

**PROPERTY RULES, LIABILITY RULES, AND PATENTS: ONE
EXPERIMENTAL VIEW OF THE CATHEDRAL**

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ABSTRACT

In their seminal 1972 article, "Property Rules, Liability Rules, and Inalienability: One View of the Cathedral," Guido Calabresi and A. Douglas Melamed proposed an analytic framework for comparing entitlements protected by property rules and liability rules. Their article has become one of the cornerstones of modern legal scholarship, and the influence of the theory of legal rules they established has extended far beyond tort and property into almost every area of the law, including intellectual property. Despite the prodigious influence this theory of legal rules has had, its implications have never been explored experimentally. To remedy this knowledge gap, we conducted a series of controlled experiments on liability and property rules, using the patent system as an experimental model. Expressed in the nomenclature of Calabresi and Melamed, the United States' patent law has recently witnessed a shift away from property rules and towards liability rules. This Article presents an experimental study that attempts to test the hypothesis that amounts of innovation, productivity, and social utility vary across patent systems that tend to emphasize either property rules or liability rules. The results of our experiments suggest that the choice between property and liability rules does, indeed, matter, but in a surprising way. Despite the common assumption that property rules tend to outperform liability rules, we found the opposite: in a computational model of the patent system, liability rules outperformed property rules in generating innovation, productivity, and social utility.

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INTRODUCTION

In *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, Guido Calabresi and A. Douglas Melamed proposed an analytic framework for comparing entitlements¹ protected by property rules and liability rules.² Their article is one of the cornerstones of modern legal scholarship,³ and the influence of their theory of legal rules has extended far beyond tort and property into almost every area of the law, including intellectual property.⁴ Although Calabresi and Melamed's theory has had a prodigious influence on legal scholarship, its implications have never been explored experimentally. To remedy this knowledge gap, we conducted a series of controlled experiments on liability and property rules, using the patent system as an experimental model. Expressed in the nomenclature of Calabresi and Melamed, U.S. patent law has recently shifted away from property rules and towards liability rules.⁵ This Article presents an experimental study that attempts to test the hypothesis that amounts of innovation, productivity, and social utility vary across patent systems that emphasize either property rules or liability rules. The results of our experiments suggest that the choice between property and liability rules matters, but in a surprising way.

¹ Calabresi and Melamed consider the concept of "entitlement" foundational to the law, and offer the following explication and illustration:

The first issue which must be faced by any legal system is one we call the problem of "entitlement." Whenever a state is presented with the conflicting interests of two or more people, or two or more groups of people, it must decide which side to favor. Absent such a decision, access to goods, services, and life itself will be decided on the basis of "might makes right"—whoever is stronger or shrewder will win. Hence the fundamental thing that law does is to decide which of the conflicting parties will be entitled to prevail. The entitlement to make noise versus the entitlement to have silence, the entitlement to pollute versus the entitlement to breathe clean air, the entitlement to have children versus the entitlement to forbid them—these are the first order of legal decisions."

Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089, 1090 (1972) [hereinafter *One View of the Cathedral*].

² *Id.* As the title suggests, Calabresi and Melamed also address inalienability rules. Our article focuses on property rules and liability rules, leaving inalienability rules for a later study.

³ *One View of the Cathedral* has been cited more than 2600 times in scholarly articles and books (Google Scholar, last visited July 25, 2011).

⁴ See, e.g., Dan L. Burk, *Property Rules, Liability Rules, and Molecular Futures: Bargaining in the Shadow of the Cathedral*, in GENE PATENTS AND CLEARING MODELS: FROM CONCEPTS TO CASES (Geertrui van Overwalle ed., 2009).

⁵ *eBay, Inc. v. MercExchange, L.L.C.*, 547 U.S. 388, 394 (2006).

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Despite the common assumption that property rules tend to outperform liability rules,⁶ we found the opposite: in our computational model of the patent system, liability rules outperformed property rules in generating innovation, productivity, and social utility.

Until 2006, a patent owner that prevailed in an infringement suit was effectively entitled to a permanent injunction as a matter of right.⁷ In *MercExchange v. eBay*, the Federal Circuit noted the “general rule that courts will issue permanent injunctions against patent infringement absent exceptional circumstances.”⁸ The “general rule” cited by the Federal Circuit was a property rule: namely, a patent owner may obtain injunctive relief upon a finding of infringement of its valid and enforceable patent.⁹

In *eBay v. MercExchange*, the Supreme Court overturned the Federal Circuit’s “general rule,” asserting:

[T]he Court of Appeals erred in its categorical grant of [injunctive] relief. . . . [T]he decision whether to grant or deny injunctive relief rests within the equitable discretion of the district court, and . . . such discretion must be exercised consistent with traditional principles of equity, in patent disputes no less than in other cases governed by such standards.¹⁰

Depending on how lower courts apply the decision in *eBay*, the Supreme Court’s reversal of the “general rule” in favor of injunctive relief may potentially shift protection of the entitlement accorded the owner of an infringed patent away from a property rule and towards a liability rule.¹¹ Empirical data derived from patent cases decided since *eBay* suggest that patent owners who prevail on the issue of infringement have been granted injunctive relief approximately seventy-two percent of the time.¹² This figure may represent a

⁶ Richard A. Epstein, *A Clear View of the Cathedral: The Dominance of Property Rules*, 106 YALE L. J. 2091, 2091 (1997).

⁷ See, e.g., Herbert F. Schwartz, *Injunctive Relief in Patent Cases*, 50 ALBANY L. REV. 565, 571 (1986).

⁸ 401 F.3d 1323, 1339 (2005).

⁹ Unless otherwise stated, further discussion of findings of infringement will assume that the patents successfully asserted have not been found either invalid or unenforceable.

¹⁰ 547 U.S. 388, 394 (2006).

¹¹ Since an owner of an infringed patent is statutorily entitled to seek, and often simultaneously receive, both monetary damages (35 U.S.C. §284 (2006)) and injunctive relief (35 U.S.C. §283 (2006)), any such shift will be one of emphasis rather than of kind.

