INVESTING IN PRIVATE EVIDENCE: THE EFFECT OF ADVERSARIAL DISCOVERY

Alice Guerra [†] *and Francesco Parisi*[‡]

ABSTRACT

Much of the conventional wisdom of evidence law rests on the premise that the amount of evidence available in any given case is exogenously determined. With the advent of evidence technology (e.g. dashcams, black-box technology, digital data storage, surveillance cameras), the availability of evidence is substantially controlled by individuals. In this article, we show that evidence rules play an important role in determining individuals' decisions to invest in private evidence. We compare the evidence rules adopted in the USA and Europe and analyze their relative impact on the voluntary adoption of evidence technology. We find that by making private evidence not discoverable, more rather than less evidence would be made available to courts.

1. INTRODUCTION

Technological innovation is rapidly changing the domain and reach of legal discovery. A wide range of our daily activities can be observed and accurately documented at a relatively low cost, and the amount of information that is routinely collected and stored continues to increase at a steady rate. When searching for evidence, factfinders can use modern technologies to acquire information about past events.

While some of these technologies—such as airspace or street surveillance systems—are adopted by governments and municipalities for general security

[†] Department of Economics, University of Bologna, via Angherà 22, 47921, Rimini, Italy. E-mail: alice.guerra3@unibo.it

[‡] School of Law, University of Minnesota, USA and Department of Economics, University of Bologna, Italy.

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purposes, many others involve instruments that are voluntarily adopted by private parties. Examples include dashcams on cars, body or helmet action cameras used by cyclists or police officers, black-box recording technology, Google Timeline®, and other applications of telematic and GPS location devices, digital timestamps of recordings and cellular transmissions, cloud data storage and digital archives, fingerprint, face, and eye recognition systems. Technological progress has reduced the cost of evidence technology, facilitating access to a wide range of information in court proceedings. Notwithstanding some resistance to the use of private evidence technologies and the legal challenges raised against the admissibility of the data collected in court proceedings, European legal systems have revised and extended the application of some of their evidence rules, leveraging on the opportunities offered by these technological transformations (Parisi, Pi, & Guerra, 2022).[1]

Discovery of private evidence in European jurisdictions differs from the discovery rules applied in US jurisdictions (for an extensive review, see, e.g. Moloo et al. 2017). For the purpose of our analysis, a relevant difference is that European courts do not offer instruments of adversarial discovery to let parties engage in "fishing expeditions," (i.e., in the search of evidence that they do not have to strengthen their case). In this article, we consider the effect of these differences in discovery rules on the incentives for the voluntary adoption of evidence technology. Our focus is on investments that are specifically made to collect information about present events that can increase the accuracy of evidence and the ability to satisfy burdens of proof in the event of an accident and future litigation. We generally refer to them as investments in "private evidence." The core idea of this article is that if the party investing in evidence is given the option to present or withhold it, there is a greater incentive to make the investment, which can be desirable. This basic intuition follows the same logic of Kronman's (1978) seminal paper: If a contracting party has a legal duty to disclose information that benefits his contractual counterpart (e.g. a requirement to disclose positive information, such as hidden qualities of the good that he wants to purchase), his ex-ante incentives to acquire the information would be

1 See, e.g. the challenges to the admissibility of webcam videos, which reached the German Federal Court of Justice (one of Germany's multiple topical Supreme Courts), 15 May 2018—VI ZR 233/17. Although the Court affirmed that ongoing recording and video storage of normal driving is not permitted, as a violation of the personality rights of other traffic participants, recordings triggered by cause (either through technical means such as an accelerometer detecting the onset of sharp braking, or manually in the case of a driver wishing to document something like road rage from another driver) are permitted. Ongoing deletion of the information recorded is required, with a data securing function only warranted when some relevant event occurs.

