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PROPERTY RIGHTS AND LIABILITY RULES:

THE *EX ANTE* VIEW OF THE CATHEDRAL

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Abstract

Whenever one party's use of an asset imposes an externality on other parties' use of their assets, the law must choose how to allocate and protect entitlements. In the last three decades, starting with the classic work of Calabresi and Melamed published thirty years ago, legal scholars have examined such choices from an *ex post* perspective. Taking as given the presence of an externality and of the parties affected by it, this literature has focused on identifying the rules that would most likely lead to an *ex post* efficient outcome. This paper focuses instead on the effects of alternative rules on parties' *ex ante* investments and actions. Once these effects are taken into account, important conclusions of prior work on the subject need to be reconsidered. In contrast to the claims of such prior work, I show that the choice of rules matters not only when *ex post* bargaining is difficult but also when it is easy; that the distribution of *ex post* value is relevant for efficiency; and that liability rules are not generally superior to property rights. The analysis provides a framework for identifying the rules that would be best from the perspective of *ex ante* efficiency, and it has implications for a broad range of questions that the law must resolve.

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I. INTRODUCTION: ALTERNATIVE VIEWS OF THE CATHEDRAL

This paper aims to contribute to the study of a fundamental question of legal policy – how to allocate and protect entitlements in the presence of externalities. In a classic and influential article published thirty years ago, Calabresi and Melamed put forward what they labeled "one view of the Cathedral" – a framework for analyzing how to allocate entitlements in such cases.[1] Calabresi and Melamed, and the substantial work that has followed their path,[2] have followed an "*ex post* approach." Taking as given the presence of an externality and the parties affected by it, the *ex post* approach seeks to determine which allocation of entitlement would most likely lead to an efficient outcome. As this paper shows, however, the allocation of entitlements also has an important set of *ex ante* effects commonly overlooked by the literature. By identifying and analyzing these *ex ante* effects, the analysis of this paper provides a framework for identifying the allocations of entitlements that would perform best from the perspective of *ex ante* efficiency. Once these *ex ante* effects are taken into account, several important conclusions that arose from prior work need to be revised. The analysis of the paper demonstrates the need to reconsider some standard ways of analyzing private law questions, and carries implications for a broad range of issues in law and policy.

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[1] Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85, HARV. L. REV. 1089 (1972). This article is considered to be a part of the legal canon. *See* Carol M. Rose, *The Shadow of* The Cathedral*, 106 YALE L. J. 2175 (1997) ("*One View of the Cathedral* is now so much a part of the legal canon that it is widely known by the joined names of its two authors…."); James E. Krier & Stewart J. Schwab, *The* Cathedral *at Twenty-Five: Citations and Impressions,* 106 YALE L. J. 2121 (1997) (demonstrating the influence of the article through citation analysis).

[2] *See, e.g.,* Louis Kaplow & Steven Shavell, *Property Rules versus Liability Rules: An Economic Analysis*, 109 HARV. L. REV. 713 (1996); Ian Ayres & J.M. Balkin, *Legal Entitlements as Auctions: Property Rules, Liability Rules, and Beyond,* 106 YALE L. J. 703 (1996); Ian Ayres & Eric Talley, *Solomonic Bargaining: Dividing a Legal Entitlement to Facilitate Coasian Trade*, 104 YALE L. J. 1027 (1995); James E. Krier & Stuart J. Schwab, *Property Rules and Liability Rules: The Cathedral in Another Light*, 70 N.Y.U. L. REV. 440 (1995); A. Mitchell Polinsky, *Resolving Nuisance Disputes: The Simple Economics of Injunctive and Damages Remedies*, 32 STAN. L. REV. 1075 (1980) (hereinafter: Polinsky, *Resolving Nuisance Disputes*); A. Mitchell Polinsky, *Controlling Externalities and Protecting Entitlements: Property Right, Liability Rule, and Tax-Subsidy Approaches,* 8 J. LEGAL STUD. 1 (1979) (hereinafter: Polinsky, *Controlling Externalities*); Robert C. Ellickson, *Alternatives to Zoning: Covenants, Nuisance Rules, and Fines as Land Use Controls*, 40 U. CHI. L. REV. 681 (1973).

Consider a factory (Factory) and a resort (Resort) located along a river, where Factory is located upstream and Resort is located downstream. Factory might discharge waste to the river, thereby polluting its water and reducing the price Resort can charge its patrons. In such a situation, the law must resolve two questions. First, does Factory have an entitlement to pollute the river or does the Resort have an entitlement to water unpolluted by Factory's use? Second, given the resolution of the first question, what form of legal protection should be given to the entitlement to the water accorded to one of the parties? As noted by Calabresi and Melamed, the legal protection of entitlements could be of two forms: property rules and liability rules.[3]

Calabresi and Melamed, and the subsequent literature on the subject, have largely followed an *ex post* approach to these questions. [4] By an *ex post* approach, I mean an approach that takes as given the presence and payoffs of the parties at the time that the potential externality arises. In the above example, an *ex ante* approach would take as given the existence of Factory and Resort and the values of operating Resort and Factory (with and without pollution) to their respective owners at the time that the potential externality arises. Given these variables, the *ex post* framework seeks to ensure the efficient outcome: that Factory will pollute if and only if the value of pollution to Factory exceeds the harm it would impose on Resort.

The common starting point of the *ex post* framework has been the Coasian insight that, if bargaining is not impeded in any way, the outcome will always be efficient regardless of the prevailing legal rules.[5] Calabresi and Melamed and their followers have therefore asked which allocation of entitlements will most likely facilitate an efficient outcome in a world in which bargaining might be impeded. Taking as given the presence of an externality and the parties affected by it, they have focused on impediments to *ex post* bargaining between the parties and have sought to examine which rules would best address these impediments.

In particular, Calabresi and Melamed argued that liability rules are superior when private bargaining is impeded by large transaction costs,

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[3] *See* Section II.C. *infra.* Calabresi and Melamed also examine an additional form of protection – inalienability rules. *See* Calabresi & Melamed, *supra* note 1, at 1111-1115. However, this paper will focus, as much of the literature has focused, on alienable rights, rights that parties may sell or waive. For an economically oriented analysis of inalienability rules, see Susan Rose-Ackerman, *Inalienability and the Theory of Property Rights*, 85 COLUM. L. REV. 931 (1985).

[4] *See infra* Section II.C.

[5] R.H. Coase, *The Problem of Social Cost*, 3 J. LAW & ECON. 1 (1960).

and when courts can accurately assess the harm produced by the externality.[6] In an important subsequent study, Kaplow and Shavell have suggested that liability rules would work better than property rights even where courts lack concrete information about damages.[7] Introducing a new dimension to the *ex post* framework, Ayres and Talley have argued that *ex post* bargaining is less likely to be impeded under a liability rule, because liability rules are better in overcoming asymmetric-information impediments to bargaining.[8]

The approach of this paper differs from that of prior work in three important and related respects. First, this paper focuses on *ex ante* rather than *ex post* effects.[9] In considering a situation like our Factory-Resort example, the approach of prior work was to take the presence of the two parties and their payoffs as given. In contrast, this paper's analysis rests on recognition that, in many cases, the structure of the *ex post* situation is a function of *ex ante* actions and investments by the parties.

For example, the presence and the payoffs of the parties in the Factory -Resort case might well be a product of *ex ante* actions and investments going back in time, prior to the emergence of the externality. To begin, there were the decisions of Factory and Resort to locate along the river. Also, the *ex post* value derived by Factory from its activities might well be a function of Factory's *ex ante* investments and decisions. Factory might have made decisions about what scope of production to develop, what products to produce, how many workers to hire and how much to invest in their human capital, and how much to invest in research and development. Similarly, Resort might have made decisions such as what

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[6] *See* Calabresi & Melamed, *supra* note 1, at 1106-1110.

[7] *See* Kaplow & Shavell, *supra* note 2, at 725-727 (arguing that, regardless of how imperfect the state's information is about harm or prevention costs, a liability rule with damages equal to average harm is superior to a property rule).

[8] *See* Ayres & Talley, *supra* note 2.

[9] In carrying out my work, I build on the approach of a large economic literature on "incomplete contracts." This literature has sought to analyze how, in various settings in which parties contract with each other, the division of surplus in subsequent renegotiations that they might undertake affects earlier investments. While the contractual contexts studied by that literature are different from those analyzed in this paper, its analytical approach, which I shall rely on in this paper, is relevant. *See, generally,* OLIVER HART, FIRMS, CONTRACTS, AND FINANCIAL STRUCTURE (1995) (hereinafter: HART, FIRM, CONTRACTS); Oliver Hart & John Moore, *Property Rights and the Nature of the Firm*, 98 J. POL. ECON. 1119 (1990); Oliver Hart & John Moore, *Incomplete Contracts and Renegotiation*, 56 ECONOMETRICA 755 (1988); Sanford J. Grossman, & & Oliver D. Hart, *The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration*, 94 J. POL. ECON., 691 (1986).

activities to develop (*e.g.*, should patrons be offered the opportunity to canoe in the river?), how much to invest in developing them, how many employees to hire, and how much to invest in their human capital. Finally, both parties might have made decisions that influenced the potential harm to Resort from pollution produced by Factory.

Second, because prior work took the presence and payoffs of the parties as given, it assumed that the distribution of *ex post* value between the parties - Factory and Resort - does not matter from the perspective of efficiency.[10]   To be sure, writers have differed on whether the distributive consequences of alternative rules are by themselves important – that is, important due to goals of distribution or fairness that have independent value of efficiency. But as far as efficiency is concerned, the conventional wisdom has been that the particular *ex post* distribution of value produced by a given rule is irrelevant to assessing how efficient it is. In contrast, the analysis of this paper shows that, once the significance of *ex ante* effects is recognized, the *ex post* division of value might have considerable efficiency implications. Different divisions of *ex post* value lead to very different incentives affecting *ex ante* actions and investments. As a result, identifying how a given rule affects the *ex post* division of the "pie" between the parties is important for assessing the overall *ex ante* efficiency of the rule.

Third, prior work has assumed that, in cases where bargaining between the parties is easy *ex post*, the choice of legal rules has little or no significance from an efficiency point of view. In such cases, bargaining would ensure *ex post* efficiency.[11] Thus, because of its focus on *ex post* efficiency, prior work has directed its attention to cases in which bargaining is difficult (or even impossible). However, as the analysis of this paper will show, once *ex ante* effects are taken into account, the choice of the rule might have important efficiency implications even with easy bargaining. The choice of rule will affect the position of each side in the *ex post* bargaining and thus determine the *ex post* division of value, which in turn will affect *ex ante* incentives and *ex ante* efficiency.

The analysis of this paper will examine how alternative rules affect bargaining between parties and the *ex post* division of the pie. To illustrate these effects, note that in the above example Factory would be generally better off if it had a property right to pollute rather than if Resort had a property right not to pollute. Suppose that bargaining is easy, and suppose also that pollution is efficient because its value to Factory

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[10] *See infra* Section II.E.(2) and sources cited therein.
[11] *See infra* Section II.E.(3) and sources cited therein.

exceeds the cost it imposes on Resort. Whereas both rules would likely lead to pollution taking place, the distribution of value between Factory and Resort would differ between the two rules. If Factory has the property right, it would pollute without any payment, whereas if Resort has the property right, Factory would make a payment to Resort to obtain its consent to the pollution. Likewise, both rules would result in no pollution in the case in which the value of pollution is smaller than its cost. But if Resort has the property right, it would not have to pay to induce Factory to abandon its pollution plans, whereas if Factory has the property right, Resort would have to pay Factory to induce it not to pollute.

Having identified the distributive effects of alternative rules, the analysis will then examine how the choice of rule will in turn affect the *ex ante* investments that parties make. To illustrate the type of effects to be analyzed, consider again the choice between granting a property right to Factory and granting a property right to Resort, and let us consider the effect of the choice of the rule on the incentives of Factory to invest *ex ante* in activities that enhance the value of Factory. When Resort has a property right to be free from pollution, the *ex ante* investment by Factory will be too low. This is because Resort's property right enables it to capture part of the value created by Factory's *ex ante* investment. Since Factory anticipates not capturing the full value of its *ex ante* investment, its level of such investment would be too low. In contrast, if Factory enjoyed a property right to pollute, it would not have to share the value of its *ex ante* investment with Resort. Thus, granting a property right to Factory encourages it to invest *ex ante*. Indeed, for reasons to become clear later, Factory might even invest excessively if granted a property right.

Now suppose that Resort is given an entitlement to be free of pollution, but with a liability-rule protection. As will be shown later, in this case, even though Resort has a right to be free of pollution, Factory's investment will not be discouraged. Under a liability rule, Factory has to pay Resort a court-determined amount of damages reflecting the harm that pollution inflicts on Resort. This damages amount, however, is set independently of the value of Factory. Put differently, under a liability rule Resort would not be able to extract part of the *ex post* surplus created by Factory's *ex ante* investment. Consequently, Factory captures the full social value of its investment, and thus faces socially optimal investment incentives.

Consider now the effect of this very choice on the incentives of Resort to invest in enhancing the value of its operations. Following the reasoning of the previous paragraph, granting a property right to Factory would

enable it to extract, in return for Factory's consent to forego pollution, some of the value created by the investment of Resort, thus discouraging such investment *ex ante*. In contrast, if Resort has a property right, it would not be discouraged to invest in enhancing its value. Indeed, for reasons to become clear later, Resort might even invest excessively if granted a property right. Granting Resort a right to be free of pollution protected by a liability rule would not solve its excessive-investment problem. Indeed, as will be shown later, it would actually lead to Resort's making excessive investments, with an even distortion than in the case in which Resort is granted a property right.

In addition to analyzing investments that affect the value of parties' respective activities, the analysis will also examine parties' *ex ante* investments to reduce the magnitude of the harm that might arise from the conflicting use of the river's water. For example, the parties might make investments that might eliminate or reduce their reliance on the river's water in case a conflicting use problem arises down the road. The choice of rule might also affect these investments and the extent to which they overlap with, or deviate from, the socially optimal outcome. The analysis shows that, if Resort is protected with a liability rule, Resort will have no incentive to make any such investments in harm-reduction whereas Factory would have an incentive to make such investments at the socially optimal level. In contrast, if the rule takes the form of a property right, with either Factory or Resort having the property right, both parties would have incentives to make some – but less than socially optimal – investment in potential harm-reduction.

There is thus a range of *ex ante* effects that the choice of rule can entail, and the optimal rule, from an *ex ante* perspective, would depend on the balance of these considerations. This paper's analysis provides a framework for identifying this optimal rule by studying the various *ex ante* effects associated with each allocation of entitlements. This framework provides us with relevant factors for an assessment of the overall *ex ante* efficiency effects.

