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DUALITY IN PROPERTY:
COMMONS AND ANTICOMMONS

Francesco Parisi, Ben Depoorter and Norbert Schulz

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Francesco Parisi

Ben Depoorter

Norbert Schulz

Francesco Parisi[1] - Norbert Schulz[2] - Ben Depoorter[3]

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ABSTRACT: Commons and Anticommons problems are the consequence of symmetric structural departures from a unified conception of property. In this paper, we provide a dual model of property, where Commons and Anticommons problems are the consequence of a lack of conformity between use and exclusion rights. While Commons and Anticommons problems are symmetric in this sense. They are associated with asymmetric transaction costs. The paper formulates a hypothesis of legal rules for promoting unity in property and suggests a list of possible areas of application.

1. Introduction

Law and economics scholars of property law have recently embraced a new term of art: the anticommons. The concept of the Tragedy of the Anticommons, first introduced by Michelman (1982) and then made popular by Heller (1998 and 1999), is a mirror-image – in name and in fact – of Garret Hardin's (1968) well known Tragedy of the Commons.

The concept of the Tragedy of the Commons describes situations where multiple individuals are endowed with the privilege to use a given resource. Because of problems in the effective enforcement of each individual's right of use, the resource becomes vulnerable to a tragedy of overuse.

Symmetrically, in situations when multiple owners hold rights to exclude others from a scarce resource and no one exercises an effective privilege of use, a resource might be prone to underuse: a

[1] Professor of Law, George Mason University School of Law & Co-Director, J.M. Buchanan Center for Political Economy, Program in Economics and the Law.
[2] Professor of Economics & Chair, Economics Department, University of Würzburg (Germany).
[3] Center for Advanced Studies in Law and Economics, Faculty of Law, Ghent University (Belgium) & Olin Fellow, Yale Law School, 2002-03. The authors would like to thank Clay Gillette, Richard Merrill, Richard Posner, Andrew Sellgren and Paul Stephan, III for extremely helpful conversations, comments and advice. Two anonymous referees provided helpful comments. An earlier draft of this article was circulated as UVA School of Law, Law & Economics

problem known as the Tragedy of the Anticommons.

In this paper, we provide a dual model of property, demonstrating that Commons and Anticommons problems are the consequence of a lack of conformity between use and exclusion rights. While Commons and Anticommons problems are symmetric in one sense, as will be argued, the Anticommons problem is associated with asymmetric transaction costs. From these observataions this paper formulates a hypothesis of legal rules for promoting unity in property.

Section 2 further elaborates on the economic concept of anticommons. Because the concept is relatively underdeveloped in economic theory, Section 2 presents a formal model of the anticommons problem, which is analyzed in considerably more detail in Schulz, Parisi, Depoorter (2002). Section 3 will point out the symmetry or dual nature of the concepts of 'commons' and 'anticommons'. In the second part of this section we will demonstate that, the far-reaching symmetry, an idea that was recently put forward by Buchanan and Yoon (2000), exists mainly on conceptual level. In fact, as is demonstrated in Section 3.2., in a world of positive transaction costs there is a substantial asymmetry between problems of Commons and Anticommons. In section 4 we explore possible applications of the concept of anticommons and highlight the relevant policy implications in the choice of rules for minimizing the social cost of non-conforming property arrangements. Section 5 concludes.

2. The Anticommons Problem

In an Anticommons, a property regime in which multiple owners hold effective rights of exclusion in a scarce resource,[4] the coexistence of multiple exclusion rights creates conditions for suboptimal use of the common resource. If the common resource is subject to multiple exclusion rights held by

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[4] This definition of the anticommons employed by Heller (1998) provides a powerful tool for property theory. Heller (1998) recently revitalized the concept in an article on the transition to market institutions in contemporary Russia. He discusses the intriguing prevalence of empty storefronts in Moscow. Storefronts in Moscow are subject to underuse because there are too many owners (local, regional and federal government agencies, mafia, etc.) holding the right to exclude. Frank Michelman (1982) coined the term anticommons in an article on ethics, economics and the law of property. Michelman defined the anticommons as *a type of property in which everyone always has rights respecting the objects in the regime, and no one, consequently, is ever privileged to use any of them except as particularly authorized by others*, a situation which had almost no counterpart in real-world property relations. The hypothetical example provided is that of a wilderness preserve that 'any person' has standing to enforce.

two or more individuals, each co-owner will have incentives to withhold resources from other users to an inefficient level. In the presence of concurrent controls on entry exercised by individual co-owners acting under conditions of individualistic competition, exclusion rights will be exercised even when the use of the common resource by one party could yield net social benefits. The Tragedy of the Anticommons is situated in the fact that common resources will remain idle even in the economic region of positive marginal productivity. This is because the multiple holders of exclusion rights do not fully internalize the cost created by the enforcement of their right to exclude others.

The sources of externalities in an anticommons problem are twofold. First, there are static (or current) externalities, in that the exercise of a right of exclusion by one member reduces or eliminates the value of similar rights held by other individuals. In price theory terms one can think of this externality as the cross price effect of the various exclusion rights. Second, the withholding of productive resources may create dynamic (or future) externalities, because the underuse of productive inputs today bears consequences into the future, as standard growth theory suggests.

It should be noted that there are some interesting similarities between situations of fragmented ownership and situations of joint ownership. In the usual joint ownership situation (e.g., joint ownership of a parcel of land), either owner can exclude, with an effect that may be likened to the anticommons problem of fragmented ownership. This similarity is interesting, considering that, on the face value, joint ownership and fragmented ownership seem opposite. But there are some significant economic differences between joint ownership and fragmented ownership, from the anticommons perspective, which should be anticipated explicitly at this point.

For this purpose, it is important to observe that the model of the "anticommons" is, in its essence, a model of "veto" power.[5] Whenever joint owners are subject to a unanimity rule for deciding on the use of their jointly held property, the veto (i.e., anticommons) problem arises, in spite of the different apparent structure of joint and fragmented ownership. But important differences remain, due to the different incentives of joint versus fragmented owners in the face of a value enhancing

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[5] We can think of the consent of each veto holder as a strict complement (or a fixed-proportion input) in the production of a joint resolution.

use opportunity.[6]

At this point it may be helpful to provide an example that illustrates the above general principles governing the anticommons situations and at the same time provides the foundation of the modeling approach that is further developed in this Article. Let us consider the case of a potential restaurant operator. In order to operate a public restaurant a potential operator needs to obtain a permit from two governmental agencies. The governmental body grants a permit conditional upon the satisfaction of the agency-specific standard. Image that government agent 1's responsibility relates to measures of security (e.g. the prevention of fire hazards, sprinklers, escape doors, etc.). Agent 2 is responsible for enforcing quality and health standards (i.e. the requirement of qualified cooks, separating cooking space and storing space for unprocessed food, health checks of employees, number of toilets etc). To obtain a permit the restaurant owner must fulfill the requirements of both agents. Both agencies thus have a right to exclude. With respect to the specific use of the potential building space they hold a partial property right. Consider further that each agent has some discretion to determine the extent of its requirements. The Agent's discretion also pertains to the extent of the enforcement of its requirements through monitoring etc. Agent I's discretion to exercise its right of exclusion to a varying extent is denoted by y_i. In principle y_i can take values between 0 and $\bar{y}_i$, where $\bar{y}_i$ refers to a level of requirements that would deter any activity in the restaurant business.