undermined.[2] By analogy, our article suggests that by protecting evidentiary information, regimes of nondiscoverable evidence encourage ex ante investments in private evidence, with a greater overall supply of information to factfinders. We can similarly recast this intuition along the lines of Shavell (1992), who showed that—under a negligence rule—if an injurer can be held negligent when he discovered the risk but did not take adequate precautions, but he would be held not negligent when he did not do any ex ante investigation about the risk, then acquiring information about the risk would be inefficiently discouraged. By analogy, in our context, ex ante investments in private evidence would be inefficiently discouraged when the collected information can be used in court against the party investing in such evidence.[3]

The anecdotal evidence observed in Europe supports the intuition presented in our article. Unlike in the US legal system, the conservative approach to legal discovery followed in European jurisdictions has fostered individuals to voluntarily invest in private evidence. Those traveling in Europe have noticed the frequent use of dashcams and other internal and external video recording devices on private cars, taxis, Uber cars, limousines, as well as tourist buses and delivery trucks. In the event of an accident, the devices are made available to factfinders and the recordings are produced in court by the drivers or their insurers to provide evidence that could help support their case. The different effect of European and US evidence law on the incentives to invest in private evidence is amplified by the insurance market. Although drivers are not required to install dashcams in their vehicles, in Europe the adoption of dashcams is highly encouraged by insurance companies. Many insurance companies in Europe—and every insurance company in Italy[4]—offer premium discounts to drivers who voluntarily install webcams on their vehicles, given that the evidence collected by those devices can be used by the insurance companies to reduce their liability exposure, but not adversarially discovered against them.[5] Although in the US several insurance

2 See also Allen et al. (1990), showing how the attorney–client privilege and the work product doctrine—both suppressing evidence—may lead to more evidence presented to the court.

3 On information disclosure and discovery, see also Shavell (1989), who contrasted voluntary disclosure and discovery, and analyzed how this comparison is affected by whether the party has private information.

4 See "DDL S. 2085—Senato della Repubblica." Available at http://www.senato.it/ (last accessed: December 2021).

5 "Now dashboard cameras, or dashcams, are increasing in popularity as many motorists see them as a good way to help prove their innocence in road accidents. And now having a dashcam could mean saving, as some insurers offer customers discounts on their car insurance premiums if they have a dashcam installed." Torney, Chris. 2014. Cheaper Cover for Drivers with Dashcams. http://www.confused.com/car-insurance/articles/the-insurer-offering-discounts-to-drivers-with-dashcams (last accessed: May 2020). See also Štitilis & Laurinaitis (2016).

companies offer discounts if "telematic" devices—devices that have no audio or video recording—are installed to monitor drivers' driving patterns (e.g. Progressive Insurance's Snapshot®),[6] no US insurance company offers premium discounts to their insureds for installing dashcams with video recording.[7]

The remainder of this article is structured as follows. In Section 2, we provide the legal background of our article, discussing how the more conservative use of adversarial discovery in European civil procedure has fostered investments in private evidence. In Section 3, we use a simple analytical model to study the impact of different evidence rules on voluntary adoption of different types of private evidence technology. In Section 4, we discuss the results and conclude with ideas for future research.

2. LEGAL BACKGROUND

The incentives to adopt evidence technology by private parties are affected by a critical feature of evidence law: its adversarial discovery. The differences between the rules governing adversarial discovery in the USA and Europe are significant and—put simply—the reach of adversarial discovery as practiced in the USA is not available in civil law jurisdictions (for extensive references, see Moloo et al., 2017).

In 1938, the enactment of the Federal Rules of Civil Procedure in the USA gave origin to one of the most far-reaching discovery systems in the world, authorizing discovery into any matter that is not privileged, which is relevant to the subject matter of the case. As Allen et al. (1990) pointed out, in most litigation settings modern US discovery rules make a fetish out of free access to all information, rendering most of the available evidence discoverable (Miller & Tucker, 2012; Haydock & Herr, 2016). As Subrin (1998) put it, the Federal Discovery Rules have opened the doors to "fishing expeditions" through adversarial discovery, where litigants are allowed access to documents and data of the opposing party for exploratory reasons in the search for information that may strengthen their case or weaken the case of their opponent.[8] Rules of civil procedure at the state level have followed the federal example, introducing some limits on discovery only in the interest of procedural economy.

