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# DUALITY IN PROPERTY: COMMONS AND ANTICOMMONS

ABSTRACT: Commons and Anticommons problems are the consequence of symmetric structural departures from a unified conception of property. In this paper, we endeavor to provide a dual model of property, where commons and anticommons problems are the consequence of a lack of conformity between use and exclusion rights. The general model is then extended to consider the different equilibria obtained under vertical and horizontal cases of property fragmentation. The paper concludes with a hypothesis of legal rules for promoting unity in property and suggests a list of possible areas of application.

A new term of art has recently gained acceptance among law and economics scholars of property law: the anticommons. The concept, first introduced by Michelmann (1982) and then made popular by Heller (1998 and 1999), is a mirror-image – in name and in fact – of Hardin's (1968) well known tragedy of the commons.

In situations where multiple individuals are endowed with the privilege to use a given resource without a cost effective way to monitor and constrain each other's use, the resource is vulnerable to overuse: a

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problem known as the tragedy of the commons.

Symmetrically, when multiple owners hold rights to exclude others from a scarce resource and no one exercises an effective privilege of use, the resource might be prone to underuse: a problem known as the tragedy of the anticommons.

We build upon this definition of the anticommons, which still lacks an accepted general formalization in the literature. We endeavor to provide a dual model of property, where commons and anticommons problems are shown to result from symmetrical structural departures from a unified conception of property. Specifically, both problems result from a lack of conformity between use and exclusion rights.[4] We then extend the basic model to consider vertical and asymmetric forms of anticommons. We conclude by exploring possible applications of the concept of anticommons and highlighting the relevant policy implications in the choice of rules for minimizing the social cost of non-conforming property arrangements.

## 1. Commons and Anticommons: 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

[4] In a related paper, we utilize this conception of unified property to explain the rise and fall of functional conceptions of property in Western legal history (Depoorter, Parisi and Schulz, 2000).

criterion to compare and contrast the two phenomena.

### *1.1 The Commons Problem*

If a depletable resource is open to access by more than one individual, incentives for overutilization emerge. As the number of individuals that enjoy free access grows large relative to the capacity of the common resource, overutilization will approach unsustainable levels risking the complete destruction of the common good. This tragic result was articulated by Garret Hardin (1968), who named this concept "Tragedy of the Commons". Hardin (1968: 1244) credits a mathematical amateur named William Forster Lloyd (1794-1852) for formalizing the concept in a little-known pamphlet on population growth, published in 1833.

Since Lloyd, other economists have identified problems associated with common ownership of resources being exploited by individualistic competition. Most notably, Scott Gordon (1954: 132) pointed out that, absent controls on entry, common resources will be exploited even at levels of negative marginal productivity.[5] This happens because external effects are not fully internalized within the choice of each individual decision-

[5] This is of course subject to the provisio that in certain cases an implicit property right setting will emerge, for instance through social norms, to limit counterproductive exploitation of the common resource. Consider in this respect Acheson's (1988) account of the practices of the lobster fishermen gangs in Maine. The example illustrates the emergence of spontaneous and privately enforced norms of exclusion to limit the deadweight losses of common access fisheries. For an overview of other examples of successful commons management, see Ostrom (1990). For a general discussion on the conditions favourable to the emergence of such adaptive norms, see Libecap (1989: 19-28).

maker. The sources of externalities in a commons problem are twofold. First, there are static (or current) externalities, in that the use of the resource reduces the benefit from usage to others. Second, there are possible dynamic (or future) externalities, because the use of a renewable resource today bears consequences into the future. Due to the lack of uniformity between use and exclusion rights, individuals do not consider the full social costs of their activities. Private and social returns diverge, and total use by all parties exceeds the social wealth maximizing point.[6]

### *1.2 The Anticommons Problem*

Frank Michelman (1982) coined the term anticomons 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.

Michael Heller (1998) recently revitalized the concept in an article on the transition to market institutions in contemporary Russia. He

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[6]Following Ostrom, Gerdner and Walkers' typology (1999), this type of problem can be classified as an "appropriation" problem, which relates to the flow aspect of the resource (e.g. exclusion and allocation), to be distinguished from "provision" problems, which involve the resource stock of the common-pool resource (maintenance, preservation and improvement).

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. The definition of the anticommons employed by Heller provides a powerful tool for property theory: *a property regime in which multiple owners hold effective rights of exclusion in a scarce resource*.

In the Tragedy of the Anticommons, 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 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. To put it differently, some 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 also 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.

### *1.3 In Search for a Common Ground: A Unified Conception of Property*

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 which include, among other things, the right to use their property and the right to exclude others from it. In such a framework, 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).[7] 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. [8]

In Section 2, we unveil an important asymmetry of the transaction

[7]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.

[8]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

costs occasioned by a non-conforming fragmentation of property rights. The intuition for such asymmetry 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. In Section 3, we further explore the normative implications of such asymmetry.

## 2. Commons and Anticommons: A Dual Model of Property

Despite the growing significance of the concept of the "anticommons" in both economic theory and law and economic scholarship, such a notion still lacks a generalized formalization in the literature. In this section, we will develop a dual model of property which exemplifies the economic consequences of a lack of conformity between use and exclusion rights. In thinking of real life illustrations of non conformity between use and exclusion rights, we will further distinguish between horizontal and vertical anticommons situations.