Clearly, choosing $\bar{y}_i$ cannot be in the interest of the government, or by that reason, agent i. Never issuing a permit is not a sustainable public policy. It is therefore natural to assume that it is in the interest of the agent to have some restaurants. Indeed the regulatory assignment of each agent may be an appropriate trade off between its requirements and the number of restaurants. Hence, both agents faces a trade off when determining the extent of its requirements. Raising the conditional

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[6] To illustrate, we can think of the different "pricing" incentives of joint and fragmented owners. The decision of joint owners on whether to sell a common resource to a third party -- even if subject to a unanimity rule -- would be very different from the decision of fragmented owners selling, and independently pricing, their respective fragments to a third party. The reason for this difference is quite straightforward. Joint owners, have control on the sale of the joint property, but once the sale to a third party takes place, the revenue from the sale is divided in proportion to their respective shares of ownership. Conversely, fragmented owners price independently, controlling both the feasibility of the global sale to a third party and the distribution of surplus among the various fragmented owners. Absent sustainable price coordination, the equilibrium pricing of the fragmented owners would be different from that of the joint owners. Namely, it will be

requirements improves overall security and reduces health risks but decreases the number of restaurant owners (static effect) and potential applicants for a restaurant permits (dynamic effect).

However, given the fact that a potential restaurant owner needs permits from both agencies the number of active restaurant owners do not only depend on the requirement of one agent but of the cumulative requirements of both agencies. How could an objective function be modeled to capture this trade off? Consider the following function:

$$V_i(y_i, y_j) = (1 - y_i - y_j)y_i \qquad (1)$$

The first term on the right hand side captures the decreasing number of permits, if the requirements of the agents are increased. The second term captures agent i's concern for quality. $\bar{y}_i$ is equal to 1 in this formulation. This function increases at zero, is concave in y_i and has a maximum at $(1-y_j)/2$. Suppose now that $V_i(y_i, y_j)$ is the objective function of agent i.

As it should be particularly clear in the context of the present example, as holders of fragments of property rights both agents can*not* be expected to bargain over the requirements each of them hold as a necessary condition to grant a permit. This holds true for most fragmented property situations. It may hold to a lesser extent in the case of joint ownership as alluded to above. Here we concentrate on fragmented property for which the present example is a prototype. In such a situation the Nash equilibrium of the simultaneous move game defined by the payoff functions V_i is a natural choice to model the decision of the agencies to determine their respective requirements.

At the beginning of this section we stated that the anticommons situation leads to underuse of a resource. Such underuse follows from the excessive exercise of exclusion rights. Now suppose that the preferred regulatory assignment (by society) would be that both governmental agents cooperate. At the limit this would entail that both fragments of property rights (granting of permits) are in one hand. One possible way to formally present this alternative is the societal objective function:
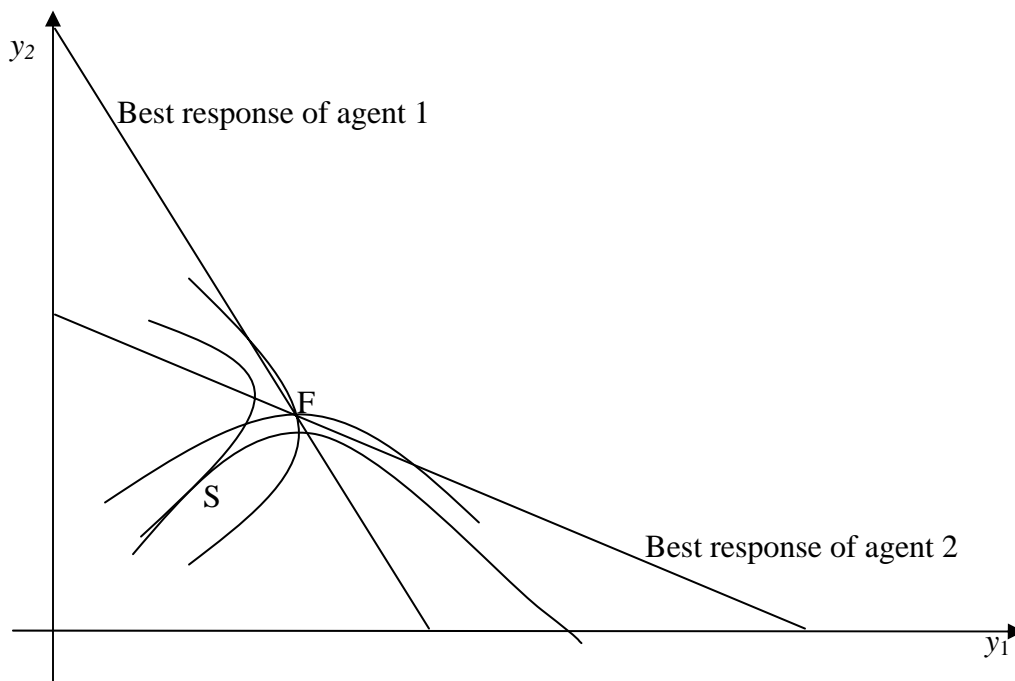
$$V = V_1 + V_2 = (1 - y_1 - y_2)(y_1 + y_2)$$

higher than the joint ownership price, if the fragments are complements, and lower, if the fragments are substitutes.

It is an easy exercise to check that this would imply maximizing choices of y_i that are below the levels of y_i which are implied by the independent choices in a Nash equilibrium. This result can be illustrated in the following figure as suggested by one of the referees of this paper:

As is well known the Nash equilibrium is characterized by the intersection of the best response functions of both players. This point is denoted by F (for fragmented property). The point of the social optimum is characterized by a tangency between the indifference curves of the payoff functions of both players. Due to the fact that these curves bend towards lower levels of the extent of requirements of the other player this point (S) must be below F. Hence the above result.

This result is very robust. As we have demonstrated elsewhere in Schulz, Parisi, Depoorter (2002) the outcome of this model does not depend on the symmetry contained in the modeling of V_i in (1), nor does it depend on the simultaneity of moves or on the number of players.

