All-or-Nothing, or Something – Proportional Liability in Private Law

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Judges and juries often make factual decisions even if the facts are disputed and there is no clear-cut evidence available. Despite this common state of uncertainty, verdicts are thought of as having clear winners and losers—either the plaintiff wins and receives a full remedy, or the defendant wins and the plaintiff gets nothing. In private disputes, factfinders base their binary factual determinations on the preponderance of the evidence. There are, however, several doctrines that allow for partial remedy, discounted by the probability that the facts support the plaintiff's case, given the available evidence (proportional liability). This Article offers a general theory for proportional liability in private law. It identifies three types of factual uncertainty—mutual uncertainty, unilateral uncertainty, and institutional uncertainty—and shows that legal economists should support proportional liability when the state of uncertainty is shared by the parties and the court (mutual uncertainty), and they should adopt an all-or-nothing rule whenever the information is observable but unverifiable (institutional uncertainty). In cases where one party holds private information (unilateral uncertainty), proportional liability is sometimes, but not always, superior to an all-or-nothing rule.

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Introduction

Factual uncertainty is a frequent problem in legal disputes. Whenever the parties disagree on the facts, the trier of facts, be it a jury or judge, must examine the evidence and infer the facts. Commonly, the evidence provides limited information, making it impossible to determine the relevant facts with certainty. Based on the evidence, then, the factfinder may consider several alternative factual states, each of which can be associated with a different likelihood.

When faced with factual uncertainty, factfinders employ one of two decision rules. According to the first rule, when the factfinder faces contradictory factual claims, it applies a binary "winner takes all" rule, based on some epistemological threshold. In civil litigation, this is the preponderance of the evidence rule, according to which the plaintiff wins if her factual claims are more likely than not, and in probability terms, if there is more than a 50% chance that her account of the facts is correct.[1] According to the second rule, the plaintiff is awarded partial remedy, based on the likelihood that the evidence presented justifies remedial relief.[2] This latter option has been referred to by several names, including proportionate damages,[3] probabilistic recovery,[4] expected value rule,[5] or court-imposed compromise.[6] I will refer to this rule as proportional liability.

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1 *See e.g.*, United states, Court of Appeals (9th circuit), Manual of Model Civil Jury Instructions for the District Courts of the Ninth Circuit § 1.6 (2007).

2 *See* John E. Coons, *Approaches to Court Imposed Compromise – The Uses of Doubt and Reason*, 58 Nw. Univ. L. Rev. 750, 754-64 (1964). Current literature is limited both in the number of articles and in normative justifications. For a thorough survey of the literature, *See generally* Michael Abramowicz, *A Compromise Approach to Compromise Verdicts*, 89 Cal. L. Rev. 231 (2001). Proportional liability can be viewed as a mechanism that smooths an otherwise "bumpy" relationship between epistemic certainty and legal outcome. For an analysis of other cases where the law can be smoothed along other parameters, see Adam J. Kolber, *Smooth and Bumpy Laws*, 102 Cal. L. Rev. 655 (2014).

3 Charles Nesson, The Evidence or the Event? On Judicial Proof and the Acceptability of Verdicts, 98 Harv. L. Rev. 1357, 1382-385 (1985);

4 Saul Levmore, Probabilistic Recoveries, Restitution, and Recurring Wrongs, 19 J. Legal Stud. 691, 693 (1990).

5 See David Kaye, The Limits of the Preponderance of the Evidence Standard: Justifiably Naked Statistical Evidence and Multiple Causation, 7 Am. B. Found. Res. J. 487, 507-08 (1982); Neil Orloff & Jery Stedinger, A Framework for Evaluating the Preponderance-of-the-Evidence Standard, 131 U. Pa. L. Rev. 1159 (1983).

6 *See* Coons, *supra* note 2; Abramowicz, *supra* note 2.

By default, common law jurisdictions adhere to the preponderance of the evidence rule in private law disputes. However, some exceptions exist, especially concerning issues of factual causation and estimation of damages in tort law and contract law.[7]

The goal of this Article is to explain which decision rule is preferable, in light of efficiency considerations[8] and from a corrective justice standpoint. The literature on proportional liability is limited. Several articles have analyzed proportional liability with regard to specific legal issues, mainly uncertain causation in tort law.[9] Very few articles have examined the use of proportional liability as an alternative to the preponderance of the evidence rule in all

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7 For example, the Lost Chance doctrine allows the plaintiff to recover her loss, discounted by the probability that the defendant's actions were the cause, in fact, of that harm. The doctrine has been applied in several jurisdictions. For a survey of the state of this doctrine in various jurisdictions, *See generally* Glenn Cooper, *Damages for the Loss of a Chance in Contract and Tort*, 6 Auckland Univ. L. Rev. 39, 39-51 (1988); Thomas Kadner Graziano, *Loss of a Chance in European Private Law – 'All or Nothing' or Partial Liability in Cases of Uncertain Causation,* 16 Eur. Rev. Priv. L. 1009, 1012 (2008); Matthew Wurdeman, *Loss-Of-Chance Doctrine in Washington: From Herskovits to Mohr and the Need for Clarification*, 89 Wash. L. Rev. 603, 603-08 (2014); Yu Xiaowei, *Causal Uncertainty in Chinese Medical Malpractice Law – When Theories Meet Facts*, 9 Tsinghua China L. Rev. 23, 36-47 (2016).

8 The analysis in this Article highlights the connection between substantive and procedural law. For this purpose, law and economics offers a convenient theoretical framework, as the analysis is not focused on the direct (or procedural) costs and benefits of applying either decision rule, but instead on how applying each rule affects the parties' incentives to comply with substantive law. Since the Article assumes that substantive law is optimal, the analysis can be directly applied to any consequentialist goal. I.e., if the lawmaker designs tort law to promote a just redistribution of assets (as opposed to optimal efficiency), factual uncertainty, as analyzed in this Article, will undermine these goals in the same manner as it would optimal efficiency. A complete analysis of the distributive effects of decision rules requires us to look into the *ex-post* distributive in addition to the *ex-ante* effects driven by incentives. This analysis, similar to the analysis of the direct costs and benefits of decision rules, exceeds the scope of this Article, and should be further pursued in future papers.

9 For articles analyzing the use of proportional liability in cases of uncertain causation in tort law from an economic standpoint, see *infra* note 50. For articles analyzing proportional liability using corrective justice theory, see *infra* notes 78-79.

private disputes. Those that did examine proportional liability as a general solution mostly utilized economic analysis and reached different conclusions.[10]

To find a general economic theory for decision rules, this Article divides cases of factual uncertainty into three categories and then examines the desirability of proportional liability in each. The use of decision rules implies that the factfinder does not possess all the necessary information. The parties, however, might possess more information. The categories of factual uncertainty are based on the information available to the parties.

In the first category, the factfinder and the parties share the same state of uncertainty. In these cases of mutual uncertainty, proportional liability creates better incentives than the preponderance of the evidence rule.

The second category includes cases where one party has full information that it cannot reliably share with the other party and the factfinder.[11] In cases of unilateral uncertainty, the analysis shows that uncertainty can cause the party that possesses full information to over-comply or under-comply with the legal rule, depending on the distribution of errors in the assessment of the

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10 For example, John Coons argues that when the factfinder cannot decide which of the sides is more convincing, splitting the remedy between them would lead to optimal results. *See* Coons, *supra* note 2, at 759. Michael Abramowicz discussed several advantages and disadvantages of proportional liability, which led him to the conclusion that the law should apply a limited version of proportional liability, to only a limited region over the epistemic spectrum. *See* Abramowicz, *supra* note 2, at 313-14. Dominique Demougin and Claude Fluet argued in several articles that the preponderance of the evidence rule creates better incentives than proportional liability. *See* Dominique Demougin & Claude Fluet, *Preponderance of Evidence*, 50 Eur. Econ. Rev. 963, 973 (2006); Dominique Demougin & Claude Fluet, *Rules of Proof, Courts, and Incentives*, 39 RAND J. Econ. 20, 22-23 (2008); Claude Fluet, *Liability Rules Under Evidentiary Uncertainty*, 30 Int'l. Rev. L. & Econ. 1, 3 (2010).

11 Full information might be a rarity—a driver may not know the speed at which she drove, and still have superior information regarding it than anyone else. The driver must have superior information, since she decides at what speed to drive and observe it directly, while other parties can only observe indirect evidence regarding that speed. I treat such cases as unilateral uncertainty for two reasons: first, the residual uncertainty of the party possessing the superior information does not substantially change the analysis. Furthermore, when such residual uncertainty exists, for example when an actor decides how much to invest and then the actual investment is stochastically drawn from some distribution around the decision parameter, the law cares, or should care, what was the decision, and not care what was the actual investment. In such cases the actual investment is used as evidence for the decision parameter, making the case one of unilateral uncertainty. *See infra* notes 37 and 51.

unknown fact. Proportional liability leads to less compliance,[12] and is therefore superior to the preponderance of the evidence rule if uncertainty causes over-compliance and inferior to it if uncertainty causes under-compliance.

In the last category of cases, both parties share common knowledge of all the facts, but they present differing stories to the factfinder. Since the preponderance of the evidence rule is less sensitive to outliers—extreme factual states with small probabilities—the parties benefit from offering a more convincing account of the facts. On the assumption that it is easier to prove the truth than to prove a fabricated story, the preponderance of the evidence rule leads the parties to tell the truth, and it is therefore superior to proportional liability in this category.

To determine how decision rules effect the parties' incentives, we might need to consider the effects of legal uncertainty, defined as the uncertainty that arises from either having no rule that applies to a particular set of circumstances or having two (or more) rules that can be applied to a particular set of circumstances. This, however, does not pose a serious problem, for two reasons. First, if courts adhere to efficiency considerations, as assumed in the analysis in this Part of the Article, then the normative theory serves as a gap-filling mechanism, informing the parties as to the correct interpretation of the law.[13] Second, the problem is rarer than one might think. Note that factual decisions, and factual uncertainty, are defined broadly in this Article, to include any decision that is affected by circumstances and not a priori normative theory. For example, the due care standard might be viewed as a legal decision, and uncertainty regarding the choice of the due care standard can might be thought of as legal uncertainty. However, if courts define due care as the care level that maximizes social welfare, then any uncertainty about the care level is factual and not legal.[14] For these reasons I assume throughout the Article that the parties face only factual uncertainty.

After reviewing the economic analysis of decision rules, this Article examines which rule conforms to corrective justice theory. Rules of evidence in civil disputes have received limited attention from corrective justice theorists. This Article is part of a larger project in which I examine how normative theories of private law apply to various aspects of civil procedure and evidence law. I would argue that corrective justice should adopt the preponderance of the

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12 That is, the party that possesses superior information complies less than she would have under the preponderance of the evidence rule.

13 The same is true to other normative theories. *See infra* note 16.

14 Richard Craswell and John Calfee's canonical article about uncertain legal standards is, under these definitions, an article about factual uncertainty. And indeed, their results coincide with my analysis. *See infra* note 54 and accompanying text.

evidence rule to resolve all private disputes, even in cases currently governed by proportional liability.

The Article proceeds in four parts: Part I offers an operational definition of factual uncertainty in legal disputes. Following that definition, cases of factual uncertainty are divided into three categories—mutual uncertainty, unilateral uncertainty, and institutional uncertainty—according to the parties' ability to acquire information about disputed facts.

Part II analyzes how the two decision rules—preponderance of the evidence and proportional liability—can be applied to continuous cases, where the disputed fact can take one of numerous possible states. It shows that the relevant statistical counterpart of the preponderance of the evidence rule in the continuous case is the median value of the distribution, while the statistical counterpart of the proportional rule is the weighted mean. This novel analysis of the two decision rules suggests that the median value of distributions should assume a more central role in civil disputes than it currently has.

