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FREEDOM OF CONTRACT AND THE LAWS OF ENTROPY

ABSTRACT: In this paper I consider the twofold relationship between freedom of contract and entropy in property. Recent literature on property fragmentation suggests that property is subject to a fundamental law of entropy, leading towards increasing property fragmentation. After considering the legal responses to the problem of entropy, I revisit the above debate considering the relevance of freedom of contract to achieve optimal outcomes in a world of imperfect information and positive transaction costs. In such a context, I discern two analytically distinct ways in which freedom of contract contributes to minimizing the problems of entropy. I conclude that entropy is not an ontological problem, but is often the byproduct of the uncoordinated use of institutional and legal constraints on free contractual arrangements.

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.[2] 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.

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[2] Ronald H. Coase. The Problem of Social Cost, 3 J.L. & Econ. 1 (1960). See also on attenuation and partitioning of property rights, Thrainn Eggertsson, Economic Behavior and Institutions 38-39 (1990).

This paper considers the normative corollaries of this basic theorem when property arrangements are carried out in the real world, where there are positive transaction and strategic costs. In Section 1, I consider the recent literature on property fragmentation, and the proposition that property is subject to a fundamental law of entropy. In the property context, entropy induces a one-directional bias which leads towards increasing property fragmentation. I contrast the zero transaction costs world with one of entropy (i.e. a world characterized by positive, asymmetric transaction and strategic costs). In Section 2, I consider the legal responses to the problem of entropy. The comparative legal analysis of property and contract rules reveals the existence of different remedial solutions, which can be tentatively grouped along the well-known categories of property-type, liability-type and inalienability rules. In Section 3, I revisit the contract versus property dichotomy often observed in the modern legal systems of the world, where freedom of contract finds a limit in the categories of property, examining the main rationales put forth in support of the distinction. In revisiting the above debate through economic lenses, I consider the role of remedies and the ability of freedom of contract to achieve optimal outcomes in a world of imperfect information and positive transaction costs. In such context, I discern two analytically distinct ways in which freedom of contract contributes to minimizing the problems of entropy. First, I consider the case of constrained freedom of contract, in which remedies are exogenously set by the legal system, where parties only have freedom to choose the level of property fragmentation, but no freedom to select the applicable laws and remedies that will govern their contractual or property arrangement. Second, I consider the ideal case in which the parties enjoy unconstrained freedom of contract, such that they can freely select both the content of their arrangement as well as the legal rules and remedies that will apply to their arrangement. In Section 4, I

consider the relative merits of alternative forms of remedial protection and the residual role of legal intervention in the peculiar context of entropy. The analysis unveils the non-ontological nature of entropy, as suggested by the fact that in an ideal world of unconstrained freedom of contract, private and social incentives would converge, leading to the adoption of a second-best level of fragmentation in a world of imperfect information.

1. Property Fragmentation and the Laws of Entropy

In this Section, I provide a formulation of the problem of property fragmentation. In Section 1.1, I begin with an intuitive explanation of the "entropy in property" metaphor.[3] In Section 1.2, I present an economic model to explain the economic forces that induce entropic fragmentation.[4]

1.1. Entropy in Property: Explaining the Metaphor

Building upon the recent literature on property fragmentation,[5] this article considers the proposition that property is subject to a fundamental law of entropy. I refer to the second law of thermodynamics, according to which every process that can occur spontaneously will go in one direction only and

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[3] The metaphor was first introduced in my paper "Entropy in Property," American Journal of Comparative Law, forthcoming.

[4] The model is drawn from F. Parisi, N. Schulz, and B. Depoorter, Duality in Property: Commons and Anticommons (University of Virginia Law and Economics Working Paper Series No. 00-08, 2000).

[5] *See* M.A. Heller, *The Tragedy of the Anticommons: Property in the Transistion from Marx to Markets*, 111 Harv. L. Rev. 621 (1998); J. Buchanan & Yong J. Yoon, *Symmetric Tragedies: Commons and Anticommons Property*, J.L. & Econ. 1 (2000); F. Parisi, *Entropy in Property*, Am. J. of Comp. Law (forthcoming).

will result in a release of energy that cannot be recaptured, so that the amount of entropy in the universe will continually increase. In the property context, entropy induces a one-directional bias which leads towards increasing property fragmentation. The law of entropy further indicates that only in the purely abstract case of (both internally and externally) reversible transformations will the overall net change in entropy be zero. In the property context, this indicates that only in a world of zero transaction costs would there be no such tendency towards fragmentation.

The economic forces that induce entropy in property are quite straightforward.[6] Property division creates one-directional inertia: unlike ordinary transfers of rights from one individual to another, reunifying fragmented property rights usually involves transaction and strategic costs higher than those incurred in the original deal.[7] Consider the case of unified property as the starting point: A single owner faces no strategic costs when deciding how to partition his property. Conversely, the reunification of fragmented rights requires the participation of multiple parties, with an unavoidable increase in transaction and strategic costs.

Thus the move from unified property to fragmented property and vice-versa poses an interesting situation of asymmetric transaction costs. The

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[6] Heller cites the fairy tale of Humpty Dumpty to illustrate his point. When Humpty Dumpty is shattered into pieces even all the king's horses and all the king's men can't re-assemble him, which stands in contrast to the ease with which he broke into pieces in the first place. M.A. Heller, *The Boundaries of Private Property*, 108 Yale L. Rev. 1163-1223 (1999).

[7] As in the physical world, where it takes considerable additional energy to roll a rock back up a hill, after it has rolled down on its own, it takes considerable financial and legal effort to reunite property rights that have been split. Parisi et al., *supra* note ___ , observe that even reversing a simple property transaction can result in monopoly pricing by the buyer-turned-seller; reunifying property that has been split among multiple parties engenders even higher costs given the increased difficulty of coordination among the parties.

presence of such asymmetry is due to the fact that fragmented owners are faced with a strategic problem, given the interdependence of their decisions. The equilibrium pricing (or quantity supply) of fragmented owners impedes the optimal reunification of non-conforming fragments into a unified bundle.

1.2. A Model of Entropy and Property Fragmentation

In the context of property, Posner first recognized the costs of excessive property fragmentation.[8] Heller most recently made the argument that it is often harder to regenerate separated bundles than to fragment them[9]; Buchanan-Yoon and Parisi-Schulz-Depoorter restated this thesis with formal economic models.[10]

For the purpose of illustrating the problem of entropy, we can thus briefly restate the results of such literature, considering a simple model of property rights fragmentation. Suppose that agent 1 owns a large estate of land which he uses as a commercial farm. Agent 2 acquires from agent 1 the right to use the estate as a recreational hunting, and agent 3 acquires from the same owner the right to use the estate as a horseback riding resort. As a result, the unitary property right is fragmented, giving the three agents partial property rights and reciprocal exclusion privileges. The property right of agent 1 is constrained by the real interests acquired by agents 2 and 3. Agent 1 holds a right to exclude any use of agent 2 and 3 other than recreational hunting and horseback riding. Agents 2 and 3 conversely hold a right to exclude any use of

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[8] "[H]aving too many sticks in the bundle of rights that is property increases the costs of transferring property." Posner, Economic Analysis of Law 76 (5th ed., 1998).