This result becomes clear once one considers the logic of the argument. What is at stake is a negative externality imposed by one agent onto the other. If one agent increases its requirements it

simultaneously decreases the objective function of the other agent. This negative externality is not accounted for if both agents act independently. Note that our result goes beyond the accepted wisdom that internalization can ameliorate the efficiency if externalities are at stake. The concern of is paper is with the excessive provision of exclusion rights by fragmented property owners, which in general is not the issue of studies of first best optima in this general form.

If one models the public good problem as a contribution game, the basic logic is identical to that of the anticommons. A typical agent will provide less than the optimal amount if s/he is asked independently of the others how much s/he is willing to provide - a typical symptom of the free rider problem. The same problem applies to the problem of the anticommons. By comparison, the anticommons problem is more general than the public good problem[7] (see Schulz, Parisi, Depoorter (2002).

At the beginning of this section we have argued that the anticommons problem relates to neglected positive externality when owners of fragmented property rights decide independently of each other, as is normally the case. The positive externality arises from a complementarity of both use rights. Note that this view does not conflict with the above reasoning. The complementarity of the two permits and the resulting positive externality of providing a permit corresponds directly to the negative externality of providing no permit. And this option of the agent is directly related the level of its requirements. Otherwise stated, granting use rights (the negative of the extent of requirements or exclusion rights) exerts a positive externality. The fact that the agencies provide an excessive level of requirements (negative externality) translates to an inefficiently low provision of use rights (a higher provision of which would correspond to a positive externality). This leads to an underuse of the resource (capability of restaurant owner and appropriate space), which is the core of the anticommons problem.

To summarize: the anticommons problem can be understood as the problem of the independent decisions of two or more holders of fragmented property rights pertaining to some specific project. If both fragments relate to complementary assets of the project they exert typically a negative

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7 The public good problem is usually modeled by an objective function of the type $U(y_1+y_2) - y_1$ for one agent and analogously for the other agent. As only the sum of contributions matters for the level of public good provision the resulting objective functions are less general than in our formulation in Schulz, Parisi, Depoorter (2002).

externality on exclusion rights (or positive externality on use rights). This in turn implies an inefficient low use of the resource in terms of the intended project.

3. Commons and Anticommons: Symmetry and Asymmetry

In this Section will first illustrate the dual nature of commons and the anticommons (3.1) and will proceed to expose the asymmetry that exists in solving commons and anticommons problems (3.2). First we concentrate on the dual nature of both concepts:

3:1 Two Tragedies on Common Ground

Both commons and anticommons problems result from a misalignment of private and social incentives of two or more individuals in the use of a common resource. Most recently, Buchanan and Yoon (2000) noted the symmetrical effects of the two problems. In this section, we further specify the nature of the symmetry, searching for a normalizing criterion to compare and contrast the two phenomena.

The symmetrical features of commons and anticommons cases result from a misalignment of the private and social incentives of multiple owners in the use of a common resource. The misalignment is due to externalities not captured in the calculus of interests of the users (commons situations) and excluders (anticommons situations). The unitary basis of the problem can be understood when thinking of the traditional structure of a property right as the normal case. According to the traditional conception of property, owners enjoy a bundle of rights over their property that include, among other things, the right to use their property and the right to exclude others from it. In such a unified ownership, the owner's rights of use and exclusion are exercised over a similar domain. The right to use and the right to exclude are, in this sense, complementary attributes of a unified bundle of property rights.

The commons and anticommons relate to the above-defined normal case as deviations in symmetric directions. In commons situations, the right to use stretches beyond the effective right (or power) to exclude others. Conversely, in anticommons situations, the co-owners' right of use is compressed, and potentially eliminated, by an overshadowing right of exclusion held by other co-owners. Put

differently, in both commons and anticommons cases, rights of use and rights of exclusion have non-conforming boundaries. The lack of conformity causes a welfare loss from the forgone synergies between those complementary features of a unified property right.

This conceptualization of the commons and anticommons allows us to link the welfare losses of the two cases through a dual model of property. Welfare losses are produced by a discrepancy between the rights of use and the rights of exclusion held by the various owners. The problem is detached from the usual understanding of the tragedy of the commons as a consequence of ill-defined or absent property rights (e.g. Cheung, 1987).[8] Common and anticommons problems are not confined to situations of insufficient or excessive fragmentation of ownership, but result from the dismemberment - and resulting non-conformity - between the internal entitlements of the property right.

It follows that the qualitative results of the commons and anticommons models represent limit points along a continuum, each characterized by different levels of discrepancy between use and exclusion rights, with welfare losses varying accordingly.[9]

With the formalization of the anticommons problem in section 2 we are well equipped to clearly see the duality of the commons and the anticommons. The problem of the commons is related to a negative externality of use rights. The proverbial number of cows grazing on a parcel of land are a measure of the extent of the right of use. The problem of the anticommons is related to a negative externality of exclusion rights (a positive externality of granting use rights). In both cases the negative externality implies underuse. But the essential difference lies in the fact that this externality refers to rights of use in the case of the commons problem and it refers to the right to exclude in the case of the anticommons case. Conceptually these problems are absolutely similar. This leads us to call these problems dual to each other.

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[8]The problem of the commons is generally attributed to the absence of defined property rights (e.g. Cheung, 1987). The problem, however, is not limited to ill-defined rights or commonly owned resources, but extends to all situations of private property where the monitoring and enforcement of existing rights is excessively costly. In this latter case, however, the overexploitation of the resource does not constitute a welfare loss given the costly monitoring and enforcement required for exercising exclusion rights.

[9]Michelman s anticommons definition resembles that of a *full-exclusion* anticommons where everyone can bar everyone else, while Heller's *limited-exclusion* anticommons defines situations where a closed number of owners can prevent each other from using a resource (see Heller, 1999).

Note that the specification of V_i in (1) resembles exactly the modeling approach of Buchanan and Yoon (2000), if y_i is replaced by p_i: Indeed as in their model p_i is the price for a parking permit and a higher price means that more people are deterred from using the parking lot, a higher price is just a higher level of exercising the right to exclude. Conceptually, this parallels the example of two governmental agencies outlined in the previous Section.

If exclusion rights would have positive externality-properties, as would be the case in a Bertrand like situation, the same principles invoked above would yield a suboptimal exercise of exclusion rights. This leads us to suggest the following taxonomy:

	SUBSTITUTES (NEGATIVE EXTERNALITY)	COMPLEMENTS (POSITIVE EXTERNALITY)
USE	Commons (Hardin Type)	Anticommons (Michelman-Heller Type)
EXCLUSION	Commons (Bertrand Type)	Anticommons (Buchanan-Yoon Type)

The column headings relate to the substitute/complement property of the use rights of different holders of fragments of property rights. The category of the Michelman-Heller type is associated to the description as a "use-type" anticommons in the literature. It should be noted however that all of these problems are not different models but different emanations of the same model of commons and anticommons.