The analysis has implications for the two questions that, for any given context involving externalities, the law must resolve: (i) which party should get the entitlement, and (ii) which form of protection should be granted to that party. For example, it shows that policymakers cannot assume, as prior work has suggested, that liability rules are generally superior. From an *ex ante* perspective, either a property-right protection or a liability-rule protection might be preferable depending on considerations that the following analysis identifies.

The analysis has various other implications for law and policy that I explore below. For example, once *ex ante* effects are taken into account, it might be desirable to expand the menu of alternative rules and include in it, say, liability rules based on super-compensatory or under-compensatory damages. Revisiting the famous debate between Coase and Pigou, I also point out the implications that the analysis has for the use of government fines and taxes.

Because the paper focuses on studying the *ex ante* dimension of the Cathedral, I will often find it helpful to assume, for simplicity of exposition, that the *ex post* problem is small or non-existent because *ex post* bargaining is easy. It should be stressed, however, that this assumption will be used (when used) only for expositional and analytical simplicity and that it does not reflect a judgment about the absolute or relative importance of the *ex post* considerations. To the contrary, I have no doubt that the *ex post* considerations identified and analyzed by prior work are important, indeed essential, elements for legal decision-making. [12] My claim is only that, while the part of the Cathedral carefully mapped by prior work is important, there is another important part of the Cathedral that has not received the attention it deserves and that must be recognized and taken into account.

Finally, it is worth noting that my analysis in this paper is limited to the choice between property rights and liability rules in controlling harmful externalities, the context on which Calabresi and Melamed and much subsequent work has focused. The Calabresi and Melamed article also raised the question why possessory interests are generally protected by a property right rather than a liability rule. As Kaplow and Shavell demonstrated, the protection-of-ownership context differs from the harmful-externalities context, and the two are better analyzed separately.[13] Therefore, although I believe that prior work on the protection of possessory interests has also neglected its *ex ante* dimension,

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[12] A recent investigation, for example, found that parties to nuisance disputes do not bargain after courts issue their judgments. *See* Ward Farnsworth, *Do Parties to Nuisance Cases Bargain After Judgment? A Glimpse Inside the Cathedral*, 66 U. CHI. L. REV. 373 (1999). Parties that have gone through litigation, however, might form strong resistance to dealing with each other. Such an impediment to bargaining does not exist in cases that are not litigated, which of course constitute the lion's share of relevant cases.

[13] *See generally* Kaplow & Shavell, *supra* note 2, at 757-783.

I provide an analysis of this dimension of the protection-of-ownership question in another work.[14]

The remainder of this paper is organized as follows. Part II introduces the problem of externalities and conflicting uses and outlines the central conclusions, and limitations, of prior work. Part III analyzes the effect of alternative legal rules on the *ex post* division of value between parties. Part IV identifies and analyzes the effects of alternative rules on parties' *ex ante* investments and actions. Part V discusses the implications of the *ex ante* perspective for legal policy and the selection of legal rules. Part VI concludes.

II. THE *EX POST* VIEW OF THE CATHEDRAL

A. The Conflicting Use Problem

This section specifies the nature of the settings occupying prior literature, as well as this paper: the extremely common situations in which uses of assets conflict – in which the use of one asset imposes an externality on the use of another asset. For expositional convenience, the analysis will proceed with reference to a paradigmatic example. As will be readily seen, the conclusions derived with respect to this paradigmatic case have general applicability to all cases of harmful externalities.

Suppose that an industrial factory, Factory, is located up a river, and a recreational resort, Resort, is located down the river. The year is 2000. This is the first point in time that the problem described below of conflicting use of the river's water arises and must be resolved by the law. Following the *ex post* literature, this Part takes all the elements characterizing the problem – the presence of the parties in their respective locations, and their potential benefits and costs from using the river – as given. The next parts will relax that restrictive assumption.

The conflicting use problem arises because Factory might benefit from engaging in a certain activity that would affect the river's water in a way that might impose harm on Resort. We shall refer to this use of the water by Factory as "polluting" the water. The benefit that Factory would derive from polluting the water will be denoted by V_F. Thus, if Factory were not to pollute, Factory would lose V_F. For the purpose of the analysis, it does not matter whether Factory's activity in question is the only one available to Factory or whether it would merely supplement

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[14] *See* Lucian A. Bebchuk, *Ownership and Exchange* (unpublished manuscript, February 2001, on file with author).

additional activities that do not pollute the river. All that matters is that the polluting activity would be beneficial, adding a value of V_F to Factory, and that if it were not to take place, V_F would not materialize.

Having the river's water unpolluted by Factory is helpful to one of Resort's activities. If the water is unpolluted, this activity generates a value of V_R to Resort. If the water is polluted, however, the activity will generate a value of V_R - H to Resort. H might represent loss of profits from a decline in the prices Resort can charge its patrons, a decrease in the number of patrons, or any other damage Resort suffers due to the pollution. Note that Resort could always shut down the activity affected by pollution rather than operate under pollution. Hence, if the harm caused by pollution to Resort, H, were to exceed the value of the relevant activity, V_R, Resort may shut down and limit its loss to V_R. Accordingly, the damage to Resort will be taken to be the smaller of V_R and H. Again, for the purpose of our analysis it does not matter whether the damaged activity is Resort's sole activity or whether it is one among many additional activities undertaken by Resort. All that matters is that Factory's polluting the river would cause damage to an activity of Resort in an amount equal to the lower of H and V_R.

The scenario described above is often referred to as an externality problem. Factory's activity has an external effect on Resort. The externality is in the amount of the reduction in value to Resort caused by Factory's activity - the lesser of V_R and H. The problem might also be referred to a conflicting use problem. Both parties would benefit from "using" the water. Factory would derive a benefit, V_F, from being able to pollute the river. Resort would benefit (by avoiding a loss), in the amount of the lesser of V_R and H, from being able to enjoy unpolluted water. Of course, since the water can be either polluted or unpolluted, both parties cannot get to use the water in the ways that benefit them. There is thus a conflict between their uses – one party's making their desired use of the water is inconsistent with the other party's making their desired use.

I shall refrain from labeling Factory as the "injurer" and Resort as the "victim."[15] Although convenient, these labels carry some normative baggage, with the party referred to as the "injurer" perceived as the only one that causes the conflicting use problem. The situation is better regarded, as Coase has taught us, as *a priori* symmetric: the presence and

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[15] Some commentators have found such labels convenient to use. *See, e.g.,* Kaplow & Shavell, *supra* note 2, at 723 (referring to an injurer and a victim); Polinsky, *Controlling Externalities*, *supra* note 2, at 2 (referring to one of the parties as the "victim.")

activities of both parties are equal causes of the conflicting use situation. To be sure, but for Factory, there would be no question that Resort would be able to use unpolluted water to Resort's benefit. But for Resort, however, there would be similarly no doubt that Factory would be able to pollute the water to Factory's benefit. Both parties contribute an essential element to the existence of the conflicting use problem, and the existence of the problem requires the law to allocate entitlements and choose their forms of protection.

B. *The Efficient* Ex Post *Outcome*

The efficient outcome is the one that, given the structure of the situation, and the values of V_F, V_R, and H, would lead to the highest total aggregate value. One can distinguish between three plausible efficient outcomes:

(i) Scenario FR. In this scenario, it is efficient for both Factory and Resort to undertake their activities – that is, for Factory to pollute and for Resort to continue the relevant activity despite the river's pollution. This scenario arises under the following two conditions: (i) the value of pollution to Factory exceeds the harm caused by the pollution to Resort, ($V_F > H$); and (ii) the harm caused by pollution is smaller than the value of operating Resort absent pollution ($V_R > H$).

(ii) Scenario F. In this scenario, it is efficient for only Factory to undertake the activity – that is, it is efficient for Factory to pollute and for Resort to shut down the harmed activity. This scenario arises under the following two conditions: (i) the benefit of pollution to Factory exceeds the harm caused by the pollution to Resort ($V_F > H$); and (ii) the harm caused by pollution to Resort exceeds the value of the damaged activity ($V_R < H$).

(iii) Scenario R. In this scenario, it is efficient for only Resort to undertake the activity – that is, it is efficient for Factory to shut down. This scenario arises when both the harm to Resort caused by pollution and the value of Resort's activity exceed the value of the polluting activity to Factory ($H, V_R > V_F$).

These three outcomes depicted in Table 1.

Table 1: Possible Scenarios

Outcome	Factory Undertakes Polluting Activity?	Resort Undertakes Activity?	Total Social Value
FR	Yes	Yes (under pollution)	$V_F + V_R - H$
F	Yes	No	V_F
R	No	Yes (free of pollution)	V_R

C. Law's Choice: Calabresi and Melamed's Four Rules

What legal rules should govern the conflicting use problem? I will use in my analysis the classification of alternative legal rules put forward by Calabresi and Melamed and subsequently followed by the literature.[16] Under this now standard classification, there are four alternative rules to consider.[17]

(i)Entitlement to Resort Protected by Property Right (the RP rule). Under this rule, Resort has an entitlement to operate free of pollution, and this

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[16] *See* Calabresi & Melamed, *supra* note 1, at 1115-1116. *See also* Frank I. Michelman, *Pollution as a Tort: A Non Accidental Perspective on Calabresi's Costs*, 80 YALE L. J. 647, 670 (1971).

[17] Other writers have suggested additional rules. As will be clear to readers, the analysis of this paper can be easily adjusted to identify the *ex ante* effects of these additional rules. The additional rules thus far suggested by commentators have involved the use of "put" options. *See, e.g.,* Saul Levmore, *Unifying Remedies: Property Rules, Liability Rules, and Startling Rules,* 106 YALE L. J. 2149, 2153-2160 (1997) (suggesting expanded sets of rules); Krier & Schwab, *supra* note 2, at 471 (envisioning a rule granting Factory the option to shut down its activity and collect damages from Resort); Madeline Morris, *The Structure of Entitlements,* 78 CORNELL L. REV. 822, 854-56 (1993) (describing put options as "reverse liability rules", in which the holder of the entitlement has both an exclusive veto power and the right to a forced compensated transfer); Ayres & Balkin, *supra* note 2, at 729-33 (discussing such put options and the way these options might be auctioned); Ian Ayres, *The 1998 Monsanto Lecture: Protecting Property with Puts,* 32 VAL. U. L. REV. 793 (1998) (reviewing the choice of the form of protection within the put/call framework).

entitlement is protected by a property right. In other words, if Resort does not agree to allow Factory to pollute, Resort will be able to get an injunction (backed, if needed, by criminal sanctions) that would prevent Factory from polluting.

(ii)Entitlement to Resort Protected by Liability Rule (the RL rule). Under this rule, Resort has an entitlement to operate free of pollution, and this entitlement is protected by a liability rule. In other words, Factory may elect to pollute, but if it did, it would have to pay Resort a court-estimated amount of damages. Recall that the damages to Resort would be the smaller of the harm caused by pollution and the value of the activity absent pollution (the smaller of H and V_R), as Resort would always have the option of shutting down the activity.[18] I will assume that the liability rule will include (as standard) this mitigation requirement, and that in setting damages the court would thus attempt to estimate this value.[19]

(iii) Entitlement to Factory Protected by Property Right (The FP rule). Under this rule, Factory has an entitlement to pollute protected by a property right. In other words, the state will allow Factory to pollute unless it agrees to forego pollution.

(iv) Entitlement to Factory Protected by Liability Rule (The FL rule). Under this rule, Factory has an entitlement to pollute, but this entitlement is protected only by a liability rule. In this case, Resort may make Factory shut down the polluting activity, but Resort will be ordered by a court to pay Factory damages in an amount that equals the benefit to Factory of its activity, V_F. Note that the FL rule is rarely observed in legal practice, perhaps due to stringent informational requirements it imposes on courts. For the sake of completeness, however, I will include this rule in the analysis.[20]

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[18] For the conditions under which Resort should mitigate its loss by shutting down the affected activity *see* the discussion in Section III.B. *supra.*

[19] The distinction between property rules and liability rules may not always be clear in theory and in practice. *See* Kaplow & Shavell, *supra* note 2, at 756-757 (describing both types of rules as "members of a continuum of liability rules that differ merely in their level of damages). That observation notwithstanding, I will follow Kaplow and Shavell and take the classification to be clear-cut.

[20] *But see* Spur Indus., Inc. v. Del. E. Webb Dev. Co*.,* 469 P.2d 700 (Ariz. 1972) (ordering a cattle feedlots operator to shut down, and the developer of a neighboring retirement community to indemnify the feedlots operator for the costs of moving or shutting down). *See also* Krier & Schwab, *supra* note 2, at 467-470 (discussing in detail the "paradox of rule four"). *But see* A. Douglas Melamed, *Remarks: A Public Law Perspective*, 106 YALE L. J. 2209 (1997) (arguing that "Rule 4" remedies are widely used in public law contexts).

These rules differ in the informational requirements they impose on courts. Under both property rules – FP and RP – the court needs only to verify if Factory pollutes the river. Under the RL rule, the court not only has to verify whether Factory pollutes but also to determine the magnitude of the damage caused by the pollution.[21] Moreover, under the RL rule with a mitigation requirement, the court needs to verify both the value of operating Resort in the absence of pollution (V_R) and the magnitude of harm (H). These values might be hypothetical, since the court is required to estimate the value of Resort's operations, when Resort does not actually operate. The precise nature of the informational burden on courts and the extent to which courts indeed possess the required information are a matter of dispute.[22] Since the thesis of this paper focuses on the *ex ante* framework, however, I find it unnecessary to take sides in that dispute.

D. *Seeking a Rule to Facilitate* Ex Post *Efficiency*

This section outlines the approach pursued by Calabresi and Melamed, and by subsequent work, in the selection of the optimal legal rule – the rule that would facilitate attaining the *ex post* efficient outcome.

The starting point for Calabresi and Melamed is the insight of Coase.[23] Coase taught us that in a world of no transaction costs, the outcome would be the efficient one described above under any of the four rules.[24] When bargaining is easy, the parties could bargain and achieve the efficient outcome regardless of the choice of legal rules. Suppose that the value of pollution to Factory, V_F, is 100, the harm caused by pollution to Resort, H, is limited to 50, and the value of operating Resort without pollution, V_R, is 70. The efficient outcome in that scenario is FR: Factory and Resort should operate and pollution should take place. Suppose the legal rule is RP, granting Resort a property right to be free of pollution. If bargaining is easy, the efficient outcome will be obtained despite the legal rule. Factory has an incentive to offer Resort an amount between 50 and 100 in order to induce him to suffer the harm associated with pollution. Resort is better off accepting such offer because if it insists on enforcing its

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[21] Likewise, under the FL rule the court would have to verify the value of the Factory's forgone activity, V_F.

