutions to protect land property rights, as Calabresi and Melamed suggest.¹¹⁰

3.5 Empirical analysis: application in registration of rights

Both types of land registry, registries of rights and recording of deeds enable the enforcement of *in rem* property rights. However the due process to achieve this enforcement is different. As mentioned in section 3.4, the recording system rests on checking *ex-ante* only that the submitted instruments fulfill the established legal requirements necessary to provide public notice to private contracts. However, if disputes over contradictory chains of title arise, they will be settled *ex-post* before a court. Conversely, the registry of rights system rests on gathering parties' consent to exchange property rights and updated information on the property rights themselves as well as the right-holder's identity. To achieve this, the registrar purges contradictory property rights *ex-ante*. Thus the registered right-holder acquires indefeasible title.¹¹¹

This system requires the registrar to gather consent not only from the parties carrying out the private transaction but also from any third parties holding property rights that may be affected in any way by the new private contract submitted for registration. Furthermore, the registry of rights safeguards everyone's interests even those of parties

¹¹⁰ See Guido Calabresi and Douglas Melamed, 'Property Rules, Liability Rules, and Inalienability: One View of the Cathedral' (1972) 85 Harvard Law Review 1089, on inalienable entitlements and their economic efficiency related to externalities affecting third parties.

¹¹¹ Indefeasibility of title implies that the good faith buyer keeps the acquired property right if the transaction was conveyed upon registrar's information. For an introduction to indefeasibility and the extent of its regulation in countries with a Torrens system, see Kelvin FK Low, 'The Nature of Torrens Indefeasibility: Understanding the Limits of Personal Equities' (2009) 33 Melbourne University Law Review 205; Pamela O'Connor, 'Deferred and Immediate Indefeasibility: Bijural Ambiguity in Registered Land Title Systems' (2009) 13 Edinburgh Law Review 194.

not directly involved in the transaction. Thus, registration can be considered a quasi-judicial process for which the registrar must remain neutral and independent from all parties, hence, the need for territorial monopoly and centralization.¹¹²

As in recording, registries of rights apply the priority rule, “first in filing for registration, first in right”. Unlike the recording system, if title disputes arise or errors in the registration process are detected and claims are brought before a court, the registry of rights system usually applies the liability rule. That is, assuming the registrar has performed due diligence and, thus, has purged any contradictory property rights *ex-ante*, the good faith buyer acquires indefeasible title. If, subsequently, the seller’s consent or the registrar’s actions are proven defective, courts will protect the good faith buyer, allowing him/her to keep title of the property right, and will grant the damaged claimant the right to pursue liability against the seller and/or the registrar.

At the time of writing, there are two initiatives designed for registries of rights. The first one is a public initiative from the Georgian Government partnered with technology developer Bitfury. The second, in Sweden, is a private initiative from a consortium of entities, including the Lantmäteriet –the Swedish land registry–, with ChromaWay as the technology developer. Both initiatives are designed for storing information –there is no tokenization of real estate– and are kept under the control and governance of the already established public registry of rights. However, they differ in the purpose of the use of the blockchain-based system. Georgia publishes in the public Bitcoin blockchain “snapshot hashes” of the title certificate as a means of controlling for institutional corruption; whereas Sweden uses a private permissioned blockchain solution to store information pertaining to the conveyancing and registration processes of transacting ownership rights.¹¹³

¹¹² Arruñada, ‘Property Enforcement as Organized Consent’ (n 4); Arruñada, *Institutional Foundations of Impersonal Exchange* (n 4) ch 2.