As was noted in Section 2 the exercise of exclusion rights with respect to a specific project can easily be translated to an exercise of use rights. In our example, an increased exercise of exclusion rights by the two government agents is analogous to a situation where the agents grant fewer rights

of use to potential restaurant owners. It is therefore legitimate to express the problem in terms of exclusion rights exclusively.

Suppose now that the complementarity of both permits is not perfect as in the formulation of (1) but imperfect. In this case the objective function of agents 1 may formulated as

$$V_1(y_1, y_2) = (1 - y_1 - by_2)y_1$$

As long as b is positive both exclusion rights are complements (an increase in exclusion rights diminishes the number of accepted permits, negative externality). If b is negative, exclusion rights are substitutes (an increase in exclusion rights increases the number of accepted permits, positive externality). Let b take values in [-1, 1]. The Nash equilibrium solution is

$$y_i^F = \frac{1}{2+b}$$

and the maximizing solution to the problem of joint maximization is

$$y_i^S = \frac{1}{2+2b}$$

Obviously, $y_i^F > y_i^S$, if $b > 0$. Hence, exclusion rights lead to underuse (excessive exclusion) if exclusion rights are complements. In fact, they lead to a higher level of underuse, if b increase. The maximal level of underuse is obtained for perfect complements ($b = 1$). For $b = 0$ there are no externalities and the property rights are properly aligned. The converse result obtains in the case of substitutes (negative b). The most excessive use is obtained for perfect substitutes ($b = -1$) This exemplifying result underscores the remark on the continuum of potential results of misalignment of property rights alluded to above. The interval [-1, 1] reflects this continuum within the framework of the chosen parameterization of the problem.

In the following section, we unveil an important asymmetry of the transaction costs occasioned by a non-conforming fragmentation of property rights. In Section 4, we further explore the normative implications of such asymmetry and provide a number of legal applications.

3.2 Commons and Anticommons and Asymmetric Transaction Costs

In a world of zero transaction costs, an efficient allocation of resources occurs regardless of the initial allocation of legal entitlement and choice of remedies to protect them.[10] In our context, the Coase theorem suggests that if all rights are freely transferable and transaction costs are zero, an inefficient initial partitioning of property rights will not impede an efficient final use of the resources. In the event of inefficient fragmentation of property, voluntary agreements will reaggregate property into efficiently sized clusters, maximizing the total value of the resources.

Once the ideal conditions of the positive Coase theorem are relaxed, over-fragmentation poses an interesting situation of asymmetric transaction costs. The presence of such asymmetry is due to the fact that the reunification of fragmented rights usually involves transaction and strategic costs of a greater magnitude than those incurred in the original fragmentation of the right. As shown above, the intuition for such asymmetry is quite straightforward. A single owner faces no strategic costs when deciding how to partition his property. Conversely, as shown in Section 2, multiple non-conforming co-owners are faced with a strategic problem, given the interdependence of their decisions. The equilibrium pricing (or quantity supply) of anticommons owners will impede the optimal reunification of non-conforming fragments into a unified bundle.

In the context of the anticommons, the argument that it is often harder to regenerate separated bundles than to fragmentize them has been put forth by Heller (1998).[11] While intuitively correct, the argument warrants some further explanation.[12] In selecting the optimal level of fragmentation, a

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[10] Coase (1960). See also on attenuation and partitioning of property rights, Eggertson (1990b: 38-39).

[11] Posner first recognized the costs of excessive fragmentation, providing an application in the property law of servitudes. The common law distinction between promises that touch and concern the land and restrictive covenants that are merely personal is explained in this light. The idea, formulated in the early editions of his textbook, is expressed in the latest edition as follows: "One reason is that having too many sticks in the bundle of rights that is property increases the costs of transferring property." (1998, p. 76). Furthermore, some of the usual transactional impediments can be expected: (a) finding and negotiating among the parties, and (b) overcoming strategic bargaining. Notably, the former category of problems (finding & negotiating) is more likely to dominate commons problems, whereas the latter problems (strategic bargaining) tends to dominate anticommons situations. Search and transaction costs would generally be high in traditional commons (open access) cases, given the potentially unlimited number of individuals that could enter an open access resource destabilizing and exploiting any agreement that the incumbent users could have reached among themselves. In anticommons cases, however, as in Heller's storefront properties, each party tries to exercise a right to exclude. But to make that threat work, the party has to identify him/herself to the other parties. Hence the problem will not be finding the rights-holders, but rather getting them off their respective strategic bargaining positions.

[12] Heller (1999) cites the fairy tale of Humpty Dumpty to illustrate his point. When Humpty Dumpty is shattered into

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rational owner estimates the expected value of the alternative partitioning of his property and would rationally select the arrangement that yields the highest net present value. The owner's optimal choice would rest on the estimation of (a) the respective probability that each alternative partitioning may coincide with the desired final allocation, and (b) the respective ex post reallocation costs (if the chosen level of fragmentation proves to be ex post sub-optimal). This optimization process leads to a choice of initial allocation that maximizes the present value of the property at the net of possible reallocation costs and resulting inefficiencies. In this respect, owners act efficiently taking full account of the available information and with full consideration of the asymmetric transaction costs induced by property fragmentation.

But, in spite of the perfect alignment of private and social incentives, anticommons problems remain. Owners aim at maximizing the value of their property, but - given some uncertainty on the optimal final use - they do so with some normally distributed margin of error. Because of the one-directional stickiness in the fragmentation process (i.e., sub-optimal fragmentation can be easily corrected ex post, while excessive fragmentation is likely to be irreversible) the normal distribution of errors has cumulative, rather than offsetting, effects on society.[13]

An illustration might be helpful. Consider the case of an owner that purposefully chooses to fragment his property as a way to control the future use of property (e.g. the case a naturalistic clubs and wildlife associations that utilize anticommons-type fragmentation as a way to ensure long-term or perpetual conservation of the land in its current naturalistic use).[14] The size and configuration of each fragmented parcel is intentionally chosen as to render any parcel (or combination of few

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pieces it takes all the kingdom's horses and all the kingdom's men to re-assemble him, which stands in contrast to the ease with which he fell into pieces.

