


2001

Property Rights and Liability Rules: The Ex Ante View of the Cathedral

Lucian Arye Bebchuk
Harvard Law School

Follow this and additional works at: <https://repository.law.umich.edu/mlr>

 Part of the [Law and Economics Commons](#), and the [Property Law and Real Estate Commons](#)

Recommended Citation

Lucian A. Bebchuk, *Property Rights and Liability Rules: The Ex Ante View of the Cathedral*, 100 MICH. L. REV. 601 (2001).
Available at: <https://repository.law.umich.edu/mlr/vol100/iss3/3>

This Article is brought to you for free and open access by the Michigan Law Review at University of Michigan Law School Scholarship Repository. It has been accepted for inclusion in Michigan Law Review by an authorized editor of University of Michigan Law School Scholarship Repository. For more information, please contact mlaw.repository@umich.edu.

PROPERTY RIGHTS AND LIABILITY RULES: THE EX ANTE VIEW OF THE CATHEDRAL

Lucian Arye Bebchuk*

TABLE OF CONTENTS

I. INTRODUCTION: ALTERNATIVE VIEWS OF THE CATHEDRAL.....	602
II. THE EX POST VIEW OF THE CATHEDRAL.....	607
A. <i>The Conflicting-Use Problem</i>	607
B. <i>The Efficient Ex Post Outcome</i>	609
C. <i>Law's Choice: Calabresi and Melamed's Four Rules</i>	610
D. <i>Ex Post vs. Ex Ante Efficiency</i>	611
1. <i>From Ex Post to Ex Ante</i>	611
2. <i>Ex Post Distribution Matters for Efficiency</i>	612
3. <i>Rule Matters Even When Ex Post Bargaining Is Easy</i>	614
III. THE EFFECT OF RULES ON THE EX POST DIVISION OF VALUE	614
A. <i>Scenario FR: Factory and Resort Should Both Operate</i> ...	615
B. <i>Scenario F: Only Factory Should Operate</i>	616
C. <i>Scenario R: Only Resort Should Operate</i>	617
IV. THE EX ANTE EFFECTS OF ALTERNATIVE RULES	619
A. <i>Introducing Ex Ante Investments</i>	619
B. <i>Investment by Factory to Enhance the Value of Its Activity</i>	621
1. <i>The Socially Optimal Investment Level</i>	621
2. <i>Investment Under Alternative Rules</i>	621
C. <i>Resort's Ex Ante Investment to Enhance the Value of Its Activity</i>	624
1. <i>The Socially Optimal Investment Level</i>	624

* William J. Friedman & Alicia Townsend Friedman Professor of Law, Economics and Finance, Harvard Law School; Research Associate, National Bureau of Economic Research and Center for Economic Policy Research. — Ed. A companion piece, “Ex Ante Investments and Ex Post Externalities,” available on <http://papers.ssrn.com/abstract=303417>, develops a model that establishes in a formal and general way the claims made in this Article. I am indebted to Assaf Hamdani for his invaluable assistance. I also benefited from the helpful comments of Oren Bar-Gill, Omri Ben-Shahar, Bob Ellickson, Bert Huang, Oliver Hart, Ryan Kantor, Louis Kaplow, Suzanne Scotchmer, Steve Shavell, and participants in workshops at Berkeley, Hamburg, Harvard, and Michigan. The financial support of the Harvard Law School John M. Olin Center for Law, Economics and Business is gratefully acknowledged.

2. <i>Investment Under Alternative Rules</i>	625
D. <i>Ex Ante Investments in Harm Reduction</i>	628
1. <i>Socially Optimal Investment Levels</i>	628
2. <i>Investment Under Alternative Rules</i>	629
E. <i>Taking Stock</i>	632
V. IMPLICATIONS FOR THE CHOICE OF RULE.....	633
A. <i>Property-Right Protection vs. Liability-Rule Protection</i> ...	633
B. <i>Which Party Should Get the Entitlement?</i>	635
C. <i>Should We Expand the Menu of Rules?</i>	636
D. <i>Taxes and Fines</i>	637
VI. CONCLUSION.....	639

I. INTRODUCTION: ALTERNATIVE VIEWS OF THE CATHEDRAL

This Article aims to contribute to the study of how the law should allocate and protect entitlements in the presence of externalities. In their classic article published thirty years ago, Calabresi and Melamed studied such questions and offered what they labeled “one view of the Cathedral.”¹ I seek to add to the inquiry started by Calabresi and Melamed by offering an *ex ante* perspective and analyzing how allocations of entitlements affect parties’ *ex ante* actions and investments.

Suppose that an upstream Factory would benefit from an activity that would pollute a river and harm an activity conducted by a downstream Resort. In this as in many other cases, the respective rights of the parties must be determined. Does Factory have the right to engage in the polluting activity, or does Resort have the right to water free of pollution? If Resort is entitled to unpolluted water, should it be protected by a property right or by a liability rule?²

Calabresi and Melamed, and the subsequent extensive literature on the subject,³ have primarily conducted what I will label an “*ex post*

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 widely viewed as a seminal contribution to law economics and legal theory. See 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); 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. . .”).

2. In addition to property rights and liability rules, Calabresi and Melamed also examined an additional form of protection — inalienability rules. See Calabresi & Melamed, *supra* note 1, at 1111-15. This Article will focus, however, as much of the literature has done, on alienable 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).

3. See, e.g., Ian Ayres & J.M. Balkin, *Legal Entitlements as Auctions: Property Rules, Liability Rules, and Beyond*, 106 YALE L.J. 703 (1996); Ian Ayres & Paul M. Goldbart, *Optimal Delegation and Decoupling in the Design of Liability Rules*, 100 MICH. L. REV. 1 (2001); Ian Ayres & Eric Talley, *Solomonic Bargaining: Dividing a Legal Entitlement to Facilitate Coasean Trade*, 104 YALE L.J. 1027 (1995); Robert C. Ellickson, *Alternatives to Zon-*

analysis.” I use this term to refer to an analysis that takes as given the payoffs that parties would have with and without externality-producing actions. In the above example, an ex post analysis would take as given both the presence of Factory and Resort and their potential costs and benefits from their respective activities. Taking these elements of the situation as given, the analysis would examine which entitlement allocations would lead to the efficient level, if any, of pollution-producing activity on the part of Factory.

The common starting point for an ex post analysis is the Coasean insight that, in cases in which the relevant parties can easily bargain ex post, the allocation of entitlements will matter little in terms of efficiency.⁴ As long as parties can bargain around legal rules, the ex post outcome will be always efficient. Given that bargaining is subject to transaction costs and imperfect information, however, such ex post efficiency cannot be guaranteed. The ex post analysis therefore examines which allocation of entitlements would most likely facilitate the efficient outcome in a world where such obstacles to bargaining exist.

This Article focuses on how ex ante decisions are affected by allocations of entitlements. By ex ante decisions I mean throughout this Article those decisions that (i) take place before decisions whether to undertake externality-producing actions are made, and (ii) influence the parties’ potential payoffs with or without these externality-producing actions. Thus, in the considered example, the ex post payoffs of Factory and Resort with and without pollution might be a product of their ex ante decisions whether to locate along the river in the first place and, if so, how close to the river to locate; 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; and so forth. Such ex ante decisions are ubiquitous, of course, and they critically affect the ex post structure of cases the law must address.⁵

ing: Covenants, Nuisance Rules, and Fines as Land Use Controls, 40 U. CHI. L. REV. 681 (1973); Louis Kaplow & Steven Shavell, *Property Rules Versus Liability Rules: An Economic Analysis*, 109 HARV. L. REV. 713 (1996); 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, *Controlling Externalities and Protecting Entitlements: Property Right, Liability Rule, and Tax-Subsidy Approaches*, 8 J. LEGAL STUD. 1 (1979) [hereinafter Polinsky, *Controlling Externalities*]; A. Mitchell Polinsky, *Resolving Nuisance Disputes: The Simple Economics of Injunctive and Damage Remedies*, 32 STAN. L. REV. 1075 (1980) [hereinafter Polinsky, *Resolving Nuisance Disputes*].

4. R.H. Coase, *The Problem of Social Cost*, 3 J. L. & ECON. 1 (1960).

5. Some of the researchers whose analysis focused on what I term ex post effects also recognized the presence of what I term ex ante effects. In particular, Kaplow and Shavell, *supra* note 3, at 738-39, discuss how any protection of victims might discourage them from making investments that would reduce the potential harm to them from externality-producing actions. Kaplow and Shavell indicate that such a factor might influence the choice of rule, but they do not attempt to analyze the range of ex ante effects or the conditions under which any given rule would be optimal from an ex ante perspective. Ayres and Talley, *supra* note 3, also discuss how ex ante considerations might militate against the use of liabil-

To study the ex ante dimension of the Cathedral in isolation from the ex post problems extensively studied in prior work, I will put aside these problems by assuming that ex post bargaining between the parties is easy. It is worth stressing, however, that I have no doubt that ex post considerations are important for legal decisionmaking in the externalities context. To analyze the ex ante effects, however, it will be useful to abstract from the ex post problems, and to this end I will focus in this Article on situations in which ex post bargaining is easy.

In examining the ex ante effects of alternative rules, my analysis builds on the large economic literature analyzing "incomplete contracts."⁶ This literature has sought to analyze how the potential division of surplus in later renegotiations might affect earlier investments. Although this literature has focused on contexts that differ from the harmful-externalities context on which I focus, its analytical approach has been useful for carrying out my analysis.

It is worthwhile highlighting at the outset some general differences between an ex ante and an ex post analysis. From an ex post perspective, the distribution of ex post value between the parties has no relevance for efficiency. To be sure, writers carrying an ex post analysis have differed on whether the distributive consequences of alternative rules have some importance by themselves, independent of the goal of efficiency. Such writers have nevertheless generally shared the view that ex post distribution is irrelevant from the perspective of efficiency itself.

As the analysis of this Article demonstrates, however, once ex ante effects are taken into account, the ex post division of value might have considerable efficiency implications. Different divisions of ex post value lead to different ex ante actions and investments. As a result, a given rule's effects on the ex post division of the total pie have an important effect on the overall ex ante efficiency of the rule.

Relatedly, the introduction of ex ante effects also makes the choice of legal rule important in cases in which ex post bargaining is easy. The standard ex post analysis assumes that, when the parties can easily bargain ex post, the choice of legal rule has little or no relevance for efficiency. In such cases, ex post bargaining can be expected to produce an efficient outcome regardless of the initial allocation of entitlements. For this reason, prior work has commonly focused on cases in which ex post bargaining is difficult or even impossible.

ity rules, but they focus on the beneficial effect that liability rules have on ex post bargaining. *Id.* at 1083-90.

6. See generally, OLIVER HART, FIRMS, CONTRACTS, AND FINANCIAL STRUCTURE (1995); 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); Oliver Hart & John Moore, *Incomplete Contracts and Renegotiation*, 56 ECONOMETRICA 755 (1988); Oliver Hart & John Moore, *Property Rights and the Nature of the Firm*, 98 J. POL. ECON. 1119 (1990).