Part III examines which decision rules create optimal incentives, depending on the type of factual uncertainty. The Part is divided into three sections, each devoted to a different type of uncertainty. Section A analyses the choice of decision rule vis-à-vis cases of mutual uncertainty. It shows that, from an efficiency perspective, proportional liability is always superior to the preponderance of the evidence, in both binary and continuous cases. Section B analyses decision rules in cases of unilateral uncertainty. It shows mixed results, suggesting that under certain circumstances proportional liability creates better incentives, and offers preliminary thoughts about typical areas where it should be applied. Section C deals with cases of institutional uncertainty. It shows that in this type of cases, preponderance of the evidence is superior, as it induces the parties to reduce the span of uncertainty, thus reducing the costs of litigation and increasing the accuracy of factual decisions.

Part IV turns to corrective justice considerations, and how they can be applied to the choice of decision rule. Corrective justice theorists have developed a comprehensive theory of private law, but no such theory of civil procedure. This Part examines how the theoretical framework of corrective justice can guide the choice of adequate decision rule. It shows that corrective justice considerations favor the preponderance of the evidence rule in most factual disputes. It suggests that in continuous cases of factual uncertainty, corrective justice should lead courts to adopt the median factual state instead of the mean, in contrast to current practice.

The Conclusion summarizes the discussion and explains why the analytic framework developed in this Article can shed light on other questions regarding proof in civil disputes.

I. Factual uncertainty

The outcome of adjudication depends on the set of the relevant facts that comprise the specific case and on the legal rule that is applied to these circumstances. Therefore, there are two sources of uncertainty regarding the outcome of a trial—either the facts are disputed, or it is unclear which rule governs the specific set of facts. I refer to the former source of uncertainty as factual uncertainty, to the latter as legal uncertainty.[15]

Legal uncertainty results from either lack of a rule that applies to the particular set of circumstances or the existence of two or more rules.[16] Obviously when there is legal uncertainty it carries influence over the parties' ex-ante incentives. However, as the goal of the Article is to analyze decision rules, which apply only to factual uncertainty, we need to isolate the effects of factual uncertainty from those of legal uncertainty. For that reason, I assume in all the examples throughout the Article that there is no legal uncertainty, which means that each possible factual state is associated with a rightful legal outcome.

For factual uncertainty to exist, factfinders must have only part of the relevant information needed for resolving the dispute.[17] While the source of legal uncertainty resides within the legal system, the source of factual uncertainty is external. Parties can affect the span of factual uncertainty

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15 In Ledcor Construction Ltd v. Northbridge Indemnity Insurance Co, [2016] S.C.R 23, § 33 (Can.), the Supreme Factfinder of Canada offered a similar distinction between questions of law and fact, stating that "[q]uestions of law are 'about what the correct legal test is.' For instance, the content of a particular legal principle of contractual interpretation is a question of law. However, in interpreting contracts, factfinders apply the legal principles of contractual interpretation to determine the parties' objective intentions. Therefore, . . . contractual interpretation is a question of mixed fact and law, which is defined as 'applying a legal standard' (the legal principles of contractual interpretation) 'to a set of facts' (the words of the contract and the factual matrix)" (internal citations omitted).

16 If factfinders operate under the same normative theory, however, then legal uncertainty should not exist—the normative theory would operate as a gap-filling mechanism, allowing the factfinder to reach the same outcome for any set of facts. *See* Charles Fried, Contract as Promise: A Theory of Contractual Obligation 67 (2d ed., 2015). However, if the parties are unaware of the way courts operate this gap-filling mechanism, or if courts might err in applying the legal rule, then the risk of such error might affect the parties' incentives.

17 To be sure, such information might not exist. If the information needed to implement the legal rule does not exist or is not readily available, uncertainty is shared by the court and the parties to the dispute. *See infra*, Section III.B.

by agreeing on specific facts, by choosing how much to invest in evidence collection, or by choosing which evidence to present.

This observation does not imply that the law cannot influence the parties' actions in collecting and presenting evidence. Evidence law and rules of civil procedure are designed to do just that. These rules govern three aspects of the fact-finding process. First, rules of admissibility determine which evidence the parties are allowed to present, preventing them from presenting evidence that might inappropriately skew the factfinder's decision.[18] In addition, rules of proof (i.e., rules of evidence weight and induction) determine how the factfinder should interpret the evidence.[19] Finally, the factfinder makes a factual decision based on decision rules. The goal of this Article is to examine decision rules. Even though the effects of these rules on the parties' investment in the legal process are important, they go beyond the scope of this Article.[20]

The operative definition of factual uncertainty allows us to distinguish between three general types of factual uncertainty in legal disputes, according to the information possessed by the parties about the relevant facts. Note that the types of uncertainty refer to a specific factual dispute. A case in which several factual elements are disputed might present several types of factual

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18 For a discussion on the role of evidence law in preventing the presentation of truth-obscuring evidence, *See generally* Jeremy Bentham, Rationale of Judicial Evidence, Specially Applied to English Practice, From the Manuscript of Jeremy Bentham, Esq. Bencher of Lincoln's INN. 550-51 (1827); M. Dumont, Legal Treaties, 1800-1926: A Treatise on Judicial Evidence: Extracted from the Manuscript of Jeremy Bentham, Esq. 229-31 (1825); Alex Stein, Foundations of Evidence Law 157-67 (2005).

19 John Henry Wigmore, The Science of Judicial Proof: As Given by Logic, Psychology, and General Experience, and Illustrated in Judicial Trials 5 (3d ed., 1937).

20 The choice of decision rules can have surprising effects on the incentives to collect evidence. In cases which are considered clear-cut under the preponderance of the evidence, parties might have negligible marginal incentives to collect evidence, since the additional evidence is not likely to have any influence over the outcome. However, in borderline cases, where the factfinder might rule either way, the marginal benefit of additional evidence might be substantial, so we might expect parties to overinvest in evidence collection. In contrast, under proportional liability, the marginal expected benefit from evidence collection is fixed in all cases, suggesting that the parties will invest more in clear-cut cases and less in borderline cases. For a more nuanced economic analysis of evidence law, see Richard A. Posner, *An Economic Approach to the Law of Evidence*, 51 Stan. L. Rev. 1477 (1999); Alex Stein, *supra* note 18, at 157-67. For a preliminary analysis of the effects of decision rules on evidence collection and other litigation costs, *see* Abramowicz, *supra* note 2, at 287-98.

uncertainty simultaneously. This does not substantially affect the analysis in the Article, since the cumulative effect of uncertainty regarding these elements equals the sum of the effects regarding each factual element individually, allowing us to examine simplified cases and still reach conclusions that can be applied to complex ceases. Furthermore, the law operates in a similar fashion: when considering several disputed factual elements, the factfinder implements one of the decision rules—either the preponderance of the evidence or proportional liability—to each of them separately.

With this in mind, we can now turn to examining the three general types of factual uncertainty, Consider the following examples.

Example 1.1 – contested maternity.[21] Plaintiff argues that Defendant, her identical twin sister, kidnapped her son after Defendant's son had died. Defendant argues that it was the Plaintiff's son who died.[22]

In this example, the factfinder cannot know with certainty who the biological mother of the child is.[23] The parties, however, possess full information regarding the identity of the biological mother. I refer to cases in which only the factfinder does not know all the facts as cases of institutional uncertainty.[24]

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21 Child custody examples are somewhat complicated by the "best interest of the child" standard, under which the identity of the biological parent might not be the most important factor. The examples should therefore only illustrate the three types of factual uncertainty.

22 This example is based on the Judgment of Solomon, taken from 1 *Kings* 3:16-28. The biblical case was also mentioned in case law, see Broca v. Giron, 2013 U.S. Dist. LEXIS 31708, at 36 (E.D.N.Y. 2013); United States v. Davis, 648 F.3d 84, 86 (2d Cir. 2011); In re T.C.M., 651 S.W.2d 525, 532 (Mo. App. 1983).

23 One could argue that no one can ever possess full information regarding any fact. For the purpose of this Article, for institutional uncertainty to exist it is enough for the court to believe that the parties hold the same information about the factual state of the world, and that the parties' beliefs are true with high probability.

24 The Judgment of Solomon, besides being an example of institutional uncertainty, presents several more unique features that have made it an interesting dilemma for economists to examine. For analysis of this example, see Georgy Artemov, *Imminent Nash Implementation as a Solution to King Solomon's Dilemma*, 4 Econ. Bulletin 1, 4-6 (2006); Parimal Kanti Bag & Hamid Sabourian, *Distributing Awards Efficiently: More on King Solomon's Problem*, 53 Games & Econ. Behav. 43, 45-48 (2004); Jacob Glazer & Ching-To Albert Ma, *Efficient Allocation of a 'Prize' – King Solomon's Dilemma*, 1 Games & Econ. Behav. 222, 224-25 (1989); Wojciech Olszewski, *A Simple and General Solution to King Solomon's Problem*, 42 Games & Econ. Behav. 315, 316 (2003); Motty Perry & Philip J. Reny, *A General Solution to King Solomon's Dilemma,* 26 Games & Econ. Behav. 279, 282-85 (1999).

Example 1.2 – negligent caregiver. Plaintiff sues Defendant for wrongful death of her son, arguing that Defendant, a caregiver, breached her duty in caring for the child by leaving him unattended, which behavior caused her child's death. Defendant argues that the child never left her sight.[25]

In this second example, the defendant knows what transpired when she was with the infant.[26] She is the only party that can acquire accurate information. The plaintiff and the factfinder might have only limited information. I refer to cases, where one of the parties possesses private information, as cases of unilateral uncertainty.[27]

Example 1.3 – contested paternity. Twin brothers had intimate relations with the same woman around the same time. The woman became pregnant. Each man claims he is the biological father.[28]

Lastly, in this third example, both potential fathers, as well as the factfinder, do not know who the biological parent is. I refer to this type of cases as mutual uncertainty.

In all of the examples, the factfinder has to decide between two possibilities or two outcomes: either the child of one sister has died, or the child of the other; either the caregiver's actions were negligent, or they were not; either one sibling is the parent or the other. In other cases, factfinders might face more than two alternative factual states, each leading to a different legal outcome. The next Section demonstrates how the two decision rules apply to binary cases as well as to cases with multiple possible factual states.

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25 This example is based on Rider v. Speaker, 692 N.Y.S.2d 920 (Sup. Ct. 1999).

26 There might be some uncertainty about the causal relation between the caregiver's conduct and the infant's harm. Such an additional layer of uncertainty is mutual uncertainty, as it depends on a counterfactual state.

27 Note that in a bilateral accident case, where the two parties can invest in care, and their investments are unobservable and unverifiable, each investment decision is an uncertain factual element, and both can be classified under unilateral uncertainty. These cases would be characterized as such even if the parties cannot, in fact, possess accurate information about their own behavior, since in such cases what the law cares about most deeply is the intended action. Since each party knows full well, or at least can know, how she intended to act, these are always cases of unilateral uncertainty.

28 This example is based on State ex rel. Department of Social Services, Division of Child Support Enforcement v. Miller, 218 S.W.3d 2, § 3 (2007).

II. Decision rules in binary and continuous cases

In order to examine how the preponderance of the evidence rule and proportional liability apply to resolve factual uncertainty, consider the following example.

Example 2 – delayed diagnosis. A physician negligently misdiagnosed a stage-one cancer tumor in a patient's lung. When the tumor was finally diagnosed, the patient had no chance of surviving. Had the physician diagnosed the tumor in time, the patient would have had a 30% chance of surviving.[29]

This example illustrates a paradigmatic binary case of factual uncertainty. There are two alternative factual states—either the physician's negligence was the cause in fact of the patient's death, or rather the patient would have died regardless of the physician's actions. The probability that the former occurred is 30%, the latter 70%.