[22] For a discussion of courts' capability to acquire information about damages and its implications for the choice between property rules and liability rules, *see* text accompanying notes 38-40 *infra*.

[23] *See* Coase, *supra* note 5.

[24] *Id.* at 8.

entitlement, i.e., operating free of pollution, it would get only 70, whereas accepting Factory's offer leaves it with a total value ranging between 70 and 120. In a similar fashion, it can be shown that the efficient outcome would be achieved for any values of V_F, V_R or H, regardless of the choice of legal rules.

But Coase also pointed out that in the presence of transaction costs the outcome might depend on the allocation of entitlements.[25] Given this insight, Calabresi and Melamed stressed the importance of first identifying the particular impediments to attaining the *ex post* efficient outcome. Having identified these impediments, the policymaker should match each set of cases with the allocation of entitlements and the legal rule that would most likely attain the *ex post* efficient outcome.[26] This analytical task envisioned by Calabresi and Melamed has guided the literature in the last three decades. Two features characterize the *ex post* literature. First, the *ex post* literature focuses on cases in which bargaining between the parties is difficult. Second, as I will discuss in greater detail below,[27] the literature has concluded that liability rules are generally superior to property rules.

E. What the Ex Post View Misses

The insights of the *ex post* view are important, and the considerations that it has identified as relevant are clearly relevant for legal policy-making. The thesis of this paper, however, is that there is another important set of considerations and factors that should be recognized, and that taking them into account calls for reconsideration of the conclusions of the *ex post* analysis and of its implications. While the following parts of the paper will analyze in detail the additional factors and the changes in conclusions they warrant, it would be worth noting briefly upfront what the *ex post* view "misses."

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[25] *Id.* at 16 (when transaction costs are large, "the initial delimitation of legal rights does have an effect on the efficiency with which the economic system operates.")

[26] *See* Calabresi & Melamed, *supra* note 1, at 1106-1111 (analyzing how different types of transaction costs affect the choice between property rules and liability rules.)

[27] *See* Section II.E(4) *infra.*

1. *The Presence and Attributes of the Parties Should Not Be Taken as Given*

The prior literature has largely taken the relevant aspects of the conflicting use problem as given.[28] In the context of our example, that premise takes the presence of Factory and Resort in the year 2000, their location along the river, and the potential costs and benefits that would arise from pollution or from its absence – V_F, V_R, and H - as given. Starting with these presumably independent givens as defining the situation, the literature has sought ways to facilitate the efficient outcome through the choice of legal rules.

But all these factors might be a function of actions taking place at some point in the past, which in turn may be a function of what legal rule the parties anticipate will govern in case a conflicting use problem will arise. Hence, the choice of legal rules has an important set of *ex ante* effects overlooked by the literature so far. The aim of this paper is to identify the set of *ex ante* effects associated with the choice of legal rules, explore their importance, and analyze their implications for the choice of legal rules.

2. *Ex Post Distribution Does Matter for Efficiency*

The choice of legal rule might clearly have distributive consequences as it might affect the division of value between Factory and Resort. Prior work has recognized the effect of legal rules on the final distribution of value between the parties in an efficient outcome.[29] Yet, it has generally taken the view that these distributional consequences are irrelevant for efficiency. What is important for efficiency in the *ex post* analysis is to attain the largest total pie, which would come with an efficient *ex post*

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[28] *See* generally Calabresi & Melamed, *supra* note 1; Kaplow & Shavell, *supra* note 2; Ayres & Talley, *supra* note 2. While some authors note in passing or comment briefly on the possibility of *ex ante* effects, none of them has paid substantial attention to this question or attempted to identify and study the range of potential *ex ante* effects identified below. For example, Kaplow and Shavell do briefly note that compensating "victims" would reduce their incentives to invest *ex ante* in precautions. *See* Kaplow & Shavell, *supra* note 2, at 738. Ayres and Talley briefly mention the tendency of liability rules to discourage investment in value-enhancing activities. *See* Ayres & Talley, *supra* note 2, at 1085-1086. But these works, which focus on a systematic and extensive analysis of the *ex post* question, pay little attention to these effects and do not recognize that they are an element of a significant set of *ex ante* effects.

[29] *See, e.g.,* Polinsky, *Resolving Nuisance Disputes*, *supra* note 2 at 1089-1092; Calabresi & Melamed, *supra* note 1, at 1098-1102.

outcome, rather than to get any particular division of the value of this total pie.

To be sure, writers have expressed different views on whether distribution should constitute an independent objective of legal policy. Calabresi and Melamed, for example, have contended that "Difficult as wealth distribution preferences are to analyze, it should be obvious that they play a crucial role in the setting of entitlements."[30] Kaplow and Shavell, by contrast, have argued that "concern about the distribution of income has no bearing on the choice between property rules and liability rules."[31] But all writers have shared the premise that as far as efficiency is concerned distribution does not matter. Calabresi and Melamed, for example, acknowledge that legal rules might differ in their distributional consequences.[32] Nonetheless, they assign the different distributional consequences of legal rules no weight in discussing the efficiency aspect of the choice of legal rules.[33]

As the analysis of this paper will show, however, once *ex ante* considerations are taken into account, the distribution of the *ex post* value does matter for efficiency. The features of the *ex post* situation – and thus the size of the total pie under the most efficient outcome attainable in this situation – are a function of the parties' *ex ante* actions and investments. These actions and investments, in turn, are shaped by the distribution of value that the parties expect to capture *ex post*. Hence, the effect of any given rule on total value will depend not only on whether *ex post*, given the features of the *ex post* situation, the rule reaches the efficient outcome but also on which *ex post* situation the rule produces in the first place. Accordingly, because an overall efficiency comparison of rules will depend on the *ex ante* incentives that they provide, the different distributive consequence of rules in similar situations matter for efficiency.

Some writers have suggested that changes in distribution might affect which outcome is efficient because changes in wealth might affect the parties' valuations, which ultimately dictate the efficient outcome. In our

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[30] *See.* Calabresi & Melamed, *supra* note 1, at 1098.

[31] *See* Kaplow & Shavell, *supra* note 2, at 744. *See also* Louis Kaplow & Steven Shavell, *Why the Legal System Is Less Efficient than the Income Tax in Redistributing Income*, 23 J. LEGAL STUD. 667 (1994) (developing the argument that legal rules should not be used to redistribute income because the income tax and transfer system is superior).

[32] Indeed, as mentioned earlier, they consider distribution a legitimate objective of legal policy. *See* Calabresi & Melamed, *supra* note 1, at 1098-1102, 1110.

[33] *Id.* at 1093-1098, 1106-1110.

example, the claim would be that V_F, V_R, and H might depend on the legal rule and should not be taken as given because, to the extent that certain parties' wealth (say, patrons, customers, or employees of one of the enterprises) is sufficiently impacted by the different distributional consequences of legal rules, alternative rules might lead to different values and thus affect which outcome would be efficient.[34]

The point made by these writers and the thesis offered in this paper share the understanding that the *ex post* distribution produced by legal rules cannot be ignored. But the two points very much differ in why, when, and how distribution should be taken into account. Note first that the point made by those critics is also an *ex post* point – taking the features of the situation as given. As a result, the point made by these critics is not that the standard analysis might lead to an inefficient conclusion. Rather, their point is only that which outcome is efficient is indeterminate, and that two rules with two different distributive outcomes might both lead to an efficient outcome, and that in choosing between these two outcomes (and the rules underlying them) efficiency by itself would not be a sufficient criterion to make the selection.

In contrast, the thesis of this paper suggests that, by ignoring distribution of value and its *ex ante* effects, standard analysis might sometimes lead to the selection of a rule that would be unequivocally *less*

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[34] *See e.g.,* Duncan Kennedy, *Cost Benefit Analysis of Entitlement Problems: A Critique,* 33 STAN. L. REV. 387, 401-421 (1981) (arguing that the price a party is willing to pay to prevent a harm from happening might differ from the price the party will ask for allowing the harm to happen, and analyzing the implications of this phenomenon for the Coase theorem); Mark Kelman, *Consumption Theory, Production Theory, and Ideology in the Coase Theorem,* 52 S. CAL. L. REV. 669, 678-695 (same).

More recently, psychologists and behavioral economists have argued, based on experimental evidence, that the initial distribution of entitlements alters the final allocation of resources through private bargaining. *See, e.g.,* Christine Jolls et al., *A Behavioral Approach to Law and Economics*, 50 STAN. L. REV. 1471, 1483 (1998) (positing that "even when transaction costs and wealth effects are known to be zero, initial entitlements alter the final allocation of resources."); Elizabeth Hoffman & Matthew L. Spitzer, *Willingness to Pay vs. Willingness to Accept: Legal and Economic Implications,* 71 WASH. U. L. Q. 59 (1993) (investigating evidence on the divergence between willingness-to-accept and willingness-to-pay measures of value and exploring the implications of the divergence for analysis in law and economics); W. Michael Hanemann et al., *Willingness to Pay and Willingness to Accept: How Much Can They Differ*, 81 AM. ECON. REV. 635 (1991); Daniel Kahneman et al., *Experimental Tests of the Endowment Effect and the Coase Theorem*, 98 J. POL. ECON. 1325, 1329-42 (1990) (reporting experiments showing asking prices to be higher than offer prices).

efficient than some other rule. Thus, overlooking distributional consequences, this paper argues, would not lead to an arbitrary selection of one among two or several equally efficient outcomes but rather might lead to an outcome that is clearly less efficient than the outcome associated with an alternative rule.

In addition, it is worth noting that the point of this paper applies in a different, and likely much wider, range of situations than the point made by the above critics. The wealth effects point is applicable in situations in which alternative allocations of entitlements have such a considerable effect on the wealth of some parties that they change considerably the value attributed by individuals to goods, services, or resources whose provision is a subject of the legal rule in question. In a situation like the Factory/Resort example, if both Factory and Resort are not sufficiently unique in the economy, that is unlikely to happen. But *ex ante* investments can be important in many situations, even when wealth effects are small or non-existent.

3. *The Choice of Rule Matters Even When Ex Post Bargaining Is Easy*

Because the literature has focused on the *ex post* situation, in which the features of the parties and of the externality are taken as given, it has generally taken the position that the choice of legal rules matters for efficiency only when the *ex post* bargaining is difficult. In the context of our example, this position implies that the choice of legal rules would matter only if Factory and Resort, in the year 2000, will find it difficult to bargain and reach an agreement.

Conversely, the literature has posited that if *ex post* bargaining is relatively easy, the choice of entitlements and their form of protection will be of little significance. In the context of our example, this position implies that if Factory and Resort, in the year 2000, can easily bargain and reach an agreement, then the choice of rules will matter little. If the bargaining is completely costless then the choice of rule is completely irrelevant. For this reason, the analysis has taken the position that legal policy makers can devote little attention to the scenario in which *ex post* bargaining is easy. Kaplow and Shavell, for instance, posited that "when bargaining is successful, there is no difference between property rules and liability rules."[35] Taking this position for granted, prior work has confined its

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[35] *See* Richard A. Epstein, *A Clear View of the* Cathedral: *The Dominance of Property Rules*, 106 YALE L. J. 2091, 2092 (1997) (arguing that "in a world in which transaction costs were zero, where all disputes could be costlessly resolved, the

attention to cases in which bargaining is difficult or even impossible and in which there is substantial likelihood, if not certainty, that the parties will be unable to reach agreement.

This paper finds this conventional wisdom to be problematic. As the analysis in the following sections will show, the choice of rule might matter greatly even where *ex post* bargaining is easy. Indeed, with limited transaction costs in the year 2000, Factory and Resort can successfully bargain and therefore reach the *ex post* efficient outcome under any legal rule. That notwithstanding, the choice of legal rule might have substantial consequences on the ultimate division of value between Factory and Resort – and thus substantial consequences on Factory and Resort's *ex ante* incentives. As a result, even when bargaining in 2000 is easy, different legal rules might substantially differ in terms of their effect on overall efficiency.

It should be stressed that, of course, I do not take issue with the Coase theorem. It is in no way my claim that inefficiencies will result in a world with no transaction costs whatsoever. In a world in which there are no transaction costs at any stage going back to the beginning of time, contracts would be adopted at those early stages to ensure that all *ex ante* investments are made efficiently. Rather, my point is that the absence of transaction costs *ex post,* while making *ex post* bargaining easy, cannot ensure that overall efficiency will be attained, or that the choice of legal rule would not matter for efficiency. The absence of transaction costs at the time the externality emerges is not by itself sufficient to place us in the Coasian world. That would require transaction costs to be absent not only at the time in which the externality arises but also at any earlier point in time in which some relevant investments and actions take place.

As I will discuss in more detail later on, there might well be many situations in which bargaining is easy *ex post* but not at earlier *ex ante* stages. In our example, it might be that in 2000, once the parties' activities have taken shape, and just before the externality arises, the parties can easily bargain, and there will be hardly any informational impediments to the successful completion negotiations. But bargaining in the 70's or 80's about *ex ante* investments or the rule governing future externalities in 2000 might have been difficult. For one thing, one of the parties might at

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choice between liability rules and property rules would be of little or no importance…."); Kaplow & Shavell, *supra* note 2, at 733 and at 754 (arguing that the legal approach adopted for the resolution of nuisance questions may be relatively unimportant because bargaining between the parties is usually easy); Krier & Schwab, *supra* note 2, at 448.

the bargaining stage not have been even present. And even if both parties were present, the type of informational problems that can impede bargaining might have been significant then. In such situations, the easy *ex post* bargaining at 2000, by itself, cannot ensure that *ex ante* actions would be optimal. And, as we shall see, legal rules might differ significantly in their performance along this dimension.

4. *Liability Rules are Not Generally Superior*

A main theme of the current literature, which stems from its focus on the problems of *ex post* outcome, is that liability rules are generally superior to property rights. Calabresi and Melamed were the first to point out some advantages of liability rules from the *ex post* perspective. Subsequent writers, in turn, have identified further advantages of liability rules, resulting with strong preference for liability rules.

Calabresi and Melamed argued that liability rules are superior to property rules when private bargaining is impeded by large transaction costs, and when courts can assess accurately the damages from the externality.[36] This is because when transaction costs are prohibitive, "even though a transfer of the entitlement would benefit all concerned, such a transfer will not occur."[37] Liability rules, which provide a collective determination of value, might thus facilitate beneficial transfers otherwise thwarted by the failure of private bargaining.

One important question left unanswered by Calabresi and Melamed is which rule is better when bargaining is difficult but courts cannot assess damages accurately. This question is important because there seem to be many cases in which courts may lack the information required to assess accurately the amount of damages that would ensure the efficiency of the transfer.[38] Kaplow and Shavell have developed an important analysis seeking to provide an answer to this question.