In a horizontal anticommons case, various right holders exercise exclusion rights simultaneously and independently. This may involve two agents in a horizontal relationship, such as multiple co-owners with cross-veto powers on the use of a common resource.

In a vertical anticommons situation, exclusion right holders are in

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resource (see Heller, 1999).

a vertical relationship with one another, with choices made sequentially by the various right holders.

While recognizing that reality may present situations that combine characteristics of the two categories, we proceed by analyzing the two hypotheses separately. This facilitates our understanding of the different equilibrium results.

In Sections 2.1 and 2.2 we consider the dual relation between commons and anticommons cases. In Section 2.3 we will extend the general model distinguishing between horizontal and vertical cases.

### *2.1. Commons and Anticommons*

In terms of efficiency the problem of the anticommons is based on a positive externality, while the problem of the commons is based on a negative externality. In order to keep the model simple, we consider the case of two agents and we denote the activities of these agents using the common resource by $x_i$.

In anticommons cases $x_i$ denotes the extent to which agent $i$ grants agent $j$ permission to use the common property. In such cases, an activity $x_1$ of agent 1 exerts a positive impact on the productivity of agent 2's activity $x_2$. Conversely, in commons cases $x_i$ represents the extent to which agent $i$ uses of the common resource. Due to the negative externality of each user on the residual productivity of the joint resource, an activity $x_1$ of agent 1 exerts a negative impact on the productivity of agent 2's activity $x_2$.

For the general case, let us denote the value of the common resource to agent $i$ by $V_i ( x_i, x_j )$.

In a typical anticommons situation, the two agents (co-owners) hold exclusion rights that limit each other's right to use the common property. Neither agent has a right to use the common resource without the consent of the other. In this context, agent *i* grants agent *j* the right to use the common resource. Agent *j* owns a complementary right to exclude agent *i* from the use of the common resource. The two agents may independently grant each other some limited right of use of the common resource. The respective grants will be denoted as $x_i$ and $x_j$. Then $V_i ( x_i, x_j )$ may denote the profit agent *i* derives from this joint project. The positive externality that agent *j* exerts on i's value can be modeled as

$$(1) \qquad \frac{\partial V_i}{\partial x_j}(x_i, x_j) > 0 .$$

Let's continue our analysis contemplating the case of exclusion rights that are exercised simultaneously and independently by the various right holders. In such anticommons situations, multiple owners exercise their veto power on equal terms.

To keep things simple let us assume that both agents are in a perfectly symmetric situation. This will be modeled as $V_i ( x_i, x_j ) = V_j ( x_j, x_i )$. What will be the result of the uncoordinated choices of these two agents? Agent *i* will choose the value of $x_i$ which maximizes $V_i ( x_i, x_j )$. The resulting Nash equilibrium is characterized by the two first order conditions

(2) $$\frac{\partial V_1}{\partial x_1}(x_1, x_2) = 0 \quad \text{and} \quad \frac{\partial V_2}{\partial x_2}(x_2, x_1) = 0 .$$

It is natural to assume that $V_i$ is concave in $x_i$ . Therefore such an equilibrium exits for mild assumptions on activities $x_i$. Given the initial symmetry assumption, we should expect a symmetric equilibrium $x_1 = x^c = x_2$.

This characterization of the uncoordinated choices of the two agents can now be compared to the efficient choices of $x_i$, which we model as the choices that maximize $V_1 + V_2$. These are characterized by the following first order conditions:

(3) $$\frac{\partial V_1}{\partial x_1}(x_1, x_2) + \frac{\partial V_2}{\partial x_1}(x_2, x_1) = 0 \quad \text{and} \quad \frac{\partial V_2}{\partial x_2}(x_2, x_1) + \frac{\partial V_1}{\partial x_2}(x_1, x_2) = 0.$$

Given the symmetry assumption, a symmetric optimum is to be expected. Indeed it is again natural to assume that $V_1 + V_2$ is concave and that (3) admits a symmetric solution. Hence, the efficient choices of both agents are equal: $x_1 = x^s = x_2$.

It is now easy to see that $x^s > x^c$. The uncoordinated choices of the two agents lead to underutilization of the common resource. The intuition for this result was already mentioned above. In formal terms recall that the two equations in (2) correspond to the best response functions of the two agents. The equilibrium is the intersection point of these two response functions. Now compare (2) and (3) and concentrate on the respective first equations. We now argue that the graph of the solution to the first equation

in (3) must lie entirely above the best response function of agent 1. For any value of $x_2$, denote $x_1$ ($x_2$) the value of the best response function of agent 1. Due to the positive externality (assumption (1)), inserting these values on the left hand side of equation (3) yields a positive value. Furthermore, due to the concavity assumption, the left hand side decreases in $x_1$. Hence, to satisfy this equation the value of $x_1$ satisfying (3) for the momentarily fixed value of $x_2$ must be greater than $x_1$ ($x_2$), which is to say that the graph implied by (3) is above the best response function of agent 1. As symmetry implies that $x^s$ and $x^c$ are characterized by the respective intersection point of these two graphs with the 45 degree line, it follows immediately that $x^s > x^c$.