Each factual state is associated with a rightful legal outcome. If the factfinder knew that the misdiagnosis caused the untimely demise, then the physician would, and should, be held liable. If the factfinder knew that the patient would have passed away at the same time even if she was accurately and promptly diagnosed, then the physician should not be held liable as she was not the cause of any harm suffered by the patient.

The application of the two alternative decision rules to this example is straightforward. Under the preponderance of the evidence rule, the factfinder would rule against the plaintiff, since the probability of the state of facts under which there is no liability is above the 50% threshold. Under proportional liability, the factfinder would award the plaintiff damages for 30% of her harm, in proportion to the probability that the plaintiff is entitled to compensation for the entire harm.

Not all cases of factual uncertainty involve only two possibilities. For example, when the factfinder needs to estimate damages in personal injury cases,[30] it could face multiple possible factual states, from which it has to choose. Consider the following example:

Example 3 – loss of earning capacity. A five-year-old boy was injured in an accident, caused by a negligent driver. The boy suffers from severe and permanent physical harm, which will prevent him from working in the future.

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29 For a case of delayed diagnosis, see Dumas v. Cooney, 1 Cal. Rptr. 2d 584 (1991).

30 In personal injury cases in the U.S., damages are usually determined by the jury. The identity of the factfinder, however, is unimportant, as the jury may be instructed to estimate damages in accordance with the preponderance of the evidence rule or in accordance with the proportional liability rule.

He is entitled to compensation for the loss of earning capacity according to the earnings he would have gained, had he been able to work.

The law regarding the loss of earning capacity of adults is clear—the victim of a tort is entitled to compensation that would put him in the position he would have been but for the accident. Adults, who have had time to learn a profession, receive compensation according to their predicted future income, given their current income and profession.[31] When the victim is a child, substantive law does not change, but the factfinder faces more uncertainty about the future earnings of the child. The possibilities are endless, and every possibility would call for a different legal outcome. Assuming there is no information about the abilities of the specific child, we can look at the distribution of income in the population to derive the potential earning capacity of the child. That is, the factfinder can assume that the child would have earned a specific income with a probability corresponding to the share of the population with the same income (if, for example, 5% of the population earns $50,000 a year, then the child would have had a 5% probability of being part of that group).

Applying the preponderance of the evidence rule to these possibilities seems nonsensical—the chances that the child would receive any particular income are infinitesimal, well below 1%. However, the factfinder can still apply the rule by looking at the cumulative probability. The victim can show that there was more than a 50% chance that he would have earned more than any sum of money that is less than the 50th percentile of the population. Similarly, the injurer can show that there was more than a 50% chance that the victim would have earned less than any sum higher than the 50th percentile of the population. Thus, by applying the preponderance of the evidence rule to continuous states, the factfinder should choose the 50th percentile, also known as the median, as the factual state on which it would base its decision.[32]

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31 Dan B. Dobbs, Law of Remedies: Damages – Equity – Restitution 364 (2d ed., 1993).

32 In an article that Alon Cohen wrote in response to an article by Ariel Porat and Eric Posner, he also noted the connection between the median and the preponderance of the evidence rule. Porat and Posner argued that factfinders should aggregate several factual claims made by the parties. For example, if a plaintiff argues that the defendant acted negligently towards her in two separate instances, and can prove each with 40% probability, then she should be entitled to compensation since there is more than a 50% chance that the defendant's actions caused at least one injury. Posner and Porat offer two alternative ways to calculate damages in this case—the mean or the median. In his response, Cohen shows that only the median is consistent with the preponderance of the evidence rule. *See* Alon Cohen, *Implementing Aggregation in Law: The Median*

Alternatively, by applying proportional liability, the factfinder would award the remedies for each possible state, multiplied by the probability that that state will occur. This calculation leads to the weighted mean. Thus, when there are an almost infinite number of states, as is the situation with all possibilities of future income of the victim, the sum of all states, each multiplied by its corresponding probability, leads to the mean (average) income in the population. When there is no specific information about the child, the factfinder can base the decision on the income distribution in the general population. If there is relevant information available it is possible to tailor a probability density function for the particular victim, given her particular characteristics.[33]

To conclude, factfinders can apply both the preponderances of the evidence rule and proportional liability to cases where the evidence supports several factual states. When applied to non-binary cases, under the preponderance of the evidence rule, the factfinder should choose the median value in the distribution of possible factual states. In those cases, under proportional liability, the factfinder should decide according to the weighted mean.

III. Choosing an efficient decision rule

For legal economists, the choice of decision rule is not apparent. According to economic analysis, the goal of private law is to incentivize private parties to maximize social welfare.[34] Thus, when choosing a decision rule, the law

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Outcome Rule, 122 Yale L.J. Online 359, 366-69, 374-77 (2013); Ariel Porat & Eric A. Posner, *Aggregation and Law*, 122 Yale L.J. 2, 29, 65-67 (2012).

33 For the most part, expert witnesses have been allowed to base their estimation on income tables, taking into account gender, race, or both, as well as other characteristics of the child. For further discussion and criticism, see Ronen Avraham & Kim Yuracko, *Torts and Discrimination*, 78 Ohio ST. L.J 661 (2017); Elizabeth Adjin-Tetiey, *Contemporary Approaches to Compensating Female Tort Victims for Incapacity to Work*, 38 Alberta L. Rev. 504 (2000).

34 *See* Robert Cooter & Thomas Ulen, Law and Economics 7-9 (2016) (arguing that the primary goal of private law should be primarily efficiency, and not distribution or other policy values); Steven Shavell, Foundations of Economic Analysis of Law 593-661 (2004) (arguing that civil law is, and should be, structured to primarily promote welfare maximization, and since moral notions advance social welfare it will often coincide with rules prescribed by moral principles); Louis Kaplow & Steven Shavell, Fairness versus Welfare (2002)

should consider how that choice affects the incentives of private actors.[35] These incentives depend not only on the decision rule, but also on the information the parties can acquire before they make their choices.[36] Therefore, cases of mutual uncertainty, unilateral uncertainty, or institutional uncertainty would differ in their analysis.[37]

Several articles have examined the effect of proportional liability on incentives in specific areas of law, mainly regarding causation in tort law.[38] Only a few articles, however, have examined the use of proportional liability as a general alternative to the preponderance of the evidence rule in all private disputes. Those that did examine proportional liability as a general solution reached different conclusions regarding the desirability of the rule.[39]

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35 This analysis is not unique to the utilitarian theory of private law, which is usually supported by legal economists. Any consequentialist normative theory of private law conceives private law as an instrument to advance some other (moral) goals. As such, any such theory would care about the incentives that the law creates. The argument in this Section is independent of the content of substantive law, and thus is applicable to any theory that cares about incentives that the law creates.

36 Note that the difference between the types of uncertainty is not concerned with the information the parties actually possess, but with their capabilities to acquire the information in the first place. For example, a car driver can know the speed at which she drives her car by looking at the speedometer. This option is not shared by other actors. Thus, the uncertainty about the speed at the time of the accident should be characterized as unilateral uncertainty even is the driver decides to never look at her speedometer. This does not mean that unilateral uncertainty is superior to other forms of uncertainty.

37 Only information available at time of decision making would affect the parties' choice, and that might differ from the information available at the time of the trail. The analysis in the following sections takes into account the possible disparity between the information profiles in the two periods. *See*, *e.g.*, *infra* note 51.

38 *See infra* Section III.A.

39 For example, John Coons argues that when the factfinder cannot decide which of the sides is more convincing, splitting the remedy between them leads to optimal results. *See* Coons, *supra* note 2, at 759. Michael Abramowicz discussed the advantages and disadvantages of proportional liability, reaching the conclusion that the law should adopt a limited version of proportional liability, applicable only to a limited region over the epistemic spectrum. *See* Abramowicz, *supra* note 2, at 313-14. Dominique Demougin and Claude Fluet argued that the preponderance of the evidence rule creates better incentives than proportional liability. *See* Demougin & Fluet, *Preponderance of Evidence*, *supra* note 10, at

This Article differs from current literature in one important aspect: by recognizing three types of factual uncertainty and examining each separately, this Article offers a general analysis regarding the efficiency of the two decision rules. This analysis applies to all cases of factual uncertainty in private law. Previous articles implicitly related to only one type of uncertainty, assuming that all cases qualify under that type.[40]

Note that according to the economic analysis of law, procedural rules and substantive rules have the same goal: to maximize social welfare. Thus, if factual uncertainty predictably distorts the incentive created by substantive law, the legislator could solve the problem by changing substantive law, instead of finding the decision rule that distorts incentives the least. Although this solution is theoretically possible, it faces a practical problem—substantive law is often determined before uncertainty appears, and several types of factual uncertainty might appear in cases regarding the same law, making it impossible to change substantive law to accommodate factual uncertainty. Thus, if there are optimal procedural rules that apply to cases of factual uncertainty independently of the legal subject matter, it makes sense to design substantive private law in disregard of factual uncertainty, leaving it to the factfinder to apply the relevant procedural rule once it knows the type of factual uncertainty of the particular case.

The next three sections explore which decision rule should be implemented in each of the different types of factual uncertainty.

A. Mutual Uncertainty

Mutual uncertainty arises when the factfinder, as well as both parties, cannot know which of several factual states applies to the case. There are three leading causes of mutual uncertainty. First, substantive law sometimes requires the parties to show a counterfactual state, i.e., what would have happened if circumstances were different. For example, to prove factual causation between a breach of contract and the resulting harm, the promisee must show that she suffered some loss that would not have occurred if the promisor had fulfilled her obligations. In all cases that require a counterfactual determination, by definition, the parties will not be able to present definitive evidence, since the state in question never occurred. Therefore, whenever the law requires the factfinder to assess a counterfactual, and the establishment of a counterfactual is not possible, mutual uncertainty arises.

973; Demougin & Fluet, *Rules of Proof, Courts, and Incentives*, *supra* note 10, at 22-23; Fluet, *supra* note 10, at 3.

40 *Id*.

Example 2, the delayed diagnosis example, presents such a case—for the factfinder to determine if the delay in diagnosis caused the harm, it needs to know whether the plaintiff would have survived had the physician made the diagnosis earlier. Not only is the factfinder unable to know what would have happened with any level of certainty, but also both the defendant and the plaintiff do not know what would have been the result.

The second cause of mutual uncertainty is the need to determine future facts. For example, the factfinder might need to ascertain the future revenues of a business following breach of contract, in order to estimate the harm. Similarly, in personal injury cases, the factfinder has to determine the plaintiff's future income and compare it to the estimated income but for the injury.[41] No one, including the plaintiff, can know with certainty what the future holds.

The third source of mutual uncertainty is inability to distinguish between similar parties. Example 1.3, of contested paternity involving identical twins, illustrates such a case. No one, the brothers included, can know which of them fathered the child. Another example is the seminal case of *Summers v. Tice*, where two hunters negligently shot in the general direction of a third hunter, and one had hit the victim.[42] Neither of the three, nor the factfinder, can tell which hunter caused the harm.

From an economic standpoint, cases of mutual uncertainty are relatively easy to solve. Consider again Example 2, the delayed diagnosis example. Assume that the physician knows that whenever she misdiagnoses a patient who later suffers harm, the probability of causation will always be 30%. In that case, to optimally incentivize the physician, she should internalize 30% of the harm whenever she negligently misdiagnoses a patient. It is easy to see

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41 The law might resolve the uncertainty by waiting for the future to materialize. In many cases, however, this alternative creates substantial administrative costs. In most jurisdictions, if no harm has materialized in the present, plaintiffs are instructed to file a suit in the future, when harm materializes. If some harm has materialized, but its future economic consequences are uncertain, in both common law and civil law countries, plaintiffs are compensated according to estimation of future consequences, which means the adoption in practice of a proportional liability rule. *See* Amsterdam Law Institution, Restatement of the Law – Torts: Liability for Physical and Emotional Harm, § 3 at para. H (2010); Peter Cane, Atiyah's Accidents, Compensation and the Law 129-42 (8th ed., 2013); Helmut Koziol & Reiner Schulze, Tort and Insurance Law: Tort Law of the European Community, 36-37 (2008). Alex Stein and Ariel Porat have argued that the law should allow for proportional liability for future harm even if no harm has yet materialized. *See* Ariel Porat & Alex Stein, *Liability for Future Harm*, *in* 221 Perspectives on Causation (Richard Goldberg ed., 2010).