¹¹³ Giulio Prisco, ‘Bitfury, Republic of Georgia Push Ahead With Blockchain Land-Titling Project’ (*Bitcoin Magazine*, 8 February 2017) <<https://bitcoinmagazine.com/articles/bitfury-republic-georgia-push-ahead-blockchain-land-titling-project/>> accessed 21 August 2018; Marcus Kempe, ‘The Land Registry in

3.5.1 Georgia

The National Agency of Public Registry (henceforth NAPR) is the entity in charge of the Public Registry in Georgia and it is placed under the Ministry of Justice.¹¹⁴ The NAPR was created in 2004 to fight corruption and to work towards increasing clarity, transparency, more efficient registration processes and a self-financed organization.¹¹⁵ The Public Registry is organized as a set of six different registries among which there are three that handle data on land property rights: the Registry of Immovable Property Rights, the Registry of Tax Liens/Mortgages and the Registry of Public-law Restrictions.¹¹⁶

The Georgian land property rights system is affected by at least three problems: (1) misalignment between the legal configuration and NAPR's practices; (2) unreliable cadaster information and corruption; (3) parties' *ex-ante* uncertainty of *in rem* enforcement.

Firstly, there is a gap between how the public registry of property rights is conceived by Georgian law and how the NAPR conducts the registration of land property rights in practice. According to the law, in Georgia the existing land title system is a registry of rights. Information related to land property rights contained in the public registry enjoys the legal presumption of accuracy.¹¹⁷ Hence, theoretically, a good faith third party acquiring property rights from the registered right holder is protected against inaccurate records even if inaccuracy is proven and the record is subsequently declared null and void with the usual exceptions to good faith, that is, the buyer knows that the seller cannot convey the land property right or there is already a claim against the registry's

the Blockchain - Testbed' (2017)
<https://chromaway.com/papers/Blockchain_Landregistry_Report_2017.pdf>
accessed 5 July 2018.

¹¹⁴ Law of Georgia on the Public Registry 2008, Art. 1.

¹¹⁵ Penelope Fidas and Jim McNicholas, 'Need Land Administration Reform? Start a Revolution' (World Bank, Celebrating Reform 2007).

¹¹⁶ Law of Georgia on the Public Registry (n 114), Art. 10.

¹¹⁷ *ibid*, Art. 5.

records accuracy.¹¹⁸ The presumption of accuracy of the registry is complemented with a presumption of the seller's ownership, i.e., the acquirer enjoys *in rem* enforcement of ownership rights as long as the seller is registered as the owner in the public registry, even if the acquirer knew at the time of the transaction that ownership was under dispute.¹¹⁹

However, in practice, all registries are under NAPR control. This agency has established the one-stop-shop principle and has decentralized the service by implementing information technologies.¹²⁰ In terms of the registration process, the authorized representative of the public registry has limited review powers and limited professional competence. Therefore, he/she simply controls parties' identities, witnesses parties' signature to the agreement, and checks that the person conveying the right to the buyer is the right-holder according to the registry's digital records. Therefore, the set-up of the Georgian registry of rights, compared to the general characterization provided at the beginning of this section, not only lacks the involvement of specialized registrars on land property rights to perform *ex-ante* purging but also leaves the

¹¹⁸ See an introduction to Georgian civil law on good faith and immovable property, Tamar Zarandia, 'Purchase of Immovable Property in Good Faith from Unauthorized Seller Per Georgian Case Law' [2016] *Studia Universitatis Moldaviae - Științe Sociale* <<http://ojs.studiamsu.eu/index.php/social/article/view/590>> accessed 18 November 2018.

¹¹⁹ Article 185 of the Civil Code of Georgia recognized this presumption of ownership. It was declared unconstitutional by judgment of the Georgian Constitutional Court on 17 October, 2017, "The Citizen of Georgia Nodar Dvali v. The parliament of Georgia" (Constitutional Complaint N550), Constitutional Court of Georgia, 'Information on Constitutional Justice in Georgia 2017' (Constitutional Court of Georgia 2018) Annual Report <www.constcourt.ge/en/ajax/downloadFile/3714> accessed 15 December 2018.