Hence, we have derived the quite general result that the uncoordinated exercise of exclusion rights leads to underutilization of a common resource.

### *2.2. The Duality of "Use" and "Exclusion" Rights*

Before we proceed to variations of the anticommons model, let us devote some brief remarks to the dual problem of the commons. As mentioned in the introduction of this section, the essential problem lies in the fact that the activities of the two agents using the common resource (e.g. the proverbial grazing of the cows of the agents) exert a negative externality on each other. We will therefore maintain all assumptions imposed above, with the essential exception that we now assume

(4) $$\frac{\partial V_i}{\partial x_j}(x_i, x_j) < 0 .$$

Using all the above arguments above, now leads to the converse result $x^s < x^c$. Hence with uncoordinated choices of the two agents the common resource is overutilized. This inefficiency can be overcome by internalizing the external effect with a transfer of rights to a common agent maximizing $V_1 + V_2$. Again this result is quite general.

The classic argument that exclusion rights can lead to the efficient use of the common resource is easy to see in the context of the typical textbook example. If the efficient number of cows of the two agents do not graze together on the common land, but the cows of each agent are concentrated on "his" half of the land, the right to exclude will lead each agent to have only the efficient number of cows grazing on his land. This is so because $x^s$ maximizes $V_1 ( x^s, x^s ) + V_2 ( x^s, x^s ) = 2\, V_1 ( x^s, x^s )$. Agent 1 obtains $V_1 ( x^s, x^s )$. Here a possibly mixed population of cows is allowed. With the separation of the cows it is natural to assume that the value to agent 1 satisfies $V_1^e( x ) = V_1 ( x, x )$. Hence the value of $x$ maximizing $V_1^e$ is again $x^s$.

Summarizing: what we have reestablished is the traditional result that a pure right to use a common resource leads to overutilization and that an additional right to exclude can lead to an efficient outcome.[9]

Let us now return to the anticommons problem. Here the problem

[9] Note that the framework above is much more general than the typical textbook treatment or the treatment in Buchanan and Yoon (2000), see *infra*, note 13. Furthermore some of the assumptions are to a large extent sufficient but not necessary to derive this result.

derives from a positive externality due to some complementary features of exclusive use rights. The right to exclude is embedded in the control that each agent exercises over the use of the common resource by other agents. In our model, exclusion rights can be formalized as follows. Let $y_i$ denote the extent of an exclusion right. If $x$ is the maximum possible extent of using a property, $y_i = x - x_i$ relates the extent of exercising an exclusion right to the extent of allowing the use up to the extent of $x_i$. If $W_i ( y_i, y_j ) = V_i ( x_i, x_j )$, $W_i$ would inherit the concavity property from $V_i$ and would have first partial derivatives which have the inverse signs. This transformation of "use" rights into "exclusion" rights would therefore leave the qualitative nature of the general result intact.

Our dual model of property reveals that the private incentives of users (commons case) and excluders (anticommons case) do not capture the external effects of their individual decisions. This leads to an excessive level of use or exclusion, with the symmetric results of overutilization (commons) and underutilization (anticommons) of the joint property.

The above model of "use" and "exclusion" rights has a parallel formulation where the two agents control the prices of their rights of use or exclusion, $p_i, p_j$ , instead of their quantities, $x_i, x_j$. Such a dual version is analytically easier to represent if the two property rights are indivisible and strict complements.[10] Let $p_i$ denote the price which agent $i$ asks for giving up his right to exclude. Let $V_i ( p_i, p_j )$ denote the value which agent $i$

[10] Exclusivity of property rights are often seen as a prerequisite of selling the property right. With the transfer of the property the right to exclude is transferred as well. In this view a price of some property can also be seen as a price for the right to exclude others from using the property. This enables another variation of modeling the anticommons problem which is again a dual form of the first version.

derives from selling his right. As the two rights are, by assumption, complements, it is natural to assume

$$(5) \qquad \frac{\partial V_i}{\partial p_j}(p_i, p_j) < 0 .$$

Analytically this corresponds directly to the problem of the commons. In the commons problem, the external effects of the "use" decisions result in over-utilization of the common resource. In the present setting, the external effects of the "exclusion" decision generate higher than efficient prices, with a resulting under-utilization of the common resource. In this form, the suggested price-driven model of the anticommons is the general version of the example contemplated by Buchanan and Yoon (2000).[11]