6 https://www.boltinsurance.com/pros-and-cons-of-using-insurance-driving-monitors-in-your-car/ (posted March 5, 2020)

7 No insurance company offers premium discounts for using a dash camera. https://www.insurance.com/auto-insurance/claims/7-reasons-to-use-a-dash-cam.html (posted February 13, 2020).

8 For example, in *United States v. Microsoft*, 87 F. Supp. 2d 30 (D.D.C 2000), prosecutors used e-mails sent between Microsoft executives to prove anti-competitive intent towards Netscape. For other examples of e-discovery, see Miller & Tucker (2012).

Under a fully discoverable evidence regime, keeping track of one's actions makes the saved information subject to being discovered and subpoenaed, and possibly used as evidence by opposing parties in the event of a dispute. Under US evidence law, private investments in evidence could thus have a backlash effect on the party that invested in the technology. The impact of discovery practice on private information technology in the USA has been widely documented in the empirical legal literature (e.g. Miller & Tucker, 2012).[9]

The nonadversarial procedural traditions of Europe adopt a different approach in legal discovery, letting each party produce the evidence that is available to them, with very narrow use of court-ordered discovery of evidence (Redish, 2001; Foggo et al., 2007; Murray, 2007; Bakhsh, 2011). These approaches are deeply entrenched in the civil law tradition and echoed in current case law, as best exemplified by the rules and cases governing adversarial discovery in Europe. A few representative examples are offered below.

The relevant laws governing the discovery of evidence in France are Articles 10, 138, and 139 of the Code of Civil Procedure ("*Code de procédure civile*"). Under the French Code of Civil Procedure, parties may petition the court to order the other party or third parties to produce evidentiary material (Article 10), but the judge's decision to allow discovery is discretionary (Guinchard & Ferrand, 2009, Nos. 341-42 and 341-52). However, French judges do not allow adversarial access to evidence for exploratory reasons, and only force production of evidence in cases where the opposing party already has knowledge of the content of the sought-after evidence and has no other means to prove its claim (e.g. to obtain a signed agreement that remained in possession of the opposing party; El Ahdab & Bouchenaki, 2011).[10]

The opportunity for adversarial use of evidence under the Italian Code of Civil Procedure ("*Codice di Procedura Civile*") is even narrower, allowing parties to seek sequestration of physical documentary evidence (now interpreted to also include electronic, audio, and video evidence) that contains information already known to the other party and that—if later admitted by the court—could be critical for the resolution of the dispute (Article 670 Italian Code of Civil Procedure).[11] The role of the sequestration is purely conservative: evidence is placed in the trust of a third party, and it is not given to the

9 Miller & Tucker (2012) studied the effects of state e-discovery rules on the adoption of electronic medical records by hospitals. The study suggests that in states that adopt e-discovery rules, hospitals reduced the use of electronic records to limit risks that they could be adversely discovered and used against them in future litigation.

10 Requirements on the petitioning party further limit the application and viability of forced production petitions within the French legal system (Moloo et al., 2017).

11 For discovery practices in selected jurisdictions, see Moloo et al. (2017).

opposing party for the search of other information that could help to corroborate their case (Article 671 Italian Code of Civil Procedure). The admissibility of the preserved evidence in court is governed by Article 210 of the Italian Code of Civil Procedure. Italian case law—ranging from trial courts to a recent decision of the Italian Supreme Court ("*Corte di Cassazione*")—has narrowly interpreted Article 210, affirming that adversarial discovery is granted at the discretion of the judge, and should not be granted as an instrument to aid the party in meeting the burden of proof.[12] Case law restated that the content of the requested evidence should be known and specified by the requesting party, and discovery should not be asked for exploratory reasons.[13] If the requesting party fails to specify the exact content of the document requested through adversarial discovery, the request should be denied.[14] In 2016, the Italian Supreme Court reaffirmed this principle, highlighting its rationale when it stated that "the purpose of discovery is not to help the party prove something that he would not have been able to prove in the absence of the new information acquired through discovery."[15]