As the analysis of this Article will show, however, once we take ex ante effects into account, the choice of rule might have important efficiency implications even when ex post bargaining is easy. By affecting the bargaining positions of each party in ex post bargaining, the choice of rule will affect the ex post division of value. This ex post division of value, in turn, will affect ex ante incentives and thereby ex ante efficiency.

My analysis therefore begins by examining how various alternative rules affect bargaining between parties and, in turn, the ex post division of value. To illustrate these effects, note that, in the considered example, Factory would generally fare better if it had a property right to pollute rather than if Resort had a property right to enjoin Factory's pollution. Suppose that Factory and Resort can freely bargain with one another, and suppose also that pollution would be efficient because the value to Factory of the pollution-causing activity exceeds the harm it imposes on Resort. Given easy ex post bargaining, both rules would result in polluting by Factory. The rules would differ, however, in the distribution of value between Factory and Resort that they would produce.

If Factory had the property right, it could keep the full value of its pollution-producing activities to itself. By contrast, if Resort had the property right, Factory would not be able to capture fully the value of its pollution-producing activity. Resort would be able to extract some of this value in exchange for consenting to Factory's pollution.⁷

After identifying the distributive effects of alternative rules, the analysis will examine how these different ex post distributions of value affect parties' ex ante investments. Consider the incentives for Factory to invest ex ante in enhancing the value it can derive from its activities. If Resort had a property right to enjoin Factory, Factory would invest too little ex ante, because Resort's property right would enable Resort to extract part of the value created by this investment. Because Factory can anticipate this need to share the value of its activity with Resort, it would not have incentives to invest optimally. In contrast, if Factory were granted a property right to pollute, Factory would not have to share with Resort any part of the value produced by Factory's ex ante investment. Thus, granting a property right to Factory would encourage it to invest ex ante. Indeed, for reasons to become clear later, if Factory were granted a property right, it would even tend to invest excessively.

Now suppose that Resort were granted an entitlement to a pollution-free river but with the weaker protection of a liability rule. In this

7. Similarly, if pollution were inefficient, any allocation of entitlements would result in no pollution, but different rules would produce different distributions of total value. If Resort were granted the property right, it would not have to pay to induce Factory not to pollute, whereas if Factory received the property right, Resort would have to pay.

case, Factory would still have an incentive to invest. Under this liability rule, if Factory were to operate, Factory would pay Resort the (court-estimated) harm that pollution would inflict on Resort. As a result, Factory would retain the excess of the value of its activity over this harm, and Factory would thus fully capture any incremental increase in the value produced by its *ex ante* investment. Consequently, Factory would have an incentive to invest at the efficient level.

Consider also the effects of the allocation of entitlements on Resort's incentives to invest *ex ante* in enhancing the value of its activities. If Resort were granted a property right to pollution-free water, Resort would have incentives to invest, and indeed might even invest excessively. Providing Resort with the entitlement protected only by a liability rule would not solve this problem of excessive investment. Indeed, as the analysis will show, liability rule protection would lead Resort to make investments that would be excessive to a degree even greater than under a property-right rule.

In addition to *ex ante* investments in enhancing the values of the parties' respective activities, the analysis will also examine Factory's and Resort's *ex ante* investments in reducing the harm that would result in the event of conflicting use. Factory and Resort, for example, could make investments to eliminate or reduce their reliance on the river in case a conflicting use problem arises down the road. The choice of rule might affect also these investments.

If Resort were granted the entitlement with a liability-rule protection, Resort would have no incentive to make any such potentially harm-reducing investments. In this case, however, Factory would have an incentive to invest in harm reduction at the socially optimal level. In contrast, giving a property right to either of the parties would provide each party with incentives to make some — but less than socially optimal — investments in harm reduction.

The choice of legal rule thus involves a number of *ex ante* considerations. The optimal rule from an *ex ante* perspective depends on a balance of these considerations. The analysis of this Article will provide a framework for determining which allocations of entitlements would perform best from the perspective of *ex ante* efficiency. This framework could be used in answering the two questions that, for any given context involving externalities, the law must resolve: (i) which party should get the entitlement?, and (ii) what form of protection should be provided to this party?

The analysis will show that, from the perspective of *ex ante* efficiency, liability rules are not generally superior to property rights. This conclusion is worth noting because the literature has identified certain *ex post* advantages of liability rules. The analysis also indicates that we may want to expand our menu of alternative rules and include in it liability rules based on supercompensatory or undercompensatory damages. Finally, the analysis identifies certain advantages that the use of

government fines and taxes has in terms of inducing optimal ex ante investments.

Before proceeding, I should note that the analysis of this Article is limited to the choice between property rules and liability rules in cases of harmful externalities. Calabresi and Melamed's article raised the question of why, in cases involving possessory interests, courts generally protect ownership with a property right rather than a liability rule. As Kaplow and Shavell have demonstrated, however, this protection-of-ownership context differs substantially from the harmful-externalities context.⁸ In another work, I carry out an ex ante analysis of the protection-of-ownership question.⁹

The remainder of this Article is organized as follows. Part II introduces the problem of externalities and discusses the differences between ex post and ex ante perspectives. Part III analyzes the effects of alternative legal rules on the ex post division of value between parties. Part IV uses this analysis to identify and examine the effects of alternative rules on parties' ex ante investments. Part V discusses the implications that ex ante considerations have 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 discusses the question occupying both prior literature and this Article: How should we address the extremely common situation in which uses of assets conflict — that is, 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 apparent, however, the conclusions derived with respect to this paradigmatic case have general applicability to other cases of harmful externalities.

To continue with our example from the preceding Part, suppose again that an industrial factory, Factory, stands on a river upstream and a recreational resort, Resort, stands on the river downstream. The time is the year 2000. At this point in time a problem of conflicting use of the river's water arises and must be resolved by the law. As is standard in the analysis of ex post problems, this Part assumes that all the elements characterizing the problem have been fixed: the parties already exist in their respective locations and face certain potential

8. See generally Kaplow & Shavell, *supra* note 3, at 757-83.

9. See Lucian A. Bebchuk, *Ownership and Exchange* (2001) (unpublished working paper) (on file with author).

benefits and costs from using the river. The following Parts will relax this 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. I will refer to this use of the water by Factory as "polluting" the water, and I will denote the benefit that Factory would derive from this activity as V_F . Thus, if Factory were not to pollute, it would lose V_F . For the purpose of my analysis, it does not matter whether Factory's considered activity is the only activity available to Factory or whether there are additional activities that do not pollute the river. It matters only that this polluting activity would provide Factory with a value, which would not materialize otherwise, in the amount of V_F .

Further suppose that pollution of the river's water by Factory would reduce the value of a potential activity of Resort. If the water remained free of Factory's pollution, Resort's activity would generate a value of V_R . If Factory were to pollute the water, however, Resort's activity would generate only a value of $V_R - H$, where H represents the loss that Resort would suffer from pollution as a result of, say, a decline in the prices it could charge or a decrease in the number of its patrons.

Note that Resort can always shut down its activity altogether rather than operate suboptimally under pollution. Hence, if pollution would cause Resort a level of harm exceeding the value of its activity, Resort can simply cease to engage in the activity, thereby limiting itself to a loss of V_R . Accordingly, the damages Resort will suffer will never exceed V_R and will always equal the lesser of V_R and H . Again, for the purposes of our analysis it does not matter whether the activity in question constitutes Resort's sole activity or merely one among many; it only matters that Factory's pollution would damage one of Resort's activities in an amount equal to the lesser of H and V_R .

We can view the scenario described above as one involving an externality problem. Factory externalizes part of the costs produced by its activity. This externality equals the amount by which Factory's activity reduces the value of Resort's activity and thus equals the lesser of V_R and H . We can also refer to the problem as a conflicting-use problem. Both parties would benefit from using the water, but because the water can only be either polluted or unpolluted, both parties cannot simultaneously use the water to their maximum benefit. Thus, a conflict arises: one party desires to use the water in a way inconsistent with the other party's desired use.

I shall refrain from labeling Factory as the "injurer" or Resort as the "victim." Although convenient, these labels carry normative baggage because we tend to perceive of the "injurer" as the party that *causes* the conflicting-use problem. As Coase has taught us, however, we should view the problem as a priori symmetric, with both parties

causing the conflicting-use situation. To be sure, but for Factory, Resort could use the unpolluted water to its own benefit. On the other hand, but for Resort, Factory could pollute the water to its own benefit just as well. Both parties thus contribute an essential element to the existence of the conflicting-use problem.

B. *The Efficient Ex Post Outcome*

The most efficient resolution of the conflicting-use problem is the outcome that would maximize total aggregate value given the structure of the situation and the values of V_F , V_R , and H . As Table 1 below indicates, there are three possible scenarios as to which outcome would be efficient.

(i) *Scenario FR*. In this scenario, it would be efficient for both Factory and Resort to engage in their respective activities; that is, Factory should pollute and Resort should continue its activity despite the pollution. This scenario arises whenever the following two conditions hold true: (i) the value that pollution would bring to Factory would exceed the harm it would cause Resort ($V_F > H$); but (ii) Resort still would derive a positive value from its activity, despite the harm from pollution ($V_R > H$).

(ii) *Scenario F*. In this scenario, it would be efficient that only Factory engage in its activity; that is, Factory should pollute, and Resort should shut down its harmed activity. This scenario would arise whenever the following two conditions hold true: (i) the harm Resort would suffer exceeds the benefit it would gain if it engaged in its activity despite pollution ($V_R < H$); but (ii) the benefit Factory would derive from polluting exceeds the harm that pollution would cause Resort ($V_F > V_R$).

(iii) *Scenario R*. In this scenario, efficiency calls for only Resort to engage in its activity and for Factory to shut down. This scenario arises whenever both the harm to Resort caused by pollution and the value of Resort's activity exceed the value of the polluting activity to Factory ($H > V_F$ and $V_R > V_F$).

TABLE 1. THE THREE SCENARIOS			
Outcome	Factory Undertakes Polluting Activity?	Resort Undertakes Activity?	Total Social Value
<i>FR</i>	Yes	Yes	$V_F + V_R - H$
<i>F</i>	Yes	No	V_F
<i>R</i>	No	Yes	V_R

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

What legal rules should govern the conflicting-use problem? In analyzing this question, I will use the classification of alternative legal rules put forward by Calabresi and Melamed and subsequently followed by much of the literature.¹⁰ Under this classification, four alternative rules need to be considered:¹¹

(i) *Entitlement to Resort Protected by a Property Right* (the *RP* rule). Under this rule, Resort has an entitlement to operate free of pollution under the protection of a property right. In this case, if Resort does not wish to allow Factory to pollute, Resort can secure an injunction against Factory (backed, if needed, by criminal sanctions).