42 Summers v. Tice, 33 Cal. 3d 80, §§ 82-83 (1948).

that under the preponderance of the evidence rule the physician would never be held liable. Whenever she negligently misdiagnoses, the patient is unable to prove causation beyond a preponderance of the evidence.

Similarly, applying the preponderance of the evidence rule to cases of mutual uncertainty may result in too much liability. Assume that whenever the physician misdiagnoses a patient who later suffers harm, the probability of causation is 70%. In that case, the factfinder will always find the physician liable for the entire harm whenever she misdiagnoses a patient, even though in 30% of the cases harm would have materialized regardless of the physician's conduct.

In some cases, the preponderance of the evidence rule can create optimal incentives. For example, if in half of the cases when the physician is negligent and damage occurs there is a 70% chance of causation, and if in the other half of cases the probability is 30%, then in expected terms, the physician causes the harm in 50% of all cases, and she is liable for the harm in 50% of the cases (whenever the probability is 70%). From the physician's ex ante perspective, she internalizes 50% of the harm from negligently misdiagnosing her patients, as she should.

Note, however, that proportional liability would lead to optimal internalization of harm in all the cases—if in all cases the probability of causation is 30%, the physician would always pay 30% of the harm. Since that is the expected harm of the physician's negligence, proportional liability leads to optimal deterrence. The result holds for any distribution of causation across cases.

This analysis presents a general principle: in cases of mutual uncertainty, expected liability should be equal to the expected value of the uncertain facts from the parties' ex ante perspective. Therefore, the preponderance of the evidence rule creates optimal incentives when the probability distribution of the unknown fact, across cases, is symmetrically around 50%.[43] On the other hand, proportional liability always creates optimal incentives, regardless of the probability distribution of the unknown fact. Applying proportional liability to cases of mutual uncertainty ensures optimal incentives for both parties.

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43 As the analysis of Example 2 showed, the preponderance of the evidence creates optimal incentives even if the distribution in a particular case is skewed, as long as the distribution of the distributions across cases is symmetrically around 50%. I.e., each case of uncertainty regarding causation can be described as a *Bernoulli p* distribution. In cases where the injurer cannot know what the probability of causation would be if the victim suffers some harm, the different possible probabilities of causation can be described as a continuous distribution of values between 0 and 1. If this distribution is symmetrically around 50%, the preponderance of the evidence will create optimal incentives.

The same insight holds for continuous factual states. Recall that for continuous states, applying the preponderance of the evidence rule leads the factfinder to adopt the median value, while proportional liability leads to the adoption of the mean. To see why proportional liability creates better incentives in cases of mutual uncertainty about continuous factual states, consider again Example 3, the loss of earning capacity example. On the assumption that the 5-year-old victim has no information about his potential earnings, uncertainty about his earning capacity illustrates another case of mutual uncertainty. As noted above, applying the preponderance of the evidence rule to the estimation of loss of earning capacity, the factfinder should choose the median income in the population as the base of compensation. Conversely, applying proportional liability, the factfinder should choose the mean income.

From an economic perspective, the answer is simple: only the mean income creates adequate incentives.[44] Income distribution in most countries follows a Pareto distribution, whereby a small portion of the population earns a high income, while a larger share of the population's income is relatively low.[45] In the U.S., for example, the mean annual wage in 2019 was $53,490, while the median annual wage was only $39,810.[46] If an injurer hits 100 victims, their total loss would approximate 100 times the average wage. If the factfinder compensates the victims according to the median wage, it will, on average, undercompensate the victims. Thus, from the injurer's ex ante perspective, awarding damages based on the median leads to under-deterrence.

In other cases of mutual uncertainty regarding continuous factual states, the distribution might favor the plaintiff. For example, in personal injury cases, factfinders often examine the victim's life expectancy and work-life expectancy, in addition to the loss of earning capacity.[47] Unlike the distribution of income, the distribution of life expectancy at birth follows an opposite

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44 *See* Louis Kaplow & Steven Shavell, *Accuracy in the Assessment of Damages*, 39 J.L. & Econ. 191,203-04 (1996).

45 For further explanation about the Pareto distribution, *see* Barry C. Arnold, *Pareto Distribution*, in Wiley StstsRef: Statistics Reference Online (N. Balakrishnan, et al., eds., 2015). For evidence that distribution of income follows a Pareto distribution, *See* Fabio Clementi & Mauro Gallegati, *Pareto's Law of Income Distribution: Evidence for Germany, The United Kingdom, and the United States*, *in* 3 Econophysics of Wealth Distributions (Arnab Chatterjee, Sudhakar Yarlagadda & Bikas K. Chakrabarti eds., 2005)

46 *See* U.S. Bureau of Labor Statistics, Occupational Employment Statistics: May 2019 National Occupational Employment and Wage Estimates United States (2020), https://www.bls.gov/oes/current/oes_nat.htm.

47 *See, e.g.,* in re Joint Eastern & Southern Dist. Asbestos Litigation, 726 F. Supp. 426 (E.D.N.Y. 1989).

pattern—very few people will live a short life, while the life expectancy of most of the population exceeds the mean.[48]

Interestingly, while the law typically requires factfinders to apply the preponderance of the evidence rule when examining causation, it allows factfinders to apply proportional liability (that is, the mean value of the distribution) when assessing damages. For example, in personal injury cases, life expectancy, work-life expectancy, and lost wages are all calculated using the mean and not the median.[49]

As this Article shows, at least from an economic perspective, uncertainty regarding the assessment of damages and uncertainty regarding causation are similar—both are cases of mutual uncertainty. In all such cases, only proportional liability consistently leads to optimal incentives. The preponderance of the evidence rule will align the expected variable with the expected liability and create optimal incentives, but only if the distribution is symmetrical. It is not surprising that several legal economists have suggested adopting proportional liability in cases involving uncertain causation or harm, especially where the distribution is systematically biased.[50] To avoid the need to examine the skewness of the distribution between cases, economic analysis suggests that

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48 For example, in 2017 the estimated median age of death for the entire population was around 83 years, while the life expectancy at birth (that is, the weighted mean age of death for the entire population) was only 78.6 years. *See* Elizabeth Arias & Jiaquan Xu, *United States Life Tables 2017*, 68 Nat'l Vital Stat. Rep. (2019), https://www.cdc.gov/nchs/data/nvsr/nvsr68/nvsr68_07-508.pdf.

49 *See generally* Hugh Richards & Michael Donaldson, Life and Worklife Expectancies (2d ed., 1999); James Ciecka, Thomas Donley & Jerry Goldman, *A Markov Process Model of Work-Life Expectancies Based on Labor Market Activity in 1997-98*, 9 J. Legal Econ. 33, 177 (1999); Lawrence M. Spizman & John Kane, *Loss of Future Income in the Case of Personal Injury of a Child: Parental Influence on a Child's Future Earnings,* 5 J. Forensic Econ. 159, 160-62 (1992)*; See also*, *supra* note 41.

50 Daniel A. Farber, Toxic Causation, 71 Minn. L. Rev. 1219, 1221 (1987); John Makdisi, Proportional Liability: A Comprehensive Rule to Apportion Tort Damages Based on Probability, 67 N.C. L. Rev. 1063, 1065-66 (1989); Ariel Porat, Misalignments in Tort Law, 121 Yale L.J. 82, 108-14 (2011); J. David Prince, Compensation for Victims of Hazardous Substance Exposure, 11 Wm. Mitchell L. Rev. 657, 694-96 (1985); Glen O. Robinson, Probabilistic Causation and Compensation for Tortious Risk, 14 J. Legal Stud. 779, 782-83 (1985); David Rosenberg, Class Actions for Mass Torts: Doing Individual Justice by Collective Means, 62 Ind L.J. 561, 594-95 (1986); David Rosenberg, The Causal Connection in Mass Exposure Cases: A 'Public Law' Vision of the Tort System, 97 Harv. L. Rev. 849 (1984); Steven Shavell, Uncertainty over Causation and the Determination of Civil Liability, 28 J.L. & Econ. 587, 587-88

under mutual uncertainty, the factfinder should apply proportional liability instead of the preponderance of the evidence rule.

B. Unilateral Uncertainty

In cases of unilateral uncertainty, one party has private information regarding a relevant fact (or at the very least, can acquire such information), while the other party and the factfinder cannot acquire such information, and thus cannot know the relevant fact with certainty. Unilateral uncertainty prevails where the disputed fact concerns the behavior, knowledge, or intentions of one of the parties. That party would usually know what it did, knew or thought, while the other party and the factfinder would not.[51] For example, in contract cases, unilateral uncertainty arises when a contract requires the promisor to exert a minimum level of effort, and only the promisor knows the actual level of effort exerted.[52] Similarly, in tort law, unilateral uncertainty might arise in negligence cases, as only the injurer knows precisely how she acted,[53] while the victim can only estimate how the injurer has acted. I will refer to the party that possesses the relevant information as the decision-maker. Consider the following example:

Example 4 – negligent driving. Injurer drives her car and accidentally hits Victim. Victim argues that Injurer drove at excessive speed and caused the

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(1985); Alexander Stremitzer & Avraham D. Tabbach, The Robustness Case for Proportional Liability, 14 B.E. J. Theoretical Econ. 371 (2014).

51 The analysis holds even if the actor has some uncertainty with regard to her own conduct. In either case, the actor forecasts a distribution of expected jury confidence levels based on the facts she expects to be produced at trial. The private level of confidence could be higher or lower without directly changing that forecast.

52 Oliver Hart & John Moore, Incomplete Contracts and Renegotiation, 56 Econometrica 755, 756 (1988); Eric A. Posner, Economic Analysis of Contract Law after Three Decades: Success or Failure?, 112 Yale L.J. 829, 844 (2003); Alan Schwartz, Relational Contracts in the Factfinders: An Analysis of Incomplete Agreements and Judicial Strategies, 21 J. Legal Stud. 271, 274 (1992).

53 Or intended to act since, incentive-wise, the law should care about how the injurer intends to act and not on her actual actions. In practice, courts assign liability according to actual care, when such levels are verifiable and intended levels are not. For inefficiencies derived from this distinction, see Robert D. Cooter & Ariel Porat, Getting Incentives Right: Improving Torts, Contracts, and Restitution 61-73 (2014) (arguing that when people's actions differ from their intended actions due to unavoidable laps in attention, they should not be found liable for the resulting harm).

accident. Injurer knows the actual speed at the time of impact. Both Injurer and Victim present evidence regarding the driving speed, which is inconclusive.

Unlike in the case of mutual uncertainty, it is impossible to align the expected variable and the expected outcome, at least from the decision-maker's point of view. Decision-makers know the value of the uncertain variable. To align the value and the outcome of the trial, the factfinder must apply the specific result associated with the value—i.e., find liability whenever, and only when, the facts support it. In the negligent driving example, Injurer knows at what speed she drove. To align the unknown variable with the legal outcome, she should be liable only if she drove at excessive speed. Since uncertainty makes it impossible for the factfinder to always reach the correct legal outcome, unilateral uncertainty distorts the incentives of the decision-maker. In the example, Injurer knows she may bear liability even if she drove at a reasonable speed and may be found not liable even if she drove at an excessive speed. These two possibilities distort incentives to drive at optimal speed.