[9] Heller, *supra* note___.

[10] Buchanan et al., *supra* note ___; Parisi et al., *supra* note ___.

the land by agent 1, which is in conflict with their respective rights. In this sense, the previously unitary proprietary interest over the land is now fragmented. Such fragmentation will remain beneficial for all parties as long as the mixed use of the land for the respective activities of the fragmented owners remains the most valuable allocation of the land for the parties.

Suppose now that a third party sees an opportunity which would generate more value than the current use. Take, for example, the construction of a hotel resort on a parcel of the larger estate. The construction of the hotel would obviously compress the property rights held by the three agents. Each agent could thus withhold his consent to the transformation of the land and exercise his veto right impeding the value-enhancing transformation. As the opportunity is supposed to be more valuable than the current use, it would however be rational for the various agents to agree to the proposed transformation. Yet, each fragmented owner would rationally attempt to maximize his profit from the sale of his partial property right. We should thus consider the likely price mechanism that would lead to the development of the land and compare it to the alternative scenario of a property transformation controlled by a single unified property owner.

An application of the Buchanan and Yoon model could illustrate our problem.[11] Imagine that, in our case of fragmented ownership, a third party developer has to purchase development rights (e.g., a land lease) from the three joint property owners at a price of p_i. Let's consider that the value of the land lease is given by a constant value, V, which is subject to depletion, according to the number of leases, Q, issued for comparable development projects on the jointly held estate, i.e., $V - Q$. Note that the efficient number of land lease developments is therefore obtained by maximizing $Q\,(V - Q)$ which gives the

[11] Buchanan and Yoon, *supra*, note___.

value $Q^s = V/2$. Note also that if the land were held in fee simple by only one unified owner, the land lease would be offered at the price $p^m = V/2$ (i.e., each lessee pays the price $p = V - Q$, hence profits are $p\,(V - p)$ and the maximizing lease price is $V/2$). That is to say, given the full internalization of the cross price effects of each property fragment, the unified property owner would choose the efficient price.

Let's compare the hypothetical single agent (unified owner) case to our case where partial property rights over the estate are held by different individuals. Recalling our example, let's imagine that the three fragmented owners of the estate charge prices for the lease of their property fragment without coordination among themselves, p_1, p_2 and p_3 respectively. In this setting, the number of lessees has to satisfy $p_1 + p_2 + p_3 = V - Q$. Hence p_1, p_2 and p_3 result in a demand for development rights over the land equal to $Q = V - p_1 - p_2 - p_3$. This in turn leads to profits for agent 1: $p_1\,(V - p_1 - p_2 - p_3)$. Let each agent charge the price which maximizes his profit. The corresponding first order condition for agent 1 is: $V - 2\,p_1 - p_2 - p_3 = 0$. For agents 2 and 3 analogous equations can be derived. This leads to equilibrium values of $p_1 = p_2 = p_3 = V/4$ or $p_1 + p_2 + p_3 = 3V/4$.

Hence, the uncoordinated pricing of the three fragmented property owners result in a higher total cost of land leases and therefore to a potential underutilization of the land, beyond what any one of them would do as unified owners of the estate, in order to maximize their own profit. Interestingly, the "competitive" (i.e., fragmented) supply of land development rights leads to higher prices than those that would be charged by a single "monopolistic" (i.e., unified) owner.

As pointed out by Schulz, Parisi and Depoorter, the differences between the two equilibria are due to the presence of negative externalities in

the independent choices of the fragmented property rights.[12] This result should not come as a surprise. The position of multiple property owners in the face of a new opportunity, which requires a reunification of their fragmented property rights, creates a strategic problem similar to the well-known hold-up problem.[13] Sub-optimal final use of resources may result from such fragmentation.

At this point, we should note that identical results would obtain if the three agents were each owners of neighboring parcels of land and the construction of the hotel necessitated the physical reunification of their lots. The results, in fact, do not strictly depend on the legal or physical nature of property fragmentation. In this context, property fragmentation merely indicates the existence of multiple rights held by different individuals to control or veto a change in the use of their land. As shown in our example, sub-optimal final allocations of resources may be the consequence of fragmented decision rights, even when such fragmentation concerns a unitary physical asset.[14] Even in the face of value enhancing opportunities, multiple right holders may face incentives to employ their veto power to maximize the private return from the joint enterprise. The combined effect of the various agents' strategies leads to an inefficient outcome.[15]

As pointed out by Schulz-Parisi-Depoorter, the outcome of this model of fragmented property is perhaps most easily understood if it is further

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[12] Schulz et al., *supra*, note___.

[13] See, Hart, Oliver D., Firms, Contracts and Financial Structure, Oxford, Oxford Clarendon Press (1995).

[14] With respect to the best use, rights may then turn out to be overly fragmented even though at the level of the objects themselves no fragmentation is visible.

[15] We should note here that exclusion rights – the lack of which is at the origin of the well-known commons problem – give origin to anticommons situations if simultaneously granted to multiple individuals.

recognized that each agent exerts a positive externality on the other agent.[16] Hence, the above result is consistent with conventional wisdom, according to which in situations of positive externalities the use of some resource is less than optimal.

The above model of property fragmentation can be extended to show that an increase in the number of fragmentation giving property owners independent control on the price of their property right exacerbates the extent of final underutilization of the resource. Recalling our example, let's imagine that the estate was partitioned among a larger number of agents, *n*. Let's further assume that the property fragments are controlled by independent agents and that the development of the land necessitates the agreement of all *n* individuals.[17] What would be the equilibrium price of the land lease if the fragmented property owners are pricing their fragments independently from one another?

The solution to this *n* person pricing problem comes from a generalization of the solution outlined above. In the case of *n* property owners charging prices p_i without coordination among themselves, the number of land leases on the property has to satisfy $\sum p_i \{ i = 1 \ldots n\} = V - Q$. Hence the

[16] As shown by Schulz, Parisi and Depoorter, Fragmentation in Property: Towards a General Model, in *Journal of Institutional and Theoretical Economics* (forthcoming), the sources of externalities in an anticommons problem are twofold. First, there are static (or current) externalities, in which the exercise of a right of exclusion by one individual reduces or eliminates the value of similar rights held by other individuals. In our example, we can think of this externality as the cross price effect of the various property owners' price increase on the value and marketability of the other property fragments. Secondly, the withholding of productive resources may create dynamic (or future) externalities, because the underuse of productive inputs today bears its consequences into the future. Thus, the current underutilization of property may have long term effects on the future capital value of such land. The independent pricing of present property fragments takes only partial account of such long term effects.