(ii) *Entitlement to Resort Protected by a Liability Rule* (the *RL* rule). Under this rule, Resort again has an entitlement to operate free of pollution, but this time under the weaker protection of a liability rule. Factory may elect to pollute, but in this case it would have to pay Resort a court-estimated amount for the damages caused to Resort. Recall that these damages would equal the smaller of the harm resulting from the pollution and the value of Resort's activity in the absence of pollution — that is, the smaller of H and V_R — as Resort would always have the option of shutting down its activity.

(iii) *Entitlement to Factory Protected by a Property Right* (the *FP* rule). Under this rule, Factory has an entitlement to pollute protected by a property right. Therefore, Factory would be free to pollute at its discretion.

(iv) *Entitlement to Factory Protected by a Liability Rule* (the *FL* rule). Under this rule, Factory again has an entitlement to pollute but this time under the weaker protection of a liability rule. In this case, Resort may still make Factory cease its polluting activity, but if Resort were to do so, Resort would have to pay Factory an amount that equals the court-estimated damages caused to Factory as a result: the loss of the value V_F . Note that the *FL* rule is rarely used in practice,

10. See Calabresi & Melamed, *supra* note 1, at 1115-16; see also Frank I. Michelman, *Pollution as a Tort: A Non-Accidental Perspective on Calabresi's Costs*, 80 YALE L.J. 647, 670 (1971) (reviewing GUIDO CALABRESI, *THE COSTS OF ACCIDENTS: A LEGAL AND ECONOMIC ANALYSIS* (1970)).

11. As will be clear to readers, the analysis of this Article can be extended to identify the ex ante effects of additional rules. Some recent work has suggested additional rules based on the use of options. See, e.g., Ian Ayres, *The 1998 Monsanto Lecture: Protecting Property with Puts*, 32 VAL. U. L. REV. 793 (1998) (reviewing the choice of rule within the put/call framework); Ayres & Balkin, *supra* note 3, at 729-33 (discussing put options and the way these options might be auctioned); Krier & Schwab, *supra* note 3, at 471-72 (envisioning a rule granting Factory the option to shut down its activity and collect damages from Resort); Saul Levmore, *Unifying Remedies: Property Rules, Liability Rules, and Startling Rules*, 106 YALE L.J. 2149, 2153-60 (1997) (suggesting additional rules); RONEN AVRAHAM, *MODULAR LIABILITY RULES*, (Olin Center for Law and Economics, University of Michigan, Working Paper No. 01-003) (analyzing a group of options-based rules).

perhaps due to the stringent informational requirements it imposes on courts. For the sake of completeness, however, I will include this rule in the analysis.¹²

Significantly, all of these rules differ in the informational requirements they impose on courts. Under both property rules, *FP* and *RP*, the court needs only to verify whether Factory pollutes the river. In contrast, under the *RL* rule, a court not only has to verify whether Factory pollutes but also to estimate the damages produced by the pollution. The imperfect information of courts might therefore make it difficult to obtain ex post efficiency. To focus on the analysis of ex ante effects, however, I shall put aside these informational issues, and I shall assume for simplicity that courts can ex post accurately observe H , V_F and V_R .

D. *Ex Post vs. Ex Ante Efficiency*

1. *From Ex Post to Ex Ante*

As already emphasized, prior work has largely focused on identifying the rule that would facilitate attainment of the ex post efficient outcome. Taking as given the presence of a potential externality, and recognizing that in a world of costless bargaining the efficient outcome will always occur under any of the four rules, Calabresi and Melamed stressed the importance of identifying the impediments to an ex post efficient outcome.¹³ Having identified these impediments, the efficient allocation of entitlements in any given case would be the one that would most likely attain the ex post efficient outcome. Much work has subsequently focused on this question.

Although the ex post view yields insights that have much relevance for legal policymaking, such an analysis is significantly incomplete. In the context of our paradigmatic example, an ex post analysis would take as given the existence 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, which we have denoted by V_F , V_R , and H . With these elements taken as given, the focus is on which legal rule would lead to the efficient ex post outcome.

12. *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 generally* Krier & Schwab, *supra* note 3, at 467-70 (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).

13. *See* Calabresi & Melamed, *supra* note 1, at 1106-11 (analyzing how different types of transaction costs affect the choice between property rights and liability rules).

These elements of the situation, however, might very well have arisen as a function of actions occurring at some point in the past, which in turn may well have been influenced by the legal rule that the parties anticipated would govern in the event that a conflicting-use problem would arise in the future. As a result, the choice of legal rule has important ex ante effects. Before turning to a detailed analysis of these effects, however, I wish to make two general observations about the consequences of incorporating such effects into the analysis.

2. *Ex Post Distribution Matters for Efficiency*

Clearly, the choice of legal rule can have significant distributive consequences, affecting how total value is divided between Factory and Resort. Prior work has recognized this effect that rules have on the final distribution of value.¹⁴ This literature has generally taken the view, however, that these distributional consequences have no relevance for efficiency. Rather, in the standard ex post analysis, efficiency consists only of ensuring ex post that factory would pollute if and when doing so would be efficient — that is, would maximize the total pie of the parties.

To be sure, commentators have expressed different views on whether distribution of this total ex post pie should constitute an independent objective of legal policy. Calabresi and Melamed, for example, take the view that “difficult as wealth distribution preferences are to analyze, it should be obvious that they play a crucial role in the setting of entitlements.”¹⁵ In contrast, Kaplow and Shavell have taken the view that “concern about the distribution of income has no bearing on the choice between property rules and liability rules.”¹⁶

Nonetheless, writers have generally shared the view that, as far as efficiency is concerned, the ex post distribution of value does not matter. For example, although Calabresi and Melamed believe that the distributional consequences of the choice of rules should be given some weight in themselves,¹⁷ they view these distributional conse-

14. See, e.g., Calabresi & Melamed, *supra* note 1, at 1098-1102; Polinsky, *Resolving Nuisance Disputes*, *supra* note 3 at 1089-92.

15. See Calabresi & Melamed, *supra* note 1, at 1098.

16. See Kaplow & Shavell, *supra* note 3, 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) (arguing that the choice of legal rules should not be influenced by distributional considerations because redistributing income through the income tax and transfer systems would be superior).

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

quences as irrelevant for the evaluation of this choice from the perspective of efficiency.¹⁸

Once we take *ex ante* considerations into account, the distribution of the *ex post* value does make a difference to overall efficiency. The size of the total pie under the most efficient *ex post* outcome depends on the parties' *ex ante* actions and investments. These actions and investments, in turn, depend in part on the *ex post* distribution of value that the parties anticipate *ex ante*. Hence, total value — that is, the total size of the pie — depends not only on whether a legal rule reaches the efficient outcome in any given *ex post* situation, but also on which *ex post* situation the rule produces in the first place.

It is worth comparing the point under consideration to the claim made by various writers that distribution might affect efficiency because changes in the final distribution of wealth might affect parties' relative valuations of an entitlement.¹⁹ In our example, for instance, it might be argued that, for any given *ex post* situation, the value that Factory and Resort would place on the river's water would not be independent of the allocation of entitlements.

Although the point made by these writers and the point made in this Section both imply that *ex post* distribution matters for efficiency, they very much differ. Note that these writers do not claim that ignoring distributional effects might lead to an inefficient outcome. Rather, they claim only that the efficient outcome and efficient rule are often indeterminate. Consequently, they argue efficiency alone cannot provide a basis for selecting between two equally efficient outcomes and the rules that underlie them. In contrast, the analysis of this Article suggests that ignoring the *ex ante* effects of the final distribution of value might sometimes lead to the selection of a rule that would be unambiguously *less efficient*.

18. *Id.* at 1093-98, 1106-10.

19. Such claims were made in works by scholars associated with the Critical Legal Studies movement. See Mark Kelman, *Consumption Theory, Production Theory, and Ideology in the Coase Theorem*, 52 S. CAL. L. REV. 669, 678-95 (1979) (arguing that the price that a party is willing to pay 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); Duncan Kennedy, *Cost-Benefit Analysis of Entitlement Problems: A Critique*, 33 STAN. L. REV. 387, 401-21 (1981) (noting the same). Work in behavioral economics and in psychology has shown that initial allocations of entitlements can indeed affect valuations. See, e.g., W. Michael Hanemann et al., *Willingness to Pay and Willingness to Accept: How Much Can They Differ?*, 81 AM. ECON. REV. 635 (1991); 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); 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).

3. Rules Matter Even When Ex Post Bargaining Is Easy

From the ex post perspective extensively applied by prior work, legal rules matter only when parties cannot easily bargain ex post. In the context of our example, this position implies that legal rules would matter only if, in the year 2000 when Factory and Resort confront the conflicting-use problem, they were unable to bargain easily and reach an agreement. For this reason, an ex post analysis directs our attention to cases in which ex post bargaining is difficult or even impossible.

Once ex ante considerations are taken into account, however, the choice of legal rule might matter greatly even where parties can easily bargain ex post. Suppose that, in the year 2000, Factory and Resort can successfully bargain, and thereby attain the ex post efficient outcome, under any legal rule. The choice of legal rule might still have substantial influence on the ultimate division of value between Factory and Resort and thus, in turn, substantial influence on Factory and Resort's ex ante incentives. As a result, even assuming easy bargaining in 2000, alternative legal rules can substantially differ in their effects on overall efficiency.

Of course, the suggestion that rules matter also when ex post bargaining is easy does not take issue with the Coase theorem. In a world with no transaction costs at *any* point in time, parties would reach agreements at early stages to ensure that they make all their ex ante investments efficiently. A truly Coasean, transaction-cost-free world involves freedom from transaction costs 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. The absence of transaction costs ex post, however, does not imply the presence of Coasean bargaining in all relevant earlier points in time. Thus, even when bargaining is ex post very easy, the choice of legal rule might matter in terms of efficiency.

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

Having made some general observations about ex ante considerations, I now turn to analyzing how the choice of rule affects ex ante actions and decisions. This Part will take the first step in this analysis by comparing alternative rules in terms of their effects on the ex post division of value.²⁰

To abstract away from ex post issues, I will assume that the parties can easily, and indeed with no impediments whatsoever, bargain ex

20. For an analysis of the effects of property rights and liability rules on the division of value in disputes between patent-holders and second-stage inventors infringing on these patents, see Mark Schankerman & Suzanne Scotchmer, *Damages and Injunctions in Protecting Intellectual Property*, 32 RAND J. ECON. 199 (2001).

post. This implies, among other things, that bargaining involves neither transaction costs nor informational asymmetries.

In particular, I assume that both parties know each other's payoffs. I also assume that courts can accurately assess all the values relevant for implementing the rules under consideration. Under these conditions, the parties will reach the ex post efficient outcome under any one of the alternative rules. The division of value, however, will differ considerably among alternative legal rules.

For the ease of exposition, I make the simplifying assumption that the parties have equal bargaining power and therefore will share equally in any gains from mutual trade. This assumption will not affect our qualitative conclusions about ex ante effects, and it will be apparent to the reader that the analysis can be adjusted to accommodate different assumptions about the parties' relative bargaining power.