¹² See Ernest Grumbles, III et al., *The Three Year Anniversary of eBay v. MercExchange: A Statistical Analysis of Permanent Injunctions*, 16 INTELL. PROP. TODAY 25, 25-29 (2009).

substantial decline in the probability of injunctive relief upon a finding of infringement from the near certainty of such relief under the pre-*Ebay* regime. It may also indicate a shift towards a liability rule for relief in cases of infringement.

A novel approach to investigating the differential effects of property and liability rules in patent law is to conduct simulation experiments. From the 1950s onward, Vernon Smith and others gradually established experimental economics as a method for studying economic phenomena.¹³ Analogous experimental methods provide a framework for studying and analyzing legal problems.¹⁴ And one of the most powerful experimental methods for legal inquiry involves interactive, computer-based simulations.

“The Patent Game” is an interactive computer-based model that attempts to simulate patent systems.¹⁵ It allows multiple users to create, patent, dedicate as open source¹⁶, make, and sell inventions, and to assign, buy, license-in, license-out, and litigate patents.¹⁷ Among its features, the Patent Game can offer as remedies for infringement to a patent owner injunctive relief, monetary damages,¹⁸ both, or neither. In this study, groups of human subjects “played” four different patent systems designed to probe the influence of liability rules (damages) and property rules (injunctive relief) on amounts of innovation, productivity, and social utility generated by inventors. Four experimental treatments were tested in our study, differing only in the available remedies for infringement. These remedy treatments were as follows:

- (1) Availability of both damages and permanent injunctive relief;
- (2) Availability of permanent injunctive relief, but no damages;

¹³ See, e.g., Vernon L. Smith, *Experimental Economics: Induced Value Theory*, 66 AM. ECON. REV. 274, 274-79 (1976); Vernon L. Smith, *Microeconomic Systems as an Experimental Science*, 72 AM. ECON. REV. 923, 923-55 (1982).

¹⁴ See, e.g., Andrew W. Torrance & Bill Tomlinson, *Patents and the Regress of Useful Arts*, 10 COLUM. SCI. & TECH. L. REV. 130, 142-58 (2009).

¹⁵ The Patent Game uses an SQL database to record all user actions, allowing detailed analysis of all actions that occur in individual trials.

¹⁶ Open source is usually associated with copyright (or “copyleft”). However, our experimental system is capable of allowing patent owners to dedicate their patent rights in an invention to the commons. We discuss this hypothetical “patent open source” procedure, and the results of its application in human experiments, in an earlier article. Torrance & Tomlinson, *supra* note 14.

¹⁷ See *id.*

¹⁸ Upon a successful adjudication of infringement, a patent owner may receive up to treble damages from the defendant.

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- (3) Availability of damages, but no permanent injunctive relief;
- (4) Availability of neither damages nor permanent injunctive relief.

Experimental data from our human trials show that amounts of innovation, productivity, and social utility generated by inventors can vary across simulated patent systems that differentially emphasize either property rules or liability rules (Graphs 1-3). Our data also show that some of the differences in innovation, productivity, and social utility across remedy treatments can be statistically significant (Table 1). Amounts of innovation, productivity, and social utility were lowest in patent systems where remedies for infringement included both injunction and damages, higher where the remedy was injunctive relief only, higher still where the remedy was damages only, and highest in a patent system where no remedy for infringement was available.

Part I of this article reviews Calabresi and Melamed's theoretical framework for comparing property rules and liability rules. Part II outlines the experimental methods used in this study. Part III presents and analyzes the data generated in this study. Part IV relates the experimental results to Calabresi and Melamed's theoretical framework. Finally, we conclude by discussing possible sources of error and future research directions.

I. PROPERTY RULES, LIABILITY RULES, AND INTELLECTUAL PROPERTY

A. The Cathedral

In *One View of the Cathedral*, Calabresi and Melamed considered the roles of property rules, liability rules and inalienability rules in deciding conflicts between conflicting entitlements.¹⁹ Among other contributions, they established a theoretical framework that has proved useful for predicting and explaining how property and liability rules influence behavior in legal actors.²⁰ *One View of the Cathedral* has been enormously influential,²¹ and others have extended this framework beyond tort and property law, into areas such as intellectual property law.²²

¹⁹ Calabresi & Melamed, *supra* note 1, at 1090.

²⁰ We do not address inalienability rules further because they are largely irrelevant to patent law.

²¹ Epstein, *supra* note 6.

²² See, e.g., Burk, *supra* note 4.

Under a property rule, an owner can retain an entitlement until she voluntarily sells it.²³ As expressed by Calabresi and Melamed “An entitlement is protected by a property rule to the extent that someone who wishes to remove the entitlement from its holder must buy it from him in a voluntary transaction in which the value of the entitlement is agreed upon by the seller.”²⁴ The owner has exclusive power to determine the value of the entitlement, and can refuse any offer proffered by an interested buyer. In other words, the transfer value of the entitlement is left entirely to the owner. Nevertheless, a collective decision must be made by some third-party authority to determine who receives the initial entitlement.

Liability rules operate somewhat differently from property rules. Calabresi and Melamed defined liability rules in the following way:

[A] liability rule denies the holder of the asset the power to exclude others or, indeed, to keep the asset for himself. Rather, under the standard definition he is helpless to resist the efforts by some other individual to take that thing upon payment of its fair value, as objectively determined by some neutral party.²⁵

Under a liability rule, some neutral third-party authority other than the owner objectively determines the value of the asset in controversy. In fact, the owner does not set the transfer value of the asset and cannot resist having the asset taken away, if the offer matches the objectively determined value of the entitlement.²⁶ Under a liability rule, the owner of an entitlement is legally powerless to keep it exclusively for herself. In sum, if an interested buyer takes the entitlement against the wishes of the owner, the owner must accept compensation at the objectively determined value.