This distortionary effect of unilateral uncertainty on the decision-maker's incentives has been recognized by legal economists. In their seminal article, John Calfee and Richard Craswell have shown two effects of unilateral uncertainty.[54] First, the decision-maker, knowing the factfinder might err in her favor, internalizes only a part of the marginal social benefits (or costs) of her actions. On its own, this partial marginal internalization effect causes the decision-maker to under-comply with the legal rule. In the negligent driving example, Injurer may increase her speed inefficiently. Second, since compliance with the legal rule increases the decision-maker's chances of receiving a favorable outcome at trial, she receives a private benefit from over-complying with the legal standard in the form of favorable evidence—i.e., the more the decision-maker complies with the legal rule, the less likely the factfinder is to find her at fault. This private evidentiary benefit effect, again on its own, causes the decision-maker to over-comply with the legal rule.

Since both effects of unilateral uncertainty work in every case and in opposite directions, the overall result of unilateral uncertainty may be either over-compliance or under-compliance. The overall effect depends on the

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54 Richard Craswell & John E. Calfee, Deterrence and Uncertain Legal Standards, 2 J. L. Econ. & Org. 279, 279-80, 298-99 (1986); Jason S. Johnston, Bayesian Fact-Finding and Efficiency: Toward an Economic Theory of Liability under Uncertainty, 61 S. Cal. L. Rev. 137, 156-64 (1987). For an intuitive explanation as to how evidentiary considerations may adversely affect primary behavior in different situations of unilateral uncertainty, *see generally* Gideon Parchomovsky & Alex Stein, The Distortionary Effect of Evidence on Primary Behavior, 124 Harv. L. Rev. 518 (2010).

influence of the decision-maker's actions on social costs and benefits, as well as the probability distribution of the possible factual states. While Calfee and Craswell have argued that both under-compliance and over-compliance are possible, subsequent articles have mostly argued that over-compliance is more likely to occur.[55]

Consider how these effects work with regard to the negligent driving example. Assume that 60 mph is the legal speed limit, and that the factfinder has the means to observe the speed, but such observation is uniformly distributed at 10 mph above and below the actual speed. That is, when Injurer drives at 60 mph, the factfinder might observe any speed between 50 mph and 70 mph, with equal probability. Further assume that the factfinder is unaware that it might err in its observation.[56]

It is easy to see the two effects of unilateral uncertainty. First, Injurer knows that if she drives at 60 mph, there is a 50% chance that the factfinder will observe a speed higher than 60 mph and find her negligent. For that reason, if she slightly increases her speed above 60 mph, she internalizes 50% of the social costs. This is an example of the partial marginal internalization effect. Since Injurer internalizes only part of the social cost from increasing her speed, this effect alone would cause her to drive too fast. For example, if reducing the speed by 1 mph from 61 mph to 60 mph costs her 5, and reduces the expected costs of accidents by 8, she will not slow down, as she internalizes only half (i.e., 4) of the reduction in expected accident costs.

However, by changing her speed, Injurer also affects the likelihood that the factfinder will find her liable. If Injurer reduces her speed from 60 mph to 59 mph, the probability that she will be found liable drops from 50% to 45%. This reduction in costs illustrates the private evidentiary benefit effect. It is a private benefit and not a social benefit—it reduces the probability of paying damages and not the probability of causing the harm. This effect will cause Injurer to slow down below the social optimum. Assume that the costs of slowing down from 60 mph to 59 mph are 10 and that the expected harm from accidents at 60 mph is 208, while at 59 mph the expected harm is 200. In that case, the reasonable speed would be 60 mph since the cost of reducing the speed (10) is higher than the reduction in accident risk (8). Still, Injurer would choose to drive at 59 mph considering that driving at 60

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55 Steven Shavell, Economic Analysis of Accident Law 93-97 (1987); Giuseppe Dari-Mattiacci, *Errors and the Functioning of Tort Liability*, 13 Sup. Ct. Econ. Rev. 165,178-84 (2005).

56 This simplifying assumption is made only to show the two effects of unilateral uncertainty. After explaining the two effects of uncertainty I relax the assumption to show how the two decision rules might influence these effects.

mph, Injurer's expected liability is 104 (50% of 208), while at 59 mph her expected liability is only 90 (45% of 200). Injurer will be happy to bear the cost of 10 and reduce her speed, reducing her liability by 14, even though it is inefficient to do so.

To estimate the strength of the private evidentiary benefit on Injurer's incentives, we need to estimate the rate at which changes in speed affect expected liability. When choosing at which speed to drive, Injurer knows she can avoid liability by driving at 50 mph, since at that speed the factfinder would never observe a speed higher than 60 mph. Similarly, she knows she would certainly face liability at 70 mph or faster, since then the factfinder will never observe her driving at a speed lower than 60 mph. We can think of this region—50 mph to 70 mph—as the intermediate expected liability region. Across this region, every increase of 1 mph is associated with a 5% increase in expected liability.[57] This 5% increase in expected liability for every marginal increase in speed causes the driver to reduce the speed. If the speed detecting technology is more accurate, making the distribution of error around the actual speed more condensed, the intermediate expected liability region will be narrower. In that case, every reduction of 1 mph would cause a more significant reduction in liability, making the private evidentiary benefit effect stronger.

Thus far, we have assumed that factfinders are unaware of the possibility that they might err. Being aware of the distribution of errors, the factfinder can calculate the probability of fault based on the observed speed. For example, if the factfinder observes a speed of 55 mph, it can assume that the actual speed is uniformly distributed between 45 mph and 65 mph, so there is a 25% probability that the driving speed exceeded the reasonable standard.[58] This probabilistic interpretation of the evidence allows us to examine the effect of the decision rules on the incentives of the decision-maker.

The effects of unilateral uncertainty would not change under the preponderance of the evidence rule. If the distribution of errors is symmetrical around the actual speed, whenever the observed speed falls below the standard,

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57 The effect is linear due to the assumption of uniform distribution of errors. If we assume other forms of symmetrical distributions, like normal distribution, the effect would no longer be linear, but all of the substantial conclusions still hold.

58 I assume that the factfinder's prior belief about the distribution of speed is uniform. In other words, before seeing the evidence, the factfinder has no prior belief about how fast people are driving. This assumption coincides with the notion that judges should not let private information inform their factual decisions. *See*, *e.g.*, Henrik Lando, *When is the Preponderance of the Evidence Standard Optimal?*, 27 Geneva Papers on Risk & Ins. – Issues & Pract. 602, 603 (2002).

the factfinder will estimate that the probability that the driver was negligent is lower than 50%. Similarly, whenever the observed speed exceeds the standard, the factfinder will estimate that the probability that the driver was negligent is above the 50% threshold and find her liable for the entire harm. Thus, to know whether the driver is liable, we need only to see if the observed speed was below or above the standard.

The results are different under proportional liability. The partial marginal internalization effect under proportional liability is similar to the partial marginal internalization effect under the preponderance of the evidence rule—by choosing a driving speed of 60 mph, the driver faces expected liability of 50% of the harm. In that case, if the factfinder's observed speed is 60 mph, it will impose liability of 50%, and the distribution of error and the corresponding liability for each observed speed is symmetrical around the actual speed. Thus, against any risk of underassessment of the speed, and subsequent reduction in liability, there is an equal risk of overassessment of the speed and increased liability. In this situation, by increasing the speed slightly above 60 mph, the driver internalizes only half of the increase in the risk of accident instead of all of it.

The evidentiary distortion effect, however, is less significant under proportional liability. Remember that under the preponderance of the evidence rule, the driver could escape liability by reducing her speed to 50 mph. That option is no longer available under proportional liability. Whenever the factfinder observes a speed higher than 50 mph, it will impose some liability on the driver, since there is still a chance that the driver's speed exceeded the standard, even though it falls below 50%. To entirely escape liability, the driver must slow down to 40 mph, totally eliminating the possibility that the factfinder will observe a speed higher than 50 mph.

Similarly, the driver would face full expected liability only if her speed is higher than 80 mph—if she drives at a lower speed, there is a chance that the factfinder's observed speed will fall below 70 mph, so the driver will not be liable for the entire harm. That means that the intermediate expected liability region is wider under proportional liability—40 mph to 80 mph, not 50 mph to 70 mph. Throughout this region, any increase of 1 mph is associated with an average increase of 2.5% in expected liability.[59] Since the private evidentiary benefit effect causes the decision-maker to over-comply, and that effect is weaker under proportional liability than under the preponderance of

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59 Under proportional liability, the private evidentiary benefit effect is not linear, even when the distribution of error is uniform. Nevertheless, the marginal reduction in liability from the change in behavior is always smaller under proportional liability.

the evidence rule, decision-makers would comply less under this regime than they would under the preponderance of the evidence rule.[60]

Note that if factfinders make more significant errors, so the distribution of errors is 20 mph above and below the actual speed, then the intermediate expected liability region under the preponderance of the evidence rule will also be 40 mph to 80 mph—the same intermediate expected liability region under proportional liability when the distribution of errors was 10 mph. That means that the private evidentiary benefit gets smaller as the error rate increases and factfinders' decisions become less accurate. Proportional liability increases the intermediate expected liability region, so its function resembles an increase in the factfinder's error rate.

We learn from the example that cases of unilateral uncertainty may cause either over-compliance or under-compliance, regardless of the decision rule. We further understand that proportional liability leads to less compliance than the preponderance of the evidence rule. Thus, whenever unilateral uncertainty causes over-compliance, proportional liability is superior from an economic standpoint. However, whenever unilateral uncertainty results in under-compliance, the preponderance of the evidence rule is superior.

As mentioned above, several legal economists have argued that unilateral uncertainty is much more likely to cause over-compliance.[61] It is hard to find evidence in support of this claim. However, if this is indeed the case, there is an excellent reason to adopt proportional liability instead of the preponderance of the evidence rule as the default regime for cases of unilateral uncertainty.

The analysis of unilateral uncertainty does not provide a definitive recommendation for adopting either decision rule based on efficiency considerations, as it depends on the available information regarding the uncertain fact and on the cost structure that the decision creates. One recommendation from this analysis concerns cases that are rich in evidence, where we expect factfinders to err less in both respects—frequency and magnitude. In highly regulated practices, such as safety in selected workplaces or medical procedures, some regulations are intended to provide evidence for later examination. For

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60 In their articles, Dominique Demougin and Claude Fluet have noted that proportional liability reduces care decisions vis-à-vis the preponderance of the evidence rule. In their models, however, they only contended with the risk of under-compliance with the legal standard. Since they found that proportional liability leads to less compliance than the preponderance of the evidence rule, they reached the conclusion that proportional liability should be rejected. *See* Demougin & Fluet, *Preponderance of Evidence*, *supra* note 10, at 971-97; Demougin & Fluet, *Rules of Proof, Courts, and Incentives*, *supra* note 10, at 29.

61 *See supra*, note 55.

example, safety protocols include recording the incidence and its circumstances, as well as upgrades and maintenance of safety measures. In hospitals, the staff is often instructed to maintain detailed records of the treatment and subsequent results, as well as the frequency of follow-up visits. In these instances, according to the analysis of unilateral uncertainty, the risk of over-compliance is much more substantial than the risk of under-compliance. Many defensive medicinal practices, such as unnecessary referrals to experts and unneeded tests, provide an excellent example of the private evidentiary benefit from precaution. Physicians adopt these practices that are easy to prove later, in case the patient suffers from an adverse result. These practices are aimed at avoiding liability, while their cost exceeds the benefit in reducing harm. Since proportional liability reduces the incentives to over-comply, factfinders should apply proportional liability in these cases instead of the preponderance of the evidence rule.

Conversely, in other areas evidence is usually scarce, so the error rate of the factfinder is often high. For example, when the factfinder needs to ascertain the intentions of one of the parties, it is unlikely to find any good evidence about the party's state of mind. In such cases, under-compliance is much more likely to occur; so the preponderance of the evidence rule provides better incentives than proportional liability.