Below I will analyze bargaining and the distribution of value produced by it in each of the three scenarios concerning the efficient outcome identified in Section II.B.

A. *Scenario FR: Factory and Resort Should Both Operate*

In this scenario, both Factory and Resort should operate. As identified earlier, this scenario arises whenever $V_F > H$ and $V_R > H$. Under the *RP* rule, Factory must secure Resort's consent to conduct its polluting activity. When pollution takes place, Resort's value from its own activity is reduced by H , but Factory obtains a value of V_F . The net social surplus created by pollution, then, equals $V_F - H$. In order to obtain Resort's consent, Factory would have to compensate Resort for its damages, H , as well as pay Resort part of this net surplus.

Therefore, under the assumption that the parties share equally in gains from trade, Factory would pay Resort for its harm, H , plus half the amount of $V_F - H$. The final division of value would thus be as follows: Factory would net $0.5(V_F - H)$, and Resort would net $V_R + 0.5(V_F - H)$. The property protection that Resort enjoys would enable it not only to recover compensation for its damages from pollution but also to extract some of the surplus generated by Factory's activity.

In contrast, under the *RL* rule, Factory could pollute the river without Resort's consent as long as it pays Resort damages in an amount that equals H . In the scenario under consideration, the benefit of pollution to Factory exceeds the harm that pollution causes Resort ($V_F > H$). Thus, Factory would decide to pollute and compensate Resort for H . Factory, however, would not need to offer Resort any part of the surplus produced by Factory's activity. Under the final division of value, Factory would net $V_F - H$, and Resort would net V_R . Under liability-rule protection, no bargaining would take place because Re-

sort could not extract from Factory an amount exceeding H and would have no reason to agree to any amount below H .

Under the *FP* rule, Factory's property right would enable it to operate and pollute. Because it is efficient for Factory to operate in the scenario under consideration, the parties would have no incentive to bargain for a reallocation of their entitlements. Under the final division of value, Factory would net V_F , and Resort would net $V_R - H$.

Under an *FL* rule, Resort would have the right to prevent Factory from polluting if it pays Factory damages in the amount of V_F . In the scenario under consideration, however, the harm to Resort from pollution would be less than the value of pollution to Factory. Hence, Resort would prefer to operate under pollution rather than exercise the option granted to it by the rule. In the final division of total value between the parties, Factory would net V_F , and Resort would net $V_R - H$.

TABLE 2. DIVISION OF VALUE IN SCENARIO <i>FR</i>				
Rule	Payments Made by			
	Factory	Value to Factory	Value to Resort	Total Value
<i>RP</i>	$H + 0.5(V_F - H)$	$0.5(V_F - H)$	$V_R + 0.5(V_F - H)$	$V_F + V_R - H$
<i>RL</i>	H	$V_F - H$	V_R	$V_F + V_R - H$
<i>FP</i>	No Payment	V_F	$V_R - H$	$V_F + V_R - H$
<i>FL</i>	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 its activity. As noted earlier, this scenario arises whenever $V_R < H$ and $V_F > H$.

Under the *RP* rule, Resort would have a right to operate and pollute. Given that the value of pollution to Factory would exceed the value to Resort of operating free of pollution, however, Resort would "sell" its right to Factory and shut down its operations because such a transaction would produce a surplus of $V_F - V_R$. In such an exchange, Factory would be expected to pay Resort an amount that would compensate Resort for the forgone value of its activity and, furthermore, would provide Resort with a fraction of the surplus produced by the exchange. Under the assumption of equal sharing of surplus, Resort would end up netting $V_R + 0.5(V_F - V_R)$, and Factory would end up netting $V_F - 0.5(V_F + V_R)$.

Under the *RL* rule, Factory would be able to operate without Resort's consent, provided only that Factory pay Resort its damages. Be-

cause it would be efficient for Resort to shut down its activity altogether in the presence of pollution, these damages would equal V_R . Whereas Resort would be compensated for the lost benefit from its potential activity, Resort would be unable to extract from Factory anything more than these damages. The final division of value would provide Factory with a net value of $V_F - V_R$ and Resort with a net value of V_R .

Under the *FP* rule, Factory would have the right to operate without paying any damages. Because it would indeed be efficient for Factory to operate, the parties would have no incentive to bargain over a reallocation of entitlements. Also, because the potential harm to Resort from operating under pollution would exceed the potential value to Resort from its activity, Resort would shut down. In the final division of value, Factory would net V_F and Resort would end up with no value.

Finally, under the *FL* rule, Resort would have the power to force Factory to shut down its polluting activity by paying Factory damages equal to the value of Factory's activity, V_F . However, because the value of Factory's activity exceeds the potential value of Resort's activity, $V_F > V_R$, Resort would prefer not to exercise this option and would shut down its own activity instead. The final division of value would provide Factory with a net value of V_F and provide Resort with no value.

TABLE 3. DIVISION OF VALUE IN SCENARIO F				
Rule	Payments Made by		Value to Resort	Total Value
	Factory	Value to Factory		
<i>RP</i>	$V_R + 0.5(V_F - V_R)$	$V_F - 0.5(V_F + V_R)$	$0.5(V_R + V_F)$	V_F
<i>RL</i>	V_R	$V_F - V_R$	V_R	V_F
<i>FP</i>	No Payment	V_F	0	V_F
<i>FL</i>	No Payment	V_F	0	V_F

C. Scenario R: Only Resort Should Operate

In this scenario, it is efficient for Resort to operate and for Factory to shut down, as V_F is lower than both H and V_R .

Under the *RP* rule, Factory would be allowed to operate only if it obtained Resort's consent, but it would not be worthwhile for Factory to pay as much as would be needed to obtain such consent. Because the value of Factory's polluting activity in the considered scenario does not exceed the damages from pollution to Resort, the parties would have no incentive to bargain over the reallocation of rights.

Factory would end up with no value, and Resort would end up with a value of V_R .

Under the *RL* rule, Factory would prefer to shut down its activity rather than operate and pay the damages to Resort as required by the rule. Thus, again, Factory would end up with no value, and Resort would end up with V_R .

Under the *FP* rule, Factory would agree not to use its right to operate in return for a payment from Resort. In this exchange, Factory would be able to extract a price equal to the value of its activity, V_F , plus a fraction of the surplus produced by the exchange.

The size of this surplus would depend on the relative magnitudes of H and V_R . In the case in which the value of Resort's activity exceeds the potential harm from pollution, $V_R > H$, the damages to Resort from pollution would equal H , and the surplus from Factory's shutting down its activity would be $H - V_F$. Under the assumption of equal bargaining power, Factory would receive an amount equal to the forgone benefits from its polluting activity, V_F , plus half the surplus, that is, $0.5(H - V_F)$. Resort in turn would end up with a value equal to V_R minus the payment of $V_F + 0.5(H - V_F)$ made to Factory, an amount equal to $V_R - 0.5(V_F + H)$.

In contrast, in the case in which the potential harm to Resort from pollution exceeds the value of Resort's activity, $H > V_R$, pollution would lead Resort to shut down, the damages to Resort from pollution would be V_R , and the surplus produced by Factory's shutting down would thus be $V_R - V_F$. Under the assumption of equal bargaining power, Resort would again pay Factory for its forgone benefits, V_F , plus half the net surplus, $V_R - V_F$, and Factory thus would end up with a value of $0.5(V_R + V_F)$. Resort would end up with a value of $V_R - V_F - 0.5(V_R - V_F)$, an amount equal to $V_R - 0.5(V_R + V_F)$.

Finally, under the *FL* rule, Resort would have the power to prevent Factory's pollution by paying Factory damages in an amount equal to the value of its forgone activity, V_F . In this case, Factory would not be able to extract from Resort any payment in excess of V_F but, on the other hand, would have no reason to accept any offer of payment below V_F . The final division of value thus would provide Factory with a net value of V_F and Resort with a net value of $V_R - V_F$.

TABLE 4. DIVISION OF VALUE IN SCENARIO R				
Rule	Payments Made			
	by Resort	Value to Factory	Value to Resort	Total Value
RP	No Payment	0	V_R	V_R
RL	No Payment	0	V_R	V_R
FP	$V_F + 0.5(H - V_F)$ (if $V_R > H$)	$0.5(V_F + H)$ (if $V_R > H$)	$V_R - 0.5(V_F + H)$ (if $V_R > H$)	V_R
	or $V_F + 0.5(V_R - V_F)$ (if $V_R < H$)	or $0.5(V_F + V_R)$ (if $V_R < H$)	or $V_R - 0.5(V_F + V_R)$ (if $V_R < H$)	
FL	V_F	V_F	$V_R - V_F$	V_R

The analysis of this final scenario *R* completes our comparison of the legal rules in terms of their ex post distributive consequences. I shall now turn to examine how these differences in ex post division translate into different ex ante behavior as well.

IV. THE EX ANTE EFFECTS OF ALTERNATIVE RULES

This Part analyzes the effects of alternative rules on ex ante investments. Section A introduces ex ante investments into the analysis. Sections B and C then examine the effects of the four alternative rules on parties' ex ante investments in enhancing the values of their activities. Section D next analyzes the rules' effects on ex ante investment in harm reduction. Finally, Section E provides an overall comparison of the rules in terms of their ex ante effects.

A. Introducing Ex Ante Investments

Following the standard analysis of the ex post problem, we have thus far treated *as given* the values defining the situation at hand: the potential value of Factory's activity, V_F ; the potential value of Resort's activity, V_R ; and the potential harm resulting from joint operation by the parties, H . These values, however, might be a product of the parties' actions at earlier points in time.

For example, the value of Resort's and Factory's activities, V_F and V_R , might be a function of their ex ante decisions about the scope of their activities, their products or services, the number of their employees, and their investments in the employees' human capital. Similarly, the harm that would result from joint operation by Resort and Factory, H , might also be a function of various ex ante actions and in-

vestments. For example, the magnitude of H might depend on the extent to which Factory or Resort invested to reduce the reliance of their respective activities on the river's water.

I will denote below as x_F and x_R the investments made ex ante by Factory and Resort respectively in enhancing the value of their respective activities. I will also denote below as y_F and y_R the investments in harm-reduction made by Factory and Resort respectively. I will assume that all these investments have the standard feature of diminishing marginal effectiveness, with each additional dollar invested producing a positive but diminishing benefit.

Which ex post allocation of entitlements would provide the parties with the best incentives for making these ex ante investments? In examining this question, I will assume that courts cannot observe the level of ex ante investments and that the ex post allocation of entitlements thus cannot be made dependent on such investments.²¹ Furthermore, I will focus on choosing a rule from among the four basic legal rules that Calabresi and Melamed identified.

If the parties could negotiate ex ante — that is, prior to making their investments — they could adopt an arrangement that would govern the ex post allocation of entitlements. Even in such a case, it would be valuable for lawmakers to identify the optimal arrangement and provide it as a default. Moreover, in many situations where parties can be expected to bargain ex post with ease, bargaining ex ante might still be difficult, or even impossible, to conduct and successfully conclude.