[17] As we said, the term "fragments" in this context refers alternatively to cases of legal or physical fragmentation of the resource.

independent prices charged by the various fragmented owners for the development of the commercial resort, p_i, result in a demand for land leases $Q = V - \sum p_i \{ i = 1 \ldots n\}$. This in turn leads to profits for fragmented property owner 1: $p_1 (V - \sum p_i \{ i = 1 \ldots n\})$. Let each fragmented owner charge the price which maximizes his profit. The corresponding first order condition for owner 1 is: $V - 2 p_1 - \sum p_i \{ i = 1 \ldots n + 1\} = 0$, with similar first order conditions for all other fragmented property owners. This leads to equilibrium prices for all property fragments of $p_i = V / (n + 1)$, with a total cost for the land developer of $\sum p_i \{ i = 1 \ldots n\} = n V/ (n + 1)$.

The analysis shows that the severity of the deadweight losses from dysfunctional property fragmentation increases monotonically with the number of independent fragmented owners. The larger the number of individuals who can independently price an essential input for the land development project, the higher the equilibrium price that each of these individuals will demand for his own fragment. At the margin, as the number of fragmented owners approaches very large numbers (or infinity), complete abandonment of the land will result.

2. Entropy and the Legal Remedies for Unified Property

Entropy occurs when a scarce resource is divided into non-conforming fragments, thereby foregoing complementarities.[18] Initially, it might look reasonable to divide the property. Later, however, an opportunity might arise

[18] 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. However, besides this paradigmatic case, we can easily think of other essential attributes of a property right that are meant to be under the control of a single individual. Entropy losses may emerge when such a dysfunctional separation occurs.

to exploit the complementarities that used to exist between different parts of the now fragmented property. The initial choice turns out to be suboptimal, given the greater costs of reunification.[19] Legal systems consider these asymmetric frictions, but withstand entropy problems with different legal instruments and dogmatic constructs.

Three main approaches generally are employed in this context: (a) preventive approach (i.e., inalienability-type rules); (b) balancing approach (i.e., selective use of property-type and liability-type rules); (c) corrective approach (i.e., other ex post correctives).

2.1 Inalienability-Type Constraints for Unified Property

A first group of remedies for entropy can be classified under the heading of "ex ante" or preventive approaches. In this context, it is important to note that there is a peculiar tension between the principles governing property and those related to contracts.[20] Traditional contract theory grants full autonomy to the parties and allows them to customize their contractual

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[19] There is no static notion of optimal fragmentation. History has shown that what may have been an efficient property framework under certain social and economic circumstances may become suboptimal under different conditions and vice-versa. Imagine the fragmentation of a large estate, such as a former farm, into buildable lots, when the surrounding area consists of valuable small-acreage residential property. In such a 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. Policymakers cannot perfectly control the volatility of land development and the resulting changes in the optimal use of property. However, they may attempt to ensure that property maintains sufficient flexibility to adapt to the changing needs of the time.

[20] 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.

relationships as they see fit.[21] Yet property law limits contractual freedom by allowing only a closed list of standardized property forms and restricting the parties' autonomy in attempting to customize the content of property rights.[22] This dichotomous treatment grants the parties "freedom of contract" on the choice of content of their property transaction, but limits the contractual freedom of the parties with respect to the choice of judicial remedies and third party effects.[23]

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[21] The legal concept of freedom of contract emerged in the late 18th-early 19th centuries as an offspring of the ideal of economic and intellectual freedom espoused by liberal political theory. James R. Gordley, The Philosophical Origins of Modern Contract Doctrine (Oxford University Press, 1991). Continental European contract theory applied the notion of freedom of contract to a wide range of situations that are generally grouped under the three general headings of freedom of form, type, and object. By the end of the 19th 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 19th 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. *See* F. Parisi, *Private Property and Socal Cost*, 2 Eur. J.L. & Econ. 149-173 (1995).

[22] As mentioned above, these contractual freedoms are often grouped under three general headings in European contract theory, namely freedom of form, type, and object. Parisi, *supra* note ___. The freedom of type addresses issues of taxonomy in contractual arrangements. The thrust of this freedom is that parties to a contract are at liberty to forge new types of contracts outside of the standardized contractual types of the modern Civil law codes. In the history of contract law, *innominate* or atypical contracts are, indeed, defined as those contracts that do not fall within standard contractual types, and for which the law does not provide any specific set of rules designed for the particular transaction. These atypical contracts enjoy full enforcement by the legal system and are generally adjudicated on the basis of the general principles of contract law (often contained under the title "On Contracts in General" in European codes) and the specific choice of governing provisions agreed upon by the parties.

[23] Unlike standard form contracts, *numerus clausus* doctrines curtail the freedom of the parties to innovate and to go beyond available prototypes to tailor special arrangements appropriate to the circumstances. In short, property owners cannot opt out of these standard-form alternatives. Even though the parties can contractually agree to be bound by different rules in their relationship with one another, legal systems do not recognize

Several explanations have been offered for this dichotomy. One occasionally voiced argument is that the *permitted* property interests encompass *all possible* property interests.[24] This explanation, which has been referred to as the "absence of demand" rationale, obviously proves too much. If we had no demand for the creation of atypical property rights, the *numerus clausus* doctrine would have no reason to exist, or at least its abstract application would be uncontroversial. In real life, however, individuals do attempt to create alternative property interests, rendering such doctrines relevant and often controversial.

Another group of explanations suggests that the limits to commodification of property lie in the fact that property arrangements are opposable *erga omnes,* thus affecting third parties that were not in privity with the original contract, as suggested by the Latin maxim "*transit terra cum onere*" (i.e., burdens and encumbrances go with the land).[25] Most recently, Mattei[26] notes that, unlike personal contracts, property arrangements can have

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such contractual amendments as enforceable real rights.

[24] This argument is considered by Rudden in the context of the *numerus clausus* of property interests. Bernard Rudden, Economic Theory v. Property Law: The *Numerus Clausus* Problem, in Oxford Essays on Jurisprudence 239 (J. Eekelaar & J. Bell eds., 3d ed.

[25] Applying Wesley N. Hohfeld's conception of rights, Fundamental Legal Conceptions as Applied in Judicial Reasoning: And Other Legal Essays (Walter Wheeler Cook ed., 1923), Rudden, *supra* note ___, at 251-52, thinks that a fancy property right could "alter *for the worse* the legal position of people who did not consent thereto." Rudden illustrates his point with the following observation. Suppose Black owns Blackacre, and, next door, White owns Whiteacre. If White gives Black a right of way over Whiteacre, then that transaction imparts to Black a replica of White's claim that no one build on Whiteacre. Thus, in a transaction involving only Black and White, the legal position of the rest of the world is altered in that they now owe "Black a duty-not to build."