¹²⁰ NAPR is the sole registration body that services all Georgian public registries. There are 6 of them: 'The Public Registry is a set of the Registry of Immovable Property Rights, the Registry of Public-law Restrictions, the Registry of Tax Liens/Mortgages, the Registry of Movable and Intangible Property Rights, the Registry of Entrepreneurs and Non-entrepreneurial (Non-commercial) Legal Entities, and the Address Registry' Law of Georgia on the Public Registry (n 114), Art. 4.1.

parties to shoulder the responsibility derived from the content and validity of the agreement.¹²¹

Secondly, cadaster information is unreliable and is affected by corruption. In Georgia two types of documents are equally valid –in theory– for submission for the registration of land property rights transactions: the paper-based or the electronic version of the cadaster drawings. These two versions of cadaster drawings are based on two different methods of measurement: the paper-based version provides the shape and the area of the plot using the longitude and latitude method whereas the electronic version gives the exact location thanks to satellite data using the coordinates system and was compiled in 2010. These two versions were never reconciled into a single one, leaving title owners to face situations in which their paper-based cadaster drawings could differ from the electronic version to the extent that land plots may overlap. Operating simultaneously with these two versions of the cadaster data to be submitted at the registry as valid identification of a parcel of land has brought uncertainty to the system and, in some cases, has deprived landowners of their original property, given that the digital version of the cadaster registered the land under someone else’s legal name, often that of the state.¹²²

What is more, apparently the NAPR has not been purging contradictory property rights surfacing from comparing both versions when new transactions were filed for registration. In practice, it has seemingly been relying prominently on the electronic version. If ownership disputes originated by these disparities were brought before a court, judges have usually focused their decisions on the registry’s compliance with the registration process, finding NAPR’s control duties fulfilled if there is inter-compliance of electronic records, even if such a

¹²¹ Papuna Ugrehelidze, ‘Using Blockchain in Georgia’, *Land Governance in an Interconnected World. Annual World Bank Conference on Land and Poverty* (2018) <https://www.conftool.com/landandpoverty2018/index.php?page=browseSessions&form_session=653&presentations=show> accessed 24 February 2018; Zarandia (n 118).

¹²² Association Green Alternative and others, ‘Stripped Property Rights in Georgia (Third Report)’ (2012) <https://www.transparency.ge/sites/default/files/post_attachments/StrippedPropertyRights_April2012_Eng_0.pdf> accessed 18 November 2018.

practice has no legal backing. In cases where the original owner from the paper-based cadaster filed for ownership before a court and saw the claim granted, he/she was still left with an *in personam* enforcement of the right, because the system granted *in rem* rights to the good-faith acquirer due to the abovementioned legal presumption of ownership in place in the Georgian legal system.¹²³

Thirdly, from an evidentiary perspective, parties face uncertainty on the extent to which the registry's records constitute legal evidence for the courts to adjudicate title claims and enforce *in rem* rights. The 2017 judgment of the Georgian Constitutional Court declaring unconstitutional the presumption of ownership changes the legal landscape and can be expected to impact the court's *in rem* adjudication of property rights. According to the tribunal, the law was introducing imbalanced protection of property rights when, even in the case of a dutiful owner defending his/her rights before a court, this owner could be damaged by the status of good faith acquirer being conferred on the buyer who, when acquiring property rights from the registered owner, knows or could know—if due diligence is conducted—that ownership is being disputed either by an administrative claim at the registry office or by a civil claim before a court. Conferring the status of good faith acquirer to the buyer under these circumstances would render ineffective the protection of ownership rights if the dispute is solved in favor of the unregistered party.

Hence, after the Constitutional Court's judgment, for a 'conscientious acquirer' to hold good title of the real property right, they need not only to check the registry's information but also to search if ownership is being disputed before a civil court that could alter the registry's records—and they must be able to prove their due diligence—or bear the risk if the registry's entry is ever declared null and void.¹²⁴ This sentence introduces uncertainty to the impersonal exchange of

¹²³ This is the case of Mr. Nodar Dvali who ended up filing a complaint with the Constitutional Court. These NAPR practices and courts' tendencies to solve this type of disputes are described in the report 'Stripped Property Rights in Georgia' (ibid.)