In particular, conditions necessary for easy bargaining, such as absence of informational asymmetries, might obtain ex post but not ex ante. Even when parties are ex post informed about each other's potential payoffs, they might not possess such information ex ante. For example, before the parties make their respective investments ex ante, Factory and Resort might have some private information regarding the effectiveness of their respective investments. After those investments are made, and after the ex post situation crystallizes, the potential payoff of each party might become apparent to the other side, but that might not have been the case ex ante. The presence of ex ante informational asymmetries might therefore impede ex ante bargaining and might make the choice of legal rule especially important.

Before proceeding to analyze how alternative rules affect ex ante investments, let me note two assumptions that I will use for simplicity of exposition. First, I will assume that ex ante investments do not determine which of the three scenarios (FR , F , or R) will occur. Which scenario eventually materializes will be assumed to depend on exogenous developments, say, in the markets within which Factory and Re-

21. This assumption is similar to the standard assumption made in the incomplete contracts literature that parties' ex ante investments are noncontractible. See, e.g., HART, *supra* note 6.

sort operate. Ex ante investments, however, will be assumed to influence parties' potential payoffs under each scenario.

Second, I will use specific numerical examples for the probabilities of the three scenarios. It will be clear, however, that the reasoning and qualitative conclusions of the analysis will apply equally to any other values that these probabilities might take. Specifically, I will assume that the probability of scenario *FR* (in which it is efficient for both Factory and Resort to operate) equals 1/2; that the probability of scenario *F* (in which it is efficient for only Factory to operate) equals 1/3; and that the probability of scenario *R* (in which only Resort should operate) equals 1/6.

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

1. *The Socially Optimal Investment Level*

From a social point of view, a party should invest up to the point where marginal social benefit equals marginal social cost, such that one dollar of investment produces one dollar of expected social value. In our example, enhancement of V_F will provide social value only in those scenarios — *F* and *FR* — in which Factory will actually operate. Consequently, the social value of increasing V_F by \$1 will be equal to \$1 multiplied by the combined probability of these two scenarios, which is 5/6 ($1/3 + 1/2$) in our example. Thus, Factory should invest only up to the point where 5/6 of the marginal increase in V_F produced by an additional dollar of investment falls to \$1.²² As I now turn to show, however, Factory's private calculus for its investment in enhancing V_F might diverge from the socially optimal calculus.

2. *Investment Under Alternative Rules*

a. Entitlement to Resort with Property-Right Protection. As Part III demonstrated, if Resort is given the entitlement with property-right protection, then Resort will be able to extract value from Factory whenever it is efficient for Factory to pollute. Thus, under an *RP* rule, Resort will allow Factory to operate in scenarios *FR* and *F* in exchange for part of the value produced by Factory's activity. Assuming that the parties enjoy equal bargaining power, we have concluded in Section III that, in scenarios *FR* and *F*, Factory will capture only half of any marginal increase in the value of V_F .

22. This means that the socially optimal investment x satisfies $5/6 * V_F'(x) = 1$. More generally, if P_F and P_{FR} denote the probabilities of scenarios *F* and *FR*, respectively, then the optimal investment x will satisfy $(P_F + P_{FR}) * V_F'(x) = 1$.

Consider now Factory's private calculus as to how much to invest ex ante. Factory will, of course, bear the full cost of every dollar of marginal increase in its investment, x_F . Factory will benefit from a marginal increase in the value of V_F , however, only in scenarios F and FR , which have a combined probability of $5/6$. Moreover, even in those scenarios Factory will capture only half of the marginal increase in value of V_F .

It follows that Factory will have no incentive to invest beyond the point where $5/12$ (which is $5/6 * 1/2$) of the resulting marginal increase in V_F produced by an additional \$1 of investment falls to \$1.²³ This implies that Factory will set its level of investment, x_F , below the socially optimal level because Factory will expect Resort to capture half of the return produced by Factory's investment. Essentially, Factory will bear the full cost of increasing x_F but, under the RP rule, will capture only half of the resulting social benefits. For this reason, Factory's incentives to invest will be inadequate, and Factory will invest too little.²⁴

b. Entitlement to Resort with Liability-Rule Protection. If Resort receives the entitlement but with only liability-rule protection, Factory will have to pay damages to Resort in scenarios F and FR . Recall, however, that these payments of damages to Resort (H in scenario FR and V_R in scenario F) will not depend on the value of Factory's activity, V_F .

Consider Factory's private calculus as to how much to invest ex ante under this rule. Again, Factory will bear the full cost of every dollar of marginal increase in its investment, x_F , and will benefit from any resulting increase in V_F only with a probability of $5/6$, the combined likelihood of scenarios F and FR . Unlike the RP rule, however, the RL rule will allow Factory to capture in these two scenarios the full marginal increase in V_F because Factory's payment to Resort under the RL rule will not depend on the value of V_F . Therefore, Factory will invest up to the point where $5/6$ of the increase in V_F produced an additional \$1 investment falls to \$1.²⁵

This conclusion implies that, under the RL rule, Factory will invest at the socially optimal level. Because the payment that Factory will

23. Formally, Factory's investment under the rule would satisfy $5/6 * 1/2 * V_F'(x) = 1$. More generally, let us assume that the bargaining between the parties will result in Resort's capturing a fraction ϕ of the surplus and Factory's capturing the remaining fraction $(1 - \phi)$ of the surplus. Under this more general assumption, Factory's investment would satisfy $(P_F + P_{FR}) * (1 - \phi) * V_F'(x) = 1$.

24. This result is similar to the standard result in the analysis of the standard hold-up problem: when the value that a party A produces can be expected to become subject to a hold-up by party B , party A will underinvest in enhancing this value. See, e.g., HART, FIRMS, CONTRACTS, *supra* note 6, at 39-42.

25. Formally, Factory's investment under the rule would satisfy $5/6 * V_F'(x) = 1$, which is the condition defining the socially optimal level of investment. See *supra* note 22. More generally, Factory's investment would satisfy $(P_F + P_{FR}) * V_F'(x) = 1$.

have to make to Resort when Factory operates will not depend on the value of Factory's activity, V_F . Factory will be the "residual claimant" that captures the full value of marginal increases in V_F . As a result, Factory's private incentives will induce it to invest optimally.

c. Entitlement to Factory with Property-Right Protection. Granting Factory an entitlement with property-right protection will enable 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 its activity. In scenario R Factory will be able to extract a payment from Resort in return for not polluting. As Section III.C showed, in scenario R Factory will receive an amount equal to V_F , the amount Factory would be giving up by shutting down its polluting activity plus, under the assumption of equal bargaining power, half of the surplus produced by Factory's shutting down, a surplus which will equal the lesser of $(H - V_F)$ or $(V_R - V_F)$. Thus, Factory would get an amount equal to V_F plus half of the higher of $(H - V_F)$ and $(V_R - V_F)$, or, equivalently, half of V_F plus half of the higher of H and V_R .

Now consider Factory's investment decision under the FP rule. As always, Factory will bear the full cost of every 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 $5/6$, in which Factory will operate. Finally, in scenario R , in which Factory will shut down, Factory will still gain an amount equal to half of V_F plus half of the higher of H and V_R . Thus, on the whole, Factory will make an expected gain of $11/12$ of each marginal increase in V_F . Factory therefore will invest up to the point where the marginal increase in V_F produced by an additional \$1 investment falls to $\$11/12$.²⁶

Recall, however, that Factory's socially optimal level of investment is at the point where $5/6$ of the marginal increase in V_F falls to \$1. It follows that Factory will adopt under the FP rule an excessive — that is, higher than socially optimal — level of investment x_F .

Essentially, because Factory will be able to obtain benefit from an increase in V_F even in scenario R , in which Factory's activity would shut down and produce no social value, Factory will obtain from its investment some extra private benefits that will not reflect social value. This divergence between the private and social calculus will lead Factory to invest excessively.²⁷

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

27. This result is similar to those results in the law and economics literature showing that, in some contexts, compensating a party for a value that is not going to be in fact realized might lead to overinvestment. For example, Steve Shavell has shown that the expectation damages remedy in contracts will lead to overinvestment in reliance. The relying party will disregard the fact that its investment would not produce social value in the event that the contract is breached because it would be compensated by the other side. See Steven Shavell,

d. Entitlement to Factory with Liability-Rule Protection. Let us now turn to the rule that also gives the entitlement to Factory but with only liability-rule protection. Under this rule, Factory would again be able to capture value not only in scenarios *F* and *FR* but also in scenario *R* in which it would shut down its activity. In scenario *R*, Resort would be able to make Factory shut down but would have to pay Factory the forgone value of its V_F .

Thus, under the *FL* rule, Factory will capture the marginal increase in the value of V_F resulting from its investment in every scenario, including scenario *R* in which the increase in the value of V_F would produce no social value. Thus, Factory will invest up to the point where the increase in V_F from an additional \$1 of investment falls to \$1.²⁸

This level of investment by Factory will exceed the socially optimal level. Furthermore, under the *FL* rule Factory would capture in scenario *R* the full marginal increase in the value of V_F produced by additional investment, whereas under the *FP* rule Factory would capture in this scenario only half of such a marginal increase. It follows that the *FL* rule would distort Factory's incentives even more severely in the direction of excessive investment than would the *FP* rule.²⁹

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

1. The Socially Optimal Investment Level

As already noted, from a social point of view, a party should invest only up to the point where the marginal expected social value from additional investment falls to its marginal cost. Increasing the value of V_R would produce a social benefit only in scenarios *R* and *FR*, and it would produce no social value in scenario *F* in which Resort would

Damage Measures for Breach of Contract, 11 BELL J. ECON. 466 (1980). Similarly, Robert Cooter and Louis Kaplow have suggested that full compensation for government takings leads to overinvestment because parties disregard the fact that their investments might not produce social value in the event that their property is taken by the government. See Robert Cooter, *Unity in Tort, Contract, and Property: The Model of Precaution*, 73 CAL. L. REV. 1 (1985); Louis Kaplow, *An Economic Analysis of Legal Transitions*, 99 HARV. L. REV. 509 (1986).

28. Formally, Factory's investment under the rule would satisfy $V_F'(x) = 1$.

29. Under the *FL* rule, Factory will net a lesser share of the total ex post value than under the *FP* rule. As a consequence, Factory might appear at first glance to have a weaker incentive to overinvest in V_F under the *FL* rule than under the *FP* rule. The *FL* rule, however, provides a stronger incentive *on the margin* to increase V_F . Under the *FL* rule, Factory will capture in scenario *R* the full value of any increase in the value of V_F . In contrast, under the *FP* rule in scenario *R*, Factory would in addition get half of the surplus — which would be $V_R - V_F$ or $H - V_F$ — created by Factory's shutting down. Because increasing V_F would reduce this surplus, this extra element of value under the *FP* rule would operate to mitigate the incentive to overinvest in increasing V_F . As a result, the overinvestment under the *FP* rule will be less severe than under the *FL* rule.

shut down its activity. Accordingly, an increase of \$1 in the value of V_R would produce a social gain of \$1 only in scenarios R and FR , which have in our example a combined probability of $2/3$ ($1/6 + 1/2$).