[26] Ugo Mattei, Basic Principles of Property Law 39 (2000).

essentially perpetual ramifications.[27] The need to limit the "permanent impact" of property rights over scarce resources justifies, in Mattei's view, the current boundaries of freedom of contract with respect to remedies in property. By the same token, these concerns in theory explain the common law rule against perpetuities and other rules that promote unity in property. These rules try to limit the impact of property fragmentation on future generations so that, even without a full-fledged *numerus clausus* doctrine, common law systems recognize the need to limit entropy in property.

Various economic rationales for the property versus contract dichotomy have also been examined and readily dismissed by legal scholars. For example, the marketability justification of restrictions on the fragmentation of property – related to the idea that the creation of atypical property rights would have the potential to hamper marketability of land – appears to be a self-defeating rationale.[28] The dominant effect of dysfunctional fragmentation of property would be to lower the value of the property: rational owners would be induced to discount the loss of value or marketability of land when deciding whether to fragment and market forces would thus serve as a natural limit to inefficient forms of property fragmentation.

In recent times, legal scholars have recently used transaction and information cost arguments to explain the examined doctrines of unified

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[27] Mattei, *supra* note ___, calls this effect the "permanent impact factor." The idea is that when property rights are created, everybody is bound to respect such rights, even if they are not in privity with the original parties. Conversely, when a mere contractual right is created, such agreement binds only the individuals who actually entered into the contract.

[28] Rudden, *supra* note ___, at 254, cites a quotation from Ginossar: "every real obligation risks creating an obstacle to the free circulation of things." Thus, fancies may be prohibited to reduce the difficulty and costs of transactions in general.

property. Most notably, Rose[29] suggests that limitations on the freedom of the parties to create atypical property rights are linked to the governmental function of record-keeping. This function is particularly relevant in the case of property because, unlike all other aspects of patrimonial private law, property has pervasive *erga omnes* effects that create a need for effective notice to third parties. Merrill and Smith[30] have offered the most recent variation on the information cost rationale, suggesting 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 respect their nature and content.[31]

These arguments reveal both the foundation and limits of the information cost explanation. If we could organize a public record sufficiently dependable to keep track of property rights, there would be no reason to limit their number.[32] Most generally, information cost explanations lose most of

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[29]Rose, Carol M. "What Government Can Do for Property (and Vice Versa)", in Nicholas Mercuro and Warren Samuels (eds.), The Fundamental Interrelationship between Government and Property, Connecticut: JAI Press Inc., (1999), pp. 209-222.

[30] Thomas Merrill and Henry Smith, Optimal Standardization in the Law of Property: The *Numerus Clausus* Principle, 110 Yale L.J. 1 (2000).

[31] Merril et al., *supra* note ___, at 8, set forth a positive theory of the *numerus clausus*, providing an explanation for why property rights, unlike contract rights, are restricted to a limited number of standardized forms, stating "The root of the difference ... stems from the in rem nature of property rights: When property rights are created, third parties must expend time and resources to determine the attributes of these rights, both to avoid violating them and to acquire them from present holders. The existence of unusual property rights increases the cost of processing information about all property rights. Those creating or transferring idiosyncratic property rights cannot always be expected to take these increases in measurement costs fully into account, making them a true externality. Standardization of property rights reduces these measurement costs."

[32] Mattei (pp. 91-92) pushes this argument to its logical conclusion, observing that the property owners' freedom to dispose of their property and to fashion new legal property regimes "should be safeguarded until the social signals that he or she conveys to the market are not ambiguous and capable of misleading the reliance of third

their cogency as new information technologies increase the possibility of real-time and inexpensive access to public records. Nevertheless, the strong presumption against judicial recognition of new forms of property retains its power across legal systems.

2.2 Balancing Approach and Selective Use of Remedies

A second group of solutions for entropy problems consists in the selective use of property-type and liability-type remedies. Quite interestingly, even legal systems that have been open to recognizing new forms of atypical property provide them less remedial protection.

In contrast to other real rights (e.g., affirmative or negative easements) at common law, atypical real rights (such as real covenants) are enforceable only with damages.[33] Indeed, although in many jurisdictions it is now accepted that covenants transfer with land, an individual still cannot obtain an injunction to enforce his rights even upon proof of a valid covenant. The right holder can obtain a judicial declaration of his rights, but the defendant can persist in the violation simply by paying damages.

The limited protection given to atypical (or innominate) rights still characterizes the modern-day law of remedies in both common law and civil law jurisdictions. Professors of property law often cite this fact as one of the many unexplained puzzles of their field,[34] assuming that availability of liability-type remedies for certain categories of real rights is merely

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parties."

[33] In case of a breach of a real covenant, for example, the dominant landowner can only obtain relief through damages.

[34] *See* William B. Stoebuck, *Running Covenants: An Analytical Primer*, 52 Wash. L. Rev. 861, 882-85 (1977).

coincidental. In a popular textbook on property, Dwyer and Menell,[35] observe that "because of one of the many historical accidents that plague property law, real covenants are enforced by a damages remedy only." I suggest that these anomalies are not merely happenstance.

As discussed above, the asymmetrical effects of entropy in property dictate that remedies should be determined based on the expected directional costs, as opposed to the average or total transaction costs in the contract or property relationship. This justifies a system that favors more liberal use of property-type remedies when redressing claims of owners of non-fragmented property and that requires limited liability-type protection in response to claims concerning dysfunctional property. This selective use of remedies is analogous to a gravitational force that can overcome entropy in property. These legal mechanisms promote the reunification of rights and privileges that should naturally be held by a single owner, given their complementarity. This reunification regenerates the natural conformity between the complementary attributes of a right (e.g., between use and exclusion rights), even though, because of the natural laws of entropy, the restoration of the *status quo ante* requires additional expenditures.[36]

Interestingly, most of these default reunification mechanisms do not apply with respect to typical property rights,[37] which, in fact, already are

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[35] John P. Dwyer and Peter S. Menell, Property Law and Policy: A Comparative Institutional Perspective 760 (1998).

[36] Restoring the original natural arrangement requires legal and transactional efforts (just like rolling the stone back up the hill requires physical efforts with an increased expenditure of energy). In short, after the reunification things may look like they did before, but the journey is not without social costs.

[37] Merrill and Smith, *supra* note ___, pose the interesting question as to why such preoccupations arise only with respect to atypical real rights. The authors' conclusion dismisses Heller's anticommons explanation of the *numerus clausus* doctrine and suggests that the goal of such rules is the minimization of information costs. Heller,

internally consistent, thereby eliminating the need to favor reunification over preserving the *status quo*. Conversely, non-conforming property arrangements (i.e., those that dismember the closely complementary attributes of a property right) are either (a) subject to time limitations, or (b) enjoy the effect of automatic reunification mechanisms discussed in the previous section. In addition, application of selective remedies can minimize the welfare loss occasioned by entropy.