There are no areas in private law where proportional liability is applied to cases of unilateral uncertainty. The analysis here suggests that at least in some cases of unilateral uncertainty, and perhaps even most cases, proportional liability creates better incentives than the preponderance of the evidence rule. One possible explanation for this apparent inefficiency of the law is the different treatment accorded to over-compliance and under-compliance. From an economist's perspective, over-compliance and under-compliance are equally worrisome, as both create inefficient social costs. Judges and legislators, however, may be more concerned about under-compliance than over-compliance. Under-compliance means that decision-makers will foist some unreasonable or unlawful risk on others, while over-compliance means that decision-makers will bear high costs to perform an action that benefits them.

C. Institutional Uncertainty

In cases of institutional uncertainty, the parties have common knowledge of all the relevant facts and the factfinder knows that they share common knowledge of the facts. However, at trial the parties present conflicting accounts of the facts, leaving the factfinder uncertain.

There are many instances of institutional uncertainty in legal disputes. For example, Institutional uncertainty might arise when parties disagree on

the interpretation of a contractual provision. Rules of contract interpretation usually defer to the parties' intention at the time of contract formation. In some cases, the parties might have sincere disagreement about the interpretation of their contract. In other cases, however, the factfinder might believe that the parties had agreed on what the language of the contract means when they drafted the contract, but they nonetheless present different interpretations. In such cases, the factfinder faces uncertainty because one or both parties decided to be untruthful.

Since the parties can always resolve institutional uncertainty, the optimal decision rule should incentivize the parties to disclose truthful information to the factfinder. Revealing accurate information reduces litigation costs—if the parties agree on the facts, they do not need to present any evidence. The further the parties' estimates deviate from the truth, the more the parties have to invest in evidence collection and presentation, as it is less likely that they will find evidence in support of their claim. It is important to determine which decision rule will encourage the parties to reveal the truth. Consider the following example:

Example 5 – paid loan. Creditor gave Debtor a loan, to be paid back with interest. The parties agree that at the time the loan matured, Debtor owed Creditor $1,000. The parties met at that time, and Debtor paid Creditor a sum of money in cash, which Creditor counted on the spot. Creditor sues Debtor for the remaining debt. The parties disagree on the amount Debtor paid during their meeting.

Example 5 presents a typical case of Institutional uncertainty. Both parties agree that Debtor owed Creditor $1,000, and that some sum of money was paid in cash. Both agree that Creditor counted the money in front of Debtor (confirming that they have common knowledge of the amount of money). In that case, the court knows that any uncertainty regarding the sum of money owed is a result of one or both parties being untruthful.

During the trial, the parties present evidence regarding the disputed facts. As mentioned above, the analysis focuses on the last stage of the fact-finding process—decision making—which takes place after the factfinder has been presented with all the (admissible) evidence.[62] The truthfulness (or accurateness)

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62 *See supra*, notes 18-20, and accompanying text. This distinction between the evidence-gathering stage and the decision-making stage of adjudication is not new. *See* Luke M. Froeb, Bernhard Ganglmair, & Steven Tschantz, *Adversarial Decision-Making: Choosing Between Models Constructed by Interested Parties*, 59 J.L. & Econ. 527, 529-530 (2016). Legal economists have focused mainly on the first stage of the fact-finding process. *See*, *e.g.*, Andrew F. Daughety & Jennifer F. Reiganum, *On the Economics of Trials: Adversarial Process, Evidence,*

of the evidence is determined primarily by rules of civil procedure. At that last stage of the fact-finding process, the parties have already produced all the evidence, either voluntarily or through discovery procedures, and can only offer an interpretation of the evidence. In example 5, the parties could produce bank statements of both parties and eyewitnesses to the meeting. Since the evidence is known, each party argues for a sum of remaining debt, and tries to show how the evidence fits their account of the events.

To resolve the state of uncertainty, the factfinder can apply either of the two decision rules. Following the preponderance of the evidence rule, the factfinder would estimate the relative likelihood of each amount owed and choose the more likely one.[63] That is, by applying the preponderance of the evidence rule, the factfinder commits to choosing one of the sums offered by the parties. When applying proportional liability, the factfinder is unbound by the parties' suggested sums, and it may choose a third sum of money that lies in between the parties' suggested amounts according to the relative likelihood.

To see how the decision rules should apply to Example 5, assume that Debtor claims that she paid Creditor $900, so her remaining debt is only $100, while Creditor claims that Debtor Payed only $200, so her remaining debt is 800$. Furthermore, assume that between these two claims, the factfinder believes Creditor's claim to be more plausible. Specifically, the factfinder thinks that Creditor's claim is true with a probability of 60%, while he believes that the probability that Debtor's claim is true, given the evidence, is only 40%.

Following the preponderance of the evidence rule, the factfinder would decide that the remaining debt is $800, according to Creditor's claim. Applying proportional liability, however, the factfinder would weigh the evidence and choose a sum which best reflects the weighted average claims made by Debtor and Creditor, finding that the debt is $520.[64]

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and Equilibrium Bias, 16 J. L. Econ, & Org. 365 (2000); Luke M. Froeb & Bruce H. Kobayashi, *Evidence Production in Adversarial vs. Inquisitorial Regimes*, 70 Econ. Letters 267 (2001); Paul Milgrom & John Roberts, *Relying on Information of Interested Parties*, 17 Rand J. Econ. 18 (1986).

63 Some legal economists have argued that this formulation applies generally to legal disputes—if every case has a value, which is determined by the available evidence and is known to both parties, then every case can be modeled generally as an unknown variable, where each party offers one value and the factfinder then chooses one of the values or some point in between. *See* Froeb, Ganglmair, & Tschantz, *supra* note 62, at 530-33; Giuseppe Dari-Mattiacci & Margherita Saraceno, *Fee Shifting and Accuracy in Adjudication*, 63 Int'l Rev. L. & Econ. 2-3 (2020).

64 This is the weighted mean of both claims: $40\% \times 100 + 60\% \times 800 = 520$

To determine which decision rule is more desirable, we must examine how the parties would react to each rule. Again, to isolate the decision-making stage from the discovery stage, we assume that the set of evidence is given. For convenience, think of the two parties as pondering how to present their account of the events, where the goal is to persuade the factfinder, given the evidence.

The endeavor of learning the facts from evidence suggests that evidence has a connection to the underlying facts. If we think of each piece of evidence as a random variable drawn from some probability distribution function, and the true value as the mean of the probability distribution, then the evidence will hold a relation to the true value while still being inaccurate. Under this formulation, when each party presents an account of the events, it argues that the pieces of evidence were produced by some distribution function with different means. On average, these accounts will be more convincing as their mean value gets closer to the truth.[65]

Consider how this might affect Debtor's and Creditor's claims. Let us assume, for example, that the real debt is $500. Under the preponderance of the evidence rule, if Debtor chooses to argue that the debt is only $100, Creditor's best move would be to claim that the debt is $800—still very favorable to her, and closer to the truth, and thus more likely to be chosen as the correct claim. Knowing that Creditor will react in that manner, Debtor's best move is to claim that the debt is $300. This game will continue until, in equilibrium, when the factfinder applies the preponderance of the evidence rule, both parties set their values at or close to the correct amount.[66]

Conversely, when the factfinder is allowed to choose a third interpretation that lies in between the parties' positions under a rule of proportional liability, the parties are incentivized to present untruthful claims about the debt. For example, if Debtor chooses to argue that she owes Creditor $500 (the correct amount), Creditor is better off claiming that the debt is actually $900—the factfinder might find that very unlikely, but if it is at all possible, following proportional liability the factfinder would determine that the debt was higher than $500. Since Debtor faces similar incentives, she will not claim that the

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65 For a formal analysis, *See* Froeb, Ganglmair & Tschantz, *supra* note 62.

66 Parties will not necessarily reach an agreement in equilibrium. The outcome depends to a large extant on the accurateness of the fact-finder's evaluations. When the fact-finder's procedure is noisy, the parties may gamble and present values that differ a bit from the true value. Nevertheless, the preponderance of the evidence rule still induces truth-telling, as compared to proportional liability. For economic models supporting the use of this rule in settings of institutional uncertainty, see *infra* note 67. For empirical research reaching similar conclusions, see *infra* note 68.

remaining debt was $500 in the first place and would instead claim a lower amount.

The incentivizing effect on the parties' truth-telling of the preponderance of the evidence rule has led to the promotion of a legal mechanism, named "final-offer arbitration," or by its more colloquial name, "baseball arbitration." According to this procedure, each party to a business dispute gives the arbitrator an estimate, and the arbitrator can only choose one of the two estimates. Under final-offer arbitration, the parties compete at being more convincing, as the most convincing party wins the entire case. Thus, economic models predict that in equilibrium, both parties will offer similar evaluations, closer than they would under any other decision-making rule.[67] Empirical experiments support the theoretical model.[68]

Even though the preponderance of the evidence rule seems superior to proportional liability in cases of mutual uncertainty, courts rarely apply the rule. Even when the parties request the court to apply it, they usually refuse to do so. The mechanism forces the court to choose one of two factual states, even if both are unconvincing, and therefore courts tend to reject it. In Gonsalves v. Straight Arrow Publishers, the Delaware Supreme Court decided that state courts must evaluate the evidence and reach their own conclusion, and thus are not allowed to apply the final-offer arbitration mechanism.[69]

As the ruling of the Delaware Supreme court suggests, when the parties offer their evaluations or their opposing claims regarding the possible factual states, the evidence might support a continuum of factual states in between. This observation offers a second way to apply the preponderance of the

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67 This is similar to a competition between two firms in the market—each firm would prefer to raise its price (or in the current context, offer a self-serving evaluation), but then the other firm can slightly reduce its own price and win the entire market. Carl Stevens was the first to suggest that final-offer arbitration works in the same manner and to refer to it under that name. *See* Carl M. Stevens, *Is Compulsory Arbitration Compatible with Bargaining?*, 5 Indus. Rel. J. Econ. & Soc'y 38, 49-50 (1966). For economic analysis of final-offer arbitration, which claims that the mechanism encourages the parties to give truthful evaluations, see Henry S. Farber, *An Analysis of Final-Offer Arbitration*, 24 J. Conflict Resol. 683, 688-94 (1980); Paul Gordon, *Submitting 'Fair Value' to Final Offer Arbitration*, 63 Univ. Colo. L. Rev. 751, 756-57 (1992); Christian J. Henrich, *Game Theory and Gonsalves: A Recommendation for Reforming Stockholder Appraisal Actions*, 56 Bus. L. 697, 703-05 (2001).

68 Charles Adams, Final Offer Arbitration: Time for Serious Consideration by the Courts, 66 Neb. L. Rev. 213, 239-44 (1987); Ramsumair Singh, Final Offer Arbitration in Theory and Practice, 17 Indus. Rel. J. 329 (2007).

69 Gonsalves v. Straight Arrow Pub., 701 A.2d 357, § 362 (1997).

evidence rule to these types of cases. As we have seen, in cases of continuous factual states, the factfinder can apply the preponderance of the evidence rule by adopting the median value. Applying proportional liability, the factfinder would choose the mean value instead of the median. Currently, factfinders seem to be unaware of the distinction between mean and median values of the distribution, and as a result ignore the median factual state.

Instructing the factfinder to choose the median result would better incentivize the parties to reveal the truth. The mean is more sensitive to outliers—extreme states with small probabilities. If the factfinder applies the mean result, parties are incentivized to offer extreme values, even if they know the evidence for these values is not very convincing, in the hope of pulling the mean in their direction. Thus, applying the mean will cause the parties to expand the span of possible factual states, resulting in less accurate judicial decisions, with higher costs. When the median is applied, extreme values are almost entirely disregarded. Therefore, the parties gain much more by offering convincing evaluations that are closer to the real value. Even if factfinders cannot apply final-offer arbitration in cases of mutual uncertainty, informing the parties that in this type of cases the choice will be made according to the median factual state might lead them to offer more honest evaluations.