Our general treatment is helpful in at least two respects. First it

[11] For illustrative purposes it might be helpful to mention the example used by Buchanan and Yoon (2000). The authors consider the case of a common resource – a parking lot – jointly owned by two individuals. The two joint owners have autonomous exclusion rights. This implies that a third party who wishes to utilize the parking lot needs to obtain the consent of both co-owners. In their example, users have to purchase two tickets (one from each agent) at a price of $p_i$. The value of a user is $a - Q$, where $Q$ denotes the number of users. Note that the efficient number of users is therefore obtained by maximizing $Q(a - Q)$ which gives the value $Q^s = a/2$. Note also that one agent owning the parking lot would choose the price $p^m = a/2$. (Each user pays the price $p = a - Q$, hence profits are $p(a - p)$ and the maximizing price is $a/2$.). Therefore this monopolist just chooses the efficient price. If the two agents charge prices without coordination among themselves, $p_1$ and $p_2$ respectively, the number of users has to satisfy $p_1 + p_2 = a - Q$. Hence $p_1$ and $p_2$ result in a demand for parking $Q = a - p_1 - p_2$ . This in turn leads to profits for agent 1: $p_1 (a - p_1 - p_2)$. Let each agent charge the price which maximizes his profit. The corresponding first order condition for agent 1 is: $a - 2p_1 - p_2 = 0$. For agent 2 an analogous equation derives. This leads to equilibrium values of $p_1 = p_2 = a/3$ or $p_1 + p_2 = 2a/3$. Hence uncoordinated choices result in a higher price and therefore underutilization of the parking lot.

allows, but does not require, strict complementarity. The two exclusionary rights may be partial (or less-than-perfect complements). The Buchanan and Yoon (2000) article assumes strict complementarity and thus represents a special case of our general model. Cases of partial exclusion rights are conceivable in real life property relations. One can think of several situations where the encumbrance of a third party exclusion right reduces, yet does not eliminate, the right of use (and the value) of the burdened property. More generally, one can think of various hypotheses of less-than-perfect complementarity between the two rights.

In this way, the cases of strict complementarity and perfect substitution between the rights of the joint owners can be seen as the dual limit points along a continuum centered at the normal case of unified property, characterized by the perfect conformity between use and exclusion rights. In the normalized case of unified property, the unified owner fully internalizes the costs and benefits of the use and exclusion rights of his property.

The relevant variable along the commons-anticommons continuum is given by the degree of substitutability, or complementarity, between the various components of the property right. In the commons case, the use rights are substitutes with respect to the residual value of the property (e.g., the reduction in the use of any of the joint owners is sufficient to increase the residual value of the property). In the anticommons case, the exclusion rights are perfect complements with respect to the valued use of the property (e.g., the consent of all exclusion right holders is necessary for any use of the joint property).

Commons and anticommons problems are thus shown to be the

consequence of a dysfunctional bundling or fragmentation of property rights. The presence of external effects in the decisions of the right holders causes deadweight losses that are monotonically increasing in complementarity of use and exclusion rights.

Second, our dual model unveils the similar effects of utilizing price and quantity as control variables. The more convenient formalization in terms of prices instead of activities generates qualitatively analogous results. As long as large activities correspond to low prices, as in the usual case where both entities are related by a downward-sloping demand relationship, both formalizations are dual to each other. Note that the example satisfies all assumptions made under the heading of the problem of the commons. Hence there are two duality relations of interest: the relationship between activities and prices and the relationship between the problem of the commons and that of the anticommons.

| | **SUBSTITUTES** | **COMPLEMENTS** |
|---|---|---|
| **ACTIVITY** | "Use" Commons (Hardin Type) | "Exclusion" Anticommons (Michelman-Heller Type) |
| **PRICE** | "Price" Commons (Bertrand Type) | "Price" Anticommons (Buchanan-Yoon Type) |

The price versions of the commons and anticommons can be analogized to situations of price-driven duopoly.[12] In the Buchanan and Yoon (2000) model, the anticommons sellers are pricing strict complements.[13] We can think of the dual case as a situation similar to a standard Bertrand (1883) duopoly case, where the sellers price homogeneous goods or perfect substitutes.

As shown in Section 2.2, the differentiating element between the

[12] Quite interestingly, the price version of the anticommons problem (Buchanan-Yoon type) is the dual of a price-driven duopoly case. For the sake of complete symmetry, we can imagine a hypothetical price-driven commons (Bertrand-type), where joint owners have independent authority to sell the common property and retain the full amount of the proceedings from the sale. In pricing the property in competition with one another, the owners will have incentives to engage in a Bertrand-type price competition leading to a (private) marginal cost pricing of the common property.

[13] The original formulation of the problem of independent pricing of complementary goods is attributable to the Austrian economist Bohm-Bawerk (1884), where in Chapter IX of his book he discusses the problem of valuation and pricing of perfect complements. Morgenstern (1972), citing Bohm-Bawerk, considers the popular example of the valuation of right shoes and left shoes, introducing the idea of the "closing unit" (i.e., the unit that finishes out the pair), bringing value to its existing strict complement. In Morgenstern's endowment model, if an individual has $m$ left shoes and $n$ right ones with $n > m$, his or her reservation price for each of $n - m$ left shoes is the value of a pair and for each left shoe beyond that number it is zero. Likewise, the reservation price for any additional right shoe is zero given the endowment.

commons and anticommons cases is found in the cross-price effect of the two goods.

In the (Hardin type) commons case the activities are substitutes and the cross activity effect is negative, given the negative externalities imposed on the other users. In the (Michelman-Heller type) anticommons, the goods are complements and the cross activity effect is positive, given the positive externality of an increase in the supply of a complementary good. The same duality holds in the case of price-driven commons and anticommons. In the (Bertrand type) price commons case the two goods are substitutes and the cross price effect is positive. In the (Buchanan-Yoon type) price anticommons case, the goods are perfect complements and the cross price effect is negative.