[13] This solution to the owner's optimal allocation problem requires the assessment of the likelihood of different situations arising in the future, and the evaluation of the impact of asymmetric transaction costs, given the uncertainty over the optimal final allocations. In order to solve the allocation problem under uncertainty, owners would consider: (a) the relative cost of reallocating from the initial allocation to the efficient allocation; and (b) the probability that the chosen initial allocation is the most efficient final allocation, among the possible alternative allocations. The presence of asymmetric transaction costs renders this optimization problem different from the usual optimal allocation problem under uncertainty because, in the presence of asymmetric reallocation costs, optimization requires proper consideration of the one-directional stickiness in the exchange process. The optimal initial allocation is derived considering the costs and benefits of alternative allocations, in light of such asymmetry.

[14] In Section 3.3 of this paper, we consider this real life example in greater detail, where fragmentation is purposely promoted by nature clubs to ensure the future (and, possibly, perpetual) preservation of natural reservoirs. These associations purchase large estates and then partition the land into excessively small parcels, transferring title to such fragmented plots of land to association members.

parcels) unusable for other practical purposes. If the preservation goal, which motivated the initial anticommons fragmentation, becomes impossible due to some unforeseen act of nature (e.g., the wildlife abandons the reserve, or a fire destroys the natural flora and fauna that warranted preservation, etc.), the fragmented owners and society are left with a sunk cost, given the wasteful patchwork of unusable small entitlements.

The interesting point here is that, while anticommons fragmentation may be occasionally ex ante efficient (given the specific goals pursued by property owners), it may result in inefficient ex post allocations. In the following Section, we consider some of the ways in which legal systems address these problems.

4. Unified Property and Choice of Remedy

In this section we take a closer look at the positive transaction costs under the anticommons and we further explore the normative implications of such asymmetry while providing a number of legal applications in the law of property.

4.1 The Choice of Optimal Remedies under Anticommons: A Workable Hypothesis

The *one-directional stickiness* in the fragmentation process leads rational owners to make different decisions under property as opposed to liability rules. Under a liability-type rule, rational owners would choose an optimizing level of fragmentation of their property, considering the lower expected reallocation costs induced by the liability remedy. Conversely, under a property-type rule, rational owners would choose a different (and lower) level of fragmentation, given the higher costs of rebundling property at a later stage. In turn, the choice of different remedies affects the social loss occasioned by the imperfect decision-making of property owners.

In our specific context, the optimal choice of remedy would take into account the peculiar asymmetry of the transaction costs created by a dysfunctional fragmentation of property. Choosing a remedy in such an asymmetric scenario requires balancing a wide range of concerns.

For the general case of positive transaction costs, the result of Calabresi and Melamed (1972) is that property-type remedies may impede efficient reallocations of rights. Likewise, in the absence of

overriding social concerns, inalienability rules would foreclose value enhancing property arrangements because courts and legislatures are unable to evaluate the subjective value and idiosyncratic preferences of the parties. Therefore, liability rules emerge as the best candidates for the difficult task of balancing individual autonomy against efficiency concerns in the presence of positive transaction and strategic costs.[15]

In the realm of non-conforming property arrangements, positive transaction costs often generate a *one-directional stickiness* in the transfer of legal entitlements. As discussed above, externalities and holdouts are two major impediments to transfers. In the anticommons setting these impediments stand in direct relationship to each other. The optimal legal remedy will be the one that minimizes the net social cost of externality and holdout costs in any particular institutional setting.[16] Our efficiency hypothesis further predicts that legal systems responding to problems arising in a positive transaction cost environment will develop rules that generate allocations that approximate those that would obtain in a zero transaction cost world. In our specific context, the testable hypothesis is that legal systems would grant a less extensive property-type protection in favor of non-conforming property arrangements.

Under most normative criteria, however, the risk of anticommons deadweight losses would fall short of justifying the use of inalienability-type rules.[17]

The presence of one-directional transaction and strategic costs would justify a more selective use of

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[15] This is consistent with the general result of Calabresi and Melamed (1972), who have shown that, under most circumstances, liability-type remedies achieve a combination of efficiency and distributive results which would be difficult to attain under the alternative property-type and inalienability-type solutions.

[16] This consideration builds upon the existing literature on non-conforming property rights, offering a revised formulation of the normative Coase theorem for the definition of optimal remedies in situations characterized by asymmetric transaction costs. The presence of asymmetry transaction costs may justify the selective use of different remedies for the same entitlement or relationship. Asymmetric remedies would compensate for the asymmetric frictions encountered in the transfer of such rights. In this setting, legal rules may offer different remedial protection to legal relationships that appear equivalent according to the traditional canons of evaluation. The choice of optimal remedies in the presence of asymmetric strategic and transactional impediments may thus induce a dichotomous regulation of legal relationships.

[17] See, for instance, Epstein's (1982) view that property-type remedies are appropriate for the protection of servitudes that run in perpetuity. Rational parties will anticipate any devaluation from fragmentation and take into account the expected present value of forgone opportunities and strategic costs when fragmenting the entitlement, thereby avoiding any divergence between ex-ante and ex-post outcomes in terms of welfare. Recent scholars have defended the *numerus clausus* doctrines and other inalienability-type rules in the realm of property. See Merrill and Smith (2000) for an information-cost explanation of the *numerus clausus* principles.

liability-type remedies.[18] Likewise, other legal rules may create default reunification mechanisms. Time limits, statutes of limitation, liberative prescription, rules of extinction for non-use, etc., can all be regarded as legal devices to facilitate the (otherwise costly and difficult) reunification of non-conforming fragments of a property right.

These legal solutions can be analogized to a gravitational force, reunifying rights that, given their strict complementarity, would naturally be held by a single owner. This tendency towards reunification works to rebundle property rights in order to regenerate the natural conformity between use and exclusion rights (and, more generally, between any two complementary fragments of property). Interestingly, most of these reunification mechanisms do not apply with respect to typical property rights. Typical property rights already provide conforming boundaries of use and exclusion rights. This eliminates any reason to favor reunification over persisting fragmentation. Conversely, atypical property arrangements may justify the activation of reunification mechanisms to overcome entropy and persisting fragmentation.

In sum, the important lessons developed around Coase's theorem hypothesize that legal rules and remedies are driven by the comparative evaluation of the relative costs and benefits of alternative legal remedies. In the context of asymmetric transaction costs, our corollary of the Coase theorem thus consists of a normative proposition and a testable hypothesis.

The normative proposition supports the selective use of asymmetric remedies to compensate for the one-directional stickiness of the voluntary exchange.

The positive hypothesis suggests that courts and legislators, consciously or unconsciously, already account for the asymmetric effects of property fragmentation, when considering the optimal choice of rules and the optimal structure of remedies. Legal systems take into account the anticommons problems selecting rules designed to minimize the total deadweight losses of property fragmentation.

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[18] In the field of contracts, a more liberal use of specific performance may be expected with respect to contracts that are aimed at reunifying non-conforming fragments of property, rather than contracts that are aimed at creating such fragmentation. Recontracting is, in fact, substantially cheaper in the latter case, reducing the need to conserve the original agreement.