The relevant rules governing the adversarial discovery of evidence in Germany are found in the German Code of Civil Procedure ("*Zivilprozessordnung*"). Similar to its French and Italian counterparts, the German Code of Civil Procedure does not offer procedures for pretrial discovery similar to those found in US jurisdictions, and the German principle against the use of discovery for exploratory reasons is upheld in case law.[16] Also in transnational litigation, under German law there is no general obligation to produce documents to assist the opposing party. This procedural principle led Germany to introduce reservations in the ratification of the Hague Service of Process Convention, which entered into force on June 26, 1979. In ratifying the Hague Convention, Germany introduced declarations and reservations that excluded the application of Chapter II of the Convention. As a result, in transnational disputes, Germany will not execute requests of pretrial discovery of documents as known in the USA (Article 23 of the Declaration).

In Section 3, we use a simple analytical model illustrate the effect of these procedural differences on individuals' incentives to invest in private evidence technology.

12 Tribunale—Frosinone, 18/04/2018, n. 379; Tribunale—Grosseto, 07/01/2020, n. 8.

13 Tribunale—Spoleto, 01/07/2019, n. 461.

14 Corte Appello sez. I—Torino, 08/07/2019, n. 1153.

15 Cassazione civile sez. I - 15/03/2016, n. 5091.

16 Federal Court of Appeals (BGH), June 4, 1992, NJW 1992, 3096 (3099).

3. A STYLIZED MODEL

We consider two parties—a potential injurer (I) and a prospective victim (V)—facing the risk of an accident under a negligence regime. We distinguish between two types of evidence technologies: those better able to track the user's actions, which we refer to as "first-party evidence" (FP); and those better able to document the activity of others, which we refer to as "third-party evidence" (TP). Examples of FP include black-box technology, Google Timeline®, Snapshot®, and cloud data storage. Examples of TP include surveillance cameras, fingerprints and face recognition.

In the following, we define the variables of the model, and then formally analyze Injurer's incentive to adopt evidence technology under nondiscoverable versus discoverable evidence regimes. Similar reasoning applies to Victim's incentives.

$x_I^{FP} \in \Re^+$: Injurer's investment in FP

$x_I^{TP} \in \Re^+$: Injurer's investment in TP

$x_V^{FP} \in \Re^+$: Victim's investment in FP

$x_V^{TP} \in \Re^+$: Victim's investment in TP

$E_I^{FP}(x_I^{FP})$: Evidence pertaining to Injurer's behavior/negligence produced by x_I^{FP}.

$E_I^{TP}(x_V^{TP})$: Evidence pertaining to Injurer's behavior/negligence produced by x_V^{TP}.

$E_V^{FP}(x_V^{FP})$: Evidence pertaining to Victim's behavior/negligence produced by x_V^{FP}.

$E_V^{TP}(x_I^{TP})$: Evidence pertaining to Victim's behavior/negligence produced by x_I^{TP}.

We assume that, from an ex ante perspective, each party is equally likely to be negligent or not negligent. That is, any x is equally likely to produce evidence showing that Injurer/Victim was negligent and evidence that Injurer/Victim was not negligent.

Let $b_I \in \Re^+$ denote a measure of Injurer's behavior, *as perceived by the court*, where a lower b_I represents more prudent behavior and a higher b_I represents less prudent (more negligent) behavior. Before hearing any private evidence, the court perceives b_I^0. The private evidence that is presented to the court increases or decreases b_I.

Let $b_V \in \Re^+$ denote a measure of Victim's behavior, *as perceived by the court*, where a lower b_V represents more prudent behavior and a higher b_V represents less prudent (more negligent) behavior. Before hearing any private

evidence, the court perceives b_V^0. The private evidence that is presented to the court increases or decreases b_V.