Calabresi and Melamed suggest that three criteria, “economic efficiency, distributional preferences, and other justice considerations,” may be used to decide the ownership of entitlements.²⁷ Economic efficiency is achieved if society benefits optimally from the scarce resources available to it.²⁸ Society may have distributional preferences whose satisfaction requires reallocation of economic prosperity from those with more resources to those with fewer resources.²⁹ Calabresi and Melamed group other

²³ Calabresi & Melamed, *supra* note 2, at 1092.

²⁴ *Id.*

²⁵ Epstein, *supra* note 6, at 2091.

²⁶ *Id.*

²⁷ *Id.* at 1093.

²⁸ N. GREGORY MANKIW, PRINCIPLES OF ECONOMICS 850 (5th Ed.) (2009).

²⁹ *Id.* at 5

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criteria for deciding the allocation of entitlements into a residual category they name “other justice considerations.”³⁰ While they admit that “it is hard to know what content can be poured into that term,”³¹ they suggest that this residual category can be useful for describing criteria not wholly explicable in terms of either economic efficiency or broad distributional preferences, or both.³² These three decision criteria may vary in weight depending on societal preferences.³³

After assigning initial entitlements, society must determine which rules should apply to protect the entitlements: liability rules or property rules.³⁴ Calabresi and Melamed suggest that efficiency may play an important role in the initial allocation of rights.³⁵ If transaction costs are too high, then liability rules will be more efficient than property rules. Namely, liability rules may better protect entitlements when the market valuation of those entitlements is either unavailable or too expensive to determine.³⁶ Under such conditions, property rules tend to fail. Calabresi and Melamed illustrate this contrast by considering which rules society should apply to auto accidents. They suggest that liability rules will tend to be applied to auto accidents because negotiations between victims and perpetrators of such accidents tend to be infeasible or too costly to transact.³⁷ One poignant example they use to illustrate the difficulties surrounding such negotiations involves losses of human limbs in accidents, and the subsequent need to calculate the economic values associated with these catastrophic losses.³⁸ One important role society plays is to make sound decisions about whether to apply property rules, liability rules, or both, across the spectrum of potential legal disputes. Property rules might be assumed to outperform liability rules when a small number of parties are involved in a dispute, and the cost of identifying these parties is low.³⁹ Thus, property rules might be favored over liability rules for disputes in which transaction costs are low. Conversely, when transaction costs are high, liability rules might be favored over property rules.⁴⁰

³⁰ Calabresi & Melamed, *supra* note 1 at 1102-05.

³¹ *Id.* at 1102.

³² *Id.* at 1105.

³³ *Id.* at 1093-1105.

³⁴ *Id.* at 1105. As noted above, though other rules may be possible, such as an “inalienability” rule, our study explores only rules directly relevant to current patent law, namely liability and property rules.

³⁵ *Id.* at 1093.

³⁶ *Id.* at 1110.

³⁷ *Id.* at 1127.

³⁸ *Id.* at 1108-09.

³⁹ Abraham Bell & Gideon Parchomovsky, *Liability Rules*, 101 MICH. L. REV. 1, 15 (2002).

⁴⁰ James E. Krier & Stewart J. Schwab, *Property Rules and Liability Rules: The Cathedral in Another Light*, 70 N.Y.U. L. REV. 440, 451 (1995).

Testing the validity of these assumptions could assist society in making sound choices of legal rules.

Calabresi and Melamed proposed four general legal decision rules derived from an example involving the law of pollution and nuisance.⁴¹ The first (“Rule 1”) is a property rule, protecting the entitlement by excluding others from polluting (that is, nuisance with injunctions). The second (“Rule 2”) is a liability rule, protecting the entitlement by allowing others to pollute providing they pay damages (that is, nuisance with damages). The third rule (“Rule 3”) is a property rule that allocates the entitlement to the polluter, thus conferring a right to pollute (that is, no nuisance but damages). The fourth (“Rule 4”) is a liability rule that protects the entitlement of the polluter’s right to be paid to not pollute. By analogy, Rules 1-4 can be applied to situations involving patent owners and patent infringers.

B. Property Rules, Liability Rules, and Patents

Calabresi and Melamed’s framework may also be applied to intellectual property, and to patents in particular. Patent infringement litigation often involves remedies derived from property rules, in the form of injunctive relief, and liability rules, in the form of damages.⁴² Professor Rinehart uses the following example to illustrate the competing rules in the context of a patent infringement lawsuit.⁴³ According to Rinehart, if a company decides to incorporate into a product features claimed in multiple patents, then the transaction cost of obtaining permission from all of the owners of these patents may be prohibitively high. Under a property rule regime, the company may not be able to proceed with its product unless it obtains legal permissions from all patent owners. By contrast, a liability rule regime will allow the company to make and sell the product, even if so doing infringes the patents, as long as it later pays damages to the patent holders. If the company values the making and selling of its product more than the cost of damages, and patent holders who refuse to sell licenses to the company are compensated by monetary damages, then an efficient outcome is possible.

Calabresi and Melamed’s four rules may be mapped onto the phenomenon of patent infringement.⁴⁴ For example, Rule 1 (a property rule) would confer upon patent owners the legal right to prevent others from practicing their patented inventions. It would be efficient for courts to apply this rule if the “alleged infringer could

⁴¹ Calabresi & Melamed, *supra* note 1, at 1115-18.

⁴² Amelia Smith Rinehart, *Contracting Patents: A Modern Patent Exhaustion Doctrine*, 23 HARV. J. L. & TECH. 483, 503 (2010).

⁴³ *Id.* at 507.

⁴⁴ *Id.* at 506.

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avoid the cost of infringement more cheaply than the patent owner.”⁴⁵ By contrast, Rule 3 (a property rule) would provide infringers with the right to practice inventions covered by patents owned by others. It would be efficient for courts to apply this rule when the patent owner could avoid the cost of infringement more cheaply than the infringer. Rule 2 (a liability rule) would confer upon patent owners the legal right to collect monetary damages from patent infringers. Rule 4 (a liability rule) would confer upon patent infringers the legal right to collect monetary damages from patent owners in return for not infringing patents.