It is important to point out that, in both price and activity-driven scenarios, commons and anticommons cases are dual to each other and all four situations represent limit points along a continuum centered around the "normalized" case of two independent goods with zero cross price elasticity. Such normalized case characterizes our definition of a unified and conforming property.

### *2.3. Horizontal and Vertical Anticommons*

In thinking of real life illustrations of non conformity between use and exclusion rights, two distinct cases should be further distinguished.

First, we can think of situations were the exclusion rights are exercised simultaneously and independently by the various right holders. We shall refer to these cases as "horizontal" anticommons situations. This

may involve two agents who are linked in a horizontal relationship, such as multiple co-owners with cross-veto powers on other members' use of a common resource.[14] These situations are characterized by the aspect that both agents contribute rights on the same level of a value chain.

Second, we can think of situations where the exclusion rights are in a vertical relationship with one another.[15] The exclusion rights are exercised sequentially by the various right holders. We shall refer to these cases as "vertical" anticommons. This may involve multiple parties in a hierarchy each of whom can exercise an exclusion or veto power over a given proposition. Real life examples can range from a bureaucracy-like situations where multiple permits need to be acquired in order to exercise a given activity, to a production process where a given producer purchases one essential input from a monopolistic seller.[16]

Both horizontal and vertical anticommons problems are the consequence of non-conformity between use and exclusion rights. The results of the general case presented in Sections 2.1 and 2.2 are symmetric and fully descriptive of horizontal anticommons under conditions of initial symmetry. No such symmetry can be expected in vertical anticommons cases, due to the unavoidable structural asymmetry of the initial conditions

[14] More generally, one can think of multiple independent owners pursuing a project which requires the annexation of other individual's land or facing (with other individual owners in a similar position) the demand of a third party for their property rights.

[15] This is meant to refer to a situation where one of the agents wants to pursue a project and needs to obtain the right of the other agent to do so. A classical textbook example of the double marginalization problem was first formalized by Spengler (1950), where the retailer needs the right to use an intermediate input of some producer. See also, Tirole (1993: 174).

[16] On property rights and transaction costs, see Miceli (1996). One can think of various examples of administrative procedures (e.g. filings for building permits, etc.) with multiple administrative bodies (e.g., zoning, environmental, etc.) exercising control over a given

(e.g., sequential moves of agents, upstream versus downstream firms, etc.) The remainder of this section will concentrate on the results of such asymmetric cases.

In vertical anticommons situations, suboptimal equilibria may occur due to the presence of external effects of quantity or price restrictions. Similar to the other anticommons situations, we assume that every agent benefits from other agents' activity. Hence there is a positive externality. Symmetrically, every agent occasions a negative externality to other agents when it reduces its own activity or increases its price.

As suggested above, situations of vertical anticommons are by definition asymmetric with respect to the two agents. As is well known (e.g. Hart, 1995), these situations give rise to hold-up problems which are a special form of the anticommons. We can thus think of the vertical anticommons as a generalized version of the traditional hold-up problem (e.g., Hart, 1995).

Consider two independent firms (or individuals), one located downstream and the other upstream. The upstream firm 2 invests $x_2$ with costs $C_2(x_2)$. The downstream firm 1 bears costs of $C_1(x_1)$ relating to her investment. Both investments have a positive impact on the revenue of firm 1, $R(x_1, x_2)$. If both exclusive rights to determine the investment levels were united in one hand, such an agent would choose the levels maximizing

(6) $$W(x_1, x_2) = R(x_1, x_2) - C_1(x_1) - C_2(x_2) .$$

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proposal.

As long as these exclusive rights remain in the hands of the two agents respectively the agents have to agree on some sharing rule of the resulting profits. Let $U(x_1, x_2)$ be the amount which firm 1 agrees to pay to firm 2. In the hold-up literature, $U$ is modeled as the Nash-bargaining solution of the underlying bargaining situation. This implies the following value to the two agents:

$$(7) \qquad V_1(x_1, x_2) = R(x_1, x_2) - C_1(x_1) - U(x_1, x_2)$$
$$V_2(x_2, x_1) = U(x_1, x_2) - C_2(x_2).$$

Using the interpretation of $U$ as the outcome of the Nash-bargaining solution, we can impose the following assumptions. $U$ has positive first partial derivatives. Hence, the investments lead to a higher compensation for firm 2. Moreover, the impact of the investments in $x_2$ on the revenue of firm 1 is not fully reflected in $U$. Analytically this means that the first partial derivative of $U$ with respect to $x_2$ is smaller than this partial derivative of $R$. Finally, we assume that $V_i$ is concave in $x_i$ and the first and second cross partial derivatives of $V_i$ are positive. All these assumptions are satisfied in the typical hold-up model.