Let $\alpha(b_I, b_V) \in [0, 1]$ denote Victim's probability of winning (or share of damage award) at trial, where $\frac{d\alpha(b_I,b_V)}{db_I} > 0$ and $\frac{d\alpha(b_I,b_V)}{db_V} < 0$ with decreasing marginal effects, i.e. $\frac{d^2\alpha(b_I,b_V)}{db_I^2} < 0$ and $\frac{d^2\alpha(b_I,b_V)}{db_V^2} > 0$.[17]

We begin by analyzing Injurer's incentives to invest in private evidence technology under nondiscoverable evidence regimes, wherein the information gathered by private evidence technology is not discoverable by the opposing party, and can only be used by the user of the technology.

The evidence that the court would hear under a nondiscoverable evidence regime is summarized in Table 1.

Let us denote the top-left cell by "N, N;" the bottom-left cell by "N, NN;" the top-right cell by "NN, N;" and the bottom-right cell by "NN, NN." These four situations represent objective facts about the state of nature (i.e. whether Injurer/Victim was negligent or not), and not a court ruling about the parties' negligence. For example, the "NN, NN" situation represents a state of nature where both parties are non-negligent, and not a court finding that they are both non-negligent.

Injurer's payoff would be:

$$\Pi_I = \frac{1}{4}\Big[\alpha^{N,N}(b_I^{N,N}, b_V^{N,N}) + \alpha^{N,NN}(b_I^{N,NN}, b_V^{N,NN}) + \\ + \alpha^{NN,N}(b_I^{NN,N}, b_V^{NN,N}) + \alpha^{NN,NN}(b_I^{NN,NN}, b_V^{NN,NN})\Big] D + x_I^{FP} + x_I^{TP} \quad (1)$$

Injurer's investment in first-party private evidence, x_I^{FP}, satisfies the FOC:

$$\frac{1}{4}\left[\frac{d\alpha^{NN,N}(b_I^{NN,N}, b_V^{NN,N})}{db_I} + \frac{d\alpha^{NN,NN}(b_I^{NN,NN}, b_V^{NN,NN})}{db_I}\right] \cdot \frac{dE_I^{FP}(x_I^{FP})}{dx_I^{FP}} \cdot D = 1 \quad (2)$$

17 Without the loss of generality, these conditions refer to negligence regimes where the behavior of both parties is taken into consideration for the allocation of liability (i.e. contributory negligence and comparative negligence regimes). The same qualitative results would apply to regimes of simple negligence, where courts only take into account the behavior of the injurer, $\frac{d\alpha(b_I,b_V)}{db_I} > 0$ and $\frac{d\alpha(b_I,b_V)}{db_V} = 0$, and strict liability with a defense of contributory negligence, where courts only take into account the behavior of the victim, $\frac{d\alpha(b_I,b_V)}{db_V} < 0$ and $\frac{d\alpha(b_I,b_V)}{db_I} = 0$. Under these latter liability regimes, evidence technology would be focused on the party whose behavior is relevant for the adjudication of the case, and the incentives to invest in that evidence technology will be similarly affected by discovery rules.

Table 1. Evidence under nondiscoverable evidence regimes.

Panel a

		Injurer	
		Negligent	Not negligent
Victim	Negligent	$E_I^{TP}(x_V^{TP})$, $E_V^{TP}(x_I^{TP})$	$E_I^{FP}(x_I^{FP})$, $E_V^{TP}(x_I^{TP})$
	Not negligent	$E_I^{TP}(x_V^{TP})$, $E_V^{FP}(x_V^{FP})$	$E_I^{FP}(x_I^{FP})$, $E_V^{FP}(x_V^{FP})$

Panel b

		Injurer	
		Negligent	Not negligent
Victim	Negligent	$b_I = b_I^0 + E_I^{TP}(x_V^{TP})$ $b_V = b_V^0 + E_V^{TP}(x_I^{TP})$	$b_I = b_I^0 - E_I^{FP}(x_I^{FP})$ $b_V = b_V^0 + E_V^{TP}(x_I^{TP})$
	Not negligent	$b_I = b_I^0 + E_I^{TP}(x_V^{TP})$ $b_V = b_V^0 - E_V^{FP}(x_V^{FP})$	$b_I = b_I^0 - E_I^{FP}(x_I^{FP})$ $b_V = b_V^0 - E_V^{FP}(x_V^{FP})$