¹²⁴ Constitutional Court of Georgia (n 119).

property rights since a registered right holder who acquired it on good faith would not necessarily see their rights enforced *in rem* by the court. A judge would decide on *in rem* enforcement of property rights not only based on the registry's records but also based on the good faith acquirer being able to produce proof of due diligence at the time of the transaction. The problem is that legal criteria for proving the acquirers' conscientiousness are yet to be clearly defined.¹²⁵ In sum, in case of a dispute, claiming parties face high uncertainty regarding the evidence that a judge would consider as sufficient proof for allocating ownership and regarding which party would be granted *in rem* enforcement.

In order to address these problems, in 2016, NAPR partnered up with technological developer BitFury.¹²⁶ They aim to both increase security and safety of the registry's information and to use Bitcoin as a backup of the original documents—seeking to benefit from the advantages this blockchain may offer.¹²⁷ BitFury's solution combines the use of a customized permissioned blockchain—based on BitFury's Exonum framework—and the use of a public permissionless blockchain, Bitcoin, by *anchoring* Exonum to Bitcoin. In this case it is the information about the hash generated at the property registry that is published, i.e. anchored, in the public blockchain. Any differences between information stored in NAPR and Bitcoin would indicate that documents had suffered alterations at the registrar's office, assuming the blockchain has not been tampered with.

¹²⁵ The Constitutional Court in its sentence did not set the criteria for due diligence when searching for possible claims filed against the registry's records. Criteria in past sentences range from considering it proven if there is no passive knowledge of a claim to showing that an exhaustive search has been conducted. See Benjamin Paine and Mary Kopaleishvili, 'Constitutional Court Sets out New Standard for Purchase of Real Estate in Georgia' (*International Law Office*, 9 February 2018) <<https://www.internationallawoffice.com/Newsletters/Real-Estate/Georgia/Paine-Stevens-LLC/Constitutional-Court-sets-out-new-standard-for-purchase-of-real-estate-in-Georgia>> accessed 19 November 2018.

¹²⁶ Ugrekhelidze (n 121).

¹²⁷ Exonum Team, 'What Is Exonum - Exonum Documentation' <<https://exonum.com/doc/get-started/what-is-exonum/>> accessed 5 July 2018; Graglia and Mellon (n 13).

The blockchain-based solution implemented partially helps to solve the abovementioned problems. On the one hand, since Georgia's land title system is, in practice, closer to recording of deeds than to a registry of rights, the solution suits the purposes of performing the little *ex-ante* controls the NAPR requires for the information to enter the registry and for recording chains of transactions of property rights. On the other hand, since it uses the Bitcoin blockchain as a back-up of the registry's records, the solution helps to control corruption within the registry.¹²⁸ It allows property right-holders to be warned of any change in the records due to collusive activity performed by the registry's authorized personnel and, for the time being, at low cost.¹²⁹ The blockchain-based design seems to fit the promoters' view of the blockchain technology as the solution for improving or replacing badly-managed –or even corrupt– land title records.¹³⁰ However, this view of the technology as a remedy for fraud has been questioned.¹³¹

¹²⁸ The Georgian public registry services have suffered from internal corruption. See Fidas and McNicholas (n 115); Association Green Alternative and others (n 122).

¹²⁹ Citizens are charged a fee as they were before the blockchain-based solution was deployed. In terms of costs, the operational costs are estimated to have decreased by 90% and the registration process takes one day instead of three. However development costs are still unknown (David Alessie, Maciej Sobolewski and Lorenzino Vaccari, 'Blockchain for Digital Government' (Publications Office of the European Union 2019) EUR - Scientific and Technical Research Reports <<http://publications.jrc.ec.europa.eu/repository/handle/111111111/55890>> accessed 25 May 2019.) Notwithstanding, these costs were covered by the technology developer as per the agreement between the Georgian government and BitFury, as of April 2018 (Nata Goderdzishvili, Eka Gordadze and Nikoloz Gagnidze, 'Georgia's Blockchain-Powered Property Registration: Never Blocked, Always Secured: Ownership Data Kept Best!', *Proceedings of the 11th International Conference on Theory and Practice of Electronic Governance* (ICEGOV '18, 2018) <<http://doi.acm.org/10.1145/3209415.3209437>> accessed 18 November 2018.)