Kaplow and Shavell have suggested that, in any case in which bargaining fails, a liability rule would dominate a property rights regime

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[36] *See* Calabresi & Melamed, *supra* note 1, at 1106-1110.

[37] *Id.*, at 1106.

[38] *See* Krier & Schwab, *supra* note 2, at 453-6 (arguing that "assessment costs" might impede efficient damage calculations by courts). In that respect, Krier and Schwab follow Polinsky. *See* Polinsky, *Resolving Nuisance Disputes*, *supra* note 2, at 1111.

even when courts cannot be relied upon to estimate damages accurately.[39] The intuition for their argument is that, if bargaining is to fail, the party not having the entitlement would likely make a less efficient decision when faced with an infinite price (which is what a property right to the other side would imply in the absence of an agreement) than with a price equal to a court's estimate of the damage to the other side (even if this estimate is somewhat erroneous).[40] Thus, to the extent the initial allocation of the entitlement was inefficient, parties would be induced to undo that legal allocation through the liability system. Entitlements protected by property rules, by contrast, cannot be privately reassigned if bargaining is unsuccessful.

Calabresi and Melamed and Kaplow and Shavell made the above arguments assuming implicitly that whether bargaining fails does not depend on the type of protection provided by the law. Ayres and Talley, on the other hand, have argued that, in addition, the likelihood of a bargaining failure under a property-rights regime is higher than under a liability-rules regime. This is because liability rules have superior ability to overcome impediments to bargaining resulting from the parties' asymmetric information over their valuation of the underlying entitlement.[41]

The analysis of this paper will show, however, that the superiority attributed to liability rules arose from the focus of prior work on the *ex post* problem. As will be seen later, once *ex ante* effects are incorporated, liability rules no longer dominate.[42] Granting a party a liability-rule protection rather than a property-right protection would shift value from this party to the other party. In our example, if the entitlement is granted to Resort with liability protection, then in some scenarios Resort would end up with less value, and Factory will end up with more value, compared to the situation in which Resort is granted the entitlement with a property-right protection. This shift in *ex post* distribution will affect *ex*

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[39] *See* Kaplow & Shavell, *supra* note 2, at 725-727 (suggesting that, regardless of how imperfect the state's information is about harm or prevention costs, a liability rule with damages equal to average harm is superior to a property rule).

[40] *Id.* at 725 ("the virtue of the liability rule is that it allows the state to harness the information that the injurer naturally possesses about his prevention costs.")

[41] *See* Ayres & Talley, *supra* note 2, at 1038-1039. *See also* Louis Kaplow & Steven Shavell, *Do Liability Rules Facilitate Bargaining,* 105 YALE L.J. 221 (1995) (questioning Ayres and Talley's argument); Ian Ayres & Eric Talley, *Distinguishing between Consensual and Nonconsensual Advantages of Liability Rules,* 105 YALE L.J. 235 (1995) (responding to Kaplow and Shavell's critique).

[42] *See* Section IV.F(1) *infra.*

ante incentives of both Resort and Factory. This effect, as we will see, might be either positive or negative for either party. Hence, once *ex ante* effects are taken into account, it is no longer the case that liability rules will necessarily dominate.

III. THE EFFECT OF RULES ON THE *EX POST* DIVISION OF VALUE

Having seen what the *ex post* approach of prior work might have missed, I now turn to examine how the choice of rules affects the *ex ante* actions and decisions by the parties. This Part will pursue the first step in this analysis by comparing the different legal rules in terms of their effects on the *ex post* division of value between the parties.

To abstract away from the problems identified by the prior literature, I will assume that *ex post* bargaining is easy, indeed costless. This implies, among other things, that bargaining involves neither transaction costs nor informational asymmetries. In particular, I assume that each party knows not only its own benefits and costs associated with the conflicting use, but also the other party's benefits and costs. Thus, Factory knows the values of H and V_R, and Resort knows the value of V_F. Finally, I will assume that, when required by the rule in effect, courts assess accurately all the relevant values. Under these conditions, the parties will always reach the efficient outcome under each one of the alternative rules. The division of value between the parties, however, will considerably differ under alternative legal rules.

Another simplifying assumption that I make for ease of exposition is that the parties have equal bargaining power and will therefore share equally in any gains from mutual trade. This assumption will not affect our qualitative conclusions about the effect of alternative legal rules on actions and investments *ex ante*, and it will be apparent to the reader that the analysis can accommodate different assumptions about the parties' relative bargaining power.

It will be useful to analyze the bargaining and the ensuing outcome under each of the three efficient scenarios identified earlier:[43] the scenario in which it efficient for both Factory and Resort to operate, the scenario in which it is efficient for only Factory to operate, and the scenario in which it is efficient for only Resort to operate. Sections A-C will accordingly examine the division of value under each of these scenarios.

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[43] *See* Section II.B. *infra.*

A. Scenario FR: Factory and Resort Should Both Operate

Under this scenario Factory and Resort should operate. As mentioned earlier, this scenario arises when: (i) the benefits of pollution to Factory exceed the harm to Resort, $V_F > H$; and (ii) the harm to Resort is smaller than the value of Resort's damaged activity, $V_R > H$.

Under the RP rule, Factory needs to get Resort's consent in order to conduct the activity polluting the river. Without pollution, Resort derives a value of V_R from its relevant activity, and Factory captures no benefits. When pollution takes place, the value derived by Resort is reduced to $V_R - H$, but Factory derives a value of V_F. The net social surplus created by pollution, then, is $V_F - H$. In order to obtain Resort's consent, Factory must compensate Resort for its damages, H, and pay it part of the net surplus. Therefore, under the assumption that the parties share equally in gains from trade, Factory will pay Resort its harm, H, plus half the amount of $V_F - H$. The final division of value between the parties will thus be as follows: Factory will end up with $0.5(V_F - H)$; Resort will end up with $V_R + 0.5(V_F - H)$. The property protection granted to Resort enables it not only to recover its harm, but also to extract some of the net surplus generated by Factory's activity.

Under the RL rule, Factory can pollute the river without Resort's consent as long as it pays Resort damages in an amount that equals its harm, H. By hypothesis, the benefit of pollution to Factory exceeds the harm caused by pollution to Resort ($V_F > H$). Thus, Factory will decide to pollute and compensate Resort for the harm, H. The final division of value between the parties will be as follows: Factory will end up with $V_F - H$; Resort will end up with V_R. Under liability-rule protection, the parties will have no incentive to bargain because Resort will be unable to extract from Factory an amount exceeding H, and will reject any offer of payment below H.

Under the FP rule, the state will ensure that Factory can pollute unless it consents to forego pollution. Since Factory's operation is efficient, there will be no incentive for the parties to engage in bargaining for the reallocation of their entitlements. Accordingly, the final division of value between the parties will be as follows: Factory ends up with V_F; Resort ends up with $V_R - H$.

Under a FL rule, Resort has the right to prevent Factory from polluting the river if it pays Factory damages in the amount of V_F. By hypothesis, however, the harm suffered by Resort due to pollution is smaller than the value of pollution to Factory. Hence, Resort will prefer to operate under pollution rather than to prevent Factory from polluting the

river. The final division of value between the parties is the following: Factory ends up with V_F; Resort ends up with $V_R - H$.

The division of value under the alternative legal rules is summarized in Table 2.

Table 2: Division of Value in Scenario FR

Rule	Payments Made by Factory	Value to Factory	Value to Resort	Total Value
RP	$H + 0.5(V_F - H)$	$0.5(V_F - H)$	$V_R + 0.5(V_F - H)$	$V_F + V_R - H$
RL	H	$V_F - H$	V_R	$V_F + V_R - H$
FP	No Payment	V_F	$V_R - H$	$V_F + V_R - H$
FL	No Payment	V_F	$V_R - H$	$V_F + V_R - H$

B. Scenario F: Only Factory Should Operate

In this scenario, it is efficient for Factory to operate and for Resort to shut down the damaged activity. As mentioned earlier, this scenario arises under the following two conditions: (i) the benefit of pollution to Factory exceeds the harm caused by the pollution to Resort, $V_F > H$; and (ii) the harm caused by pollution to Resort exceeds the potential value of the damaged activity, $V_R < H$.

Under the RP rule, Resort has a right to prevent Factory from operating, allowing it to operate itself free of harm and capture a benefit of V_R. However, given that the value of pollution to Factory exceeds the value of operating free of pollution to Resort, $V_F > V_R$, Resort will "sell" its right to Factory, since the transaction produces a surplus of $V_F - V_R$.

When pollution takes place, it is efficient for Resort to shut down the damaged activity. Thus, the expected payment made by Factory to Resort should compensate Resort for its forgone benefits and give it a fraction of the net surplus. Under the assumption of equal sharing of surplus, Resort will get $V_R + 0.5(V_F - V_R)$, whereas Factory will be left with $V_F - 0.5(V_F - V_R)$.

Under the RL rule, Factory can operate without Resort's consent, provided it pays Resort damages equal to the harm suffered by Resort. Since under pollution Resort should shut down, the damages would equal V_R. Resort would not be able to extract from Factory an amount exceeding the expected damage award. On the other hand, Resort would not agree to any offer of payment below the expected damage award. Hence, the parties would have no incentive to bargain. The final division of value between the parties will thus be as follows: Factory will end up with $V_F - V_R$; Resort will end up with V_R.

Under the FP rule, Factory has the right to operate without paying damages. Since Factory's operation is efficient, there will be no incentive for the parties to engage in bargaining aimed at the reallocation of rights. Also, since the harm produced by pollution exceeds the value of its activity, Resort will shut down. The final division of value between the parties will thus be as follows: Factory will end up with V_F; Resort will end up with nothing.

Under the FL rule, Resort can prevent Factory from polluting the river, *i.e.*, make it shut down, by paying Factory damages equaling the value of Factory's activity, V_F. But, since the value of Factory's activity exceeds the value of Resort's activity, $V_F > V_R$, Resort would prefer not to exercise this option and shut down its own activity instead. The final division of value between the parties will thus be as follows: Factory will end up with V_F; Resort will end up with nothing.

The division of value in scenario F under the alternative legal rules is summarized in Table 3:

<u>Table 3: Division of Value in Scenario F</u>

Rule	Payments Made by Factory	Value to Factory	Value to Resort	Total Value
RP	$V_R + 0.5(V_F - V_R)$	$V_F - 0.5(V_F + V_R)$	$0.5\,(V_R + V_F)$	V_F
RL	V_R	$V_F - V_R$	V_R	V_F
FP	0	V_F	0	V_F
FL	0	V_F	0	V_F

C. Scenario R: Only Resort Should Operate

In this scenario, the efficient outcome is for Resort to operate and for Factory to shut down because the value of Factory's activity producing the pollution is smaller than both the harm caused by pollution and the value of Resort's activity, $V_F < H, V_R$.

Under the RP rule, Factory can operate only if it obtains Resort's consent. Resort will not agree to any payment exceeding the value of the net harm it suffers as the outcome of pollution, *i.e.*, either H or V_R.[44] Factory, on the other hand, has no reason to offer a payment that exceeds the value of its own activity, V_F. Since the value of Factory's polluting activity is smaller than both the harm caused by pollution to Resort, and the value of Resort's activity, $V_F < H, V_R$, there will be no incentive for the parties to engage in bargaining aimed at the reallocation of rights. The final division of value between the parties will be as follows: Factory will end up with nothing; Resort will end up with the full value of its activity without pollution, V_R.

Under the RL rule, Factory can operate at the cost of paying Resort damages in the amount of the harm produced by pollution, H, or the value of Resort's activity, V_R. In this scenario, the value of the polluting activity is smaller than both the harm it causes and the value of Resort's activity.

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[44] The net harm would equal the harm, H, if it were efficient for Resort to operate despite the pollution. The net harm would equal the value of Resort's operation, V_R, if it were efficient for Resort to shut down its activity under pollution.

Hence, Factory will prefer to shut down and avoid such payment. The final division of value between the parties will be as follows: Factory will end up with nothing; Resort will end up with the full value of its activity without pollution, V_R.

Under the FP rule, Factory has the right to operate and pollute unless it agrees to forego the activity producing the pollution. But given that the value of the polluting activity is smaller than both the harm it causes and the value of Resort's activity, Factory will prefer to sell its right to Resort. The price required by Factory to shut down would equal the value of the activity to Factory, V_F, plus a portion of the net surplus. The price Resort will be willing to offer depends on the relative magnitudes of H and V_R. First, consider the case where the value of Resort's operation exceeds the potential harm associated with pollution, $V_R > H$. In this case, Resort will operate regardless of Factory's actions. Hence, if Factory agrees to shut down, Resort gains by avoiding the harm, H. Accordingly, the net surplus produced by shutting down Factory's polluting activity is $H - V_F$. Under the assumption of equal bargaining power, the payment made by Resort to Factory would equal the forgone benefits of the polluting activity, V_F, plus half the net surplus, $0.5(H - V_F)$. Resort would thus end up with $V_R - 0.5(H - V_F)$.

Now suppose that the potential harm associated with pollution exceeds the value of Resort's activity, $H > V_R$. In this case, Resort will shut down if Factory operates. Thus, Factory's consent to cease pollution (and shut down) produces a gain of V_R to Resort. Accordingly, the net surplus produced by shutting down Factory's polluting activity is $V_R - V_F$. Under equal bargaining power, the payment made by Resort to Factory would equal the forgone benefits associated with the polluting activity, V_F, plus half the net surplus, $0.5(V_R - V_F)$. Resort would end up with $V_R - 0.5(V_R - V_F)$.

Under the FL rule, Resort can prevent Factory's operation by paying it damages in an amount that equals the value of the forgone activity, V_F. Therefore, Factory will not be able to extract from Resort a payment exceeding V_F. On the other hand, since the legal rule guarantees Factory a damage award of V_F, Factory will not agree to any offer of payment smaller than V_F. The final division of value between the parties will be as follows: Factory will end up with V_F; Resort will end up with $V_R - V_F$.

The division of value in scenario R under the alternative legal rules is summarized in Table 4:

Table 4: Division of Value in Scenario R

Rule	Payments Made by Resort	Value to Factory	Value to Resort	Total Value
RP	0	0	V_R	V_R
RL	0	0	V_R	V_R
FP	$V_F + 0.5(H - V_F)$ (if $V_R>H$) *or* $V_F + 0.5(V_R - V_F)$ (if $V_R<H$)	$0.5(V_F + H)$ (if $V_R>H$) *or* $0.5(V_R + V_F)$ (if $V_R<H$)	$V_R - 0.5(V_F + H)$ (if $V_R>H$) *or* $V_R - 0.5(V_R + V_F)$ (if $V_R<H$)	V_R
FL	V_F	V_F	$V_R - V_F$	V_R

The analysis of this scenario completes the comparison of the rules in terms of their distributive *ex post* consequences. As we have seen, alternative legal rules differ considerably in their effect on the *ex post* value attained by the parties. As we shall next examine, these differences in the *ex post* division will translate into different *ex ante* behavior by the parties.