Applications of these rules to patent law have often focused on one particular stick in the bundle of property rights held by the patent owner: the “right to exclude” others.⁴⁶ Crane suggests that the decision about which of Calabresi and Melamed’s rules to apply should depend on the totality of the sticks in the bundle of property rights.⁴⁷ Also valuable may be a right to bundle multiple forms of intellectual property, such as patent and copyright, together in a single license.⁴⁸ Adjudicators may be reluctant to enforce a strong right to exclude if a patent undergirding that right is licensed alongside alternative forms of intellectual property.⁴⁹ In fact, the strength of the “right to exclude others from making, using, offering for sale, or selling the invention”⁵⁰ may help to determine whether a property rule or liability rule is preferable. For example, a strong right to exclude others may militate against allowing a right to bundle, and vice versa. In addition, underlying decisions about whether patent rights ought to be enforced as property or liability rules is the fundamental question of whether patent rights confer enough incentives to “induce the inventive or creative activity at the lowest social cost possible.”⁵¹ Perhaps in response to worries that property rules confer too much power upon intellectual property owners, there has been a recent shift in intellectual property rights away from property rules and towards liability rules.⁵²

Crane cites the U.S. Supreme Court decision in *eBay v. MercExchange*⁵³ as an illustration of the courts’ choice between property rules and liability rules and increasing reliance on the

⁴⁵ *Id.*

⁴⁶ Daniel A. Crane, *Intellectual Liability*, 88 TEX. L. REV. 253, 255-56 (2009). The “right to exclude others” is conferred upon patent owners by 35 U.S.C. § 154(a)(1) (2006).

⁴⁷ *Id.* at 256.

⁴⁸ *Id.* at 255-56.

⁴⁹ *Id.*

⁵⁰ 35 U.S.C. § 154(a)(1) (2006).

⁵¹ Crane, *supra* note 46, at 299.

⁵² *Id.* at 254.

⁵³ 547 U.S. 388 (2006).

latter.⁵⁴ In this case, the Supreme Court decided that, before granting a permanent injunction against future patent infringement, a court must consider the same four factors as in other areas of the law: irreparable harm, no adequate remedy at law, balance of hardships, and public interest when considering whether to award injunctive relief.⁵⁵ Prior to *eBay v. MercExchange*, a plaintiff, having prevailed at trial, was granted a permanent injunction “absent exceptional circumstances.”⁵⁶ In the aftermath of *eBay v. MercExchange*, the presumption that a plaintiff is entitled to protection via a property rule no longer prevails.⁵⁷ Instead, a patent owner must affirmatively demonstrate to the court that a patent should benefit from property rule protection. Because of *eBay v. MercExchange*, there has been a shift in federal court patent jurisprudence away from property rules and towards liability rules.

C. An Experimental View of the Cathedral

One View of the Cathedral has had a profound and enduring influence on the law. Scholars have expanded on the theoretical framework it established,⁵⁸ and many have been influenced by it.⁵⁹ However, experimental approaches have been neglected as means of testing hypotheses about inventor, patent owner, and patent infringer behavior under property rule and liability rule regimes. In taking an experimental approach to Calabresi and Melamed, this article departs from the existing literature. Specifically, it reports the findings from a series of experiments that employed human subjects to explore how property rules and liability rules may influence the patent system and innovation. In this study, human subjects played a simulation game of the U.S. patent system in which the strength of property rules (represented by injunctive relief) and liability rules (represented by damages) were varied. For each scenario, the outputs—amounts of innovation, productivity, and social utility—were measured. The four sets of experimental conditions compared in this article are (1) strong injunctive relief, (2) strong damages, (3) both strong injunctive relief and strong damages, and (4) neither injunctive relief nor damages. Our experimental simulation approach to addressing behavior within patent systems allows the testing of specific hypotheses and the generation of large amounts of data. These results probe conventional

⁵⁴ Crane, *supra* note 46, at 263-264.

⁵⁵ 547 U.S. 388 (2006).

⁵⁶ 401 F.3d 1323, 1339 (2005).

⁵⁷ Crane *supra* note 46, at 264-65.

⁵⁸ See *id.* See also Burk, *supra* note 4.

⁵⁹ *One View of the Cathedral* has been cited more than 2600 times in scholarly articles and books (Google Scholar, last visited July 25, 2011).

assumptions about how, and how well, patent systems function to deliver innovation, productivity, and social utility to society.

II. METHODS

A. *Technological Methods*

The technological system underlying the experiments described here builds on a system that has been presented in detail elsewhere.⁶⁰ This section provides a brief summary of the system as a whole, and then provides detail on the aspects of the system that are different from those reported previously.

1. *Summary of the Patent Game*

The Patent Game is an online interactive system through which an arbitrary number of players may engage in simulated business interactions. The system is built using Ruby on Rails[®], a computational platform for creating database-backed web services. The system includes a set of web pages that serve as the interface to a computational engine that processes data stored in a MySQL database.

Through the web interface, each player has the ability to make virtual products by combining several abstract “components” (here, the characters “A,” “B,” “C,” “D,” and “E”) in an arbitrary order (the process of innovation), receiving some amount of money for each particular combination. For example, a player might make the combination “BCE” and receive \$8 when she sells it. Longer combinations tend to be worth more and to reflect the value of their substrings; if “BCE” is worth \$8, “BCED” could be worth \$8, \$16, \$24, or \$32.

In addition to making combinations for a profit, players are able to patent specific combinations, thereby influencing the behavior of other players. As with the U.S. legal system, a combination may only be patented if there is no disqualifying prior art.⁶¹ The technological implementation tracks all combinations (“BCE”) and sub-combinations (“BC” and “CE”) that have been made, and prohibits patenting of combinations already established. Once a player has patented a combination, she can license or sell that patent to other players, or choose to enforce the patent if someone makes that combination or a combination for which the patented combination is a subset. If a player enforces a patent, both that player (the plaintiff) and the defendant then choose how many lawyers to assign to the case (at some specified cost for lawyers). The outcome

⁶⁰ Torrance & Tomlinson, *supra* note 14, at 130-68.