¹³⁰ De Soto declared that: 'I have dedicated my life to improving access to capital, and our work in the Republic of Georgia is the first in a series of many important steps to bringing corruption-proof digital systems to all' (Prisco n 108).

¹³¹ 'Conferring oversight of the blockchain registration process on the registration authority does not assure complete protection from fraud or misuse' Lemieux, Flores and Lacombe (n 39) 24.

Nonetheless, whether the land title institution relies on a blockchain-based system does not address the main issue. The weakness of the Georgian system relies on the rule of law along with the presence of an unspecialized registry of land property rights which grants *in rem* adjudication of rights relying on a mere recordation process –which may still be tainted by corrupt practices– and whose operating digital records have not been purged.¹³² As a result, impersonal exchange of property rights faces too many uncertainties –the 2017 judgment of the Georgian Constitutional Court being the latest case– that drive up transaction costs on the real estate market.

The Georgian blockchain-based solution is similar to the CCRD’s repository of ‘paperless Certified Digital Files’. The CCRD solution makes it possible to verify on the public blockchain, Bitcoin, that the certified content of the record has not been manipulated after its issuance. However, it is the reverse of the Propy solutions in which it is the hash from the conveyancing smart contract generated on a public blockchain, Ethereum, that is entered in the Recorder’s office by writing it on the (paper-based) deed of title produced by the blockchain platform to be filed for recording.

3.5.2 Sweden

The project for the Swedish land registry of rights, Lantmäteriet, is a private initiative from a consortium of private and public entities, including the land registry itself. The project has designed a blockchain-based solution for both the registry of land property rights—for registering transfers of ownership rights—and the registry of mortgage deeds—for mortgage deed processes—as the Swedish system keeps mortgages in a registry separated from the rest of land property rights. I

¹³² As the facts presented before the Tbilisi City Court by a group of citizens in a claim against the state suggest. The Court ruled in favor of the group of citizens and confirmed that ‘property rights may not be restricted on the grounds that the cadastral map has been registered as a paper document’ Oliko Shermadini, ‘Land Rights in Georgia: The Stench of Corruption’ (*www.transparency.org*, 26 April 2017) <https://www.transparency.org/news/feature/land_rights_in_georgia_the_stench_of_corruption> accessed 31 March 2019.

will focus my analysis on the former, the registry of land property rights. ChromaWay is the technological partner.

The blockchain-based solution relies on a private permissioned blockchain—PostChain—that employs smart contracts—Esplix—to record the contracting workflow process.¹³³ Hence, access is restricted to a group of trusted and authorized parties who enter and validate transactions. It records information exclusively about parties' consents to contractual agreements and the transaction process. Thus, at the time of writing, it does not contemplate the use of bearer instruments, i.e., there is no tokenization of ownership title like the Velox.RE proposal or Propy's 'deed smart contract'.

This solution, in essence, develops a unified blockchain-based platform for the land conveyancing market and the registry of land property rights. Land buyers would be able not only to complete the conveyancing contractual process—transfer of *in personam* rights—but also to file for registration of the acquired land property rights—transfer of *in rem* rights. According to the developers, the late involvement of the registry in the real estate conveyancing process is one of the reasons behind the length of the registration process.¹³⁴

The proposed design fits the conceptual solution of a business-to-government (henceforth B2G) platform and fulfills the 'compliance by design' principle; i.e., it enables a trust-based relationship between the private agents operating in the land conveyancing market and the public registry of land property rights built on their overlapping interests—

¹³³ PostChain is a permissioned technical ecosystem that combines enterprise database and a private permissioned blockchain. Esplix is a smart contract enabled workflow middleware. ChromaWay, 'ChromaWay Platform' <<https://chromaway.com/platform/>> accessed 5 July 2018.

¹³⁴ Kempe (n 113) 15.