Only substantial and systematic asymmetries in transaction costs, could justify the use of directional remedies.[38] Examples of such asymmetries include those produced by (a) structural attributes of the relationship; (b) an uneven number of parties on the buying and selling sides; or (c) asymmetric strategic incentives among the contracting parties. Whenever such systematic differences are expected, remedies might be chosen in order to minimize the expected social deadweight loss.

2.3 Ex Post Correctives for Entropy Problems

A third group of solutions for entropy problems consists in ex post remedial solutions. Such solutions create a "gravitational force," which facilitates the reunification of property fragments and terminates obscure,

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supra note ___.

[38] The implementation of a paradigm of "directional remedies" obviously requires *ex ante* information concerning the magnitude of directional costs. The choice of remedies undertaken in the previous section, in fact, refers to *ex ante* choices of optimal remedies. Remedies are selected on the basis of the expected directional costs, and would not be applicable in situations where no systematic directional differences can be expected. An *ex post* evaluation of such costs, while potentially improving upon the allocational efficiency, would increase the uncertainty of the available remedial protection for the current owners, reducing the incentives for value-enhancing investments for rational, risk-averse owners.

neglected, or outmoded property claims. In recent years, the proliferation of atypical property arrangements (such as private communities and residential subdivisions) has necessitated reunification mechanisms to deal with the pervasive risk of entropy. Whenever inalienability-type constraints have been relaxed, modern property law has introduced a variety of solutions for disposing of unduly burdensome claims against property.[39] Likewise, rules of liberative and acquisitive prescription (at civil law) and statutes of limitation (at common law) are frequently used to extinguish outmoded property claims. In some common law jurisdictions, real covenants automatically expire after a statutorily fixed period of time unless renewed.[40] In civil law jurisdictions, full property rights are not subject to liberative prescription,[41] but limited property rights often are. For example, the term for the prescription of *nominate* property rights is usually 20 or 30 years.[42] In contrast, one must bring action for injunction or damages if an innominate or atypical property right (such as a building restriction or subdivision covenant) is violated in a

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[39] This is further facilitated by limiting the right to oppose property transactions only to the original parties and to third parties who had sufficient notice of the arrangement. Recording systems are a key factor: unrecorded or unregistered claims, for example, are forfeited against innocent third party buyers. Other contractual limitations on the use of property that are not visible or properly recorded also cannot be enforced against subsequent purchasers. Rose, *supra* note ___, further observes that this creates incentives to publicize and to record their claims and, most importantly, to use standard-form property packages.

[40] Dwyer et al., *supra* note ___.

[41] Property is obviously subject to acquisitive prescription (i.e., adverse possession).

[42] See, for example, Article 617 of the French Civil Code, setting a 30 year prescription term for usufruct. Likewise, Paragraph 195 of the German BGB establishes a general 30 year prescriptive period applicable to real actions. Conversely, Articles 970 and 1014 of the Italian Civil Code establish a 20 year prescription, for emphyteusis and usufruct rights, respectively.

much shorter period of time.[43] In all these cases, statutes of limitation do not merely bar the action to enforce the atypical property right, but rather extinguish the real right itself, in essence reunifying the fragmented property with respect to third parties.[44] Upon prescription of the rights, the restrictions are treated as if they never existed, and the property is permanently freed of all the burdens that had been violated.[45]

These rules have been applied quite liberally. For example, according to traditional civil law principles, liberative prescription can only accrue against actual violations to which there has been no response for the entire duration of the statute of limitation. This approach is consistent with the conception of *usucapio libertatis*, namely the reinstatement of complete freedom of use after the extinction of preexisting restrictions on the property. But courts are often much more active, freeing the property from other related

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[43] For example, according to Article 781 of the Louisiana Civil Code (as revised in 1977), "no action for injunction or for damages on account of the violation of a building restriction may be brought after the lapse of two years from the commencement of a noticeable violation." See also the official Comment (a) under Article 781, which states that this provision does not change the law, when instead it has been emphatically noted by Yiannopoulos that such prescriptive terms depart substantially from the general rules governing the prescription of contractual obligations (with a 10, rather than 2 year prescription). A. N. Yiannopoulos, *Civil Law Property Coursebook: Louisiana Legislation, Jurisprudence, and Doctrine* (3d ed. 1983).

[44] These prescription terms are often surprisingly short. See for example the case of the Louisiana statute of limitation extinguishing the real rights after two years from the commencement of the violation. Note that, in the same jurisdiction, a personal action for the enforcement of restrictions would be subject to a much longer 10-year term of liberative prescription. See La. Civil Code Article 3499, as revised in 1983; (formerly Article 3544 of the 1870 code). Also see Yiannopoulos, *supra* note ___.

[45] See Yiannopoulos, *supra* note ___, discussing La. Civil Code Article 781, as revised in 1977.

limitations.[46] Likewise, courts have construed the prescription of a restriction against a given property parcel as tantamount to abandoning the restriction for the entire community or subdivision,[47] resulting in an exponential increase in the reunification of fragmented property.

From a policy perspective, these doctrines are problematic since they undermine the force and stability of the original contract to restrict the use of the land. Such doctrines, however, can be explained as attempts to correct ex post the effects of entropy, mitigating the effects of asymmetric transaction costs and resulting inefficiencies of fragmented property.[48]

The recognition of new forms of property rights further necessitated

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[46] According to long standing legal principles, the extinction of one type of a restriction due to the lapse of a statute of limitation does not affect the enforceability of other types of restrictions, nor does it extend to other situations (e.g., freeing other lots from the type of restriction that have been violated). Nonetheless, as Yiannopoulos, *supra* note ___, points out, courts have recently held that when an owner uses his property for commercial purposes contrary to subdivision covenants during a period in excess of two years, the property is freed of all restrictions pertaining to commercial use.

[47] According to Article 782 of the Louisiana Civil Code, building restrictions terminate "by abandonment of the whole plan" or by "a general abandonment of a particular restriction." Abandonment, like prescription, does not merely bar the right of action for the enforcement of restrictions; it extinguishes the real right. See La. Civil Code Article 782, as revised in 1977, extensively discussed in Yiannopoulos, *supra* note ___.

[48] In most cases, the availability of these ex post reunification mechanisms protects the integrity of the ex ante fragmentation of property: because the dangers of entropy in property and the resulting welfare losses are eliminated, the present value of the initial decision to fragment the property is maintained. Along similar lines, a survey of American property law by Michael Heller, *supra* note ___, 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 perpetuities, zoning and subdivision restrictions, property taxes and registration fees, etc. *See* Heller, *supra* note ___, at 1173-1174, citing zoning and subdivision restrictions such as minimum lot sizes, floor areas and setbacks that prevent people from spatially fragmenting resources excessively. Heller suggests that, by making the creation and maintenance of fragments more costly, such as 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. *Id.*

the articulation of general principles to minimize the risk of entropy in property. These principles are derived from the concepts of absolute property, advocated by 18th century jurists, and most are simple applications of the ideals of unity in property.