4.2 Disclaimer: The Potential Value of Non-Conforming Property Arrangements

Although much of the discussion in this paper considers the legal responses to problems of dysfunctional fragmentation of property, it is important to note that in certain situations legal systems create or encourage commons or anticommons situations.

Interestingly, just as in many cases *legal systems* encourage commons situations (e.g., roads, navigation, communications, ideas after the expiration of intellectual property rights, etc.),[19] in other cases, the legal system creates and facilitates anticommons fragmentation. The recent use of conservation easements and the fragmentation (and multiplication) of the administrative competences for land development can, in fact, be seen as ways to utilize the anticommons problems for the alleged benefit of the social planner (e.g., to induce greater conservation or slower pace of suburban development).[20]

Comparative legal history provides several examples of property fragmentation. Different forms of fragmentation have indeed plagued property throughout history, ranging from functional to physical and legal forms of fragmentation. In different historical settings, human societies have successfully conceived remedies to combat the effects of fragmentation, but the historical illustrations reveal a substantial degree of difficulty in the attempts to reunify fragmented property.

An example of functional fragmentation can be observed in the early evolution of property. In pastoral societies, relatively simple rules governed land ownership. The content of property rights was related to the actual use and possession of the land (Rose, 1985). The derivation of property from possession generated limited (or "functional") property rights. Through this process, multiple property claims often emerged and coexisted over the same land, with customary rules regulating the possession, use, and transfer of such functional rights. This partitioning of property into multiple functional layers (e.g., farming, fishing, hunting, etc.) was often wise, given that different owners

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[19] See Rose's seminal 'Comedy of the Commons' (1986), describing the origins of and justifications for common law doctrines and statutory strategies that vest collective property rights in the "unorganized" public as a means of optimal resource management. Most recently, Smith (2000) introduced the notion of semi commons – property arrangements where property rights are a mix of common and private rights, with significant interactions between the two – observing that this property structure allows to optimize the scale of different uses of the property (e.g., larger scale grazing, smaller scale grain growing, etc.).

[20] The idea of the anticommons in environmental regulation is explored further in Mahoney (2001).

could exercise specialized activities over the same territory with little encroachment on one another.[21] Functional partitioning of land, however, while efficient in those stable pastoral economies, became unsustainable in conditions of rapid economic change. In the transition from pastoral to agricultural economies, many societies gradually abandoned functional property in favor of spatial property. This process of transformation eventually led to the emergence of the absolute conceptions of unified property that dominated in classical Roman law, making their property systems more similar to those we are accustomed to observing in the modern Western world.[22] But the transition was often complex given the difficulties of reunification of fragmented property into unified bundles.

In medieval times, other forms of legal fragmentation evolved as instruments of economic and social control. Through the feudal process, property became quite distinct from the Roman paradigm of absolute ownership, as feudal grants were always limited by the act of license and title and possessory interests never resided in the same hands. Unlike the Roman paradigm, feudal property was neither unlimited nor absolute. Property interests were not opposable *erga omnes*, but rather consisted of a bundle of rights and duties, partially applicable to the whole community and partially dictated by the specific contractual relationship between the grantor and the grantee. This important transformation caused the entrenchment of the feudal regime of dispersed ownership (and property fragmentation) and the evolution of a complex system of political and social control.

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[21] Given the low density of the population and the limited rate of exploitation of natural resources, functional partitions of property were indeed often efficient, since they provided an opportunity to allocate the same land towards multiple privately held use rights, optimizing the property size with respect to various potential forms of exploitation.

[22] Since classical Roman law, the property owner (*proprietarius*) was not allowed to transfer anything less than the entire bundle of rights, privileges, and powers that he had in the property. Conveyances of rights in a lesser measure than full ownership were only permitted on an exceptional basis and in a limited number of cases. Thus, for example, use and exploitation rights divorced from ownership (*usufructus*) could be given only to a living person for the duration of his lifetime; the creation of legally binding restrictions on property (*servitutes*) was sharply limited. Furthermore, the creation of legally binding restrictions on property was limited to situations where it could be shown that the need and advantage to the dominant estate had a perpetual nature. In the Roman Digest we read that servitudes necessitate a *causa perpetua*. Paulus Book 25 *ad Sabinum* in D. 8.2.28: "omnes autem servitutes praediorum perpetuas causas habere debent" (all servitudes must have a perpetual cause). In other passages, the Roman sources explicitly indicate that the servitudes created for the transitional benefit of the owner of a neighboring lot (as opposed to the perpetual benefit of the land itself) could not be established as valid servitudes in Roman law. Paulus Book 15 *ad Plautium* in D. 8.1.8: "ut pomum decerpere liceat et ut spatiari et ut cenare in alieno possimus, servitus imponi non potest." (Servitudes cannot be creates to grant rights for harvesting fruit or to have meals or merely to walk on another's property) Such atypical arrangements – it was understood as an implicit corollary – could however, be created as a matter of personal obligations.

Also in this case, fragmentation of property proved problematic in times of economic change. Just like the transition from pastoral to agricultural economies rendered the so-called functional conceptions of property impracticable, the gradual growth of a market economy rendered the feudal dispersion of control over property highly impractical. Similarly, history reveals the persistence of property fragmentation. It took indeed both a political and an ideological revolution to reshape the dominant conception and content of property.

In modern days, different forces challenge the unitary conception of property. In many ways, the various layers of regulations and zoning ordinances can be thought as the contemporary analogue of dysfunctional fragmentation of ownership.

But besides these governmentally created forms of fragmentation, in modern settings, property owners also often purposely structure arrangements that create commons and anticommons regimes. Most recently, Dagan and Heller (2001) present the case of the liberal commons as a compelling illustration of efficient commons. Less obviously, we could imagine cases of purposely chosen anticommons. Examples of purposeful dysfunctional fragmentation of property can be found in situations where unified property owners want to generate anticommons problems as a way to control the use of their property beyond the time of their ownership. An interesting real life example is offered by the case of nature associations and mountain-hiking clubs that utilize anticommons-type fragmentation as a way to ensure long-term or perpetual conservation of the land in its current undeveloped state.[23] For example, fragmentation is purposely promoted by several local mountain-hiking clubs in Austria to ensure the future (and, possibly, perpetual) preservation of the land for hiking purposes.[24] These associations purchase large natural reservoirs and then partition the land into very small parcels, coordinating the acquisition of such fragmented plots of land by association members. Every member joining the club pays a small sum, acquiring title to one or more very small parcels of land in different locations in the area. The size and configuration of each parcel is such as to render any parcel (or combination of few parcels) unusable for practical development purposes. This arrangement generates an enormous patchwork of small entitlements. The idea is that, in the

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[23] The example thus concerns land use preservation though excessive fragmentation, as an alternative to state acquisition or zoning for parkland use.