'Lantmäteriet is only involved in a few steps at the end of the real estate transactions. As a consequence of this the majority of the process is not transparent, in other words, visible to the public or other stakeholders. The system is slow at registering real estate transactions. The time between the signing a legally binding purchasing contract and when Lantmäteriet receives the bill of sale and makes the approval of the title is often three to six months'

especially transparency and information quality, registrar's control over parties' compliance when exchanging *in rem* rights, shortening the length of the process—which ultimately would benefit the land property right-holder.¹³⁵

All in all, Lantmäteriet's intervention is still required on the B2G platform under this design of the blockchain-based solution. The registry not only maintains its review powers but adapts its control powers to the technological requirements. The registrar: (1) controls who can enter the system and validate transactions on the blockchain; (2) is responsible for connecting the digital representation of the land property right transferred by the smart contract with its off-line –real world– version;¹³⁶ (3) can verify if everybody's consent has been gathered –by recording the contracting workflow that parties involved in the transaction have gone through, even that of third parties holding property rights that might be affected by it–; (4) manages the registration of property rights. This is crucial in a registry of rights, since registrars need to be able to purge *ex-ante* any contradictory property rights and, if need be, to register real property rights in favor

¹³⁵ 'Compliance by design' is studied in the field of Business-to-Government (B2G) information exchange, a branch in the electronic government literature. A B2G platform supports interactions at both levels, B2B and B2G, while aiming for a lean process –increasing information quality and levels of efficiency, decreasing compliance costs and redundancy of controls and data requests, even to allow for automated reconciliation of data or validation of transactions–. See Nitesh Bharosa and others, 'Tapping into Existing Information Flows: The Transformation to Compliance by Design in Business-to-Government Information Exchange' (2013) 30 Government Information Quarterly S9; Bram Klievink, Marijn Janssen and Yao-Hua Tan, 'A Stakeholder Analysis of Business-to-Government Information Sharing: The Governance of a Public-Private Platform' (2012) 8 International Journal of Electronic Government Research (IJEGR) 54. On the challenges and requirements of designing a blockchain-based B2G platform for a Customs agency, see Sélinde van Engelenburg, Marijn Janssen and Bram Klievink, 'Design of a Software Architecture Supporting Business-to-Government Information Sharing to Improve Public Safety and Security: Combining Business Rules, Events and Blockchain Technology' [2017] Journal of Intelligent Information Systems <<http://link.springer.com/10.1007/s10844-017-0478-z>> accessed 8 April 2019.

¹³⁶ 'Lantmäteriet guarantees which digital representation a specific property has' Kempe (n 113) 38.

of a third party even without the consent of the registered property right-holder as in the event, for example, of a judicial sentence that solves a dispute between parties over an inheritance. At the time of writing, however, the solution only contemplates conveying ownership rights—and mortgages that are handled by a separate registry of mortgage deeds. Registration of any other real property rights must be requested at the registrar's office.¹³⁷

In sum, the Swedish blockchain-based solution exhibits high levels of compliance with the existing rules of evidence since they are embedded in the architectural design—a cornerstone of the B2G platform philosophy. Compared to the Velox.RE and Propy solutions, there is no tokenization of land property rights, just a digital reference representing an off-line property right whose identification is kept among the registrar's competencies, i.e. controlled by a public institution instead of a private firm, such as Velox.RE and Propy. It also differs from the CCRD and Georgia solution of using a public blockchain as a back-up repository of title documents, since on the one hand the blockchain is private and, on the other, the information stored on the blockchain is related to the contracting workflow and transactions, not digital versions of certification of titles.

From a sequential exchange perspective and although the emphasis is on compliance, the design of this blockchain-based solution has two weak points: it deals with transfers of ownership rights and it relies on 'pending' property titles.

Firstly, as mentioned above, the blockchain-based solution just deals with transfers of ownership rights and –from the report of the project– it seems that registration of such transfers of ownership rights must be preceded by a conveyancing process. The implications for the registry are that the blockchain-based system has been designed: a) at the cost of having partial information available; and b) at the cost of denting the

¹³⁷ Kempe (n 113).