Resort should invest, then, up to the point where $2/3$ of the marginal increase in the value of V_R produced by an additional \$1 of investment falls to \$1.³⁰ As we shall presently see, however, Resort's private calculus would differ from the social calculus under some of the alternative rules, and Resort would under these invest in enhancing the value of its activity at an inefficient level.

2. Investment Under Alternative Rules

a. Entitlement to Resort with Property-Right Protection. Granting the entitlement to Resort with property-right protection will enable Resort to capture value not only in scenarios R and FR but also in scenario F , in which Resort would shut down its activity. In this scenario, in return for allowing Factory to operate, Resort would be able to extract from Factory a payment equal to V_R , the forgone value of Resort's activity, plus half of $V_F - V_R$, the surplus produced by the exchange.³¹

Now consider Resort's investment decision. As always, Resort will bear the full cost of each additional \$1 investment in enhancing the value of its activity. Resort will also benefit from the full value of marginal increases in V_R in scenarios R and FR , which have a combined probability of $2/3$. Furthermore, in scenario F , which has a probability of $1/3$, Resort will capture half of any marginal increase in the value of V_R .

It follows that Resort will have an incentive to invest up to the point where $5/6$ ($2/3 + [1/3 * 1/2]$) of the marginal increase in the value of V_R produced by an additional \$1 of investment falls to \$1.³² By contrast, the socially optimal level of investment for Resort is, as noted above, at the point where $2/3$ of the marginal increase in V_R falls to \$1. It follows that the level of investment chosen by Resort will be socially excessive.

Essentially, increases in the value of V_R would provide Resort with some private benefits that would not reflect a social gains but merely a transfer of value from Factory. Because additional investment would

30. This means that the socially optimal investment must satisfy $2/3 * V_R'(x) = 1$. More generally, if P_R and P_{FR} denote the probabilities of scenarios R and FR respectively, then the optimal investment will be defined by $(P_R + P_{FR}) * V_R'(x) = 1$.

31. The net value that Resort will obtain under the RP rule in scenario F thus equals $0.5(V_R + V_F)$. See *supra* Section III.C.

32. Formally, Resort's investment under the rule would satisfy $[2/3 + (1/2 * 1/3)] * V_R'(x) = 1$. More generally, Resort's investment would satisfy $[P_R + P_{FR} + (1 - \phi) * P_F] * V_R'(x) = 1$.

produce for Resort private benefits exceeding the produced social gains, Resort will invest excessively under the *RP* rule.

b. Entitlement to Resort with Liability-Rule Protection. Under the rule that gives the entitlement to Resort with liability-rule protection, Resort will again obtain value not only in scenarios *R* and *FR* but also in scenario *F* in which it would not operate. In scenario *F*, Resort would shut down its activity but it would receive from Factory compensation for the value of its forgone activity V_R .³³ Thus, under the *RL* rule Resort will capture the full value of marginal increases in V_R in all three scenarios.

Under the considered rule, then, Resort will capture the marginal increase in the value of V_R also in scenario *F*, in which the increase in value of V_R would produce no social value. Resort thus will elect to invest up to the point where the marginal increase in the value of V_R produced by an additional \$1 of investment falls to \$1.³⁴ This level of investment will exceed the socially optimal level.

Essentially, Resort's private gains from enhancing the value of V_R would exceed the social gains from such an increase. Furthermore, under the *RL* rule, Resort would capture the full value of any marginal increase in the value V_R , whereas under the *RP* rule Resort would capture only a fraction of the increase in the value of V_R .³⁵ Hence, the *RL* rule would distort Resort's incentives in the direction of excessive investment even more severely than the *RP* rule would.

c. Entitlement to Factory with Property-Right Protection. Under the *FP* rule Factory's property right will enable it to extract value from Resort in scenario *R*. In this scenario, in which it would be efficient for only Resort to operate, Factory would agree to shut down its activity in exchange for compensation from Resort.³⁶

33. By hypothesis, only Factory should operate in scenario *F*. Thus, under the *RL* rule, the damages that Factory would pay to Resort in scenario *F* would equal V_R . Resort would receive this payment and willingly shut down. See also *supra* Section III.B.

34. Formally, Resort's investment under the rule would satisfy $V_R'(x) = 1$.

35. Note that, whereas the total value with which Resort will end up under the *RP* rule may exceed that under the *RL* rule, Resort's incentive to invest in enhancing the value of its activity under the *RL* rule is stronger *on the margin* than under the *RP* rule. The reason for this is similar to the one given earlier for why Factory's incentive to invest in enhancing the value of its activity is higher under the *FL* rule than under the *FP* even though Factory's final value is higher under the latter rule. See *supra* note 29 and accompanying text.

36. Recall that the entitlement that Factory would enjoy represents the freedom to engage in its activity, i.e., to pollute the river. Consequently, Factory can transfer the entitlement and thereby extract value from Resort only if Factory completely shuts down its polluting activity. This can occur only in scenario *R*, in which Factory should shut down its activity anyway. In scenario *FR*, Factory would not be willing to shut down its activity and thus could not transfer its entitlement and extract value from Resort, whether under the *FP* rule or the *FL* rule. By contrast, the entitlement that Resort would enjoy represents simply the freedom from pollution, such that transfer of the entitlement would not require Resort to shut down its activity but merely to suffer simultaneously the presence of pollution. Thus, granting the entitlement to Resort with property-right protection would enable it to extract

Furthermore, in the case in which pollution would be too costly for Resort to bear and operate — that is, the case in which $V_R < H$ — the amount that Factory will be able to extract depends on the value of V_R . In this case, under the assumption of equal bargaining power, Factory will be able to capture in scenario R half of any marginal increase in the value of Resort's activity.

Turning to Resort's private calculus as to how much to invest ex ante, we start by noting that, in scenario FR , which has a probability of $1/2$, Resort would capture fully any marginal increase in the value of V_R . In scenario R , however, which has a probability of $1/6$, Resort would capture only half of the marginal increase in the value of V_R . Thus, Resort will have an incentive to invest only up to the point where $7/12$ (that is, $1/2 + [1/6 * 1/2]$) of the marginal increase in the value of V_R produced by an additional \$1 investment falls to \$1.³⁷

It follows that Resort will set its level of investment below the socially optimal level. The underlying intuition is that, under the FP rule, Resort will bear the full cost of increasing x_R , but will capture only part of the resulting benefits. The remainder of the expected benefits that Resort's investment will produce will go to Factory. For this reason, Resort will have an insufficient incentive to invest at the socially optimal level.

d. Entitlement to Factory with Liability-Rule Protection. Under the FL rule, Resort will be required to pay damages to Factory in scenario R , in which it would be efficient for Factory to shut down its activity. Resort's payment in scenario R , however, would equal the forgone value of Factory's activity and would not depend on the value of Resort's activity. Thus, Factory would not be able to extract from Resort any portion of marginal increases in V_R produced by Resort's ex ante investment.

Turning to Resort's private calculus, note that Resort will capture fully marginal increases in the value of V_R in scenarios R and FR , which have a combined probability of $2/3$. Therefore, Resort will invest up to the point where $2/3$ of the marginal increase in the value of V_R from an additional \$1 of investment falls to \$1.³⁸ Thus, Resort will invest as the socially optimal level.

The intuition underlying this conclusion is that although Factory would be able to extract in scenario R some payment from Resort, this

value from Factory not only in scenario F , in which Resort would shut down, but also in scenario FR , in which Resort would continue to operate despite the pollution.

37. Formally, Resort's investment under the rule would satisfy $7/12 * V_R'(x) = 1$. More generally, relaxing the assumption that $V_R < H$, Resort's investment would satisfy $[P_{FR} + P_R * \alpha * \phi] * V_R'(x) = 1$, where α denotes the probability that $V_R > H$ in the event that scenario R takes place.

38. Formally, Resort's investment under the rule would satisfy $4/6 * V_R'(x) = 1$, which is the condition defining the socially optimal level of investment. *See supra* note 30.

payment would not depend on the value of V_R ; since Resort would receive in this scenario the excess of V_R over the damages payments made to Factory, Resort would fully capture marginal increases in V_R produced by its investment and thus would be the “residual claimant.” Because Resort would fully capture the expected social benefits from its investment in enhancing the value of its activity, its private calculus would align with that of social optimality.

e. Comparing the Rules. We can now put together our conclusions concerning how alternative rules would affect Factory and Resort’s investments in enhancing the values of their respective activities. Table 5 summarizes these conclusions:

Rule	Factory’s Investment in Enhancing V_F	Resort’s Investment in Enhancing V_R
<i>RP</i>	Suboptimal	Excessive
<i>RL</i>	Optimal	Most Excessive
<i>FP</i>	Excessive	Suboptimal
<i>FL</i>	Most Excessive	Optimal

As Table 5 indicates, none of the four rules can induce the optimal levels of *both* x_F and x_R . Each of the two property-right rules, *RP* and *FP*, would lead both parties to invest inefficiently, with the party receiving the entitlement investing excessively and the other party investing suboptimally. Each of the two liability rules, *RL* and *FL*, would lead the party receiving the entitlement to invest optimally, but the other party would invest excessively — and to a greater extent than in the case in which the party receiving the entitlement was given property-right protection.

D. *Ex Ante Investments in Harm Reduction*

1. *Socially Optimal Investment Levels*

Having examined how alternative legal rules affect parties’ investments in enhancing the value of their respective activities, I now turn to consider how these rules affect the parties’ *ex ante* investments, y_R and y_F , in reducing the magnitude of the potential harm H in the event of joint operation. From a social point of view, each party should invest in harm reduction up to the point where the expected social benefit from an additional \$1 of such investment falls to \$1.

In determining marginal social benefit, we must take into account that the potential harm would actually occur only in scenario *FR*, which has a probability of $1/2$. Thus, the expected social benefit from a given reduction in H is equal to only half of this reduction. Thus, it would be socially optimal for Factory to invest up to the point where $1/2$ of the marginal reduction in H produced by an additional \$1 of investment by Factory is equal to \$1.³⁹ Similarly, from a social point of view, Resort should invest up to the point where $1/2$ of the marginal reduction in H produced by an additional dollar of investment by Resort is equal to \$1.⁴⁰

2. Investment Under Alternative Rules

a. Entitlement to Resort with Property-Right Protection. Let us start with Factory's investment in harm reduction under the *RP* rule. Under this rule, Factory will make a payment to Resort to get its permission for Factory's activity only in scenario *FR* in which the harm would actually occur. In this scenario, Factory will end up with a value of $0.5V_F - 0.5H$.⁴¹ Thus, should scenario *FR* occur, Factory would capture half of the savings from any marginal reduction in H .