[24] The authors would like to thank Wolfgang Weigel for inadvertently providing this example of purposeful dysfunctional fragmentation of property.

advent of the enormous transaction costs of negotiating with all relevant parties, prospective developers most certainly would be discouraged from pursuing development projects in the area.

The interesting point here is that, while generally problematic, atypical partitioning of property rights may be somewhat sensible with respect to specific policy goals or other objectives pursued by property owners. These idiosyncratic arrangements are expressions of freedom of contract (for individuals) and legitimate choices of policy instrument (for social planners). As it is often the case in the design of legal solutions to these problems, the critical concern is that of respecting individual autonomy, while minimizing the undesirable deadweight losses that could result from these arrangements.

4.3 Anticommons and Legal Policy: Dual Remedies for a Unified Property

As we have seen, anticommons problems often emerge when a valuable resource is divided into non-conforming fragments with foregone complementarities.[25]

Most observed forms of fragmentation are not dysfunctional. The notions of functional and dysfunctional are relative and subject to change overtime. What is a functional fragmentation under certain circumstances may become suboptimal at a later time.[26] And vice-versa. Policy-makers cannot perfectly control the volatility of land development and the resulting changes in the optimal use of property. But they may attempt to ensure that property maintains sufficient flexibility to adapt to the changing needs of the time.

When a value enhancing opportunity arises which allows for the exploitation of the complementarities between different parts of the fragmented property, the ex-ante rational choice may turn out to be ex-post sub-optimal, given the greater costs of reunification. According to our

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[25] In general terms, dysfunctional fragmentation occurs when "closely complementary" attributes of the property are dismembered. Use and exclusion rights are a paradigmatic example of strict complements in the bundle of property. But, besides this paradigmatic case, we can easily think of other essential attributes of a property right that are meant to be in the control of a single individual. When such a dysfunctional separation takes place, anticommons problems may emerge.

[26] Imagine the fragmentation of a large estate (e.g. a former farm) into buildable lots, when the surrounding area consists of valuable small-acreage residential property. In that case, there are fewer forgone synergies between the various fragments, and those lost synergies are sufficiently overcome by the reduction of lot size to an optimal scale for the new residential purpose.

working hypothesis, when considering the optimal choice of rules and the optimal structure of remedies, legal systems take into account these asymmetric costs and select rules designed to minimize the total deadweight losses of dysfunctional fragmentation.

Several rules and doctrines in the field of real property can be evaluated in light of this hypothesis. Take for instance, the body of mandatory rules in private land-use law that regulates the creation and enforcement of atypical easements and real covenants. Although the Anglo-American law of servitudes is often described as nothing more than a historically evolved legal cobweb, close examination reveals that behind its technicalities lies a coherent economic logic. Rose (1999) and Merrill and Smith (2000) have used information-cost economics to explain the various legal efforts to avoid undue fragmentation. Their contributions concentrate on information costs and distinguish property from contract along the dimension of property law's preoccupation with avoiding fragmentation. Most specifically, Merrill and Smith (2000) explain the "numerus clausus" doctrine as an attempt to constrain the proliferation of types of property rights leading to an increase in third-party information costs. For this reason property law enforces as property only those interests that conform to a limited number of standard forms.[27]

In the present article we suggest that, even setting aside information cost explanations (indeed, such explanations may lose some of their cogency as the new information technology increases the opportunity for real-time and inexpensive access to public records), the strong presumption against judicial recognition of new forms of property retains a solid economic justification. In evaluating inalienability-type rules and "numerus clausus" doctrines we should consider the tradeoff between the forgone value-increasing opportunities for the owners and the potential deadweight losses from increased information (and anticommons) costs. As suggested above, atypical partitioning of property rights may be important for successful pursuit of the owners' objectives. From a lasseiz-faire perspective, these arrangements are expressions of freedom of contract and private autonomy of the owners. In designing legal solutions to dysfunctional property fragmentation the critical concern should be that of balancing the goals of efficiency and parties' autonomy. The "numerus clausus" principle imposes a constraint on the efforts by parties to proliferate new forms of property

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[27] Merrill and Smith (2000) suggest that, because of the long-term (or perpetual) nature of most property arrangements, it is necessary to package property transactions in such a way that subsequent purchasers can easily recognize and

rights. In this sense, the "numerus clausus" doctrine, as most other inalienability-type rules, may foreclose value-enhancing exchange opportunities. In the following pages, we thus consider the alternative role of "liability-type" remedies for maximizing the value of atypical property arrangements at the net of the potential deadweight losses that could result from them.

When we say that there is freedom of type in contracts but not in property we contrast non-comparable categories, in that contracts are often the way in which property rights are created and transferred. In many ways, the distinction between property and contracts with respect to atypical arrangements makes use of semantic juxtapositions. The real question is not that of establishing where freedom of contract ends and where formalism in property begins. Freedom of contract and "numerus clausus" doctrines happily coexist in many legal systems of the world, including the Romanistic systems that gave origin to the "numerus clausus" doctrines. *The question is that of understanding why legal systems offer property-type remedies only in a limited range of situations, utilizing liability-type remedies in the majority of other cases.* Posed in these terms, the use of categorical distinctions confuses the real understanding of the matter.[28] Property scholars that do not consider these facts cannot make sense of the apparent anomalies in the law of property protection. Most property scholars and teachers consider the presence of liability-type remedies for certain categories of real rights as merely coincidental. In a popular textbook on property, Dwyer and Menell (1998, p. 760) observe that "because of one of the many historical accidents that plague property law, real covenants are enforced by a damages remedy only." We suggest that these apparent anomalies in the law of remedies are not the result of pure chance.

The presence of one-directional transaction and strategic costs necessitates a relatively more liberal use of property-type remedies in favor of non-fragmented owners, while justifying a limited liability-type protection in favor of fragmented or dysfunctional right holders. The different protection is justified by the fact that the unified owner faces no strategic impediments when deciding among alternative uses of his property (or when internally reallocating his resources).

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respect their nature and content.

[28] There are several real property situations that only enjoy liability-type protection. Yet, there are several merely contractual arrangements that enjoy property-type protection (in a way, we can also think of specific performance as the contract law analogue of property-type remedies). As all students that survived a remedies course would realize, the substantive categories of property and contracts are only very imperfect proxies for the applicable remedial categories in the case.

Conversely, fragmented and dysfunctional owners face transactional impediments that necessitate the use of liability-type remedies.[29]

The selective use of legal remedies can thus be analogized to a lubrication mechanism to overcome entropy in property. These legal mechanisms promote the reunification of rights and privileges that, given their complementarity, should naturally be held by a single owner, (re)generating the natural conformity between complementary attributes of a right (e.g., between use and exclusion rights).