IV. THE EX ANTE EFFECTS OF ALTERNATIVE RULES

This Part identifies and analyzes the effects of alternative rules on *ex ante* investments. Section A introduces the element of *ex ante* investments into the conflicting use problem. Sections B and C then analyze the effects of the four rules on the parties' *ex ante* investments in enhancing the values of their activities. Sections D analyzes the effects of the alternative rules on *ex ante* investment in harm reduction. Section E then turns to an overall comparison of the rules in terms of their *ex ante* effects.

A. Introducing Ex Ante Investments

Following the literature on the *ex post* conflicting use problem, we have thus far treated *as given* the values shaping the situation – the value of Factory's activity, V_F, the value of Resort's activity, V_R, and the harm resulting from joint operation of the parties, H. But these values are likely

to be affected by actions taken by the parties at earlier points in time, actions that in turn might well be influenced by the legal rule.

For example, the value of the parties' activities, V_F and V_R, might be a function of the *ex ante* decisions of Factory and Resort regarding what scope of activities to develop; what products or services to provide; how many workers to hire; and how much to invest in their human capital. Similarly, the harm resulting from joint operation of the parties, H, might be a function of various actions and investments by the parties. For example, the magnitude of the harm might depend on the extent to which Factory or Resort relies on the river's waters for its activities.

We will thus assume that Factory will invest x_F, and Resort will invest x_R, in enhancing the value of their activities. We will also assume that the harm resulting from joint operation, H, will depend on the investment of the parties in harm reduction, y_F and y_R. All those investments will be assumed to have the standard feature of diminishing marginal utility, *i.e.*, the marginal effect of an investment of $1 on the value of the activity, or the size of the harm, declines for each additional dollar invested.

The question that will guide our analysis is which allocation of entitlements *ex post*, in the event the externality arises, will be best in providing incentives to the parties' *ex ante* investments. We will make the plausible assumption that the level of *ex ante* investments by the parties is not observable by courts, and legal rules thus cannot be made dependent on them.[45] We will limit our attention to the standard and familiar legal rules classified by Calabresi and Melamed and considered by the literature and the preceding parts.

Our goal is to identify the best rule taking into account *ex ante* investments. Even if the parties could negotiate *ex ante*, prior to their investments, and adopt an arrangement that will govern their relationships in the future, it would be still worthwhile for the policy-maker to provide, as the default legal rule, whatever arrangement would be optimal. Moreover, in many situations bargaining *ex ante* would be difficult or impossible even if bargaining *ex post* is expected to be easy.

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[45] This assumption is similar to the one made in the incomplete contracts literature under which the parties' *ex ante* investments are non-contractible. *See, e.g.,* HART, FIRM, CONTRACT, *supra* note 9.

To start with, one of the parties might have to make investments before the other party is present or accessible.[46] Moreover, while we assume that both parties know *ex post* the value of the other party's activity and the magnitude of the potential harm that will occur if both activities take place, parties might hold some private information *ex ante*. For example, *ex ante*, before the parties' investments are made, Factory might have some private information regarding the effectiveness of its investment in enhancing the value of its activity, V_F. Similarly, Resort might have, *ex ante*, some private information regarding the effectiveness of its investment in enhancing the value of its activity, V_R. Such informational asymmetries between the parties might impede *ex ante* bargaining between the parties over the desirable legal rule.

Before proceeding to examine how alternative rules will affect *ex ante* investments, let me note two assumptions that I will use for simplicity of exposition. First, I will assume that the *ex ante* investments do not determine which scenario will occur, only the values of the activities and the ensuing harm given the scenario.[47] I will thus assume that which scenario will materialize will depend on exogenous developments in the markets within which Factory and Resort operate. But given any scenario, the values of Factory and Resort's activities, V_F and V_R, and the magnitude of the harm, H, will be influenced by the *ex ante* investments.

Second, I will use, again for simplicity of exposition, specific numerical figures for the probabilities of the three scenarios. It will be clear from the analysis, however, that its underlying reasoning will apply to other values that these probabilities can take. Specifically, I will assume that the probability that scenario FR will occur (*i.e.*, that it will be efficient for both Factory and Resort to operate) is 1/2; the probability that scenario F will occur (*i.e.*, that it will be efficient for only Factory to operate) is 1/3; and the probability that scenario R will occur (i.e., that it will be efficient for only Resort to operate) is 1/6.

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[46] For example, it might be the case that Resort had been located along the river long before the presence of Factory, and its conflicting use of the river, could even have been foreseen.

[47] The plausible scenarios are: both parties operate (FR); only Factory operates (F); only Resort operates (R). *See* Section II.B. *supra*.

B. *Investment by Factory to Enhance the Value of its Activity*

1. *The Optimal Investment Level*

From a social point of view it is desirable for a party to invest up to the point where the marginal social benefit equals marginal social cost, *i.e.*, the point where one dollar of investment produces one dollar of expected social value. In this calculus it is important to recognize that enhancing V_F will provide social value only in scenarios F and FR, in which Factory will actually operate. In scenario R, since Factory will not engage in the considered activity, the social value of Factory's activity will be zero and thus the investment will not serve any purpose. Hence, the social value of investing another dollar would be equal to the marginal increase in V_F multiplied by the combined probability of scenarios F and FR, which is 5/6 (1/3 + 1/2). It will thus be desirable to invest up to the point where 5/6 of the marginal increase in V_F fall to one.[48] As we shall now turn to see, however, the private calculus of Factory might diverge from the social calculus and the investment of Factory in enhancing the value of its activity might consequently be inefficient.

2. *Investment Levels under the Four Alternative Rules*

(a)   *Entitlement to Resort with Property-Right Protection*

As was shown in part III, Resort's property right will enable it to extract value from Factory for allowing Factory to operate. Thus, in both scenarios FR and F, Resort will allow Factory to operate in exchange for part of Factory's profits. Given our assumption that the parties enjoy equal bargaining power, we have concluded that in scenarios FR and R, Factory will capture only half of any marginal increase in the value of its activity, V_F.[49]

We can now consider Factory's private calculus as to how much to invest *ex ante*. Factory will, of course, fully bear the cost of any $1 marginal increase in investment. But Factory will benefit from an increase in V_F only in scenarios F and FR, which have a combined probability of 5/6. In those scenarios Factory, under equal bargaining power, will

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[48] This means that the socially optimal investment x satisfies $(5/6) \times V_F'(x) = 1$. More generally, if P_F and P_{FR} denote the probabilities that scenario F and FR, respectively, materialize, then the optimal investment x will satisfy be $(P_F + P_{FR}) \times V_F'(x) = 1$.

[49] *See* Sections III.A. and III.B. *supra.*

capture half of the marginal increase in V_F resulting from the marginal increase in its investment, x_F. Thus, Factory will stop investing at the point where 5/12 of the marginal increase in V_F falls to one.[50]

The above implies that Factory will set its level of investment, x_F, at a lower level than is socially optimal. The intuition for this is that, under the RP rule, Factory will fully bear the costs of increasing x_F, but will capture only part of the social benefits of increasing x_F. The other part of the benefits from Factory's investment will be captured, or extracted, by Resort. For this reason, Factory's incentives to invest will be less than socially optimal, and it will invest too little.[51]

(b) Entitlement to Resort with Liability-Rule Protection

Under a liability-rule protection to Resort, Factory will have to pay damages to Resort in scenarios F and FR. But these payments – of H in scenario FR and of V_R in scenario F - do not depend on the value of Factory's activity, V_F. Rather, these payments depend on the size of the damage to Resort in the event that Factory operates.

Let us then consider Factory's private calculus under this rule as to how much to invest *ex ante*. Again, Factory will fully bear the cost of any $1 marginal increase in investment; Factory will also benefit from an increase in V_F in scenarios F and FR, which have a combined probability of 5/6. But, unlike under the RP scenario, under the RL scenario Factory will fully capture the marginal increase in V_F resulting from a marginal increase in its investment, x_F. The reason for this is that the payment that Resort will be getting will depend on Resort's damages and will not be determined by the value of V_F and by marginal increases in this value.[52]

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[50] Formally, Factory's actual investment would satisfy (5/6) x (1/2) x $V_F'(x) = 1$. More generally, let us assume that the bargaining between the parties will result in Resort capturing a fraction ϕ from the surplus and Factory thus capturing a fraction (1-ϕ) from the surplus. Under this more general assumption, Factory's investment would satisfy (P_F + P_{FR}) x (1-ϕ) x $V_F'(x) = 1$.

[51] This result is similar to the standard result in the literature on the hold-up problem: when the value produced by a party A is subject to hold-up by party B, party A will under-invest in enhancing this value. *See, e.g.,* HART, FIRMS, CONTRACTS, *supra* note 9 at 39-42.

[52] The distribution of ex post value between the parties under the RL rule in each of the plausible scenarios discussed in detail in Part III *supra*.

Therefore, Factory will invest up to the point where $5/6$ of the marginal increase in V_F falls to one.[53]

This conclusion implies that, under the RL rule, Factory will invest at the socially optimal level. The intuition underlying this outcome is that whereas Resort will be able to get some payment from Factory, this payment will not increase with increases in the value of Factory's activity, V_F, because the payment will depend only on the magnitude of damages to Resort. Therefore, Factory becomes the "residual claimant," who will get the excess of V_F over the damages payments made to Resort. As Factory captures the full marginal benefit produced by each \$1 of its marginal investment, its private investment incentives will be socially optimal.

(c) Entitlement to Factory with Property-Right Protection

Granting a property-right protection to Factory enables it to capture value not only in scenarios F and FR, but also in scenario R, in which it is efficient for Factory to shut down. In this scenario R, Factory will be able to extract a payment from Resort in return for not operating and thus not causing damage to R. Specifically, as I have shown earlier, under the assumption of equal bargaining power Factory will receive in scenario R, in return for shutting down and allowing Resort to operate, an amount equal to V_F - *i.e.*, what Factory will be giving up by shutting down - plus half of the smaller amount between (H - V_F) or (V_R - V_F) - which is the gain that will result from Factory's shutting down its activity.[54]

Now consider Factory's private calculus as to how much to invest *ex ante*. As always, Factory will fully bear the cost of any \$1 marginal increase in its investment. Factory will also capture the full value of its activity, V_F, in scenarios F and FR, which have a combined probability of $5/6$. Under an FP rule, however, Factory will also capture half of the marginal increase in the value of its activity, V_F, in scenario R, which will materialize with a probability of $1/6$. Thus, Factory will stop investing at the point where $11/12$ of the marginal increase in V_F falls to one.[55] And recall that the socially optimal level of investment was for Factory to

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[53] Formally, Factory's actual investment would satisfy $(5/6)$ x $V_F'(x) = 1$, which is the condition satisfied by the socially optimal level of investment. *See* note 48 *supra*. More generally, Factory's investment would satisfy $(P_F + P_{FR})$ x $V_F'(x) = 1$.

[54] *See supra* Part III.C.

[55] Formally, Factory's actual investment would satisfy $((5/6) + (1/6)$ x $(1/2))$ x $V_F'(x) = 1$. More generally, relaxing the assumption of equal bargaining power, Factory's investment would satisfy $(P_F + P_{FR} + \phi P_R)$ x $V_F'(x) = 1$.

invest just up to the point where $5/6$ of the marginal increase in V_F fall to one.[56]

The above implies that the level of investment adopted by the factory, x_F, will be excessive – that is, higher than socially optimal. This is because, under the FP rule, Factory will be able to benefit from an increase in the value of its activity, V_F, even in scenario R in which Factory would not be operating its activity. Raising V_F will hence provide Factory with some private benefits that will not reflect social gain but rather a higher ability to extract payment from Resort. As a result, Factory will invest excessively.[57]

(d) Entitlement to Factory with Liability-Rule Protection

Let us now turn to the fourth rule, which also gives the entitlement to Factory but this time only with a liability-rule protection. Under this rule, Factory will again be able to capture value not only in scenarios F and FR but also in scenario R in which it would (as is efficient) shut down its activity. In this scenario R, Resort will be able under the FL rule to make Factory shut down, but Resort will have to pay Factory the value of this forgone activity, V_F. Thus, under a liability-rule protection, the factory will capture the full value of its activity, V_F, under all scenarios, irrespectively of the relative bargaining power of the parties.

Turning to Factory's private calculus, observe that, as under all other rules, Factory will fully bear the cost of any \$1 marginal increase in its investment. Factory will also capture fully any marginal increase in V_F in all scenarios, including scenario R in which the investment in enhancing

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[56] *See* text accompanying footnote 48 *supra.*

[57] This result is similar to those in the law-and-economics literature showing that, in some contexts, compensating a party for a value that is not going to be actually produced might lead to over-investment. For example, Steven Shavell has shown that the expectation-damages remedy in contracts will lead to over-investment in reliance because the relying party will disregard the possibility that her investment might not produce social value. *See* Steven Shavell, *Damage Measures for Breach of Contract*, 11 BELL J. ECON. 466 (1980). Similarly, in separate papers, Robert Cooter and Louis Kaplow have suggested that full compensation for government takings lead to over-investment because parties will disregard the possibility that their investment might not produce a social value if their property is taken by the government. *See* Louis Kaplow, *Economic Analysis of Legal Transition*, 99 HARV. L, REV. 509 (1986); Robert Cooter, *Unity in Tort, Contract, and Property: The Model of Precaution*, 73 CAL. L. REV. 1 (1985).

V_F produces no social value. Thus, Factory will invest until a dollar of investment produces a dollar increase in the value of Factory's activity.[58]

This level of Factory's investment is clearly higher than the socially optimal one. Furthermore, whereas under the FP rule Factory receives only a fraction of the increase in V_F, under the FL rule Factory receives the entire marginal increase in V_F. Thus, the distortion in Factory's incentives in the direction of excessive investment is more severe under the FL rule than under the FP rule.

C. Resort's Ex Ante Investment to Enhance the Value of its Activity

1. *The Optimal Investment Level*

Recall that, from a social point of view, it is desirable for a party to invest up to the point where the marginal investment cost equals marginal expected social value, *i.e.*, the point at which one dollar of investment produces one dollar of expected value. Enhancing the value of Resort's activity, V_R, will provide social value only in scenarios R and FR, in which Resort will actually operate. In scenario F, since Resort will shut down, the social value of its activity will be zero and thus investment in enhancing V_R will not serve any social purpose. Hence, the social value of investing another dollar would equal the marginal increase in V_R multiplied by the combined probability of scenarios R and RF, which is 4/6 (1/6 + 1/2). It will be desirable, then, to invest up to the point where 4/6 of the marginal increase in V_R fall to one.[59] As we shall immediately see, however, Resort's private calculus might differ from the social calculus, and the investment of Resort in enhancing the value of its activity might therefore be inefficient.