Now consider the uncoordinated choices of the two agents each choosing the level of investment maximizing his own value. The first order conditions for this problem read:

$$(8) \qquad \frac{\partial V_1}{\partial x_1} = \frac{\partial R}{\partial x_1}(x_1, x_2) - \frac{\partial C_1}{\partial x_1}(x_1) - \frac{\partial U}{\partial x_1}(x_1, x_2) = 0$$

(9) $$\frac{\partial V_2}{\partial x_2} = \frac{\partial U}{\partial x_2}(x_1, x_2) - \frac{\partial C_2}{\partial x_2}(x_2) = 0\,.$$

Compare these conditions to the ones which would be relevant if the investment decisions would be chosen by one agent:

(10) $$\frac{\partial R}{\partial x_1}(x_1, x_2) - \frac{\partial C_1}{\partial x_1}(x_1) = \frac{\partial R}{\partial x_2}(x_1, x_2) - \frac{\partial C_2}{\partial x_2}(x_2) = 0$$

Using the same arguments utilized in the previous section reveals that the best response function of firm 1 lies below the graph of the solution of the first equation in (10). The same holds true for the best response function of firm 2, with respect to the second equation in (10). Furthermore, both response functions and the graphs of the solution of equations (10) are upward sloping because of the positive second cross partial derivatives. This implies that the intersection point of the best response functions must lie strictly below the point characterized by (10). Hence, the resource or right that is controlled by the respective exclusion rights of the two firms is underutilized, compared to the unified ownership alternative.

The vertical anticommons problem thus unveils the cost of vertical fragmentation of use and exclusion rights, as manifested in the deadweight loss resulting from the uncoordinated action of the two vertical right holders. The result parallels and generalizes the case of unexploited investment opportunities of two firms faced with a hold-up problem in an investment decision.

Again, we have the result that the non conformity between use and exclusion rights over a resource leads to a suboptimal use of the resource. In exercising non-conforming exclusion rights, firms and individuals do not take into account the external effects of their decisions. In the specific case of vertical anticommons, the misalignment is due to the presence of positive externalities that are not captured in the calculus of interests of the upstream excluders, leading to the underutilization of the resource.

These results are the consequence of the fact that neither party has an opportunity to internalize the full benefit of his or her activity. This is implied by the fact that none of the investing parties obtains the full increment of the resulting revenue from an increase in investment, due to the bargaining process. Therefore both invest less than the efficient amounts.

Analogous results are obtained when considering the equilibrium outcomes of price-driven restrictions. Similar to the hypothesis of quantity (or activity) restrictions, we assume the presence of positive externalities between the activities of the upstream and downstream agents. In turn, if we assume downward-sloping demand curves, this implies that every agent occasions a negative externality to the other agents when increasing the price of its own resource or right.

In this vertical anticommons setting, the two agents' independent choice of prices can thus be analogized to a double marginalization problem. The well known result of double marginalization is one of suboptimal supply. Likewise, the vertical fragmentation of decision rights gives rise to underutilization of resources in an anticommons setting. The general formulation of the vertical anticommons problem in price terms

could proceed along the lines of the hold-up problem illustrated above. The choice of model for the illustration of anticommons problems obviously hinges in essential ways on the type of application under consideration. Nevertheless, the general conclusions remain quite robust for both: (a) horizontal and vertical cases, and (b) price-driven and activity-driven forms of competition between the two right holders.

In all the four categories contemplated above (i.e, in both activity and price versions of the horizontal and vertical anticommons), the problem of underutilization is exacerbated if the right is fragmented into more than two exclusion rights, with more than two agents deciding independently on their activity or price (Schulz, 2000).[17]

## 3. Unified Property and the Asymmetric Coase Theorem

Anticommons situations are characterized by asymmetric transaction costs. An anticommons problem results from a lack of conformity between use and exclusion rights or, more generally, from the dimemberment of two or more complementary elements of a property right.

In the previous section, we showed that anticommons are the consequence of a dysfunctional fragmentation of a property right, where the

[17] Buchanan and Yoon (2000) show that an increase in the number of agents with exclusionary rights enhances the problem of underutilization in their price-driven anticommons example. In more general form, Schulz (2000) shows that similar results are obtained in a quantity-driven anticommons setting. The results are consistent with the exacerbation of commons problem with an increase in the number of users. E.g., in the symmetrical commons case, the Libecap and Wiggins (1984) study on common pool oil resources documented the positive correlation between the number of involved parties and the preemptive exploitation of the common pool resource.

nature of the fragmentation, as opposed to the mere extent of it, has a direct impact on the resulting deadweight loss.[18] Transaction costs increase monotonically in both (a) the extent of fragmentation; and (b) the synergies and complementarities between the property fragments.

When transaction costs and strategic behavior by multiple owners with rights of exclusion prevent the successful bundling of complementary inputs into value enhancing opportunities, potential value may be wasted. Here dawns the vice of the anticommons.

### *3.1 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.[19] 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, reaggregation into clusters through voluntary transactions will maximize 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

[18] In the existing literature, the expression "partitioning of property rights" refers conjunctively to spatial and functional forms of fragmentation. See, e.g., Alchian (1977) describing situations when several people each possess some portion of the rights to use the land. He also provides examples of private land-use arrangements such as servitudes (e.g. the right to grow wheat on it, to dump ashes over it, etc.).

[19] Coase (1976). See also on attenuation and partitioning of property rights, Eggertson (1990b: 38-39).

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 for the original fragmentation of the right.[20] 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 Sections 2.1 and 2.3, multiple non-conforming co-owners are faced with a strategic problem, given the interdependence of their decisions. These strategic costs increase the transaction costs of any attempted reunification of non-conforming fragments into a unified bundle.