To be clear, such doctrines have a fairly long-lived heritage, several of which date back to Roman times. In the course of history, these restrictions underwent strict scrutiny in light of the nineteenth century ideals of party autonomy and freedom of contract.[30] Almost universally, modern systems of the Western legal tradition have resolved the tension between principles of freedom of contract and protection of unified property by providing different remedial protection to typical (or nominate) and atypical (or innominate) property rights.[31]

In this sense, dual remedies can be seen as instrumental to the stability of unified property. Our efficiency hypothesis finds further confirmation in the more conservative use of property-type protection in the case of personal, non-conforming property arrangements. In a related paper, Depoorter and Parisi (2000) evaluate the comparative and historical analysis of property rules concerning the creation and enforcement of atypical easements and real covenants in light of the positive hypothesis of transaction and strategic cost minimization. The attachment of promises to land creates user rights in a property resource and as such may be regarded as a partitioning of property rights. By treating land-related promises as enforceable contracts that bind the contracting parties rather than real rights that run with the land in perpetuity, doctrines such as touch and

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[29] Put differently, the solution of the social cost-minimization problem requires remedies to be determined on the basis of the expected directional costs, as opposed to the average or total transaction costs present in the contract or property relationship. In our setting, this would explain the selective use of remedies to overcome anticommons problems.

[30] The legal concept of freedom of contract emerged in the late eighteenth-early nineteenth century as an offspring of the ideal of economic and intellectual freedom espoused by liberal political theory (Gordley, 1991). Continental European contract theory applied the notion of freedom of contract to a wide range of situations. These situations are generally grouped under the three general headings of freedom of form, type, and object.

[31] By the end of the nineteenth century, English law had also consolidated a principle of freedom of contract that stood as a central tenet of its framework of private ordering. The nineteenth-century ideal of freedom of contract rejected the imposition of legal constraints to the free determination of the parties to a contract but left room nevertheless for a distinction between typical and atypical property arrangements with a differentiated remedial protection. (Parisi, 1994).

concern in common law, prediality[32] and the *numerus clausus*[33] principles in civil law, have served as instruments to limit the cases of dysfunctional fragmentation.

Freedom of contract of the parties is left unrestrained in the domain of contractual and personal obligations. The creation of atypical property rights is, however, governed by categories and rules of contract law, with liability-type protection under most circumstances.[34] The dichotomous treatment of typical and atypical property rights can be explained as an attempt to minimize the transaction and strategic costs resulting from dysfunctional property arrangements.[35]

There are important extensions of the problem of non-conforming property rights concerning the risk of governmental intervention in the regulation of private property. Regulations often occasion a dysfunctional fragmentation of property rights. Such distortions may have a pervasive impact on the final allocation of resources, surpassing, by a large measure, the inefficiencies engendered by the occasional miscalculation of shortsighted private owners in the partition of their property.[36]

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[32] The requirement of prediality (art. 637 C.C. in Belgium and France, art. 646 Louisiana code) holds that only land-promises that are of "real" nature may run with the land. Promises of personal nature are personal rights, not real rights, and as such they do not pertain the characteristics of a real right.

[33] The *numerus clausus* doctrine holds that there is a limited number of real property rights that the legal system recognizes and grants them property-type remedial protection.

[34] This apparent anomaly in the coordination of property and contract rules has been overlooked in the literature. Recent research suggests that Anglo-American courts intuitively responded to the dangers of unrestricted fragmentation by obstructing the running of personal promises attached to land, in favor of objective arrangements intrinsic to the land in question. *See* Depoorter and Parisi (2000).

[35] Along similar lines, a survey of American property law by Michael Heller (1999) reveals what he terms a 'boundary principle,' which limits the right to subdivide private property into wasteful fragments. Property law responds to excessive fragmentation with the use of a variety of rules and doctrines such as the rule against perpetuity, zoning and subdivision restrictions, property taxes and registration fees, etc. *See,* Heller (1999: 1173-1174), citing zoning and subdivision restrictions such as minimum lot sizes, floor areas and setbacks that prevent people from spatially fragmenting resources too much. Heller suggests that, by making the creation and maintenance of fragments more costly, for instance through annual disclosure expenses, excessive fragmentation into low-value fragments will be deterred and existing fragments will be abandoned so that the state can afterwards rebundle them.

[36] In this context, Heller (1998) provides a telling example of governmental creation of dysfunctional property rights, discussing the costs of excessive fragmentation in the transition from a centralized economy to market institutions in contemporary Russia. In Heller's narrative, the Russian government undertook a dysfunctional fragmentation of property in the process of assigning private property rights to private individuals and local businesses. The assignment of fragmented property rights to different individuals occasions a suboptimal use of the newly granted property, as exemplified by the intriguing prevalence of empty storefronts in Moscow (while on the streets entrepreneurs set up thousands of metal kiosks filled with merchandise). *See*, Heller (1998: 641-642). Heller notes that, in the Russian experience, other factors, such as divergent incentives between the public agency rights holders and their bureaucratic owners, aggravate the matter. Heller's scenario thus describes the creation of dysfunctional property rights (i.e., property rights with non-conforming boundaries between use and exclusion rights), with a resulting anticommons problem.

5. Conclusion

In our dual model of property, commons and anticommons problems are shown to result from symmetrical structural departures from a unified conception of property. Specifically, both problems are the effect of a lack of conformity between use and exclusion rights, with a consequential misalignment of the private and social incentives of multiple owners in the use of a common resource. The misalignment is due to externalities not captured in the calculus of interests of the users (commons situations) and excluders (anticommons situations).

We have further shown that in the realm of non-conforming property arrangements, positive transaction costs often generate a one-directional stickiness in the transfer of legal entitlements. The intuition for such one-directional stickiness is quite straightforward. A single owner faces no strategic costs when deciding how to partition his property. Conversely, multiple non-conforming co-owners face a strategic problem (with positive added transaction costs) when attempting to rebundle independently owned property fragments.

The presence of such one directional transaction and strategic costs produces a normative proposition and a testable hypothesis.

The normative proposition supports the selective use of asymmetric remedies to compensate for the one-directional stickiness of voluntary exchange. At the same time it justifies the legal system's restriction of property-type remedies to a limited range of situations, utilizing liability remedies in the majority of other cases.

As a positive hypothesis courts and legislators have accounted for the asymmetric effects of property fragmentation. This is reflected in the legal system's reluctance to grant extensive property-type protection in favor of non-conforming property arrangements and the formulation of default reunification systems with regard to atypical property right arrangements.

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