‘mirror principle’ underpinning the indefeasibility of title guaranteed by the system of registry of rights.¹³⁸

To acquire complete information regarding land property rights, parties must file a request with the registry to know whether there are other caveats, easements, or property rights affecting said title ownership.¹³⁹ In practice, parties have to process two requests, instead of one, at the registry of rights. Thus, presumably, transaction costs can be expected to increase because filing two requests for information on land property rights over one piece of land with the registry would be costlier than filing just one.¹⁴⁰

Furthermore, the registrar would incur coordination costs to ensure that registry records comply with the ‘mirror principle’, i.e., the registrar keeps both the existing lodge and the blockchain-based one purged and updated since changes in one could be contradictory with property rights registered in the other –as when, for example, ownership of a piece of land is granted to a third party by executing a judicial sentence or an inheritance instead of being conveyed through a sale on the blockchain-based platform–.

Secondly, the unification of sources of information thanks to the B2G platform to perform both the *in personam* –land conveyancing – and the *in rem* –registration– exchange of property rights brings with it the appearance of the ‘pending property title’ category in the registration process. According to the project’s report, once parties have reached a purchase agreement, they can share the contract with the registry ‘which registers the pending property title at no cost until the

¹³⁸ The ‘mirror principle’ requires the registry of rights to act as a mirror reflecting accurately and completely all registered property rights. Theodore BF Ruoff, *An Englishman Looks at the Torrens System: Being Some Provocative Essays on the Operation of the System After One Hundred Years* (Law Book Company of Australasia 1957).

¹³⁹ Kempe (n 113).

¹⁴⁰ Although estimations set decreases of transaction time at around 95% and of transaction costs at 90%, operative costs are higher than with the previous centralized solution (Allessie, Sobolewski and Vaccari (n 129)).

final verification record for the transfer (bill of sale) is distributed'.¹⁴¹ At this point, 'the pending title is already granted and the process of verifying the agreement can proceed more quickly through *automated decisions* because the risk of incorrect formulations in the bill of sale is reduced when it is done using digital fields'.¹⁴²

The use of 'pending property titles' carries dubious implications for the system. According to the report, since the information in the blockchain-based system is automatically updated when the parties submit a copy of the purchase agreement, the transaction is registered as 'pending property titles' as long as the seller's identity matches the identity in the blockchain system. Once the parties submit the bill of sale, the 'pending property title' is automatically granted.¹⁴³

If this understanding is correct, and the registrar does not perform any purging process –considering that the blockchain only stores information regarding title ownership and that the report says nothing about how the blockchain-based system handles the updating of registered property rights between the on-line and the off-line lodges of the registry of rights–, it becomes crucial to establish a process to ensure the 'mirror principle' is duly observed, preventing the system from keeping alive two contradictory chains of property rights transactions. Otherwise the system risks becoming closer to recording of deeds than to a registry of rights. It thus falls in the same trap as the Georgian system has.

¹⁴¹ Kempe (n 113) 48.

¹⁴² *ibid* 53, emphasis added.

¹⁴³ *ibid* 46, 48, 51, 53.

3.6 Concluding remarks

From a sequential exchange perspective, the analysis of real initiatives applying blockchain technology in land registries points to four common features and four policy considerations. The features:

(1) Blend-in strategy. Blockchain technology has been steadily blended into the existing land title systems. Technology developers have, to some extent, replicated existing land title institutions and their legal processes in the designed blockchain-based system. The most disruptive proposal with the status quo is Propy's P2P Registry, but even its deployment strategy relies on first registration of land titles that have previously met existing legal requirements for clearing title.

(2) Public registries retain competencies, which rules out P2P solutions. While testing the blockchain as a tool for improving their processes and services, land registries have noticed its risks and shortcomings for the impersonal exchange of property rights if it were to replace them altogether; thus, the need for the public institutions to remain operative and retain their monopolistic competencies as a source of evidence.