⁶¹ See 35 U.S.C. §§ 102-103 (2006).

of the case is then determined algorithmically, and both players are notified of the result.

Underlying the interface is a MySQL database that includes several tables that store data about the games, players, combinations, patents, licenses, and enforcements that occur. In addition, the database stores information on all of the events that have transpired in the game, which allows the experimenters to examine in detail various facets of the interactions in which players engage.

2. *Injunction and Damages*

The version of the Patent Game used in this study possesses additional functionality not present in the two previous studies that employed the system.⁶² Additional features were implemented to enable the experiments described in this paper. Most substantially, these new features enhanced the use of injunctions and monetary damages in patent infringement actions between players. Changes were made to three aspects of the Game: the setup, the enforcement process, and post-enforcement play.

3. *Game Setup*

When setting up a given game, the experimenter has access to a range of controls that affect the parameters under which the game will be played. In addition to the parameters that already existed (e.g., patent cost, lawyer cost, time limit, etc.), several parameters were added or modified for the experiments in this study.

The game setup features two check boxes that allow for the game creator to specify whether the game should have damages (labeled “HaveDamages”) and whether it should have injunctions (labeled “HaveInjunctions”).

A “DefaultVictoryPercentage” value specifies how likely the plaintiff is to prevail in a given enforcement. The default value for this parameter is 50% (meaning that the plaintiff will prevail half the time).

A “LawyerIncrementalVictoryPercentage” value alters the DefaultVictoryPercentage based on how many lawyers the plaintiff and defendant choose to hire during a given enforcement.

A “PercentageOfInjunctiveRelief” value is used to determine how likely a victorious plaintiff is to receive an injunction against the defendant.

⁶² The authors have previously written on both of these studies, and the “Patent Game” system employed therein. See Torrance & Tomlinson, *supra* note 14, at 142-58; Andrew W. Torrance & Bill Tomlinson, *Patent Expertise and the Regress of Useful Arts*, 33 S. ILL. L. REV. 239-77 (2008).

4. *Enforcement*

The parameters specified above affect the game during the enforcement process. Victory for the plaintiff is based on the following equation:

$$\text{PercentageChanceOfPlaintiffVictory} = \text{DefaultVictoryPercentage} + (\text{LawyersForPlaintiff} - \text{LawyersForDefendant}) * \text{LawyerIncrementalVictoryPercentage}$$

If the plaintiff loses the litigation, she receives no damages, and no injunction is put in place. If the plaintiff wins the litigation, she may or may not receive damages and/or an injunction based on the parameters that were set when the game was created. If the HaveDamages check box was checked at game creation, a victorious plaintiff has a 70% chance of receiving single damages (the value of making the exact combination that has been infringed), 20% chance of receiving twice that amount of damages, and 10% chance of receiving treble damages.⁶³ The damages are subtracted from the bank account of the defendant and added to the account of the plaintiff.

If the HaveInjunctions check box was checked at game creation, a victorious plaintiff will have a probability of receiving an injunction based on the PercentageOfInjunctiveRelief value that was specified at game creation. That is, a random number is chosen between 1 and 100, and if it is below the PercentageOfInjunctiveRelief value, an injunction will occur.

After each enforcement attempt, the results are recorded in the database and displayed to both players via a results screen.

5. *Post-Enforcement Play*

In game play that occurs after an enforcement attempt, damages have no further effect beyond the transfer of money. Injunctions, however, prevent an enjoined defendant from making any combinations thereafter that include the enjoined combination. Instead, that player will be notified that she is enjoined and returned to the main game screen, where she may continue with other activities.

⁶³ Personal communication with Michael Zelig, Patent Litigation Attorney, K & L Gates, in Palo Alto, Cal. (Feb. 4, 2010). These frequencies of single, double, and treble damages are rough estimates.

B. Human Experimental Trials

Human trials were conducted largely in the same manner previously reported.⁶⁴ Groups of five human users (“Subjects”) played The Patent Game competitively in games (“Trials”) with defined parameters. Four different sets of conditions (“Treatments”) were used: (1) 100% chance of receiving injunctive relief and 100% chance of receiving damages after patent infringement (“Injunction/Damages”), (2) 100% chance of receiving injunctive relief and 0% chance of receiving damages after patent infringement (“Injunction”), (3) 0% chance of receiving injunctive relief and 100% chance of receiving damages after infringement (“Damages”), and (4) 0% chance of receiving injunctive relief and 0% chances of receiving damages after infringement (“No Remedy”).

Approval was obtained for human subjects research from the University of Kansas Institutional Research Board (“IRB”). Volunteer University of Kansas School of Law 2010 “summer starter” law students comprised the “Subjects”. None had previously studied intellectual property or patent law. All Subjects were paid \$10 per hour for the time they were involved in this study, and modest prizes were awarded for the winners of each Trial.

Before Trials commenced, all Subjects were taught how to use all of the functions available in The Patent Game. Then, all Subjects played six introductory sessions of The Patent Game to ensure familiarity with the experimental system. In response to questions from Subjects regarding the purpose of the research, the following answer was provided: “We are conducting this study to better understand the patent system. The information obtained from this study will help us gain a better understanding of the patent system.”

Twelve Trials were run for each Treatment. During every Trial the following settings were used in The Patent Game:

Time Limit = 30 minutes
Winning Goal = Unlimited
Patent Cost = \$20.00
Patent Expiration Time = Unlimited
Lawyer Cost = \$20.00
Number of Elements = 6 Elements

Each Trial involved five Subjects and lasted exactly 30 minutes. For each Treatment, different groups of Subjects played in each Trial. During each Trial, Subjects were requested not to speak with one another or to make any other avoidable noises or physical gestures. If a Subject spoke or made avoidable noises or gestures, that Subject was immediately reminded to concentrate on playing The Patent Game. Each Subject used a laptop computer wirelessly connected to

⁶⁴ Torrance & Tomlinson, *supra* note 14, at 130-68.

the Internet to play The Patent Game on the www.patentgame.net website. All Subjects were informed ahead of time that the winner of each Trial—the Subject who ended that Trial with the most money—would receive a prize.