Injurer's investment in third-party private evidence, x_I^{TP}, satisfies the FOC:

$$\frac{1}{4}\left[-\frac{d\alpha^{N,N}(b_I^{N,N}, b_V^{N,N})}{db_V} - \frac{d\alpha^{NN,N}(b_I^{NN,N}, b_V^{NN,N})}{db_V}\right] \cdot \frac{dE_V^{TP}(x_I^{TP})}{dx_I^{TP}} \cdot D = 1 \qquad (3)$$

Next, let us analyze the incentives to invest in private evidence technology under discoverable evidence regimes, where all the evidence gathered by private evidence technology is discoverable by the opposing party and may be used against the user of the technology.

The evidence that the court would hear under a discoverable evidence regime is summarized in Table 2.

Injurer's payoff would be the same as in the nondiscoverable evidence case (Equation 1). Injurer's investment in first-party private evidence, x_I^{FP}, satisfies the FOC:

$$\frac{1}{4}\left[\frac{d\alpha^{NN,N}(b_I^{NN,N}, b_V^{NN,N})}{db_I} + \frac{d\alpha^{NN,NN}(b_I^{NN,NN}, b_V^{NN,NN})}{db_I} + \right.$$
$$\left. - \frac{d\alpha^{N,N}(b_I^{N,N}, b_V^{N,N})}{db_I} - \frac{d\alpha^{N,NN}(b_I^{N,NN}, b_V^{N,NN})}{db_I}\right] \cdot \frac{dE_I^{FP}(x_I^{FP})}{dx_I^{FP}} \cdot D = 1 \qquad (4)$$

Table 2. Evidence under discoverable evidence regimes.

Panel a

		Injurer	
		Negligent	Not negligent
Victim	Negligent	$E_I^{FP}(x_I^{FP}),\ E_I^{TP}(x_V^{TP})$ $E_V^{FP}(x_V^{FP}),\ E_V^{TP}(x_I^{TP})$	$E_I^{FP}(x_I^{FP}),\ E_I^{TP}(x_V^{TP})$ $E_V^{FP}(x_V^{FP}),\ E_V^{TP}(x_I^{TP})$
	Not negligent	$E_I^{FP}(x_I^{FP}),\ E_I^{TP}(x_V^{TP})$ $E_V^{FP}(x_V^{FP}),\ E_V^{TP}(x_I^{TP})$	$E_I^{FP}(x_I^{FP}),\ E_I^{TP}(x_V^{TP})$ $E_V^{FP}(x_V^{FP}),\ E_V^{TP}(x_I^{TP})$

Panel b

		Injurer	
		Negligent	Not negligent
Victim	Negligent	$b_I = b_I^0 + E_I^{FP}(x_I^{FP}) + E_I^{TP}(x_V^{TP})$ $b_V = b_V^0 + E_V^{FP}(x_V^{FP}) + E_V^{TP}(x_I^{TP})$	$b_I = b_I^0 - E_I^{FP}(x_I^{FP}) - E_I^{TP}(x_V^{TP})$ $b_V = b_V^0 + E_V^{FP}(x_V^{FP}) + E_V^{TP}(x_I^{TP})$
	Not negligent	$b_I = b_I^0 + E_I^{FP}(x_I^{FP}) + E_I^{TP}(x_V^{TP})$ $b_V = b_V^0 - E_V^{FP}(x_V^{FP}) - E_V^{TP}(x_I^{TP})$	$b_I = b_I^0 - E_I^{FP}(x_I^{FP}) - E_I^{TP}(x_V^{TP})$ $b_V = b_V^0 - E_V^{FP}(x_V^{FP}) - E_V^{TP}(x_I^{TP})$