Accordingly, when Factory decides how much to invest, it will recognize that its expected benefit from increasing y_F by \$1 will equal $1/4$ ($1/2 * 1/2$) of the reduction in the value of H produced by such a marginal additional investment. Thus, Factory will invest up to the point where $1/4$ of the reduction in the value of H produced by an additional \$1 of investment falls to \$1.

It follows that Factory's level of investment in harm reduction will fall below the socially optimal level. The intuition behind this conclusion is that, although Factory will bear the full cost of any marginal increase in y_F , it will share with Resort the expected benefits from such investment, that is, the savings in scenario *FR* from a reduction in the value of H . As a result, compared with what would be socially optimal, Factory will invest too little.

For similar reasons, Resort will also invest suboptimally in harm reduction under the *RP* rule. The harm will affect Resort also only in scenario *FR*, and Resort would be able to capture in this scenario only half of the benefits from any reduction in the value of H . Thus, Resort will invest up to the point where $1/4$ of the marginal reduction in H

39. Formally, Factory's optimal level of investment in harm reduction would be defined by $1/2 * Hy'_F(y) = -1$. More generally, Factory's optimal level of investment in harm reduction would satisfy: $P_{FR} * Hy'_F(y) = -1$.

40. Formally, Resort's optimal level of investment in harm reduction would satisfy: $1/2 * Hy'_R(y) = -1$. More generally, Resort's optimal level of investment in harm reduction would satisfy: $P_{FR} * Hy'_R(y) = -1$.

41. See *supra* Section III.A.

produced by an additional \$1 investment by Resort falls to \$1. Thus, because Resort will bear the full costs of increasing its investment in harm reduction but will share the expected benefits of such reduction with Factory, Resort will invest too little compared with what would be socially optimal.

b. Entitlement to Resort with Liability-Rule Protection. Under the *RL* rule, which gives Resort the entitlement with liability-rule protection, Factory will pay Resort damages in the amount of H in scenario *FR*. Thus, in this scenario, which has a probability of $1/2$, Factory would capture all the benefits from any given reduction in the value of H . Using reasoning similar to that used earlier, we can conclude that Factory will invest up to the point where $1/2$ of the reduction in H resulting from an additional \$1 of investment by Factory is equal to \$1.

It follows that Factory will invest optimally in harm reduction. Essentially, under the *RL* rule Factory will both bear the full social costs of a marginal increase in its investment level and capture the full expected social benefits resulting from such investment.

In contrast, Resort's level of investment in harm reduction will be zero. This inefficiency arises because in scenario *FR*, in which the harm H would actually occur, Resort would receive full compensation from Factory. Thus, Resort will not get any benefit from reductions in the value of H , and Resort thus will have no incentive to make any investment to lowering the value of H .⁴²

c. Entitlement to Factory with Property-Right Protection. Under the *FP* rule, which gives the entitlement to Factory with property-right protection, Factory will make no payments to Resort in scenario *FR*, in which the harm H would actually materialize. Thus, Factory's payoff in scenario *FR* will not depend on the value of H . Indeed, under certain conditions, an increase in H would in fact benefit Factory by increasing the amount that Factory would be able to extract from Resort in scenario *R*.⁴³

Factory thus would have no incentive to make any *ex ante* investment in harm reduction, and will choose a zero level of investment, which will clearly fall below the socially optimal level. The problem is that, although Factory would bear the full cost of any investment it would make in harm reduction, it would derive none of the social

42. This result is similar to the result in the economic analysis of torts showing that, when courts make injurers 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 ACCIDENT LAW*, ch. 2 (1987).

43. Specifically, an increase in H will increase Factory's expected value in scenario *R* if $V_R > H$. In that situation, an increase in H would raise the damages to Resort from Factory's pollution and thus would raise the surplus that would be generated (and partly captured by Factory) from Factory's shutting down its activity.

benefits produced by it and, indeed, might even suffer a loss from the resulting decrease in H .

In contrast, Resort will invest excessively in harm reduction under the *FP* rule. In scenario *FR*, Resort would obtain no payment from Factory and would therefore bear the full cost of the harm. Furthermore, in scenario *R*, in which Factory would agree to shut down its activity and the potential harm would not materialize, a smaller value of H would decrease the damages to Resort from pollution and thereby improve Resort's bargaining position and decrease the amount that Factory would be able to extract from Resort in return for shutting down Factory's activity.⁴⁴

In considering how much to invest, Resort would take into account the benefit that it would obtain from a reduction in H both in scenario *FR*, where Resort's private benefit would fully reflect social benefit, and in scenario *R*, where Resort's private benefit would not reflect a social benefit but rather a transfer from Factory. Thus, because Resort will derive from its investment in harm reduction private benefits exceeding the social benefits, Resort will invest excessively.

d. Entitlement to Factory with Liability-Rule Protection. Finally, under the *FL* rule, which gives the entitlement to Factory but with the protection of only a liability rule, Factory will in all three scenarios end up with the full value of its activity, V_F . Thus, Factory's final value will in no way depend on the value of H . Therefore, Factory will derive no benefit from any reduction in H , will have no incentive to make any expenditures on harm reduction, and will make zero investment.

By contrast, Resort's investment in harm reduction will be set at the socially optimal level. Under the *FL* rule, Resort will bear the full harm, H , only in scenario *FR*, which occurs with a probability of 1/2. In scenarios *F* and *R*, however, the value of H would have no effect on the value that Resort would obtain. Resort therefore will invest up to the point where 1/2 of the marginal reduction in H produced by an additional \$1 of investment by Resort falls to \$1. As we have seen earlier, this level of investment will be socially optimal.

e. Comparing the Rules. Putting together the conclusions from the preceding subsections, Table 6 below summarizes our results concerning how the parties' investments in harm reduction under the four different rules would compare with the socially optimal levels:

44. Stated differently, reducing the value of H might decrease the amount that Factory would be able to extract in return for shutting down its activity in scenario *R*. Specifically, a decrease in H would reduce the expected payment that Resort would make to Factory in scenario *R* if $V_R > H$. See *supra* Section III.C.

Rule	Factory's Investment in Reducing H	Resort's Investment in Reducing H
<i>RP</i>	Suboptimal	Suboptimal
<i>RL</i>	Optimal	Zero
<i>FP</i>	Zero	Excessive
<i>FL</i>	Zero	Optimal

As Table 6 indicates, none of the rules will generally ensure that *both* Factory and Resort invest optimally in harm reduction. This state of affairs arises because none of the rules will enable *both* parties to capture the full social benefits produced by their respective investments in harm reduction.

E. *Taking Stock*

Having analyzed the effects of alternative rules both on parties' investments in enhancing the value of their respective activities and on parties' investments in harm reduction, we can now turn to an overall comparison of ex ante investments under the four legal rules:

Rule	Factory's Investment in V_F	Resort's Investment in V_R	Factory's Investment in Reducing H	Resort's Investment in Reducing H
<i>RP</i>	Suboptimal	Excessive	Suboptimal	Suboptimal
<i>RL</i>	Optimal	Most Excessive	Optimal	Zero
<i>FP</i>	Excessive	Suboptimal	Zero	Excessive
<i>FL</i>	Most Excessive	Optimal	Zero	Optimal

As Table 7 indicates, none of the rules can ensure that *both* parties will set *both* types of investments at the efficient level. Each rule will lead at least two of the four ex ante investments to deviate from the efficient level. Although each one of the rules involves some efficiency costs, the rules might well differ considerably in how far investment levels will fall short of efficiency. Therefore, the best rule from the perspective of ex ante investments is the one that would produce the lowest overall inefficiency costs.

V. IMPLICATIONS FOR THE CHOICE OF RULE

Having identified and analyzed how legal rules can affect ex ante actions and investments, I turn now to examine the implications of this analysis for the choice of rule. Section A discusses the implications of ex ante effects for the choice between property-right protection and liability-rule protection. Section B considers the choice of which party will be protected. Section C shows that, once we take ex ante considerations into account, it would be worthwhile to consider an expanded menu of legal rules. Finally, Section D identifies a certain advantage that government fines and taxes have over private law rules in addressing problems of ex ante incentives.

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

One important contribution of the existing literature has been to identify certain important ex post advantages that liability rules enjoy over property rights when ex post bargaining is not easy.⁴⁵ As the discussion below will explain, from the ex ante perspective, liability rules are not generally superior. Liability rules sometimes do work better than property rights, but sometimes they do not.

For concreteness, let us suppose that we have decided to protect Resort against Factory's pollution, so that we now must decide only whether to protect with a property right or with a liability rule — that is, choose between *RP* and *RL*. The results displayed in Table 7 suggest that, from the perspective of ex ante investments, *RL* might or might not work better than *RP*.

To understand the balance of considerations, let us first examine how these two rules affect Factory's ex ante investments. As Table 7 indicates, a liability rule (*RL*) would lead Factory to make more efficient investments than a property rule (*RP*) would.

Specifically, an *RL* rule would induce Factory to make both value-enhancement and harm-reduction investments at the socially optimal level. In contrast, an *RP* rule would induce suboptimal levels of both types of investment.

The *RL* rule, however, would produce inferior results with respect to Resort's ex ante investments. Although both an *RL* and an *RP* rule would lead Resort to invest excessively in value-enhancement, an *RL* rule would induce greater over-investment than an *RP* rule. Further-

45. See Ayres & Talley, *supra* note 3; Calabresi & Melamed, *supra* note 1; Kaplow & Shavell, *supra* note 3. Kaplow and Shavell conclude that there is a prima facie case for favoring liability rules over property rights, *id.* at 721, but they list several factors (including investments by victims in reducing potential harm) that might still make property rights desirable.

more, although both rules would induce suboptimal investment in harm-reduction by Resort, Resort would make no investment at all under the *RP* rule but would make a positive investment under the *RL* rule.

Thus, the *RP* rule would produce higher efficiency costs with respect to Factory's ex ante incentives, but the *RL* rule would produce higher efficiency costs with respect to Resort's ex ante incentives. Which rule would be better from an ex ante perspective will depend on the overall balance of these efficiency costs. Policymakers wishing to take ex ante efficiency into account should assess the relative magnitude, in the considered context or category of cases, of the factors identified above.

Thus, from the ex ante perspective, no general, one-size-fits-all prescription exists. Different categories of cases might call for different forms of protection. Below I offer several observations about circumstances that would tend to make one form of protection superior to the other.

First, when discouraging Factory from inefficient levels of investment is regarded as much more important than discouraging Resort from inefficient levels of investment, the *RL* rule will tend to be superior to the *RP* rule. The intuition underlying this observation runs as follows. The *RL* rule induces Factory to make optimal ex ante investments both in enhancing the value of its activity and in reducing *H*. On the other hand, Resort's deviations from optimality under the *RL* rule are greater than those under the *RP* rule. Hence, if Factory's deviations have a sufficiently greater significance than Resort's deviations, the *RL* rule will be superior.