The resulting conception of property as an absolute right suggests that owners enjoy property through a direct relationship with the thing they own, without any need for cooperation by third parties. This characterization of an absolute right distinguishes it from the nature of a relative right (such as personal obligations and credit rights) the fulfillment of which depends on the active cooperation of another party. This classification of rights has given succeeding generations powerful rhetoric in which absolute rights (such as property and right of the person) only create negative obligations enforceable *erga omnes*, effectively equating property with (negative) freedom.[49]

Civil law courts have also subscribed to this general principle, developing an interpretive presumption in favor of a unified property that is often referred to as the *favor libertatis* principle. It suggests that restrictive burdens on property must be interpreted to promote, to the extent possible, the freedom of the burdened property.[50] This presumption is clearly related to the post- French Revolution ideals of unity in property. From a purely interpretive perspective, however, this interpretive presumption departs from the general

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[49] During the 20th century, the equation between the structure of absolute rights and freedom became commonplace in legal, economic, and political theory. Mattei, *supra* note ___, at 123, observes that the "taxonomy requiring the object of ownership to be a tangible material thing can be explained as an expulsion from the domain of property law of those powers not related to a physical relationship with land, as used to be the case with most feudal property rights."

[50] As an application of this principle, documents that establish restrictive covenants must be interpreted in favor of, rather than against the freedom of the servient estate Yiannopoulos, *supra* note ___.

principles governing the interpretation of contracts, which mandate that the contracts should be interpreted to ensure that they can produce some effects, even if such effects limit the property's freedom.

Absent a general presumption of *favor libertatis*, common law courts have taken another "ex post" or corrective approach to promote unity, enshrined in the doctrine of "changed circumstances." This allows courts to eliminate restrictions that have lost their original purpose and value, without having to obtain the unanimous consent of the various right holders.[51] A subdivision restriction, for example, might require the use of outmoded architectural details or the use of outdated and inefficient building materials. A contractual abrogation of such a subdivision covenant may prove difficult because of the likely holdout problems of the various property-holder's rights.

Traditionally, common law jurisdictions enforced real covenants at law even though changes in the surrounding environment (e.g., gradual transformation of a residential subdivision into a commercial or industrial area) undermined the original purpose and value of the parties' covenant. In recent years, however, the majority of states have adopted a different rule to deal with obsolete real covenants, holding that the doctrine of changed circumstances is a defense to a claim for damages and may be used to terminate a real covenant.[52]

If a sufficient number of covenant restrictions have been violated, courts tend to consider the general subdivision plan as abandoned.[53] At that

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[51] Rose, *supra* note ___.

[52] *Hess v. Country Club Park*, 213 Cal. 613, 2 P.2d 782 (1931); *Restatement of Property* § 564. For a more extensive discussion, see Dwyer at al, *supra* note ___, and Stoebuck, *supra* note ___.

[53] In the Louisiana jurisprudence, the abandonment of a particular restriction is construed as an abandonment of a real covenant, affecting all parties to the original covenant. Changes in the vicinity of the subdivision, but not within it, are thus without

point, all other covenant restrictions are extinguished and the use of the property is freed for all general purposes.[54]

2.4 Other Legal Instruments for Controlling Strategic Behavior

Most of entropy problems in property are due to the strategic behavior of fragmented owners in the disposition of their property. Whenever a value-enhancing opportunity arises, fragmented owners attempt to appropriate the surplus from the reunification project by threatening to withholding their participation to the value-enhancing plan unless a larger payoff is paid to them. Strategic hold-up problems are the result of the parties' attempt to acquire a more-than-proportional share of the available surplus. The extent of such strategic behavior depends on both the size of the available surplus and the parties' awareness of the existence of such value-enhancing reunification opportunity.

Prospective buyers who carry out a reunification project have a better

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effect on the validity of the building restrictions in the subdivision. Yiannopoulos, *supra* note ___.

[54] *See* Yiannopoulos, *supra* note ___; Article 783 of the Louisiana Civil Code declares that doubt "as to the existence, validity, or extent of building restrictions is resolved in favor of the unrestricted use of the immovable." According to Louisiana courts, since servitudes and covenant restrictions often have effects similar to those of other building restrictions, any covenant that establishes restrictions on property use ought to be interpreted in *favorem libertatis.* Yiannopoulos, *supra* note ___. Thus, when there is doubt as to the content or validity of a restriction (e.g., a question on the validity of a subdivision plan or real covenant), the doubt is resolved favoring the unrestricted use of property. Yiannopoulos also provides several cases and examples explaining that when a particular subdivision restriction has been abandoned, the properties in the same subdivision are freed from that restriction only. Thus, a change in the neighborhood from residential to commercial does not automatically affect other functionally unrelated restrictions (e.g., setback from property lines) but may affect other functionally related limitations.

opportunity to succeed in their goal if the fragmented sellers are kept unaware of the existence of a value-enhancing reunification opportunity. From this perspective, it is possible to understand the role of contract rules on undisclosed agency and error (or misrepresentation) concerning the identity of the buyer as having an important impact on the resulting entropy. Indeed, another way that the common law protects against entropy in property is to allow undisclosed agency, the practice of one party acting on behalf of another in order to disguise the latter's identity. Because the actual purchaser is not known to the seller, that person will not artificially raise his asking price, or otherwise hold out on the realization of the transaction; he might act differently if he knew the broader context of the sale itself. For instance, if a seller was aware he held one of the last parcels that a developer needed to build a housing development or other major construction project, the seller might take advantage of this bilateral monopoly to demand a higher price. If, however, he were dealing with an undisclosed agent, he would negotiate a price that reflected the actual worth of the land and his willingness to part with it.

The undisclosed agent may not reveal the party for whom he is acting without permission.[55] An agent may even misrepresent the fact that he is acting on behalf of another.[56] In fact, the Restatement expressly clarifies that withholding the identity of the purchaser in order to avoid having the seller raise the price is a legitimate practice.[57] In short, as argued by Professor Randy E. Barnett,"undisclosed agency law should permit A secretly to represent

[55] American Law Institute, Restatement (Second) Agency, Chapter 10, '302 (1958).

[56] American Law Institute, Restatement (Second) Agency, Chapter 10, '304, cmt. a (1958).