III. RESULTS

A. *Data*

1. *Injunction/Damages Treatment*

The mean number of unique inventions created and made was 29.5, with a standard deviation of 8.5. The mean number of total inventions made was 194.5, with a standard deviation of 94.9. The mean amount of social utility generated by each Subject was \$34,233.00, with a standard deviation of \$37,561.50. The mean number of patents obtained was 85.4, with a standard deviation of 20.8.

2. *Injunction Treatment*

The mean number of unique inventions created and made was 36.5, with a standard deviation of 11.6. The mean number of total inventions made was 256.6, with a standard deviation of 91.5. The mean amount of social utility generated by each Subject was \$42,839.30, with a standard deviation of \$59,086.40. The mean number of patents obtained was 78.8, with a standard deviation of 18.3.

3. *Damages Treatment*

The mean number of unique inventions created and made was 45.3, with a standard deviation of 29.6. The mean number of total inventions made was 482.3, with a standard deviation of 117.5. The mean amount of social utility generated by each Subject was \$126,844.80, with a standard deviation of \$132,721.40. The mean number of patents obtained was 57.6, with a standard deviation of 18.1.

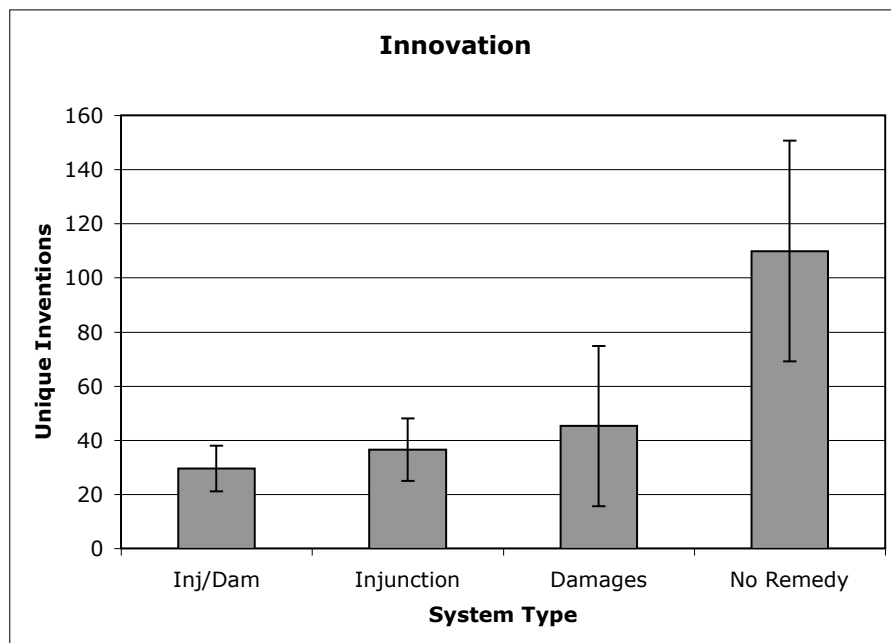
4. *No Remedy Treatment*

The mean number of unique inventions created and made was 109.8, with a standard deviation of 40.8. The mean number of total inventions made was 644.3, with a standard deviation of 132.0. The mean amount of social utility generated by each Subject was \$181,148.80, with a standard deviation of \$129,394.00. The mean number of patents obtained was 8.8, with a standard deviation of 6.6.

5. Innovation

In this study, innovation is estimated from the number of unique combinations made and sold by Subjects (“Innovation”). Graph 1 illustrates the relative amounts of Innovation generated in the Injunction/Damages, Injunction, Damages, and No Remedy Treatments. Innovation is lowest for Injunction/Damages, higher for Injunction, higher still for Damages, and highest for No Remedy. As shown in Table 1, analyses using a Student-t test reveal that the only statistically significant differences at the $p=0.05$ level are between the No Remedy Treatment and each of the other three Treatments.⁶⁵ At the $p=0.10$ level, the Injunction/Damages and Damages Treatments are statistically significantly different. At the $p=0.15$ level, the Injunction/Damages and Injunction Treatments are statistically significantly different.

Graph 1. Innovation



⁶⁵ A two-tailed homoscedastic Student-t test was used throughout the analyses.

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Table 1. Student-t Test Results: Innovation

| | No Remedy | Damages | Injunction | Injunction/Damages |
|------------|---------------------------|----------------------------|-----------------------------|--------------------|
| No Remedy | | 0.0002* | 0.000005* | 0.000001* |
| Damages | | | 0.35 | 0.09** |
| Injunction | | | | 0.11*** |
| p values | *significant at p=0.05 | **significant at p=0.10 | ***significant at p=0.15 | |

6. *Productivity*

In this study, productivity is estimated from total number of combinations made and sold by Subjects (“Productivity”). Graph 2 illustrates the relative amounts of Innovation generated in the Injunction/Damages, Injunction, Damages, and No Remedy Treatments. Productivity is lowest for Injunction/Damages, higher for Injunction, higher still for Damages, and highest for No Remedy. As shown in Table 2, analyses using a Student-t test reveal that all Treatments are statistically significantly different from one another at the p=0.05 level except for the Injunction/Damages and Injunction Treatments. These latter two Treatments are statistically significantly different from one another at the p=0.15 level.