IV. The choice of decision rules under corrective justice

Corrective justice offers a comprehensive account of private law, which is internal to the law, in the sense that it is independent of external goals or justifications.[70] The principles of corrective justice date back to Aristotle, who postulated that wrongful actions between parties violate the equality that exists in transactional dealings,[71] and therefore the judge must attempt to restore equality, to the extent possible, by compensation.[72]

The concept of corrective justice links the wrongful loss to the wrongful gain, and the particular person who lost to the one who gained.[73] Corrective justice does not offer a theory of what is a wrongful action which violates

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70 *See* Ernest J. Weinrib, The Idea of Private Law 8-17 (1995)

71 "…the justice in transactions between man is sort of equality indeed, and the injustice a sort of inequality… the law looks only to the distinctive character of the injury, and treats the parties as equal, if one is in the wrong and the other is being wronged, and if one inflicted injury and the other received it." Aristotle, Nichomachean Ethics 4 (Vol. V., W. D. Ross trans., 1999).

72 Id.

73 *See* Weinrib, *supra* note 70, at 63-64.

the right of others.[74] Nevertheless, the theoretical structure establishes two central elements of private law rights—formal equality and correlativity. Formal equality is the required assumption that the parties are equal when one applies the law, regardless of their actual status. Correlativity encapsulates the notion that the wrongful loss and the wrongful gain are linked, and so simultaneously justify the duty of the defendant to pay compensation and the right of the plaintiff to receive it.

The extant literature, however, has not applied corrective justice theory to rules of proof and evidence.[75] This Part examines how corrective justice principles apply to factual uncertainty. It shows that, following the same basic formal principles, factfinders should adopt the preponderance of the evidence rule as the main, if not sole, decision rule.

We start our examination by reviewing the case of uncertainty about factual causation. Uncertain causation is a convenient starting point for two reasons. First, there is a definite answer as to the right outcome for each factual state. On the assumption that the defendant's actions were wrongs, if the defendant caused the harm then she violated her relational duty not to injure the plaintiff and should compensate her for the harm. If, however, the defendant's actions did not cause the harm, then although she may have been negligent (or her actions may have been wrongful in some other manner), the plaintiff did not suffer a wrongful loss as a result, nor did the defendant receive a wrongful gain, and she therefore should not be liable for damages.[76]

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74 Aristotle defined the unjust action as one that is in violation of the law, but offered no moral basis for the law in question. Corrective justice theorists offer different philosophical grounds for the content of the duties people owe each other. *See* George P. Fletcher, *Fairness and Utility in Tort Theory*, 85 Harv. L. Rev. 537 (1972); Jules Colman, *Corrective Justice and Wrongful Gain*, *in* 184 Markets, Morals, and the Law; Weinrib, *supra* note 70, at 145-70.

75 Richard Wright has recognized the need to distinguish between substantive requirements for liability and evidentiary and procedural rules governing proof necessary to promote justice, see Richard W. Wright, *Liability for Possible Wrongs: Causation, Statistical Probability, and the Burden of Proof*, 41 Loy. L.A. L. Rev. 1295, 1296 (2008).

76 There are several accounts of the duty to pay compensatory damages under corrective justice. For example, Benjamin Zipursky and Arthur Ripstein have argued that people owe each other a qualified relational duty of noninjury. This duty is breached only by an injury that the specific defendant caused the specific plaintiff. Thus, causation is a precondition for showing that a violation of the duty has occurred. *See* Arthur Ripstein & Benjamin C. Zipursky, *Corrective Justice in an Age of Mass Torts*, *in* 214 Philosophy and the Law of Torts 217-20 (Gerald J. Postema ed., 2001). For a meta-analysis of corrective justice theories,

The second reason is that, unlike other factual disputes, corrective justice theorists have examined the two decision rules in the context of uncertain causation. This examination was done primarily because of common law doctrines, which allow for proportional liability in some cases of uncertain causation, such as cases that fall under the lost chance doctrine or the market share liability doctrine.[77]

It should come as no surprise that, but for very few and limited examples, corrective justice theorists have opposed the application of proportional liability, and in some cases, have found the willingness of economic analysis to allow proportional liability to be proof of the shortcomings of economic analysis as a normative theory of tort law.[78]

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see Jules L. Coleman, *The Practice of Corrective Justice*, *in* 53 Philosophical Foundations of Tort Law 56-66 (David G. Owen ed., 1995).

77 S*ee* Amsterdam Law Institution, *supra* note 41, at § 26. Several states in the United States have adopted the lost chance doctrine, while others have rejected it, and several have left the possibility open, deferring the decision to future cases. For a survey concerning the adoption of the doctrine in various states, see Matsuyama v. Birnbaum, 890 N.E.2d 819, § 827-28 (2008). This doctrine was denied in the UK, see Gregg (FC) v. Scott, [2005] UKHL 2, [2005] 2 AC 176 (appeal taken from Eng.). Gregg v Scott was adopted by Australian law, see Gett v. Tabet (2009) 254 A.L.R. 504 (Austl.), and by Canadian law, see Seatle v. Purvis, [2007] 68 B.C.L.R. 4th 288 (Can.). The market share liability doctrine was first introduced in Sindell v. Abbott Laboratories, 607 P.2d 924, § 926 (1980), where the plaintiffs were women suffering from tumors, whose mothers had taken diethylstilbestrol (DES) during pregnancy. The plaintiffs could prove that their tumors were caused by DES but could not establish which company had manufactured the drug ingested by their mothers. *Id.* at 598 The factfinder found the defendants negligent and held each liable in proportion to its share of the market unless it could prove that it had not manufactured the DES that caused the plaintiff's cancer. *Id.* at 612-13. Sindell was not denied in Canada. *See* Insurance Corporation of British Columbia v. Leland, [1999] B.C.J 2073, §§ 25-27 (Can.). In the UK, Sindell was cited in Barker v. Corus (UK) Plcc, [2006] UKHL 20, [2006] 2 AC 572, §§ 45-56 (appeal taken from Eng.).

78 For an examination of proportional liability for uncertain causation from a corrective justice perspective, see Jules L. Coleman, Risks and Wrongs 396-99 (1992); Ernest J. Weinrib, *Causal Uncertainty*, 36 Oxford J. Legal Stud. 135, 148-52 (2015); Wright, *supra* note 75, at 1330-334; Ripstein & Zipursky, *supra* note 76. Richard Wright has argued that economists' willingness to replace factual causation with probabilistic linkage proves that economic analysis cannot offer a good explanation for tort law. *See* Richard W. Wright, *Actual Causation vs. Probabilistic Linkage: The Bane of Economic Analysis*, 14 J. Legal Stud. 435, 455-45 (1985).

The most frequently cited argument against doctrines that allow proportional liability in cases of uncertain causation is that by adopting these doctrines, private law relaxes the causation requirement, which is an integral condition for tort liability.[79] This argument is convenient for corrective justice theorists, as it allows an answer to be found within the theory of private law without dealing with the underlying problem of factual uncertainty. The force of this argument, however, is limited once we consider that under the preponderance of the evidence rule, liability is granted in cases where causation has not been established without a doubt. For example, in the case of delayed diagnosis, if the patient can show a 55% probability that her physician caused the harm, the physician will be held liable for the entire harm, even though the probability that the harm would have materialized regardless of the physician's actions is 45%. That is, it is not the causation requirement itself that corrective justice needs to justify, but the choice to adopt the preponderance of the evidence rule as the applicable rule in cases of factual uncertainty.[80] Both rules relax the causation requirement in some sense—proportional liability allows for partial compensation when causation is uncertain, and the preponderance of the evidence rule grants full compensation when factual causation is slightly more probable than not. This observation highlights a broader argument—as in all cases of factual uncertainty, the correct allocation of remedies should be decided by the application of decision rules. The choice of decision rules need not depend on the legal content of the dispute and thus should apply to all factual disputes in private law. The argument focusing on the importance of factual causation to tort liability confuses legal and factual uncertainty.

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79 Wright, *Actual Causation*, *supra* note 78, at 437-439. *See also*, Richard W. Wright & Ingeborg Puppe, *Causation: Linguistic, Philosophical, Legal and Economic*, 91 Chi. Kent L. Rev. 461, 495-96 (2016); Richard W. Wright, *Causation, Responsibility, Risk, Probability, Naked Statistics, and Proof: Pruning the Bramble Bush by Clarifying the Concepts*, 73 Iowa L. Rev. 1001, 1005-1007, 1042-1043 (1988).

80 The confusion between substantive law and the law of evidence and civil procedure is a result of the language factfinders have used when adopting doctrines of proportional liability. Instead of stating that the doctrine changes the rules of proof and evidence, factfinders have stated that these doctrines relaxed the causation requirement. This, however, is inaccurate. It is hard to understand what harm would be compensated without any causation requirement, but there is no reason to adopt proportional liability if we relinquish the factual causation requirement. To truly relax the substantive causation requirement it would make more sense to award full compensation whenever the defendant committed a wrong toward the plaintiff.

A. Justifications for the Preponderance of the Evidence Rule

It is possible to derive from the structure of corrective justice a theoretical basis for adopting the preponderance of the evidence rule as a solution to factual uncertainty, which can be applied to all cases of factual uncertainty. The argument develops several elements of proof derived from the elements of corrective justice, the combination of which serves to justify the preponderance of the evidence as a decision rule in cases of factual uncertainty.

First, the basic structure of corrective justice assumes that the duty to make repair arises only when one person has changed the status quo by a wrongful act. Since the plaintiff asks the court for repairs, and as a result changes the current status quo between the parties, the burden of proof must fall on the plaintiff to prove her right to compensation. Otherwise, the plaintiff's request does not establish a right to compensation, so any payment would violate the rights of the defendant.

Furthermore, formal equality explains why the epistemological threshold in private law should be the preponderance of the evidence and none other, such as "clear and convincing evidence" or "beyond a reasonable doubt." Preponderance of the evidence acknowledges the equal status of the parties, allowing them equal opportunity to convince the court about their factual claims.[81] Note that as this threshold is insensitive to the identity of the parties, it promotes formal equality, as required by corrective justice, and not substantive equality as distributive justice might require.

In addition, the factual determination must uphold the correlativity requirement.[82] When a plaintiff asks for recourse, the judge is charged with upholding the rights of the parties as determined by the facts. For correlativity to exist there has to be a connection between the wrongful loss of the plaintiff and the wrongful gain of the defendant. This connection only exists under an established set of facts. Either the plaintiff suffered a wrongful loss and should be compensated for it, or she did not. There are no intermediate possibilities,

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81 John Coons argues that this very feature of equality before the law in cases of factual indeterminacy requires that when the parties assert equally probable versions of the facts, the remedy be divided between them. *See* Coons, *supra* note 2, at 757.

82 Correlativity can explain other evidentiary requirements. For example, correlativity demands that the remedy be determined solely on the basis of the interaction between the parties, regardless of the actions of other similarly situated parties or even previous actions of the plaintiff and the defendant. This would mean that statistical evidence should be inadmissible, and certainly cannot be the basis of any remedial relief. *See* Wright, *Causation, Responsibility*, *supra* note 79, at 1298.

which do not conform with any possible factual state. Proportional liability is thus inconsistent with the correlativity requirement, since it does not present the required connection between the right of the plaintiff to compensation and the duty of the defendant to pay. The House of Lords used similar reasoning in Gregg v. Scott to reject the lost chance of recovery doctrine in the United Kingdom, stating that "inability to establish that delay in diagnosis caused the reduction in expectation in life cannot be remedied by treating the outcome as having been somehow indeterminate."[83]

The combination of the procedural elements of corrective justice—placing the burden of proof on the plaintiff, respect for the formal equality between the parties when considering competing factual accounts, and basing the decision only on a possible factual state—leads to the adoption of the preponderance of the evidence rule. Under the rule, the factfinder chooses one possible factual state and resolves the uncertainty in a way that treats the parties equally by giving them equal opportunity to convince the factfinder.