2. *Investment Under the Four Rules*

   (a)   *Entitlement to Resort with Property-Right Protection*

Granting a property-right protection to Resort enables it to capture value not only in scenarios R and FR, but also in scenario F, in which it is efficient for Resort to shut down. In this scenario F, Resort will be able to

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[58] Formally, Factory's actual investment would satisfy $V_F'(x) = 1$.

[59] This means that the socially optimal investment satisfies $(4/6) \times V_R'(x) = 1$. More generally, if P_R and P_{FR} denote the probabilities that scenarios R and FR respectively materialize, then the optimal investment will be $(P_R + P_{FR}) \times V_R'(x) = 1$.

extract from Factory, in return for allowing Factory to operate, a payment of V_R (what Resort will be giving up by shutting down) plus of half of ($V_F - V_R$) (the net surplus resulting from Factory's operating and Resort's shutting down its activity).[60]

Now consider Resort's private calculus as to how much to invest *ex ante.* Resort will, of course, fully bear the cost of any $1 marginal increase in investment. Resort will also capture the full value of its activity, V_R, in scenarios R and FR, which have a combined probability of 4/6. Under an RP rule, however, Resort will also capture half of the marginal increase in the value of its activity, V_R, in scenario F, which will materialize with a probability of 1/3. Thus, Resort will stop investing at the point where 5/6 ((4/6) + (1/2) x (1/3)) of the marginal increase in V_R fall to one.[61] By contrast, as we have previously seen, the socially optimal level of investment was for Resort to invest just up to the point where 4/6 of the marginal increase in V_R fall to one.

The above implies that the level of investment adopted by Resort, x_R, will be higher than socially optimal. This is because, under the RP rule, Resort will be able to benefit from an increase in the value of its activity, V_R, even in scenario F, in which Resort would not be operating its activity. Raising V_R will thus provide Resort with some private benefit that will not reflect social gain but rather a higher extraction from Factory. As a result, Resort will invest excessively.[62]

(b)   Entitlement to Resort with Liability-Rule Protection

This rule gives the entitlement to Resort but with a liability rule protection. Under this rule, Resort will again be able to capture value not only in scenarios R and FR but also in scenario F in which it would (as is efficient) shut down its activity. In this scenario F, Factory would be able under the rule to induce Resort to shut down, but Factory would have to pay Resort the value its forgone activity, V_R.[63] Thus, under a liability rule

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[60] The net value to Resort in scenario F under the RP rule is therefore equal to 0.5 x ($V_R + V_F$). *See* Section III.C. *supra.*

[61] Formally, Resort's actual investment would satisfy ((4/6) + (1/2) x (1/3)) x $V_R'(x) = 1$. More generally, Resort's investment would satisfy $[P_R + P_{FR} + (1-\phi)xP_F]$ x $V_R'(x) = 1$.

[62] *See also* note 57, *supra.*

[63] By hypothesis, it is efficient for only Factory to operate in scenario F. Thus, under the RL rule, the damages paid by Factory to Resort in scenario F would equal V_R. Resort will receive a payment of V_R and shut down. *See also* Section III.B. *supra.*

protection, Resort will capture the full value of its activity, V_R, in all scenarios, irrespectively of the relative bargaining power of the parties.[64]

Turning to Resort's private calculus, observe that, as under all other rules, Resort will fully bear the cost of any $1 marginal increase in its investment. Resort will also capture fully the benefit from any marginal increase in the value of its activity, V_R, in all scenarios, including scenario F in which the investment in enhancing V_R produces no social value. Resort will thus invest until a dollar of investment produces a dollar increase in the value of Resort's activity.[65]

The above level of investment is clearly higher than the socially optimal one. The intuition is that Resort will benefit from an increase in V_R also in scenario F in which this increase will not produce any social gain. Resort's private gains from enhancing V_R will thus be higher than the social gains from such an increase. Furthermore, whereas under the RP rule Resort receives only a fraction of the increase in V_R in scenario F, under the RL rule Resort receives the entire marginal increase in V_R. Hence, the distortion in Resort's incentives in the direction of excessive investment is more severe under the RL rule than under the RP rule.

(c)   Entitlement to Factory with Property-Right Protection

As was shown in part III, Factory's property right will enable it to extract value from Resort for allowing Resort to operate free of pollution. Thus, in scenario R, Factory will agree to shut down in exchange for part of Resort's profits.[66] For simplicity of exposition, let us assume that the value of Resort's activity is always smaller than the harm suffered by Resort when Factory operates, $V_R < H$. Given our assumption that parties enjoy equal bargaining power, Resort will capture, in scenario R, only half of any marginal increase in the value of its activity, V_R.[67]

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[64] *See* discussion in Part III *supra.*

[65] Formally, Resort's actual investment would satisfy $V_R'(x) = 1$.

[66] Recall that the entitlement granted to Factory is the entitlement to engage in its activity, *i.e.*, pollute the river. Hence, Factory will be able to extract value from Resort only in scenario R, in which Factory will shut down its activity. In scenario FR, Factory will operate and thus it will not be able to extract value from Resort under the FP rule (or the FL rule). In contrast, granting the entitlement to Resort with property-right protection will enable it to extract value from Factory not only in scenario F, in which Resort will shut down, but also in scenario FR, in which Resort will operate.

[67] *See* Section III.C. *supra.*

We can now consider Resort's private calculus as to how much to invest *ex ante*. Resort will, of course, fully bear the cost of any marginal increase in its investment. Resort will fully benefit from any marginal increase in V_R in scenario FR, which has a probability of ½. In contrast, in scenario R - which has a probability of $1/6$ - Resort will capture only half of the marginal increase in the value of its activity, V_R, resulting from increasing its investment, x_R. Thus, Resort will stop investing at the point where $7/12$ $((1/2) + (1/6) \times (1/2))$ of the marginal increase in V_R fall to one.[68]

This means that Resort will set its level of investment, x_R, at a lower level than the socially optimal one. The intuition for this is that, under the FP rule, Resort will fully bear the costs of increasing x_R, but will capture only part of the benefits of increasing x_R. The other part of the benefits produced by Resort's investments will be captured, or extracted, by Factory. For this reason, Resort's incentives to invest will be less than socially optimal, and Resort will invest too little.[69]

(d) Entitlement to Factory with Liability-Rule Protection

Under a liability-rule protection to Factory, Resort will have to pay damages to Factory only in scenario R. But this payment, of V_F, does not depend on the value of Resort's activity, V_R. Rather, it depends on the value of Factory's activity, V_F.[70] The factory will thus be unable to extract from Resort any portion of its value.

Let us then consider Resort's private calculus under this rule as to how much to invest *ex ante*. Again, Resort will fully bear the cost of any marginal increase in investment; Resort will also fully capture the marginal increase in the value of its activity, V_R, resulting from a marginal increase in its investment, x_R, in scenarios R and FR, which have a combined probability of $4/6$. The reason for this is that the payment that Factory will receive will depend on Factory's damages and will not be determined by the value of V_R and by marginal increases in this value.

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[68] Formally, Resort's actual investment would satisfy $(7/12) \times V_R'(x) = 1$. More generally, relaxing the assumption that $V_R < H$, Resort's investment would satisfy $[P_{FR} + P_R \times (1-\alpha \times (1-\phi))] \times V_R'(x) = 1$. Where α denotes the probability that $V_R < H$.

[69] *See also* note 51, *supra*.

[70] In scenario R, Factory will shut down. The damages borne by Factory thus bequal the value of its forgone activity, V_F.

Therefore, Resort will invest up to the point where 4/6 of the marginal increase in V_R falls to one.[71]

This conclusion implies that, under the RL rule, Resort will invest at the socially optimal level. The intuition underlying this outcome is that whereas Factory will be able to get some payment from Resort, this payment will not increase with increases in the value of V_R because the payment will depend on the damages to Factory and not on the value of Resort's activity, V_R. Therefore, Resort becomes the "residual claimant," who will get the excess of V_R over the damages payments made to Factory. As Resort captures the full marginal benefit produced by each \$1 of its marginal investment, its private investment incentives will be socially optimal.

(e) Comparing the Rules

We can now put together our conclusions concerning the effects of alternative rules on the investment by the two parties in enhancing the values of their activities. Table 5 summarizes the relative levels of x_F and x_R, the parties' respective investment in enhancing the value of their activities V_F and V_R, under the four different rules.

Table 5: Value-Enhancing Investments under Alternative Rules

The Legal Rule	F's Investment in V_F	R's Investment in V_R
RP	Sub-optimal	Excessive
RL	Optimal	Most Excessive
FP	Excessive	Sub-optimal
FL	Most Excessive	Optimal

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[71] Formally, Resort's actual investment would satisfy $4/6 V_R'(x) = 1$, which is the condition satisfied by the socially optimal level of investment. *See* note 59 *supra.*

As the above table indicates, none of the four rules can generally induce the optimal level of *both* x_F and x_R: The two property-right rules, RP and FP, lead to both parties investing inefficiently, with the party with the property right investing excessively and the other party investing sub-optimally. Under the two liability rules, RL and FL, the party without the entitlement will invest optimally, but the party with the entitlement will invest even more excessively than it would under the property-right rule.

D. Ex Ante *Investments in Harm-Reduction*

1. *Optimal Investment Levels*

Having examined how alternative legal rules affect parties' investments in enhancing the value of their activities, we can now turn to considering how these rules affect the parties' investments, y_R and y_F, in reducing the magnitude of the harm H resulting to Resort in the event that both parties operate their activities.

From a social point of view, it is desirable to have Factory invest up to the point where the social cost from a marginal increase in investment equals marginal expected reduction in harm, *i.e.,* the point where one dollar of investment lowers expected harm by one dollar. In determining the marginal social benefit, it is important to recognize that the harm H will be actually borne only in scenario FR, which has a probability of 1/2. Thus, the social benefit from increasing y_F by \$1 is only 1/2 of the ensuing marginal reduction in H. Hence, it is socially optimal that Factory increases its investment up to the point where 1/2 of the marginal reduction in H falls to 1.[72]

Similarly, from a social point of view, it is desirable to have Resort invest up to the point where one dollar of investment lowers expected harm by one dollar. Since H will be borne only in scenario FR, which has a probability of ½, it is socially optimal that Resort increases its investment up to the point where 1/2 of the marginal reduction in H falls to 1.[73]

2. *Investments under the Four Alternative Rules*

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[72] Formally, Factory's optimal level of investment in harm reduction would satisfy: $(1/2) \times Hy_F'(y) = -1$. More generally, Factory's optimal level of investment in harm reduction would satisfy: $P_{FR} Hy_F'(y) = -1$.

[73] Formally, Resort's optimal level of investment in harm reduction would satisfy: $½ \times Hy_R'(y) = -1$. More generally, Resort's optimal level of investment in harm reduction would satisfy: $P_{FR} Hy_R'(y) = -1$.

(a) Entitlement to Resort with Property-Right Protection

Let us start with Factory's investment in harm reduction. The harm borne by Resort, H, will affect Factory only in scenario FR in which the harm actually occurs. In all other scenarios Factory's payoff will not be affected by the size of H.[74] As we have seen earlier, in scenario FR Factory will capture a value of $0.5V_F - 0.5H$.[75] Thus, should scenario FR occur, Factory will capture half of the savings from any marginal reduction in H. Accordingly, when Factory considers how much to invest, it will recognize that its marginal benefit from increasing y_F by $1 is 1/4 ((1/2) x (1/2)) of the marginal reduction in H generated by such an investment. Thus, Factory will invest up to the point where 1/4 of the reduction in H from a marginal $1 increase in y_F falls to $1.

It follows that Factory's level of investment in harm-reduction will be lower than the socially optimal one. The intuition behind this conclusion is that, whereas Factory will bear the full costs of a marginal increase in y_F, it will share the benefit resulting from such investment – the saving in scenario FR from a reduction in H – with Resort. Accordingly, compared with what would be socially optimal, Factory's private calculus will be biased toward investing too little.

For similar reasons, Resort's level of investment in reducing H will be sub-optimal. The harm will affect Resort only in scenario FR, in which it will have to bear only half of the harm. Thus, Resort will invest up to the point where 1/4 of the marginal reduction in H falls to 1.Whereas Resort will bear the full costs of a marginal increase in y_R, it will share the benefit resulting from such investment – the saving in scenario FR from a reduction in H – with Factory. Accordingly, it will invest in harm reduction at a sub-optimal level.

(b) Entitlement to Resort with Liability-Rule Protection

If the entitlement is given to Resort with a liability-rule protection, Factory will pay Resort damages in the amount of H in scenario FR in which the harm will actually materialize. Thus, should scenario FR occur, Factory will fully capture any savings from a reduction in H. When considering how much to invest, Factory will recognize that its marginal benefit from increasing y_F by $1 will be 1/2 of the reduction in H

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[74] *See* Sections III.A., III.B, and III.C. *supra.*

[75] *See Section* III.A *supra.*

generated by such a $1 increase in investment. As a result, Factory will invest up to the point where 1/2 of the reduction in H resulting from a $1 increase in its investment falls to 1.

Factory's level of investment in harm-reduction will then be socially optimal. The intuition behind this conclusion is that Factory will bear both the full social costs of a marginal increase in y_F as well as the full social benefits resulting from such investment – the expected savings in scenario FR from a reduction in H.

Resort's level of investment in harm reduction will be zero and thus clearly-sub optimal. This inefficiency will ensue due to the fact that, in scenario FR in which the harm H will actually occur, Resort will receive full compensation. Hence, Resort will not get any benefit from reducing H and will thus have no incentive whatsoever to invest in lowering H.[76]

(c) Entitlement to Factory with Property-Right Protection

If Factory is given the entitlement but with a property-right protection, Factory will make no payments to Resort in scenario FR in which the harm H will actually occur. Thus, the size of the expected harm in scenario FR will have no effect on the expected payoff to Factory. Furthermore, under certain conditions, an increase in H will in fact benefit Factory by increasing how much Factory will be able to extract from the resort if scenario R materializes.[77] Factory thus would have no incentive to make any *ex ante* investment in harm reduction.

A zero level of investment in harm reduction by Factory will be clearly sub-optimal. The intuition behind this conclusion is as follows. Whereas the factory will bear fully the cost of any marginal increase in the investment in harm reduction, Factory will derive no benefit (indeed, it might even lose) from the resulting decrease in H.