Graph 2. Productivity

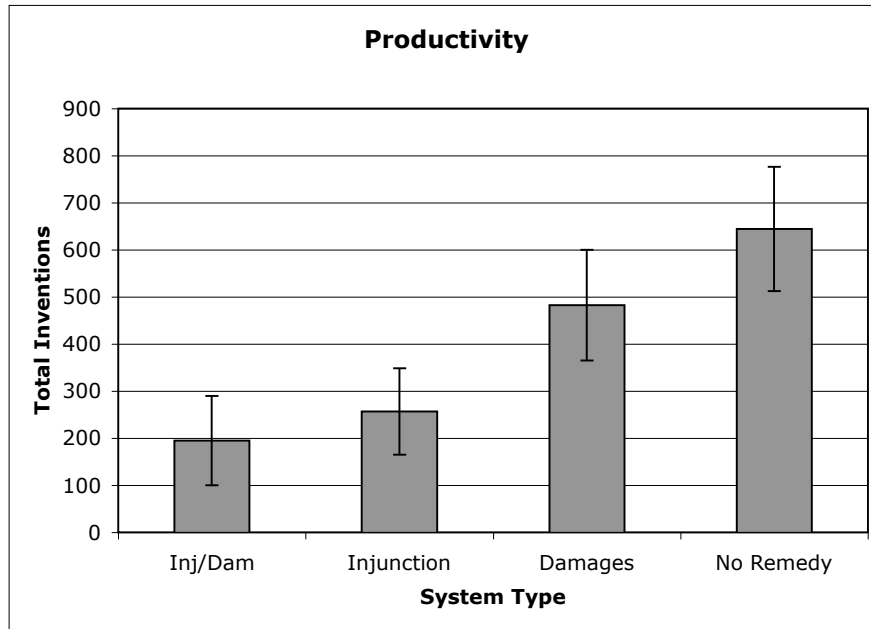


Table 2. Student-t Test Results: Productivity

| | No Remedy | Damages | Injunction | Injunction/Damages |
|------------|-------------------------|-------------------------|--------------------------|--------------------|
| No Remedy | | 0.004* | 0.00000003* | 0.000000003* |
| Damages | | | 0.00003* | 0.000001* |
| Injunction | | | | 0.12*** |
| p values | * significant at p=0.05 | **significant at p=0.10 | ***significant at p=0.15 | |

7. Social Utility

In this study, social utility is estimated from the amount of wealth accumulated by Subjects (“Social Utility”). Graph 3 illustrates the relative amounts of Social Utility generated in the Injunction/Damages, Injunction, Damages, and No Remedy Treatments. Social Utility is lowest for Injunction/Damages, higher for Injunction, higher still for Damages, and highest for No Remedy. As shown in Table 3, analyses using a Student-t test reveal that all Treatments are statistically significantly different from one another at the p=0.05 level except for the Injunction/Damages and Injunction

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Treatments. These latter two Treatments are not statistically significantly different from one another even at the p=0.15 level.

Graph 3. Social Utility

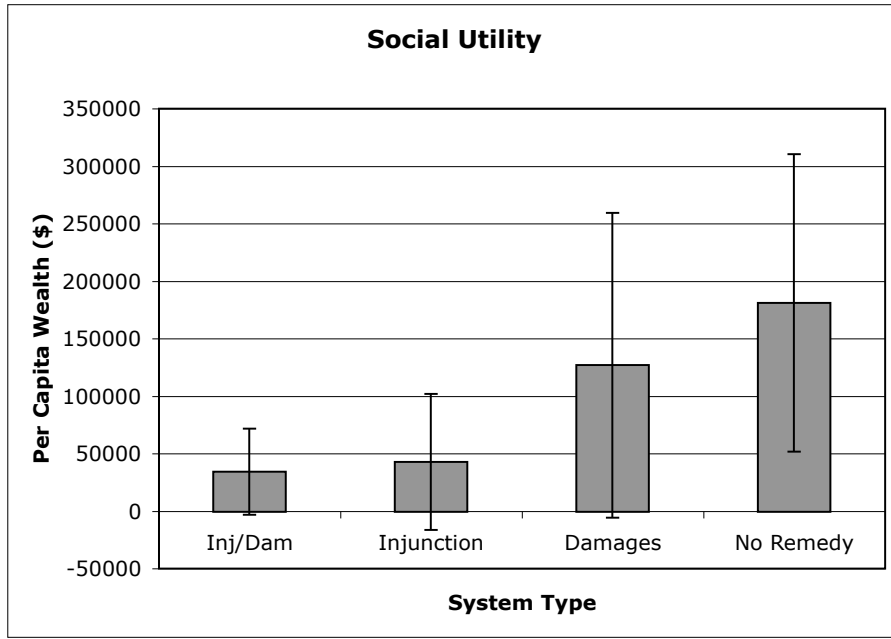


Table 3. Student-t Test Results: Social Utility

| | No Remedy | Damages | Injunction | Injunction/Damages |
|------------|-------------------------|-------------------------|---------------------------|--------------------|
| No Remedy | | 0.02* | 0.00000000001* | 0.0000000000009* |
| Damages | | | 0.00002* | 0.0000008* |
| Injunction | | | | 0.34 |
| p value | * significant at p=0.05 | **significant at p=0.10 | *** significant at p=0.15 | |

IV. ANALYSIS

To promote technological innovation in the United States, the framers of the U.S. Constitution explicitly provided Congress with the power to offer patent protection for new inventions. The intellectual property clause of the Constitution allows Congress “[t]o promote the Progress of Science and useful Arts, by securing for

limited Times to...Inventors the exclusive Right to their...Discoveries.”⁶⁶ Describing the theoretical justifications of offering patent protection for inventions, Lawrence Lessig notes:

The argument favoring patents is as old as the hills. If an inventor can't get a patent, then he will have less incentive to invent. Without a patent, his idea could simply be taken. If his idea could simply be taken, then others could benefit from his invention without the cost. They could, in other words, free-ride off the work of the inventor. If people could so easily free-ride, fewer would be inventors. And if fewer were inventors, then we would have less progress in “science and useful arts” Getting more progress is the constitutional aim of patents.⁶⁷

One important aspect of any patent system is the remedies available to patent owners upon successful adjudication of infringement by others. The U.S. patent system offers two major remedies: monetary damages and injunctive relief. In the current patent regime, a patent owner, having prevailed over an infringer in a patent infringement lawsuit, is almost always awarded monetary damages, and is usually also granted a permanent injunction to prevent future infringement by the defendant. As discussed above, injunctive relief offers patent protection under a property rule, while monetary damages offer patent protection under a liability rule. Recently, in the wake of *eBay v. MercExchange*, the remedies offered by the U.S. patent system may have shifted away from injunctive relief and toward damages, namely, away from awarding remedies under a property rule and towards awarding them under a liability rule. Where patent owners formerly could rely on grants of injunctive relief as a “general rule . . . absent exceptional circumstances,”⁶⁸ permanent injunctions are now granted to prevailing plaintiffs approximately seventy-two percent of the time.⁶⁹

The elegant theoretical framework constructed by Calabresi and Melamed in *One View of the Cathedral* suggests that property rules and liability rules often may lead to different legal and societal outcomes. This may be true for patents as well as other legal entitlements. A patent system emphasizing property rules over liability rules might be expected to perform differently, and to lead those who interact with the system to behave differently, than a patent system that emphasizes liability rules over property rules. Systems

⁶⁶ U.S. CONST. art. I, §8, cl. 8.