Injurer's investment in third-party private evidence, x_I^{TP}, satisfies the FOC:

$$\frac{1}{4}\left[-\frac{d\alpha^{N,N}(b_I^{N,N}, b_V^{N,N})}{db_V} - \frac{d\alpha^{NN,N}(b_I^{NN,N}, b_V^{NN,N})}{db_V} + \right.$$
$$\left. + \frac{d\alpha^{N,NN}(b_I^{N,NN}, b_V^{N,NN})}{db_V} + \frac{d\alpha^{NN,NN}(b_I^{NN,NN}, b_V^{NN,NN})}{db_V}\right] \cdot \frac{dE_V^{TP}(x_I^{TP})}{dx_I^{TP}} \cdot D = 1 \tag{5}$$

The previous analysis allows us to compare the incentive effects of the two discovery regimes under consideration. Let us begin by considering Injurer's incentives to invest in FP technology. This formally follows from the comparison between the FOCs under the two discovery regimes in Equations (2) and (4). The comparison shows the presence of two extra negative terms on the left-hand side of Equation (4). Those two terms capture the possible backlash effect of owning FP technology under discoverable evidence regimes. The backlash effect is given by the fact that Victim can subpoena the FP of her Injurer to prove his negligence. Specifically, the first term, $-\frac{d\alpha^{N,N}(b_I^{N,N}, b_V^{N,N})}{db_I}$, represents the

increased probability that Victim may prove Injurer's negligence, when both parties are negligent, i.e. in the "N, N" situation. The second term, $-\frac{d\alpha^{N,NN}(b_I^{N,NN},b_V^{N,NN})}{db_I}$, represents the increased probability that Victim may prove Injurer's negligence, when he is negligent and she is non-negligent, i.e. in the "N, NN" situation. Given these effects, Injurer will have weaker incentives to invest in FP under a discoverable-evidence regime.

Similarly, we can consider Injurer's incentives to invest in TP technology by contrasting Equation (3) vs Equation (5). The comparison shows the presence of two extra positive terms on the left-hand side of Equation (5), representing the increased probability that Victim may prove lack of negligence on her part. Specifically, the first term, $\frac{d\alpha^{N,NN}(b_I^{N,NN},b_V^{N,NN})}{db_V}$, captures the risk that Victim may use Injurer's TP to prove lack of negligence on her part, when Injurer is negligence, i.e. in the "N, NN" situation. Also the second term, $\frac{d\alpha^{NN,NN}(b_I^{NN,NN},b_V^{NN,NN})}{db_V}$, could reduce Injurer's incentives to invest in TP, because such evidence could help Victim prove lack of negligence on her part when both Injurer and Victim are non-negligent, i.e. in the "NN, NN" situation.[18] Given these effects, Injurer will have weaker incentives to invest in TP under a discoverable-evidence regime.

Victim's incentives to invest in private evidence can be derived following a similar logic. In the interest of brevity, we skip the mirror-image derivation of the results, but similar reasoning would show that adversarial discovery of Victim's FP would increase the probability that Injurer may prove Victim's negligence. This would reduce Victim's incentives to invest in private evidence. Likewise, adversarial discovery of TP would increase the probability that Injurer may prove lack of negligence on his part. In sum, lower overall investments in both types of private evidence would be observed under discoverable evidence regimes.

4. DISCUSSION

Much of the conventional wisdom of evidence law rests on the premise that the amount of evidence generally available in any given situation is exogenously determined (e.g. the number of witnesses or the amount of physical evidence available after an accident is generally not controlled by the parties). With the advent of new private evidence technology, the availability of evidence can be

18 In negligence regimes, when the injurer is not negligent, evidence of the victim's negligence is theoretically immaterial. However, in the "NN, NN" situation, a court may mistakenly find that the injurer was negligent, and thus TP that increases the likelihood that the court finds the victim non-negligent (in accordance with the true state) could be detrimental to the injurer.

endogenously controlled by the individuals involved in a prospective accident. And, when the production of evidence is controlled by the parties, evidence rules can play an important role in determining the decision to invest in private evidence.

In this article, we studied the effects of discovery rules in incentivizing investments in evidence technology. The analysis shows that the value of private evidence is reduced when its content can be legally obtained by the opposing party through adversarial discovery. Making evidence discoverable reduces the incentives to invest in private technology, ultimately reducing—instead of increasing—the amount of information made available to the factfinder. This finding follows the logic of Kronman (1978), according to which duties to disclose private information discourage parties to acquire information ex-ante.