We can make a similar observation about the case in which curtailing Resort's deviations from efficient investment levels is viewed as much more important than reducing Factory's deviations. In this case, the *RP* rule will tend to be superior to the *RL* rule.

Finally, the higher the likelihood that scenario *F* will materialize, the more the *RL* rule will tend to be superior to the *RP* rule. In scenario *F*, in which only Factory will ultimately operate, Factory's ex ante investment in enhancing the value of its operations activity is valuable. In contrast, in this scenario, whatever investments were made by Resort in enhancing the value of its activity or in reducing harm would not produce any social benefit. Thus, the more likely scenario *F*, the more important it is to provide incentives for Factory's ex ante investment in enhancing the value of its activity, and the less important it is to provide incentives for Resort's ex ante incentives.

B. *Which Party Should Get the Entitlement?*

We now turn to consider the entitlement allocation question: Which party should get the entitlement to the river's water? Should Factory have the right (whichever way it would be protected) to use the water for its activity, or should Resort have the right (again, whichever way it would be protected) to unpolluted water? For expositional convenience, I will assume that, whichever party is chosen to get the entitlement, the party will be protected with a property right. Accordingly, the choice to be considered is between *FP* and *RP*.

Again, the conclusions summarized in Table 7 indicate that neither rule generally dominates the other in terms of ex ante incentives. Each of them has some advantages and some disadvantages when compared to the other. Consider first how the two rules compare in their effect on the parties' ex ante investments in enhancing the value of their respective activities. Neither rule generally induces optimal investment by Factory in value enhancement. Whereas the *RP* rule will lead to suboptimal investment, the *FP* rule will lead to an excessive investment. Likewise, neither rule generally induces optimal investment by Resort in value enhancement: in Resort's case, the *FP* rule leads to suboptimal investment, whereas the *RP* rule leads to excessive investment.

Consider next how these two rules compare in terms of their effect on investment in harm reduction. The *RP* rule always performs better than the *FP* rule with respect to Factory's investment: the *FP* rule will lead Factory to make zero investment, whereas the *RP* rule will lead to a positive (though still suboptimal) investment. With respect to Resort's investment in harm reduction, however, neither rule generally dominates the other. The *RP* rule will lead Resort to make a suboptimal investment, and the *FP* rule will lead to excessive investment.

From the perspective of ex ante efficiency, whether a property right for Resort or a property right for Factory would be better depends on the various factors identified above. Again, the balance of these considerations might vary from one category of cases to another. It is worthwhile, however, to make some observations about circumstances that would tend to make one of these rules superior to the other.

When it is especially important to prevent Factory's investment in value enhancement from falling below the efficient level, the ex ante perspective will tend to favor a property right for Factory. The *FP* rule leads Factory to invest excessively, whereas the *RP* rule leads to suboptimal investment.

In contrast, when preventing Resort's investment from falling below the efficient level is relatively more important, the ex ante perspective will tend to favor a property right for Resort. Whereas the *FP*

rule will lead to suboptimal investment, the *RP* rule will lead to excessive investment.

As for investments in harm reduction, the more importance is attached to having Factory make at least some investment in harm reduction, the more one would tend to favor the *RP* rule. Whereas the *FP* rule leads to zero investment by Factory, the *RP* rule ensures positive (though still suboptimal) investment.

In contrast, when Resort's investment in harm reduction is especially important, the *FP* rule will tend to be superior. The *RP* rule will lead Resort to make a suboptimal investment in harm reduction, whereas the *FP* rule will lead to excessive investment.

C. *Should We Expand the Menu of Rules?*

One important contribution of the Calabresi and Melamed article comes from their classification of four basic alternative rules to deal with the externality problem. Subsequent literature followed this classification for quite a while, with researchers focusing on these four rules or on a subset of them. In the past several years, however, researchers have put forward additional creative rules, based on the provision of put and call options, to address situations in which courts cannot accurately observe parties' payoffs.⁴⁶ As long as courts can be assumed to know the parties' payoffs, however, researchers analyzing liability rules have generally assumed that such rules should set liability at a level equal to the harm to one party from the other party's decisions and actions. Moreover, when courts are uncertain about the accurate level of harm, researchers have generally assumed that liability rules would not set liability levels above or below the range of values within which the damages might actually fall.

Once we recognize that the division of value matters in terms of ex ante incentives, however, we can see that an expanded menu of legal rules might be beneficial. In particular, it might be useful to use liability rules in which liability is intentionally set at a level that is known to be higher or lower than actual damages harm.

Consider our comparison of how the *RP* and the *RL* rules divide ex post value. In the event that Factory operates, the *RL* rule enables Resort to receive an amount equal only to Resort's harm, whereas the *RP* rule enables Resort to receive a part of Factory's surplus. 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 divisions of value produced by the *RL* and *RP* rules, however, represent just two points along a continuum of possible ex post divisions of value. Other points on this continuum, representing differ-

46. See *supra* note 11 and sources cited therein.

ent divisions of value, might produce a better mix of investments. Thus, over- or undercompensatory damages, set above or below the estimated harm, might sometimes lead overall to more desirable levels of ex ante investments.

For example, when faced with a choice between *RL* and *RP*, we might want to consider also a supercompensatory liability rule under which, in the event that Factory pollutes, Factory would have to pay Resort an amount equal, say, to 150% of its harm. Such an “intermediate” rule might provide a better mix of ex ante incentives than either one of *RL* or *RP*. Similarly, when we are trying to decide between *RL* and no entitlement to Resort, we might want to consider also a partial liability rule under which Resort would receive in the event that Factory pollutes only, say, 50% of its actual damages.

To be sure, much work still remains before we can identify and analyze the effects of such “intermediate” rules and determine the circumstances under which they would be worthwhile. Once we recognize the influence of ex ante investments, however, we should also recognize the value of exploring such an expansion of the menu from which legal rules are selected.

D. *Taxes and Fines*

The preceding analysis has shown that none of the considered alternative rules can attain the “first-best” outcome — that is, induce efficient levels for all ex ante investments. Each rule produces some efficiency costs, with at least one of the parties not having ex ante optimal incentives.⁴⁷ Indeed, the logic of the analysis suggests that no ex post allocation of entitlements — that is, no method for dividing the total ex post value between the two parties — could fully eliminate all ex ante inefficiencies. There appears to be no way to divide the ex post value between the parties in such a way that *both* parties will at the same time capture fully and exactly the social benefits that increases in their ex ante investments generate.⁴⁸

In theory, however, under some conditions, we could provide optimal ex ante incentives to both parties through the imposition of government fines. Suppose that, without needing Resort’s help, the government could ex post observe both whether Factory operates and

47. See Table 7, *supra*, for a summary of the effects of the four rules on ex ante investments.

48. Problems of this type should be familiar to students of law and economics from other contexts. For an excellent discussion, see Cooter, *supra* note 27. Although Cooter recognizes that this problem arises in a number of contexts, he does not notice that, in the presence of ex ante investments, it also arises in the context studied in this Article. Indeed, Cooter affirmatively suggests that such a problem does not arise in the context of nuisance disputes when courts use injunctive relief, i.e., property-right protection. *See id.* at 27-28.

what level of damages Resort suffers from Factory's pollution. And consider a Government-Fine rule under which, if Factory operates, it must pay *the government* a fine equal to the social cost of Factory's activity, which is the damages from pollution to Resort. These damages, recall, will equal H when V_R exceeds H , but will equal V_R when H exceeds V_R and Resort therefore can minimize its damages by shutting down.

Under such a Government-Fine rule, each party will internalize all of the effects of its *ex ante* investments. As a consequence, *ex ante* both parties will make socially optimal investments both in enhancing the value of their own respective activities and in reducing potential harm. Essentially, the Government-Fine rule combines the efficiency advantages of both the *RL* and the *FL* rule with respect to the investments of both parties.

To start, the Government-Fine rule leaves Factory in the position of the "residual claimant" on its value-enhancing investment. Factory will thus capture fully the marginal social benefits from such investment. Furthermore, because the Government-Fine rule requires Factory to pay in the event that it pollutes neither more nor less than the damages caused to Resort from pollution, Factory will invest optimally in harm reduction. Essentially, because Factory would face the same incentives under the Government-Fine rule as under the *RL* rule, Factory will face optimal *ex ante* incentives under the former as it does under the latter.⁴⁹

Furthermore, whereas the *RL* rule would not induce optimal investments on the part of Resort, the Government-Fine rule would. With respect to Resort's investments, the Government-Fine rule would produce the same effects as the *FL* rule. Recall that the *FL* rule leads Resort to make efficient *ex ante* investments because it makes Resort the "residual claimant" on its investments both in harm reduction and value enhancement.⁵⁰

The reason as to why the Government-Fine rule can combine the good effects of both the *RL* and *FL* rules is that, unlike the *RL* and *FL* rules, the Government-Fine rule is not limited to dividing the total *ex post* value between the two parties. Instead, by introducing the government as a third party, the Government-Fine rule makes Factory and Resort each bear the full social cost produced by the externality, which in turn provides both parties with optimal *ex ante* incentives.

49. See *supra* Section IV.B(2)(ii) (discussing Factory's investment in enhancing its value under the *RL* rule); see also *supra* Section IV.D(2)(ii) (discussing Factory's investment in harm reduction under the *RL* rule).

50. See *supra* Section IV.C.(2)(iv) (discussing Resort's investment in enhancing its value under the *FL* rule); see also *supra* Section IV.D(2)(iv) (discussing Resort's investment in harm reduction under the *FL* rule).

Although the law does sometimes use fines or taxes, the Government-Fine rule is far from being generally used. The limited use of fines or taxes might be due to the fact that the assumptions in the above analysis often do not hold. First, a Government-Fine rule might not be triggered whenever Factory pollutes; why would Resort report Factory's pollution when Resort cannot expect any compensation?⁵¹ Furthermore, even if pollution by Factory could be observed by the government, Resort would have no incentive to assist the government in assessing the damages suffered by Resort. Indeed, Resort might agree to help Factory, in return for a side payment, by doing whatever possible to lower the estimate of harm.⁵² These two problems might well place limits on our ability to take advantage of the potential benefits of government fines.

VI. CONCLUSION

One of the basic questions confronting the law is how to allocate entitlements in the presence of externalities. This Article has focused on the effects that such allocations have on ex ante investments and actions. Once we take ex ante effects into account, the ex post allocation of entitlements, and the distributive effects it produces, might well be important even when parties can easily bargain ex post. By identifying the various ex ante effects of alternative rules, this Article has sought to provide a framework for assessing such effects. Such assessment should be an important element in the design of property rights and liability rules.

51. The importance of private reporting often comes up 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).

At first glance, the problem might be solved by providing Resort with a financial reward for accurately reporting the magnitude of harm. As Shavell pointed out, however, when Factory's fine exceeds Resort's financial reward, Factory might induce Resort not to report by offering a side payment intermediate between the fine to Factory and Resort's financial reward for reporting.