⁶⁷ LAWRENCE LESSIG, *THE FUTURE OF IDEAS* 205 (2002).

⁶⁸ 401 F.3d 1323, 1339 (2005).

⁶⁹ See Ernest Grumbles, III et al., *supra* note 12, at 25-29.

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that emphasize property and liability rules equally, or do not emphasize either, might be expected to perform differently still.

Advocates of strong property rights tend to favor property rules over liability rules. Richard Epstein has argued emphatically in favor of property rules, noting:

[t]he choice between property rules and liability rules should normally be resolved in favor of the former to preserve the stability of possession and social expectations that are necessary for the growth of any complex social order. The exceptions to that rule come in cases of necessity which could arise in momentary crises (private necessity) or in large-scale social arrangements (common carriers).⁷⁰

Although Epstein is referring to traditional forms of property as opposed to intellectual property, similar arguments have been advanced in favor of strong property rules for patent rights.⁷¹ Yet there is little evidence to support the proposition that strong property rules associated with patents would lead to desirable societal outcomes, such as higher rates of technological innovation, greater productivity, and more social utility.

Our experimental results do not support the hypothesis that property rules outperform liability rules along the dimensions that indicate a well-functioning patent system. In fact, all three of the variables measured in this study—Innovation, Productivity, and Social Utility—were lowest when property rules were strongest (Injunction/Damages and Injunction Treatments) and higher when property rules were weakest (Damages and No Remedy).⁷² It is possible, though unlikely, that an explanation for these results might be that The Patent Game somehow replicates the conditions of either “momentary crises” or “large-scale social arrangements.”⁷³ An alternative explanation is that liability rules outperform property rules, not just in the simulated conditions of The Patent Game, but in the real world. If so, the Supreme Court’s decision in *eBay v. MercExchange* may accelerate rates of technological innovation, commercial activity, and the generation of societal wealth, both material and informational.

⁷⁰ Epstein, *supra* note 6, at 2120.

⁷¹ See, e.g., Richard A. Epstein, *The Property Rights Movement and Intellectual Property: A Response to Peter Menell*, REG., Winter 2008, at 62.

⁷² It should also be noted that the highest values achieved by all three variables occurred under the No Remedy treatment. This is consistent with the experimental results we reported in a previous article. Torrance & Tomlinson, *supra* note 14, at 130-68.

⁷³ Epstein, *supra* note 6, at 2120.

Over the last two decades, an increasing chorus of scholars has questioned the traditional assumption that patents promote technological progress. Advocates of more “open” models of innovation even have suggested that patent rights may harm innovation. Citing empirical data, Eric von Hippel argues that patents possess “little value to innovators in most fields.”⁷⁴ More recent empirical evidence suggests that software firms reduce investments into the research and development of new innovations as they increase investments to acquire patents.⁷⁵ James Bessen and Michael Meurer have pointed out that, under certain circumstances, imitation may be “necessarily detrimental to innovation as in the canonical reward theory model . . . [and] competition might actually increase innovation.”⁷⁶ In fact, Bessen and Meurer have observed that “our evidence implies that patents place a drag on innovation. Without this drag, the rate of innovation and technological progress might have been even greater, perhaps much greater.”⁷⁷

There is an intermediate range of possible patent systems between the extremes of ironclad patent rights and open innovation. This study explores some of this terrain through experimental testing under conditions of robust property rules, robust liability rules, robust property and liability rules operating together, and neither rule. The results of this study suggest that greater amounts of innovation, productivity, and social utility may occur under conditions without strong property rules.

CONCLUSION

The results of a computer simulation used to conduct economic experiments should be interpreted with care. The experimental approach used in this study is replete with possible sources of error. A simplified computer model of the patent system may not adequately reflect crucial aspects of that system. There may be sensitivities in the model that preclude the generation of meaningful results. The specific parameters chosen for the experiments may lead to inaccurate outcomes. And the Subjects selected for the Trials may be inappropriate reflections of real world economic actors who interact with the patent system. Future experiments that vary experimental conditions and draw from other pools of potential players will help reveal the robustness and vulnerabilities of The Patent Game and the experimental approaches employed in this study.

⁷⁴ ERIC VON HIPPEL, *THE SOURCES OF INNOVATION* 48-51 (1988).

⁷⁵ James Bessen & R.M. Hunt, *An Empirical Look at Software Patents*, 2 (Fed. Reserve Bank of Philadelphia, Working Paper, 2004).

⁷⁶ JAMES BESSEN & MICHAEL J. MEURER, *PATENT FAILURE* 89 (2008).

⁷⁷ *Id.* at 146.

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With these caveats in mind, this study nevertheless offers a new perspective on the performance of property and liability rules in a specific legal setting—the patent system. The results of this experimental approach suggest that innovation, productivity, and social utility may all be relatively higher under liability rule regimes than in property rule regimes. Further experimentation is necessary to explore the effects of alternative sets of parameters. Nevertheless, this study represents a direct challenge to commonly held notions regarding the relative merits of property rules and liability rules. If confirmed, this challenge to legal orthodoxy suggests that society should consider the possible advantages of shifting its reliance towards liability rules, and away from property rules, in the realm of patent law.