[57] American Law Institute, Restatement (Second) Agency, Chapter 10, '304, cmt. c (1958).

anyone when contracting with T, provided that the obligations of T are not adversely affected by the agency relationship, and are subject to any valid contract defense that T might assert. The actual law of undisclosed agency is in accord." [58] For a recent example of the enforcement of this principle, see *Parola v. Lido Beach Hotel, Inc.*, in which a New York court, refused to excuse a contract, although the defendant did not know of the undisclosed principal=s existence.[59]

Nevertheless, the agent cannot act with complete latitude. In order to balance the desirability of reuniting property for an efficient use with the seller=s basic freedom to contract, the agent may not misrepresent the identity of the purchase if he knows that the seller would not agree to do business with that person or entity.[60] If this desire is known to the agent and he nevertheless misrepresents the identity of the buyer, then the contract may be rescinded if the seller discovers the identity of the buyer.[61] In addition, courts have allowed rescission of contracts where the agent misrepresented the use of the land after the purchase, such as when a seller sold adjacent property on the understanding it would be a blacksmith=s shop and the buyer in fact started to build a factory there.[62] Finally, sellers are protected by the fact that both the agent and undisclosed principal are jointly and severally liable for any breach of the

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[58] Randy Barnett, *Squaring Undisclosed Agency Law with Contract Theory*, 75 Cal. L. Rev. 1969, 1990 (1987).

[59] *Parola v. Lido Beach Hotel, Inc.*, 99 A.D.2d 465 (N.Y. App. 1984).

[60] American Law Institute, Restatement (Second) Agency, Chapter 10, '304 (1958).

[61] *See Barker v. Keown*, 67 Ill.App. 433 (1896); *Brook v. Oberlander*, 199 N.E.2d 613 (Ill. App. 1964) (reiterating that parties have the right to contract, or to refused to contract, with whom they please).

[62] *Diamond v. Shriver*, 80 A. 217 (Md. 1911).

contract.[63] In sum, the common law balances the need to facilitate efficient reunification of property with respect for a parties' freedom to contract by allowing the agent to represent undisclosed principals but not enabling that agency to impinge on the rights of the seller.

3. Freedom of Contract and the Laws of Entropy: Rethinking the Dichotomy

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 private parties may intentionally induce entropy as a way to tie the hands of future owners. Purposeful dysfunctional fragmentation of property can indeed be found where unified property owners want to control the use of their property beyond the time of their ownership. An interesting real life illustration is discussed in Parisi-Schulz-Depoorter, concerning the case of private associations that utilize dysfunctional forms of fragmentation as a way to ensure long-term or perpetual conservation of the land in its current state.[64] For example, extreme 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. 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)

[63] *Crown Controls, Inc. v. Smiley*, 737 P.2d 709 (Wash. App. 1987).

[64] The example thus concerns land use preservation though excessive fragmentation, as an alternative to state acquisition or zoning for parkland use. Parisi et al., *supra*, note ___.

unusable for practical development purposes. This arrangement generates an enormous patchwork of small entitlements. The idea is that, in the 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.

A few questions arise at this point concerning the role of freedom of contract in generating socially optimal levels of entropy. Given the ability of rational individuals to anticipate the likely cost of entropy when making their fragmentation decision, is any intervention necessary or even desirable? And, if so, what is the appropriate role of law in correcting the natural forces of entropy?

In order to answer these questions, we need to distinguish two groups of cases: (1) Situations where the parties can choose only the level of fragmentation, and are subject to the choice of remedies provided by the legal system; and (2) Situations where the parties can choose both the level of fragmentation and the legal remedies that courts will administer. We shall consider these two distinct hypotheses in turn, and then consider the residual role of legal intervention in correcting entropy problems.

3.1 Parties' Choice of Fragmentation with Exogenous Remedies

In many legal systems, there are several constraints on the extent to

which parties can opt out of default remedies specified by legal systems. In many property arrangements, owners cannot waive ex ante the right to obtain an injunction in case of third party interference with their property. Likewise, private contracting parties cannot always stipulate to have courts enforce their contract only with specific performance, rather than damages.

In the case of purely exogenous remedies, the parties can freely contract for the substantive content of their agreement, subject to the fact that remedies are exogenously predetermined by the legal system. The choice of alternative substantive arrangements by the parties would naturally take into account the effect of the applicable legal remedies. The choice of alternative legal remedies by legal planners would in turn affect the parties' choices in equilibrium.

Prospectively, alternative remedies would lead rational owners to make different decisions under property-type rules as opposed to those they would make under a liability regime. In contrast to Epstein,[65] I suggest that, absent an appropriate choice of remedies, the property owners' rationality will not be sufficient to minimize the cost of entropy in property. Rational parties, it is conceded, will anticipate any devaluation from fragmentation and will also take into account the expected present value of forgone opportunities when fragmenting the entitlement. But the rational choice for a level of fragmentation will differ under different remedies. This proves that remedies are not irrelevant in this context. In a liability-type regime, owners will, in fact, choose a higher level of fragmentation for their property, keeping in mind that the liability remedy will lower expected reallocation and reunification costs. Conversely, under a property-type rule, owners will choose a lower level of fragmentation because of the higher costs of rebundling property at a later stage. In turn, the choice of different remedies affects the social loss simply

[65] Richard A. Epstein, *Notice and Freedom of Contract in the Law of Servitudes*, 55 S. Cal. L. Rev. 1353-1368 (1982).

because rational owners would make different choices when subjected to different remedies.

In this context, the normative dilemma for a policymaker is that of determining the optimal choice of remedy, taking into account the peculiar asymmetry of the transaction costs created by a dysfunctional fragmentation of property and the different private choices induced by alternative legal rules. Choosing a remedy in such an asymmetric scenario requires balancing a wide range of concerns. The difficulty of this policy choice results from the fact that property-type remedies may impede efficient reallocations of rights,[66] but liability rules are often incapable of providing adequate protection of the subjective value of the parties, given the incomplete protection of idiosyncratic value and the risk of successive takings of potential infringers.

3.2 Parties' Choice with Unconstrained Freedom of Contract

In the case of unconstrained freedom of property, the parties can choose the substantive content of their agreement and specify the judicial remedies that would apply in case of breach of their contract or property arrangement. In this scenario, the parties would freely negotiate taking into account the private information that they posses regarding the subjective value of a specific property arrangement and the likely stability of the value of such arrangement overtime. Unless we assume that third party decision-makers could on average have an informational advantage in assessing the costs and benefits of alternative property arrangements, or have better foresight concerning the likely duration of the benefit of such arrangement, the free contractual choice of the parties could safely be presumed to induce preferable outcomes to those generated by an exogenous choice of remedies.

[66] See Guido Calabresi and A. Douglas Melamed, Property Rules, Liability Rules and Inalienabilty: One View of the Cathedral,85 Harv. Law Rev. 1089 (1972).

Absent any constraints on the choice of remedies, the rationality of property owners will, in fact, lead them to minimize the cost of entropy in property, giving them two degrees of freedom in the structuring of an optimal property arrangement. Rational parties will anticipate any devaluation from fragmentation and take into account the expected present value of forgone opportunities when fragmenting the entitlement. Likewise, as it will be further explained in Section 4, the owners will be induced to reveal private information when bargaining with the other parties for the choice of the applicable remedies. Owners would consequently choose a combination of substantive and remedial content, fully realizing the varying reallocation costs and protection granted by alternative remedies. Thus, they would maximize the subjective and social value of their property.