(3) Focus on ownership transfers. Developers have focused on designing blockchain-based solutions for tracking voluntary transfers of ownership, as if ownership were the only real property right recognized by the legal system and were only conveyed with the parties' consent; they have failed to consider other real property rights encumbering ownership rights and other different legal grounds for transferring ownership. Two reasons could explain this: one, developers see information regarding ownership as the only information that is relevant for parties when engaging in real estate conveyancing agreements; two, blockchain technology has yet to reach a level of development that can deal with the complexity of land property rights. Notwithstanding, the fact that the blockchain-based system only tracks ownership transfers results in either one registry with two lodges –one on-line for ownership, one off-line for the remaining real property rights– or two independent whilst coexisting registries.

(4) Private partnership. So far, all the initiatives have partnered up with a private technology developer. As these private firms have their own agenda and interests –which are not necessarily aligned with those of land property institutions and, ultimately, the public– such initiatives may give rise to vendor-lock-in effects or privatization of public registries. At the very least, pilots have served technology developers as advertisements of their blockchain-based solutions.

More generally, four policy recommendations are in order regarding the potential benefits and disadvantages of implementing blockchain-based systems for land title institutions:

Firstly, assessing blockchain’s capability for exchanging *in rem* rights requires a case-by-case approach. The system architecture of blockchain-based solutions and of land titling systems differs. Consequently, considering whether and how blockchain is capable of exchanging *in rem* rights has to take into account both the specific configuration of the designed blockchain-based system and the specific configuration and performance of the existing land property institution, especially the level of legal security and efficiency it already provides. The cases discussed here suggest that blockchain-based systems may work for conveyancing *in personam* rights but come up against difficulties for the exchange of *in rem* rights.

Secondly, a trusted third party is still needed. Property rights, unlike cryptocurrencies, are not native digital cryptoassets. Consequently, handling off-line assets, such as land property rights, requires parties to trust that –whatever the digital instrument being used to represent the real property right– the link between the on-line representation and the off-line asset is effective, and that the digital instrument is valid. Even if the technology has been labeled ‘trustless’, i.e., it works without users needing to trust any intermediary –which is illusory because ultimately users need to trust the technology and/or that the technology developers behave as promised– there is still the need to trust whoever is in charge of linking the off-line property rights with their digital representation. Hence, implementation of technology for property rights demands the presence of a trusted third-party intermediary. Entrusting this responsibility to a public land title institution would provide the required neutrality for the system to enjoy universal legal effects.

Thirdly, special care should be paid to guaranteeing the ‘mirror principle’ when the system relies on more than one register. Besides managing the digital representation of off-line property rights, the system must also deal with interactions between registers, either because there are two independently operating registries handling different sets of property rights or because a single land registry keeps two lodges, one on-line and the other off-line –the two alternatives being considered by designers at the time of writing. If interactions between the system’s lodges are not clearly established and purged –increasing coordination costs–, there is a risk that contradictory chains of property rights will be kept alive –increasing information asymmetries and, therefore, transaction costs to the point that land would no longer have value as collateral.

Fourthly, the blockchain-based system design must abide by the rules of evidence that are in place. Independent of whether new rules of evidence establishing the legal status of blockchain have to be enacted, what guarantees that land title institutions produce valid title evidence and that parties are legally safeguarded is not blockchain’s enhanced technological features but that the blockchain-based system complies with the law. Gaps between the requirements established by the rules of evidence and those the blockchain-based solution fulfills would introduce risks and increase costs to the land title system –priority uncertainty, decreased quality of stored information affecting the land registry’s capacity to produce valid legal evidence for *in rem* adjudication, thus rendering enforcement of property rights unattainable. In extreme cases, non-fulfillment could end up weakening the nature of the land title institution itself.

Lastly, further research is needed since the overall impact on the structure of transaction costs is yet to be known. At the time of writing, the main limitation is that there is no available data nor enough evidence from the pilots to determine the level and sign of the impact a blockchain-based system for land could have on the transaction costs beyond the possible sources of risks exposed here.

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