These two reasons for adopting the preponderance of the evidence rule are relevant to all cases of factual uncertainty. In Example 3, the loss of earning capacity example, we saw that applying the preponderance of the evidence rule leads to the median value and not the mean. The normative justification for the preponderance of the evidence rule in binary cases applies just as well in continuous cases—the median value always corresponds to one of the possible factual states that the factfinder is considering. Thus, the choice of the median does not require the judge to manufacture a state of the world she knows does not exist. The mean income, on the other hand, does not share this property. For example, assume that there are three working people in the population: two who earn 10 and one that earns 30. The mean income is 20, even though no one in the population has an income of 20. Thus, compensating victims according to the mean income forces the judge to manufacture a factual state that she knows does not exist.

The median also observes the formal equality of the parties—when the factfinder chooses the median, the cumulative probability does not favor one party over the other.[84] The mean does not share this feature—often the

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83 See Gregg (FC) v. Scott (2005).

84 In continuous and discrete cases that present more than two factual states, the median value represents both the minimum amount of damages that the defendant should pay, from her perspective, and the maximum amount that the plaintiff is entitled to, from her perspective. For a discrete example, assume that the factfinder considers three possible states, A, B and C. In state A the just compensation is 0, and the probability that it happened is 35%; in state B the defendant owes 100, and the probability assigned by the factfinder to this state is 40%; and in state C, defendant owes 200. The probability assigned by the factfinder to this last

probability distribution is skewed to one side, making the mean an unlikely event. For example, as mentioned earlier, in many countries the mean income is higher than the median.[85] Since it is more probable than not that the plaintiff's future earnings would have been lower than the mean income, compensating according to the mean violates the defendant's right to formal equality and overcompensates the plaintiff.

A completely separate justification for the use of the preponderance of the evidence rule in all cases of factual uncertainty is external to corrective justice, and serves as a second-best solution for achieving the just result in most cases, when the first-best solution—always achieving the just result—is unattainable.

Corrective justice, as a comprehensive theory of private law, can state for every factual state what the just allocation of remedies is. In every case of factual uncertainty, the factfinder knows what the just allocation is for any possible state, and is aware that it might make the wrong factual decision and, as a result, might wrongfully grant a remedy or deny it. As David Kaye first showed, when the factfinder considers two alternative states, the preponderance of the evidence rule minimizes the erroneous, and as a result unjust, allocation of remedies between the two parties more than any other alternative, including proportional liability.[86] For example, on the assumption that the probability of causation is 40%, and the harm is 100, under the preponderance of the evidence rule the factfinder would hold the defendant not liable. Since there is a 40% chance that the factfinder misallocated a remedy of 100, the expected error is 40. Now, if the factfinder were to award compensation of 40 under proportional liability, the probability that it would undercompensate the victim by 60 is 40%, while the probability that it would overcompensate the victim by 40 is 60%, making the expected error 48, higher than under the preponderance of the evidence rule. This justification holds for cases of continuous factual states as well—the median factual state minimizes the erroneous allocation of remedies, in the same way that the preponderance of evidence rule minimizes the erroneous allocation of remedies in binary cases. If we believe that for every set of facts there is a correct (or just) allocation

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state is 25%. In this example, from the plaintiff's perspective, there is a 65% chance that she is entitled to at least 100 (the cumulative probabilities of states B and C). Similarly, from the defendant's perspective, there is a 75% chance that she has to pay no more than 100 (the cumulative probability of states A and B). The same reasoning applies to continuous cases. *See supra* Part II.

85 *See supra* note 46.

86 Kaye, *supra* note 5. *See also*, Levmore, *supra* note 4, at 693; Stein, *supra* note 18, at 143-53.

of remedies, but we face uncertainty about which of several sets of facts occurred, using the median would minimize both the risk and the scope of misallocated remedies because of factual uncertainty.[87]

Note that this justification for the preponderance of the evidence rule cannot be based on efficiency or distributive considerations. Error minimization is only efficient if it promotes efficient incentives with regard to primary law. It cannot be an objective by itself, since the law is designed to serve an external goal. As the analysis in this Article shows,[88] proportional liability can create better incentives in many cases, even if it does not minimize the error rate.

The all-or-nothing nature of the preponderance of the evidence rule is also not supported by distributive considerations vis-à-vis the risk of errors. An all-or-nothing outcome places the entire risk of error on one party, while proportional liability divides that risk between the parties. This feature of proportional liability is particularly attractive, when considering the erroneous allocation of remedies across different plaintiffs who file claims against the same defendant. Consider the following example:

Example 6 – air pollution. A power plant operates near a neighborhood and emits significant amounts of pollutants. As a result, nearby residents suffer from increased risk of lung cancer. One hundred residents sue the power plant, arguing that the pollution caused 40 of them to suffer from malignant lung cancer. There is no possibility of identifying which 40 of the plaintiffs are those who would not have suffered from cancer, but for the plant's activity.

The probability that the power plant caused each of the plaintiffs' cancer is 40%. Regarding each plaintiff individually, the risk of an erroneous allocation of remedies is minimized by denying all the claims. But if we consider the distribution of the risk between the parties, it falls solely on the plaintiffs. If the power plant pays 40% of the harm to each plaintiff, according to the probability of causation, then the overall payment will be identical to the overall harm the power plant caused—the harm to 40 unidentified residents. Thus, this solution promotes a just allocation of the risk between the parties.

This solution, however, stands in direct contradiction to the correlativity required by corrective justice—looking at each litigant as an individual forestalls us from counting the injustice done to one defendant or plaintiff against the injustice done to others. For that reason, any doctrine that justifies

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87 For a simple proof that the median minimizes the sum of deviations across a distribution, see Neil C. Schwertman, A. J. Gilks, & J. Cameron, *A Simple Noncalculus Proof that the Median Minimizes the Sum of the Absolute Deviations*, 44 Am. Statistician 38 (1990).

88 *See supra* Part III.

proportional liability with regard to groups of plaintiffs or defendants may promote distributive justice but not corrective justice.[89]

To conclude, corrective justice theory supports the preponderance of the evidence rule, as it allows the factfinder to base its decision on the most likely factual state, while adhering to the formal equality of the parties and to the correlativity requirement. Furthermore, the preponderance of the evidence rule reduces the expected error rate, minimizing the risk of remedies being unjustly allocated between parties. Thus, according to this normative theory of private law, factfinders should always apply the preponderance of the evidence rule in binary and continuous cases.

B. Nominal Factual States

So far, this Article has covered cases of uncertainty concerning binary factual states or continuous states. Factual uncertainty, however, may relate to more than two but a finite number of possible factual states. In most cases, discrete factual states work precisely like a continuum—following corrective justice, the factfinder should apply the preponderance of the evidence rule and choose the median factual state between all the possibilities.

This application of the preponderance of the evidence rule may lead to a problem when the multiple factual states cannot be ordered. In statistics, the set of possible factual states that cannot be ordered is named the discrete nominal variable or categorical variable. Race and gender, for example, are categorical variables. It is impossible to define a median for nominal variables with more than two categories.

For example, consider a case where a plaintiff sues three defendants, arguing that all of them had acted negligently towards the plaintiff and that one unidentified defendant had harmed the plaintiff. If the plaintiff is right, there are three factual states for the factfinder to choose from: for every defendant there is one state in which that defendant caused the harm, and the other two did not. In this case, applying proportional liability is easy—each defendant will pay damages in proportion to the probability that she caused the plaintiff's harm. The median result, however, might not exist. Since the states cannot be ordered, there is no median value, and the cumulative probability of two states has no meaning in this context—it makes no sense to sum the probabilities that two separate defendants are liable.

The only way to apply the preponderance of the evidence rule to this example is to consider each defendant separately and ask whether the probability that

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89 Ernest J. Weinrib, The Idea of Private Law 153 (1995); Ernest J. Weinrib, *Causal Uncertainty*, *supra* note 78, at 137.

she caused the harm is above the 50% threshold. In many cases, especially when there are more than three defendants, no one would be found liable. However, by rejecting all possible states, the factfinder is forced to adopt a factual state under which none of the defendants caused the harm, a state it knows to be false.

This application of the preponderance of the evidence rule also increases the expected erroneous allocation of remedies—if the factfinder had full information, it would have known with certainty that the plaintiff is entitled to compensation. By barring liability, the factfinder creates the highest possible level of erroneous expected liability. Any other rule, including random assignment of liability to one of the defendants, would be better in that respect.

To conclude, corrective justice should usually adopt the preponderance of the evidence rule as the sole decision rule in all cases of factual uncertainty. The only exception may be cases of uncertainty about nominal factual states, where proportional liability might be the lesser of two evils.

Conclusion

This Article attempts to methodically analyze the use of proportional liability in private law. To do so, it deconstructs the concept of factual uncertainty in two ways. First, by noting that factual uncertainty in the legal context involves the factfinder but may not involve the parties, the Article identifies three types of factual uncertainty. From an economic perspective, each type of uncertainty calls for different treatment. For example, when dealing with mutual uncertainty, factfinders should apply proportional liability, while favoring the preponderance of the evidence rule when dealing with institutional uncertainty.

Second, this Article observes that factual uncertainty often pertains to several factual states. It shows that the common binary perception of uncertainty is too narrow. As regards how the two decision rules apply to multiple factual states, the factfinder must adopt the median factual state when applying the preponderance of the evidence rule, and the mean state when applying proportional liability.

The analysis has several possible implications for existing doctrines. In most factual disputes, factfinders rule according to the preponderance of the evidence rule. There are two areas of law where factfinders may act otherwise: in cases of causal uncertainty, the lost chance doctrine and market share liability allow for proportional liability, and in cases of uncertainty regarding damages, proportional liability is the rule rather than the exception.

Interestingly, the default rule for uncertain causation, and the exceptions to the rule, can be explained by combining the two normative theories—when there is no reason to suspect that the distribution between cases is systematically biased, the costs of applying the preponderance of the evidence rule, in terms of distorting the parties' incentives, are low. In these cases, the argument for deviating from the outcome prescribed by corrective justice is insufficient. Only when there has been a strong efficiency reason to adopt proportional liability have factfinders done so by adopting specific doctrines. Furthermore, market share liability deals with uncertainty regarding nominal factual states. As we have seen, in these cases the argument of corrective justice against proportional liability is weaker.

While factfinders mostly apply the preponderance of the evidence rule when examining causation, they always apply proportional liability when assessing damages. For example, in personal injury cases, life expectancy, work-life expectancy, and lost wage are all calculated using the mean and not the median.[90] As mentioned before, awarding compensation according to the mean result is at odds with corrective justice theory—it treats the parties differently, favoring one at the expense of the other, and it also increases the erroneous allocation of remedies and forces the factfinder to rule according to a fabricated factual state, contradicting the correlativity requirement.

This apparent contradiction between the way the law treats uncertainty regarding causation and harm may be the result of the limited view of factual uncertainty. Factfinders tend to interpret the decision rules in a limited way, applying them only to binary states. Factfinders can remedy this contradiction by choosing the median state when assessing damages awards, as required by corrective justice.

The work is not over. This Article is a part of a larger project in which I intend to use a similar framework to tackle other questions regarding the rules of civil procedure and evidence law. For example, the moral argument against the use of naked statistical evidence appears to be contingent on the type of factual uncertainty. The argument, from both economic and corrective justice perspectives, is strong in cases of unilateral uncertainty. It seems, however, that when the factfinder faces mutual uncertainty, both corrective justice and legal economists should not oppose the use of statistical evidence. Another intersection between private law and the rules of evidence involves doctrines that shift the burden of proof. Again, we might reexamine these doctrines, taking into account the type of uncertainty with which they are designed to deal.

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90 *See supra*, note 49.