3.3 The Residual Need for Retrospective and Corrective Solutions

The above results should help us reassess the residual merits of the corrective role of law in the context of entropy.

In selecting the optimal level of fragmentation, a rational owner estimates the expected value of the alternative partitioning of his property and would rationally select the arrangement which 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). As discussed above, 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 by taking full account of the ex ante information and of the asymmetric

transaction costs induced by property fragmentation.

But, in spite of the perfect ex ante alignment of private and social incentives, entropy problems often arise. 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.

The interesting point here is that, while fragmentation may be occasionally ex ante efficient (given the specific goals pursued by property owners), it may result in inefficient ex post allocations due to unforeseen exogenous changes in the environment. Parties rationally operate within the boundaries of imperfect knowledge on the basis of expected value computations. Retrospectively, the choice of different remedies may therefore have an important effect on the control of entropy in property. In the realm of non-conforming property arrangements, time limits, statutes of limitation, liberative prescription, rules of extinction for non-use, etc., can all be regarded as ex post correctives that facilitate the otherwise costly and difficult reunification of non-conforming fragments of a property right.[67]

These legal solutions are analogous to a gravitational force, reunifying rights that, given their strict complementarity, would naturally be held by a single owner. These default ex post correctives rebundle property rights, regenerating the natural conformity between use and exclusion rights and more generally, between any two complementary fragments of property. The ex post corrective approach (in combination with unconstrained ex ante freedom) provides a sensible balance between the opposing concerns examined in this

[67] If atypical rights were classified and enforced as property, with property remedies (rather than mere contracts, with liability type remedies), there would be prohibitive transaction costs in their *termination*, rather than their *creation*. *See also* U. Reichman, *Toward a Unified Concept of Servitudes*, 55 S. Cal. L. Rev. 1179, 1233 (1982).

paper, balancing the benefits of parties' autonomy with the costs of entropy and disunity in property.

4. The Design of Remedies for Entropy: Information and Incentive Problems

Inefficient levels of fragmentation may take either of two forms: (1) suboptimal fragmentation, as a result of the fact that parties will account for the inertia induced by property-type remedies if reunification of fragmented property becomes necessary; and (2) excessive fragmentation, due to the difficulties of reunifying property if new, unforeseen, value-enhancing opportunities arise that render the current level of fragmentation inefficient.

The problem faced by policymakers when attempting to design remedies in this context is due to the lack of observable measures of subjective value. Alternative remedial protection may provide property owners with varying incentives to undertake specific investments and may thus affect the subjective value obtainable by the parties. Thus the policy dilemma: on the one hand, it is most unrealistic to believe that any court or third party decision-maker could effectively evaluate the costs and benefits of alternative remedies on an ad hoc basis, yet across-the-board choices of remedies curtail the possibility for individual parties to reveal their private information in the context of bargaining over the optimal property arrangement.

In dealing with entropy problems, the design of rules and institutions should indeed consider the informational and incentive advantages of the alternative remedies for entropy.

4.1 Information Problems.

There are two relevant sets of information that bear on the issue of property fragmentation: (a) information on the subjective value of idiosyncratic property arrangements for the parties; and (b) information on future changes on the optimal use of property which may require reunification of fragmented rights. While it is conceivable that a central planner may have superior information of the latter type, such information is likely to be made publicly available so that private property owners may take such information into account when choosing the optimal use of their property. The opposite holds for the information of the former type. Private parties have superior information concerning their own subjective valuation of any alternative property arrangement. Unlike the previous case, however, there is no easy opportunity for a central planner to acquire such information, given the lack of proper disclosure incentives by the parties. On balance, therefore, the parties may be assumed to have superior, or at least comparable, information to a central planner. This undermines any information-based argument in support of a centralized determination of optimal levels of fragmentation.

4.2 Incentive Problems

The second dimension of the problem, concerns the alignment of private and social incentives of the parties. The design of legal rules should promote the alignment of owners' private incentives and the relevant social incentives.

The creation of incentive alignment necessitates extending freedom of contract to the choice of applicable remedies. Bargaining over alternative remedies creates an opportunity cost for the parties' choice, since the

contractual price would unfailingly reflect the expected cost and benefits for the parties. Mechanisms of revealed preference in bargaining will solve the unobservable "subjective value" problem for idiosyncratic arrangements. In this context, if freedom of contract extends to both dimensions of the property arrangement – the level of fragmentation and the level of ex post remedial protection – the parties would have an opportunity to reveal their subjective preferences (and private information) concerning the value of alternative combinations of substance/remedy.

Owners would have incentives to undertake an unbiased estimation of the likely duration of their "idiosyncratic" interest, revealing private information on the subjective value in the bargaining process and selecting the applicable remedies accordingly. Furthermore, the parties' self-interest and rationality would ensure that odd combinations of substance/remedy would only emerge in response of truthful preferences of the parties, since each contracting party faces the opportunity cost of choosing a given level of protection, given the availability of alternative remedies. As a result, we would expect efficient combinations of fragmentation/protection to dominate, given the rational tendency of parties to bargain until the point where subjective marginal costs and benefits are efficiently balanced in all dimensions of their property relationship.

5. Conclusion

This paper has considered the problem of entropy and its twofold relationship with freedom of contract. The unregulated autonomy of private parties is usually identified as the main source of entropy in property. The above analysis has, however, discerned two analytically different ways in which freedom of contract affects entropic fragmentation. First, we considered

the ideal case in which the parties enjoy unconstrained freedom of contract. In such a scenario, the parties could freely select both the content of their arrangement and the legal rules and remedies that should govern their relationship. Second, we considered the case of constrained freedom of contract, in which remedies were exogenously determined by the legal system. In this latter case, the parties could only choose the level of property fragmentation, with no opportunity to modify the remedies that would govern their contractual or property arrangement.

Such juxtaposition has revealed the *non-ontological* nature of entropy, as suggested by the fact that only when legal constraints on the optimal bundling of substance and legal protection are introduced, inefficient level of fragmentation may obtain.

The above analysis finally reveals the limits of freedom of contract in solving entropy problems. Although owners aim at maximizing the value of their property, in a world of imperfect information, they often make erroneous choices. 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. The effects of an ill-conceived allocation of property rights do not fade away over time and may induce long-term or perpetual welfare losses. In a world with imperfect information, we should thus expect that a positive level of entropy will persist. But such a level of entropy may coincide with the best achievable level of fragmentation for society. When such unconstrained freedom of contract is not viable in real life legal systems, policymakers are indeed faced with the formidable task of choosing one unitary boundary of freedom of contract in the context of property law, attaching specific remedies to typical property transactions, with an ex ante determination of aggregate costs and benefits in

any given set of circumstances. Such an unitary boundary would, under most parameters, fall short of achieving the socially optimal level of entropy that could otherwise result from the parties' rational choice.