In contrast, under this rule, Resort's investment in harm reduction will be excessive. In scenario FR, Resort will obtain no payment from Factory and will bear the full harm, H. In scenario R, however, a decrease in the size of H will improve Resort's bargaining position and reduce the

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[76] This result is similar to the result highlighted by the economic literature on torts that when injurers are strictly liable for victims' losses, injurers will invest optimally in precautions and victims will make no investment in precautions. *See, e.g.,* STEVEN SHAVELL, ECONOMIC ANALYSIS OF ACCIDENTS, Ch. 2 (1987).

[77] Specifically, an increase in H will increase the factory's expected value in scenario R if $V_R > H$. *See* Section III.C. *supra.*

amount Resort might have to pay Factory to make it shut down.[78] In considering how much to invest, Resort will recognize that its benefit from increasing y_R by \$1 will consist of both the benefit to Resort in scenario FR from reducing H and the benefit to Resort in scenario R from reducing H. In scenario FR, Resort will bear the full harm, H, and will thus capture the full social value of any \$1 increase in its investment. As to scenario R, any \$1 increase in harm-reducing investment might reduce the payment that Resort will make to Factory. This private benefit, however, does not reflect a social benefit because the harm, H, is not actually borne in scenario R. Thus, because Resort will capture the full social benefit in scenario FR from any reduction in H and will capture some private benefits (not reflecting a social gain) in scenario R, Resort will invest excessively.

(d)   *Entitlement to Factory with Liability-Rule Protection*

If Factory is given the entitlement, but protected only by a liability rule, F will get in all scenarios exactly the value of this activity, V_F. Hence, under this rule, any reduction in the harm H will provide Factory with no marginal benefits. Accordingly, Factory will make zero investment in harm reduction.

In contrast, the investment in harm reduction by Resort will be optimal. Under an FL rule, Resort will bear the full harm, H, only in scenario FR, which occurs with a probability of 1/2. The value of H does not affect the value captured by Resort in scenarios F and R. When considering how much to invest, Resort will recognize that its marginal benefit from increasing y_R by \$1 is 1/2 of the marginal reduction in H generated by such an investment. The resort will thus invest up to the point where 1/2 of the marginal reduction in H falls to 1. As we have seen earlier, this level of investment is socially optimal.

(e) *Comparing the Rules*

Putting together the conclusions from the preceding subsections, we can now summarize the relative levels of y_F and y_R, the parties' investments in harm-reduction, under the four different rules. Table 6

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[78]Stated differently, decreasing the magnitude of H might reduce the amount of money that will be extracted by Factory in scenario R in return for its consent to shut down its activity. Specifically, a decrease in H will decrease the expected payment made by Resort to Factory in scenario R if $V_R > H$. *See supra* Part III.C.

compares the investment of the parties in harm reduction under the four rules.

Table 6: Investments in Harm-Reduction Under Alternative Rules

The Legal Rule	Factory's Investment in Reducing H	Resort's Investment in Reducing H
RP	Sub-optimal	Sub-optimal
RL	Optimal	Zero
FP	Zero	Excessive
FL	Zero	Optimal

As Table 6 indicates, none of the rules can generally ensure that both Factory and Resort will invest optimally in harm-reduction. The reason for this state of affairs is, essentially, that under none of the rules will each of the parties bear exactly the reduction in H resulting from its investment.

E. Taking Stock

Having analyzed the effect of alternative rules on the parties' investments both in enhancing the value of their activities and in harm reduction, we can now turn to an overall comparison of *ex ante* investments under the four legal rules. Table 7 puts together the conclusions of the discussion thus far.

Table 7: Overall Comparison of *Ex ante* Investments
Under Alternative Rules

The Legal Rule	Factory's Investment in Enhancing V_F	Resort's Investment in Enhancing V_R	Factory's Investment in Reducing H	Resort's Investment in Reducing H
RP	Sub-optimal	Excessive	Sub-optimal	Sub-optimal
RL	Optimal	Most Excessive	Optimal	Zero
FP	Excessive	Sub-optimal	Zero	Excessive
FL	Most Excessive	Optimal	Zero	Optimal

As Table 7 indicates, none of the rules can ensure that all *ex ante* investments will be made at the efficient level. Each rule will cause for at least two of the *ex ante* investments to be made at an inefficient level. Although all the rules are similar in their inability to induce efficient levels for all four types of *ex ante* investments, the rules might considerably differ in how far their performance falls short of efficiency. That is, the rules might differ in their overall efficiency costs. The best rule from the perspective of *ex ante* investments is the one that produces the lowest level of such costs.

With this in mind, I will now turn to consider, in the next two sections, the two main choices facing legal policy-makers: (i) which party should get the entitlement, and (ii) which form of protection should be given to the entitlement. I will start by analyzing the second choice.

V. IMPLICATIONS FOR THE CHOICE OF RULES

Having identified and analyzed how legal rules might affect *ex ante* actions and investments, I now turn to the implications of these effects for the choice of rules. As will be explained below, the introduction of *ex ante* considerations requires revisiting conclusions that have been reached on

the basis of *ex post* considerations alone. Section A discusses the implications of *ex ante* considerations for the choice between protecting a party with a property right and protecting the party with a liability rule. Section C shows that, once *ex ante* considerations are taken into account, expanding the menu of legal rules is worth considering. Finally, Section D identifies a certain advantage that government fines and taxes have over private law rules in addressing the problems of *ex ante* incentives.

A. Property-Right Protection vs. Liability-Rule Protection

1. *Liability Rules Are Not Always Superior*

As discussed earlier, a main theme of the current literature, which stems from its focus on the problems of *ex post* bargaining, is that liability rules generally dominate property rights. This is the message that was sent by Calabresi and Melamed for some cases and was further pushed, for all externality case, by the most recent writings of Kaplow and Shavell and of Ayres and Talley.[79] As will be explained below, however, once *ex ante* effects are incorporated into the analysis, liability rules no longer dominate. From the perspective of *ex ante* incentives, a liability rule protection might or might not be superior to a property right protection

For concreteness, let us suppose that we wish to accord Resort protection against the pollution of the water by Factory, so that the only choice is whether to protect this entitlement of Resort with a property right or with a liability rule – that is, the choice between RP and RL. The results summarized in Table 7 indicate that RL is not generally superior to RP.

Let us first examine how these rules differ in their effect on Factory's *ex ante* investments. As Table 7 indicates, liability-rule protection (the RL rule) would be superior to property-right protection (the RP rule) in terms of the incentives it provides for Factory's *ex ante* investments. With respect to Factory's investment in enhancing the value of its activity, V_F, the RL rule would induce Factory to invest at the socially optimal level, whereas the RP rule would induce Factory to invest at a sub-optimal level. With respect to Factory's investment in reducing harm, H, the RL rule would induce Factory to invest at the socially optimal level, whereas the RP rule would induce Factory to invest at a sub-optimal level.

However, as Table 7 indicates, liability-rule protection will be *inferior* to property-right protection in terms of the incentives provided to Resort

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[79] *See* Section II.D. *supra.*

to make *ex ante* investments. With respect to Resort's investment in enhancing the value of its activity, V_R, both the RL and the RP rule would provide Resort with incentives to invest excessively, but the extent to which the investment is excessive is greater under the RL rule than under the RP rule. And with respect to Resort's *ex ante* investments in harm reduction, both rules would induce Resort to invest at a sub-optimal level. Yet, whereas Resort's investment would be zero under the RP rule, it would be positive under the RL rule.

Thus, whereas the RP would entail higher efficiency costs with respect to the incentives provided for Factory's *ex ante* behavior, the RL rule would entail higher efficiency costs with respect to the incentives provided for Resort's *ex ante* behavior. Which rule will be superior from an *ex ante* perspective will depend on the overall balance of the above efficiency costs. While the balance might favor liability-rule protection in some cases, it might favor property-right protection in others. Thus, once *ex ante* investments are taken into account, policy-makers should not assume that liability rules are generally superior to property rights.

2. *The Patent Infringement Example*

To illustrate the above claim that liability rules are not necessarily superior, let us consider an example used by Ayres and Talley in their article advocating greater reliance on liability rules. The example concerns two patent holders. The first has patented a pioneering invention and the second patents a "new use" that incorporates the pioneering technology. Because U.S. patent law grants property protection to the pioneer patent, the improver cannot market her invention without first negotiating a licensing agreement with the incumbent.[80]

Applying their general position favoring liability rules over property-right protection, Ayres and Talley argue that the holder of the first patent should be entitled only to damages.[81] In their view, such form of protection is desirable because it would avoid impediments to bargaining and facilitate a smooth, and efficient, *ex post* resolution of the situation. Against the background of a liability rule, Ayres and Tally suggest, the parties will be more likely to attain rapidly the efficient outcome because

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[80] *See* Ayers &Talley, *supra* note 2, at 1092-1093.

[81] *Id.* at 1092. Ayers and Talley envision a "compulsory licensing" scheme, giving the holder of the "new use" an option to infringe the pioneering patent in exchange for a fee determined by a licensing tribunal. Id.

liability rules will induce the parties to reveal truthfully their valuations of the patented technology.[82]

The *ex ante* approach put forward in this paper offers a different perspective on this case. Instead of taking the existence of the first invention and the second invention as given, this approach focuses on the fact that these inventions are the product of *ex ante* investments by the two parties. Because these investments are likely to be influenced by the legal rules allocating entitlements in case of conflicts, the investments, and thus the existence of the two inventions, should not be taken as given by the policy-maker.

Thus, what matters is not just facilitating a smooth and efficient resolution of the *ex post* conflict. The policy-maker should also pay close attention to how different types of protection divide value between the parties and in turn affect *ex ante* incentives to invest in research and development. With a property right protection, the first inventor will be able to extract part of the surplus generated by the second invention.[83] Such division will provide more high-powered incentives to a prospective inventor who hopes to come up with an invention that will be likely the base for subsequent inventions, and it will at the same time reduce the incentives of potential inventors to invest in coming up with such subsequent inventions.

Conversely, with a liability-rule protection, the first inventor will be unable to extract part of the surplus produced by the second invention. Under a liability-rule protection of patents, developers of subsequent inventions will capture the full value of their inventions. Thus, overall, a liability-rule protection would induce more *ex ante* investment by potential developers of subsequent inventions, and a property-right

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[82] Ayers and Talley suggest that a liability-rule protection provides the entitlement holder with incentives to reveal truthfully whether her valuation is above or below the damage amount. *See id.* at 1032. Such truthful signal is of particular importance in the patent context, where holders of "blocking" patents engage in thin-market bargaining. *See id.* at 1092.

[83] Note that the patent infringement example differs from the conflicting use problem analyzed by this paper. In the conflicting use problem, providing Resort with liability-rule protection has resulted in the most excessive level of *ex ante* investment by Resort. In the patent infringement example, by contrast, the level of *ex ante* investment by the patent holder under liability-rule protection would be lower than the level of investment under property-right protection. This is because in the conflicting use problem, enhancing the value of the Resort's activity will increase the compensation paid to Resort under a liability rule. Conversely, in the patent-infringement example, liability-rule protection would leave the patent holder with no power to extract a portion of the value of the subsequent invention.

protection would induce more investment by inventors who can hope to come up with an invention that would serve as basis for subsequent ones. This important tradeoff involved in the choice between the two rules, and not merely the rules' effects on the *ex post* resolution of the conflict, should be taken into account in designing the optimal protection for inventors whose patent is infringed.

3. Making the Choice

In designing rules for any particular context or category of cases, policymakers wishing to take *ex ante* efficiency considerations into account should assess the relative magnitude of the factors identified above in the considered context or category of cases. By identifying the relevant factors and their directions, the preceding analysis in this part provides a framework of analysis for such a consideration. In contrast to the *ex post* analysis, which provided a general prescription of liability-rule protection for all cases involving externalities, the *ex post* approach does not have one general, one-type-fits-all, prescription. Rather, it identifies the tradeoffs that need to be made, the factors that need to be assessed and balanced. From the perspective of *ex ante* efficiency, different categories of cases might call for different forms of protection. Below I offer just a few observations about circumstances that would make one of the two rules likely superior.

First, if it is much more important to avoid deviations of Factory's investments from their efficient levels than to avoid deviations of Resort's investments from their efficient levels, then the RL rule will tend to be superior to the RP rule. The intuition underlying this observation is as follows: The RL rule induces Factory to make optimal *ex ante* investments in both enhancing its value and reducing H. However, the deviations from the optimal level of investments by Resort are greater under the RL rule than under the RP rule. Hence, if it is sufficiently more important to avoid deviations by Factory, the RL rule is superior.

Likewise, if it is much more important to minimize deviations of Resort's investments from their efficient levels than to minimize deviations of Factory's investments from their efficient levels, then the RP rule will tend to be superior to the RL rule. The logic underlying this observation is the same as in the preceding paragraph. The deviations from the optimal level of investments by Resort are greater under the RL rule than under the RP rule. Hence, if minimizing deviations by Resort is sufficiently more important than avoiding deviations by Factory, the RP rule is superior.

Finally, if scenario F is most likely to occur, *i.e.*, if the probability that scenario F will materialize is close to 1, then the RL rule will tend to be superior to the RP rule. This is because if only Factory is likely to operate, encouraging Factory to make an optimal investment in enhancing its own value is more important than encouraging Resort to make optimal investments in enhancing its value or in reducing harm.

B. Which Party Should Get the Entitlement?

We now turn to consider the entitlement question: which party should get the entitlement to the water? Should Factory be entitled to use the water for its activity or should Resort be entitled to the use of water unpolluted by Factory's activity? For expositional convenience, I will suppose that we are going to afford the party holding the entitlement a property-right protection. Accordingly, let us consider the choice between giving the entitlement to Resort and giving it to Factory – that is, the choice between FP and RP.

Again, the conclusions summarized in Table 7 indicate that neither of the two rules generally dominates the other in terms of *ex ante* incentives. Each of them has some advantages and some disadvantages compared with the other.

Consider first how the two rules compare in their effect on the parties' *ex ante* investment in enhancing the value of their activities. To begin, neither rule is always superior in terms of Factory's investment in enhancing the value of its own activity: Whereas the RP rule will lead to sub-optimal investment by Factory, the FP rule will lead Factory to excessive investment. Likewise, neither rule is always superior in terms of Resort's investment in enhancing the value of its activity. But in this case, unlike in the case of Factory's investment, the FP rule is the one that leads to sub-optimal investment, and the RP rule leads to excessive investment.

Consider next how these two rules compare in terms of their effect on the parties' investment in reducing harm. The RP rule is always superior to the FP rule in terms of Factory's investment in reducing H: The FP rule will lead to zero investment by Factory whereas the RP rule will lead to a positive (though still sub-optimal) investment in harm reduction by Factory. With respect to Resort's investment in harm reduction, neither rule always dominates the other. The RP rule will lead to sub-optimal investment by Resort whereas the FP rule will lead to excessive investment.