The dysfunctional dismemberment of property rights thus introduces an asymmetry in the positive-transaction-cost environment of the normative Coase theorem, with a consequential one-directional stickiness in the reallocation of property rights.[21]

We will examine this problem through a revised version of the normative Coase theorem, which contemplates the choice of optimal default rules in the presence of asymmetric transaction costs. According to the normative Coase theorem, in the presence of positive transaction costs, the efficiency of the final allocation is not independent from the choice of the legal rule, and the preferable initial assignment of rights is that which

[20] It is often harder to regenerate separated bundles than to fragmentize them. Heller (1999) cites the fairy tale of Humpty Dumpty to illustrate his point. When Humpty Dumpty is shattered into 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.

[21] Non conformity between use and exclusion rights (and more generally, between any two complementary elements of a property right) often give rise to asymmetric transaction and strategic costs.

minimizes the effects of such transaction costs. When two or more parties have conflicting interests in the same resource, the law must initially decide which party shall prevail, i.e., which party shall receive the entitlement. Once the entitlement decision is made, the law must decide how the entitlement is to be protected and whether it can be transferred (Calabresi and Melamed, 1972).[22]

### *3.2 Use and Exclusion Rights: The Choice of Optimal Remedies*

By articulating the problem of non-conforming property rights in terms of choice of optimal remedy, we can consider the alternative solutions generally denoted as property-type, liability-type, or inalienability-type rules. According to these well known partitions, entitlements can be protected by property rules (transfer of the entitlement involves a voluntary sale by its holder), liability rules (the entitlement may be taken by another party if he is willing to pay an objectively determined value for it), or rules of inalienability (transfer of the entitlement is not permitted, even between a willing seller and a willing buyer).

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

[22] Calabresi and Melamed (1972) outline how, given the reality of transaction costs, an economic efficiency approach selects one allocation of entitlements over another.

efficient reallocations of rights. Likewise, 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.[23]

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.

Quite interestingly, the asymmetry 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 efficiency hypothesis would suggest that in the presence of asymmetric strategic and transactional impediments legal systems may offer a dichotomous regulation of legal relationships. Such rules would take into account the "directional"

[23] 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.

transaction costs (i.e., the costs of moving from a specific initial allocation to a different allocation) as opposed to the "relational" transaction cost (i.e., the total or average costs of reallocating rights within a given relationship).

The 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 grant a less extensive property-type protection in favor of non-conforming property arrangements. Under most normative criteria, the risk of anticommons deadweight losses would fall short of justifying the use of inalienability-type rules.[24] The presence of one-directional transaction and strategic costs would justify a relatively more liberal use of liability-type remedies. More specifically, 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. 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

[24] 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.

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 may justify the activation of reunification mechanisms to overcome the asymmetric transaction costs occasioned by non-conforming property rights.

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 consists of a normative proposition and a testable hypothesis.

The normative proposition offers a rationale for the selective and asymmetric use of remedies to compensate for the one-directional stickiness of the voluntary exchange.

The positive hypothesis follows a similar logic, suggesting that courts and legislators, consciously or unconsciously, 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 asymmetric transaction costs induced by right fragmentation and select rules designed to minimize the total deadweight losses of property fragmentation.

In the following section we will briefly discuss some of the areas of

the law where our proposition and hypothesis can be applied.

## 4. Applications

Up to this point we have defined the anticommons, placed it within a dual model of property rights and provided a formalization to illustrate its ramifications. We will now consider a list of possible areas of application of the positive hypothesis that legal systems account for the asymmetric effects of property fragmentation when selecting appropriate remedies.

Generally speaking, anticommons problems emerge when a valuable resource is divided into non-conforming fragments with foregone complementarities. When a value enhancing opportunity arises which allows for 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 positive transaction and strategic costs. According to our working hypothesis, when considering the optimal choice of rules and the optimal structure of remedies, legal systems take into account the asymmetric transaction costs induced by right fragmentation and select rules designed to minimize the total deadweight losses of dysfunctional property fragmentation.

### *4.1 Dual Remedies for a Unified Property*

Several rules and doctrines in the field of real property can be

evaluated in light of the positive hypothesis that legal systems account for the asymmetric effects of property fragmentation when considering the optimal choice of rules.

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. The attachment of promises to land, such as servitudes,[25] creates user rights in a property resource and as such may be regarded as a partitioning of property rights. When multiple co-owners attain rights of exclusion, rebundling the various fragmented pieces proves too difficult. If, in such a situation, a value-enhancing opportunity arises which requires a unified use of the fragmented land rights, a problem of wasteful underusage may develop. The specific characteristics of servitudes, whereby burdens on land may run with the land in perpetuity, amplifies the danger of anticommons waste. 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 concern in common law, prediality[26] and the *numerus clausus*[27] principles in civil law, have served as

[25] We apply the term "servitudes" here to refer to the three types of land-use arrangements that may run with the land: easements, real covenants and equitable servitudes.
[26] The requirement of prediality (art. 637 C.C. in Belgium and France, art. 646 Louisiana code) holds that only land-promises which 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.
[27] 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.

instruments to limit the cases of dysfunctional fragmentation.