The understanding of these effects—which have thus far been underexplored in the literature—deserve further investigations in a wide variety of contexts. Even though the running example and discussion of our article have been tort-centric, the issue of investment in evidence is ubiquitous and arises in contract and employment settings, compliance with financial, environmental, and safety regulations, and a wide array of other legal relationships, some of which may entail the use of highly specialized and accurate forms of evidence technology. Indeed, the core result of our article is fairly general and intuitive. The observed practice in the creation and preservation of the leading source of evidence—e-discovery of e-mails and documents—provides an illustration beyond the immediate scope of our accident law examples. As a first attempt at exploring the effects of discovery rules, our framework has been intentionally kept simple and stylized. Inevitably, some relevant extensions have been set aside for future investigation.

To begin with, a first extension could investigate the interdependent effect of discovery rules and legal presumptions on the incentives to invest in private evidence, and when parties make investments under role-uncertainty.[19] Formally, our analytical setting could be used to capture the effect of legal presumptions by using the b_I^0 and b_V^0 parameters of our stylized model. A presumption of the injurer's negligence can be expressed by setting a high b_I^0. This would reduce the marginal effect of private evidence about the injurer's negligence. Conventional wisdom suggests that parties expecting to be defendants with a legal presumption in their favor should minimize the retention of information that is not legally required, because the adversarial use of that information may be more likely to hurt rather than help them. On the other hand, parties that need to overcome a legal presumption against them—for example,

19 See Guerra, Luppi & Parisi (2022) on the effects of legal presumptions on care incentives.

by demonstrating compliance with safety or environmental standards—should collect and preserve evidence. In this respect, future work—both theoretical and empirical—should investigate the possibility to leverage the effects of alternative legal presumptions and burdens of production on the incentives to generate and preserve evidence in tort cases and other areas of law.

Secondly, when considering discoverable evidence regimes, we assumed that all the evidence gathered by the technology was discoverable by the opposing party and could be used against the user of the technology. Current discovery practice may give rise to situations that depart from this ideal scenario. For example, evidence technology may be concealed (e.g. hidden cameras), reducing the awareness of third parties regarding its existence. Likewise, private evidence can be lawfully discarded before discovery. The use of concealed technology or the possibility to discard data may thus limit the reach of adversarial discovery. Our model of nondiscoverable evidence regimes was similarly kept simple. We considered the limiting case where evidence gathered through private investments in evidence technology could only benefit—and never hurt—the user of the technology. Again, here we omitted some aspects that may deserve attention in future research. For example, in most European jurisdictions, even if the judge knows that the defendant has private evidence, discovery cannot be ordered unless the plaintiff specifies exactly what the alleged content of the evidence would be. However, when such conditions are not met, the judge may draw inferences from the defendant's unwillingness to disclose the evidence voluntarily (e.g. the judge may infer that the video may contain unfavorable information for the defendant). If these inferences are possible, the defendant's investment in private evidence technology could possibly benefit the plaintiff, also in a nondiscoverable evidence regime.

Future studies should assess the potential impact of these omitted factors on our results. Intuitively, the results of all the above extensions would show that most departures from the limiting cases of fully discoverable or nondiscoverable evidence presented in this article would mitigate the effects derived for the two discovery regimes, but would not alter the qualitative results of our analysis. Some of these extensions would likely generate corollary results that run contrary to the prevailing legal wisdom. For example, to preserve the private value of nondiscoverable evidence, we may want to prevent judges from drawing any negative inference from a party's refusal to disclose private evidence. Similarly, counterintuitive results might be reached for the legal admissibility of concealed evidence technology and the rules governing the preservation of private evidence.

Finally, our framework can be extended to explore litigation incentives and the possibility of pretrial settlement under alternative discovery rules when parties can invest in evidence technology. Even though this article does not

address this issue formally, we may plausibly expect that the conditions we identified will optimally guide the choice of evidence regimes to minimize litigation rates, especially for wrongful claims.

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