In choosing between giving a property right to Resort and giving such a right to Factory, an *ex ante* analysis would consider the various factors identified above and would assess which rule would produce overall lower *ex ante* efficiency costs. Which rule would perform better overall might vary from one category of cases to another. While a full analysis of the subject is beyond the scope of this paper, the following brief observations can be made as to the circumstances that would make one of the two rules likely superior:

When it is relatively important to avoid under-investment by Factory in enhancing the value of its activity, the *ex ante* analysis would tend to favor giving the property right to Factory. This is because the FP rule leads to excessive investment by Factory, whereas the RP rule leads to sub-optimal investment. On the other hand, when it is relatively important to avoid under-investment by Resort in enhancing the value of this activity, the *ex ante* analysis would tend to favor giving the property right to Resort. This is because the FP rule leads Resort to sub-optimal investment whereas the RP rule leads to excessive investment.

As far as investment in harm reduction is concerned, the more important it is for Factory to invest some positive amount in reducing H, the more one would tend to favor the RP rule. This is because the RP rule ensures positive (though still sub-optimal) investment by Factory in harm reduction, whereas the FP rule leads to zero investment. On the other hand, the more important it is to avoid under-investment by Resort in harm-reduction, the more one would tend to favor the FP rule. This is because the RP rule will lead to sub-optimal investment in harm reduction by Resort whereas the FP rule will lead to excessive investment.

C. Should the Menu of Rules be Expanded?

One important contribution of the Calabresi and Melamed article was their classification of four alternative rules to deal with the externality problem. This classification has been followed by subsequent literature. By and large, researchers focus on the choice among these four rules or among a subset of them.

In the past several years, researchers have put forward additional creative rules. [84] This work started from the insight that liability rules can be viewed as options. Under the RL rule, Factory has a call option to purchase Resort's entitlement for a price equal to the harm to Resort from pollution. Similarly, under the FL rule, Resort has a call option to

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[84] *See* sources cited in note 17 *supra.*

purchase Factory's entitlement for the price equal to the harm to Factory from not polluting. The more recent literature has sought to add to the legal arsenal rules that are equivalent to put options or to some other combination of options.

What is common to the earlier literature, and to the most recent research, is that, when prices are used, they are always equal to the (court's assessment of) the harm to one of the parties from losing or gaining the entitlement. This is not surprising in light of the focus of prior work on the *ex post* goal of ensuring that pollution take place if and only if it is efficient for it to occur. From this perspective, when prices are used, there seems to be no reason not to use the court's best estimate of the harm or gain to the relevant party from a certain action chosen by the other party.

But once we recognize that the division of value matters for *ex ante* incentives, one can see that an expanded menu might be worth considering. In particular, it might be worth considering using liability rules in which liability is not necessarily equal to harm.

Consider our analysis of the difference between the RP and the RL rules. The RL rule enables Resort to receive, in the event that Factory operates, an amount equal to Resort's damages, whereas the RP rule enables Resort to receive an amount equal to these damages plus part of Factory's surplus from operating. These rules represent different divisions of the *ex post* value. As a result, the RL rule performs better in terms of Factory's investments, whereas the RP rule performs better in terms of Resort's investments. These two divisions, however, represent just two possible points on a continuum, and it might be that other points – that is, other divisions of value – would produce a better mix of investments. Thus, one might consider whether the division of value that would be produced by entitling Resort to damages that are either over- or-under compensatory might be overall preferable.

For example, in attempting to make a choice between RL (entitling Resort to the damages caused to it by Factory's pollution) and RP, an analyst might want to consider an intermediate rule under which, in the event Factory pollutes, Resort would be entitled to get an amount equal to, say, 150% of the damages to Resort. Similarly, an analyst might consider a rule that falls between RL and giving the entitlement to Factory under which, in the event that Factory pollutes, Resort would be entitled to an amount below its damages – say, 50% of its damage in such a case. Thus, an analyst focusing on an the *ex ante* resolution of the conflict would have no reason to limit her attention to liability rules (or any option-like rules) that are based on the court's estimate of damages to one

of the parties. Such an analyst might consider whether under- or over-compensatory levels of damages might provide a better mix of *ex ante* investments. [85]

To be sure, much work still remains to be done before we can identify and analyze the effects of such alternative, intermediate rules, and to determine the circumstances under which they might be worth using. Once the problem of *ex ante* investments is recognized, however, the value of exploring such an expansion of the menu of rules should be recognized as well.

D. Taxes and Fines: Coase vs. Pigou Reconsidered

The preceding analysis has shown that none of the considered rules can attain the first-best outcome, *i.e.,* the outcome that will induce efficient levels for all *ex ante* investments of the parties. Each rule produces some efficiency costs, with at least one of the parties not making optimal *ex ante* investments.[86] Indeed, the logic of the results suggests that no allocation of entitlements between the two parties – no method of dividing the total *ex post* value produced by the two activities between the two parties – could fully eliminate *ex ante* inefficiencies. There appears to be no way to divide the *ex post* value so that both parties will at the same time capture exactly the marginal social benefit generated by their *ex ante* investments.[87]

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[85] Consider the patent infringement example discussed earlier. An analyst that takes into account the ex ante perspective might not limit herself to the choice between a "standard" liability rule, which entitles the owner of the first invention to a payment equal to its damages in the event that the second inventor operates without the owner's consent, and a property-right rule, which essentially entitles the owner to an "infinite" payment in such an event (or a payment high enough to always prevent such an event from happening). An analyst interested in providing a desirable mix of *ex ante* investments for would-be first - and second - inventors might find it worthwhile to consider other rules. Such an analyst might consider, say, a rule that provides the first inventor with a payment equal to 150% of its damages in the event that the subsequent inventor operates without the owner's consent. Such a rule would provide first inventors with protection and value somewhere between the conventional liability rule and the property-right rule. And the intermediate distribution of value under this rule might provide a better balancing of the parties' ex ante investments.

[86] *See* the summary of the effects of the four rules on ex ante investment in Table 7 *supra.*

[87] Problems of this type are familiar to students of law and economics from other contexts. For an excellent discussion, see Cooter, *supra* note 57. Although

In theory, however, there is a way in which the fully efficient outcome could be attained through the imposition of government fines. Suppose that, *ex post*, the government could observe without Resort's help both whether Factory operates and the level of damages to Resort from F's pollution. And consider a Government-Fine rule under which, if Factory operates, Factory must pay the government a fine equal to the social cost of Factory's activity, *i.e.*, the damage borne by Resort. The damage to Resort, recall, will be H if Resort operates and V_R if Resort decides to shut down because V_R is smaller than H.[88] Under such a Government-Fine rule, each party will fully internalize the external effect of its *ex ante* investment. Consequently, each party will make the socially optimal decisions with respect to *ex ante* investments both in enhancing the value of its own activity and in reducing the value of harm, H.

The intuition for this result is that the Government-Fine rule combines the efficiency advantages of the RL and FL rules, each with respect to the investments of a different party. First, observe that the Government-Fine rule leads Factory to make efficient *ex ante* investments both in enhancing its value and in reducing harm. The reason for this is that, under this rule, Factory will be the "residual claimant," and will capture exactly the social benefits from marginal changes in its investments. Because the Government Fine rule would place Factory in the same position as Factory would be in under the RL rule – Factory will always bear the full damage to Resort from Factory's activity but never more than that - Factory will invest optimally both in increasing its value and in harm reduction.[89]

Second, whereas the RL rule would not induce Resort to make optimal investments, the Government Fine rule would do so because, with respect to Resort's investments, the Government-Fine rule would have the same effects as the FL rule. Recall that the FL rule leads Resort to make efficient *ex ante* investments both in enhancing the value of its

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Cooter recognizes that this problem arises in a number of contexts, he does not recognize that, in the presence of *ex ante* investments, it also arises in the context studied in this paper. Indeed, examining the context of nuisance, Cooter suggests that such a problem does not arise when courts use injunctive relief (*i.e.*, a property-right protection). *See id.* at 27-28.

[88] *See* Section II.A. *supra.*

[89] *See* Section IV.B(2)(ii) *supra* (discussing Factory's level of investment in enhancing its value under the RL rule) and Section IV.D(2)(ii) *supra* (discussing Factory's level of investment in harm reduction under the RL rule.)

activity and in reducing harm.[90] The reason for this is that, under this rule, Resort will be the "residual claimant" and will capture exactly the social benefits from marginal changes in its investments both in harm reduction and in enhancing its value.

The efficiency of the Government Fine rule thus stems from its ability to combine the good halves of both the RL and FL rules. The Government Fine rule is able to do so because it is not confined to specifying some division of the *ex post* value between Factory and Resort. The introduction of a third party, the government, eliminates this restriction. With the government as a player, it is possible to make *both* parties bear the damage to Resort produced by the conflicting use problem. And this is what makes it possible to provide both parties with optimal *ex ante* incentives.

Although fines, or taxes, are sometimes used, the Government-Fine rule is far from being universally used. This might be explained by the fact that the assumptions of the above analysis often do not hold. First, there is a practical problem in triggering the Government-Fine rule. Why should Resort report the externality produced by Factory if Resort cannot expect any compensation?[91] The second difficulty is also concerned with Resort's willingness to cooperate. Recall, that in scenario F the operation of the Government-Fine rule requires an assessment of the damages borne by resort. Under the Government-Fine rule there is no reason to expect Resort's cooperation in evaluating these damages; on the contrary, Factory and Resort might agree for Resort, in return for a side payment, to do whatever possible to push down the estimated damages.[92] These two problems might place limits on our ability to take advantage of the identified potential benefits of government fines.

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[90] *See* Section IV.C(2)(iv) *supra* (discussing Resort's level of investment in enhancing its value under the FL rule) and Section IV.D(2)(iv) *supra* (discussing Resort's level of investment in harm reduction under the FL rule.)

[91] The need to rely on private reporting is often mentioned as one of the relevant considerations in choosing between private and public enforcement of law. *See, e.g.,* Steven Shavell, *The Optimal Structure of Law Enforcement*, 36 J. L. & ECON. 255, 267 (1993).

One way to solve the problem is providing the Resort with financial reward for accurately reporting the magnitude of damages. However, as noted by Shavell, *id.,* when the reward to Resort is lower than the sanction, deterrence will be diluted because bargained-for payments will tend to be less than sanctions. *See also* Gary S. Becker & George J. Stigler, *Law Enforcement, Malfeasance, and Compensation of Enforcers*, 3 J. LEGAL STUD. 1,14 (1974) ("Where victim cooperation aids enforcement, we would expect that, whatever the formal distribution of awards, victims would receive a share.")

It is worthwhile relating the above analysis to the famous debate between Pigou and Coase. In his influential 1920 work, *The Economics of Welfare*,[93] Pigou advocated the use of government taxes to deal with externalities. Such taxes, Pigou argued, would lead those who create externalities to internalize the costs that their activities impose on others. The case for using government taxes as the instrument for dealing with externalities was widely accepted among economists for the following forty years until it was challenged by Coase.

In his 1960 classic article, *The Problem of Social Cost*,[94] Coase took issue with the Pigovian case for using taxes to deal with externalities. To start with, Coase objected to viewing one of the parties as causing the externality. The externality, he pointed out, can be attributable to the joint presence of both parties. In our example, both the presence of Factory and the presence of Resort are but-for causes for the existence of an externality. Furthermore, and more importantly, Coase argued that taxes might be unnecessary in many situations – those in which transaction costs are zero or low – for attaining efficiency. In such situations, taxes are not necessary because bargaining among the parties can attain the efficient outcome without government intervention.

As already emphasized, there is no doubt that, if there are no impediments to bargaining at any stage, going back in time as far as desired, bargaining would be sufficient to ensure efficiency and there will thus be no reason to consider the use of taxes. The analysis of this paper, however, highlights an aspect of this condition for efficiency that has not received the attention it deserves. There are many situations in which bargaining appears to be easy *ex post*, but it might be difficult at some *ex ante* stages in which relevant *ex ante* investments are made. Following the conventional *ex post* literature, a policy-maker observing these situations will tend to conclude that there is no reason to consider the use of fines and taxes. This conclusion, however, is flawed. If bargaining is difficult or impossible at some *ex ante* stages in which relevant *ex ante* investments are made, then, notwithstanding the easy *ex post* bargaining, *ex post* bargaining would not be sufficient to ensure efficiency, and fines and taxes would have a certain advantage that would make them worth considering.

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[93] *See* A.C. PIGOU, THE ECONOMICS OF WELFARE, (4th ed. 1932).

[94] See Coase, *supra* note 5. For a recent discussion, from a historic perspective, of the debate between Pigou and Coase, see A. W. Brian Simpson, *Coase v. Pigou Reexamined,* 25 J. LEGAL STUD. 53 (1996). *See also* R. H. Coase, *Law and Economics and A. W. Brian Simpson,* 25 J. LEGAL STUD. 103 (1996).

Indeed, the identified advantage of fines and taxes can be viewed as very much connected to the Coasian insight that both sides, Factory and Resort in our example, are causes of the externality. This insight has been the premise of my analysis, which has assumed that the *ex ante* actions of both parties shape the *ex post* features of the situation. It is because of this assumption that, when contractual arrangements cannot specify the *ex ante* investments, no allocation of the *ex post* value between the parties can lead to first-best efficiency, whereas fines and taxes can perhaps lead to the efficient outcome. Thus, even in a policy-making environment that has internalized the important lessons of the Coasian teaching, there are sometimes reason, identified in this paper, to consider the use of Pigovian taxes and fines.

VI. CONCLUSION

One of the basic questions confronting the law is how to allocate entitlements in the presence of externalities. In the past three decades, following the lead of Calabresi and Melamed, legal scholars have extensively studied this subject. This literature has taken an *ex post* point of view, analyzing the question of which allocations would lead to the most efficient outcome once potential externalities arise. This paper has demonstrated the existence of another dimension that deserves much weight in how entitlements are allocated – the effect of such allocations on *ex ante* investments and actions.

The analysis has shown how alternative rules affect parties' *ex ante* investments in enhancing the value of their activities as well as parties' *ex ante* investments in reducing the potential losses in the event that externalities arise. Once *ex ante* effects are taken into account, several beliefs that have become part of conventional wisdom – that the allocation of entitlements has no efficiency significance when bargaining is easy; that the divisions of value produced by alternative rules is irrelevant for efficiency; and that liability rules are generally superior – are no longer valid. By identifying the various *ex ante* effects of alternative rules, the paper has sought to provide a framework for assessing the choice of rules from an *ex ante* perspective. Such assessment should be an important element in the design of property rights and liability rules.