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.[28] 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.[29]

In this sense, dual remedies can be seen as instrumental to the stability of unified property. Our efficiency hypothesis finds confirmation in the more conservative use of property-type protection in the case of personal, non-conforming property arrangements. In a related paper, the present authors 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 (Depoorter, Parisi and Schulz, 2000). 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,

[28] 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.

[29] By the end of the nineteenth century, English law had also consolidated a principle of freedom of contract which 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

governed by categories and rules of contract law, with liability-type protection under most circumstances.[30] 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.[31]

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 short-sighted private owners in the partition of their property.

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

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remedial protection. (Parisi, 1994).

[30] 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, Parisi and Schulz (2000).

[31] 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

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).[32] 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. Owners of fragmented property often necessitate the consent of other fragmented owners in order to exercise valuable use rights over the entire property. The bargaining process is often impeded by high transaction costs, exacerbated by the strategic behavior and hold-up strategies of the co-owners, each attempting to appropriate the larger share of the available surplus.

### *4.2 Tragic Choices in Intellectual Property*

Several areas of intellectual property are gradually shifting away from a commons regime toward a private property regime. Under the older commons regime, much of the knowledge was freely available in the public domain. Given the public good nature of those discoveries and information, research was publicly funded. Such information nowadays enjoys the

existing fragments will be abandoned so that the state can afterwards rebundle them.

[32] *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.

increased protection of intellectual property laws. The protection provided by intellectual property laws has gradually shifted the balance towards privatization of research. Research is conducted on a competitive basis by research institutions and private firms. Whenever possible, the results of such research are generally patented and later licensed or traded in the marketplace. This, in turn, allows research firms and institutions to capture some of the value of their discoveries, with increased incentives for valuable research.

The transition from commons to privatization, while greatly beneficial for the creation of private incentives for research, generates a gradual proliferation of exclusion rights with resulting anticommons problems. As shown in Section 2 of this paper, anticommons problems are likely to be pervasive in the production of goods requiring highly complementary inputs supplied by independent parties. For example, the use of production technology protected by multiple third party patents often occasions a fragmentation that can be analogized to the cases of non-conforming property discussed above. In this context, Heller and Eisenberg (1999) apply the anticommons concept to patent technology. They argue that granting too many patent rights in biomedical research may delay the discovery and production of life-saving products. Product developers are often faced with a difficult decision problem. Before they can develop new products and bring them to the market, they need to solicit licenses from various patent holders. In the presence of positive externalities between upstream patent holders and downstream product developers, a situation parallel to the vertical anticommons setting described in Section 2.3 above, may emerge. The failure of parties to take into account these externalities

may generate anticommons deadweight losses. Privatization of research must, in this respect, be attentive to the need to promote research in the upstream market without delaying the discovery and implementation of downstream products.

Several other applications of the anticommons can be uncovered in the field of intellectual property law. Recently, copyright scholars have suggested that with computer technology, the transaction costs necessary for copyright transfer are decreasing.[33] This allegedly eliminates the need to invoke fair use doctrines to allow transfers and uses that would otherwise be impeded by the transaction costs of the copyright transfer or license. On this point, Depoorter and Parisi (2000) argue that there are limits to such transaction cost based argument. If transaction costs are the dominant economic justification of "fair use" doctrines, an exogenous reduction of such transaction costs would reduce the domain and application of fair use defenses. According to the emerging view, in an ideal zero-transaction cost world, third party use of copyrighted material could only take place with the express consent of the copyright holder. The power of disposition of the copyright holder would implicitly include his right to veto uses, without fair use defenses of any sort. It can be held that, in light of the anticommons insight, fair use doctrines retain a valid efficiency justification even in a zero transaction cost environment. Fair use defenses can be regarded as instrumental to minimizing the welfare losses occasioned by strategic behavior of the copyright holders. Even if copyright licenses can be transferred at no cost (for instance, in a 'click and pay' frictionless

[33] Information Infrastructure Task Force, Intellectual Property and the National Information Structure (1995); Merges (1997); Kitch (1999).

computer world), the strategic behavior of the copyright holders would still create possible deadweight losses.

Along similar lines, Depoorter and Parisi (2000) suggest that various other intellectual property doctrines are best explained as rules for the prevention of anticommons deadweight losses. For example, the reluctance of some legal systems to grant legal protection to artists' moral rights may be explained as an attempt to avoid vertical or horizontal anticommons situations, where artists and copyright holders would exercise hold-up or cross-veto strategies that could induce suboptimal uses of a work of art.

## 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.

Quite interestingly, these asymmetric transaction costs may explain the selective use of different remedies for the same entitlement or relationship. Asymmetric remedies offset the asymmetric frictions encountered in the transfer of rights. In this setting, we have formulated an efficiency hypothesis, suggesting that in the presence of asymmetric strategic and transactional impediments legal systems may provide a dichotomous treatment of legal relationships. Such rules would take into account the "directional" transaction costs (i.e., the costs of moving from a specific initial allocation to a different allocation) as opposed to the "relational" transaction cost (i.e., the total or average costs of reallocating rights within a given relationship).

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.

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