Cost Burden and Credibility*

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Abstract. The cost of reporting a crime is always considered a hurdle to reporting. This paper shows that when the adjudication process is not very informative, a higher but still modest cost burden performs a valuable screening function and allows a higher equilibrium rate of conviction based on an unrefuted accusation. This higher conviction rate induces the victims to report more and reduces the type 2 error of letting go a guilty offender. This implies that the policy to discourage cross-examination in the adjudication process of Title IX cases in the name of reducing the cost burden for the victims can have the unintended consequence of discouraging reporting even if cross-examination does not expose lies directly. When the standard of proof and the cost burden can both be controlled, a policy that locally increases the cost burden and raises the standard of proof accordingly can reduce both type 1 and type 2 errors as long as the conviction rate is not full.

Keywords: credibility, screening, cross-examination, libel, report crime, standard of proof, Title IX

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JEL Classification. K13; K14; K41; D83

1. Introduction

There is a consensus that crimes are not always reported, especially sexual crimes where hard evidences are rare and only weak evidences of a he-says-she-says nature are available.[1] In response to this, the Obama administration's Office for Civil Rights (OCR) within the Department of Education issued a Title IX guidance through a Dear Colleague Letter to universities in 2011, followed by a Q&A in 2014. The main controversy of this set of guidance concerns two policies. First, when adjudicating Title IX grievance processs, the 2011 letter stated that the university should only use "preponderance of evidence" as a standard of proof (which is significantly lower than the "beyond reasonable doubt" standard for a criminal trial). Second, the 2014 Q&A stated that cross-examination should not be conducted by the parties because "[a]llowing an alleged perpetrator to question a complainant directly may be traumatic or intimidating, and may perpetuate a hostile environment."

The right to adversarial cross-examination is deeply rooted in the Sixth Amendment ("to be confronted with the witnesses against him") and the Fourteenth Amendment ("nor shall any State deprive any person of life, liberty, or property, without due process of law"). The due process requires an opportunity to confront and cross-examine adverse witnesses even in civil trials and administrative hearings "where important decisions turn on questions of fact, due process requires an opportunity to confront and cross-examine adverse witnesses."[2] The 2014 Q&A argued that "a Title IX investigation will never result in incarceration of an individual and, therefore, the same procedural protections and legal standards are not required." That is, the government at the time was simply willing to

[1] Based on a 2019 survey of the Bureau of Justice Statistics, less than half (41%) of violent crimes were reported to police and only 33.9% of rape/sexual assaults were reported to police. See Morgan and Truman (2019).

[2] Goldberg v. Kelly, 397 U.S. 254, 269 (1970).

bear more type 1 error of wrongly sanctioning an innocent person. The lack of cross-examination triggered several lawsuits against the universities alleging violation of the due process rights of the sanctioned students. The court opinions were split on whether the lack of cross-examination violated the students' due process. In Newsome v. Batavia[3], the First Circuit held in 1988 that the benefit of cross-examination is outweighed by the "necessity of protecting student witnesses from ostracism and reprisal" such that cross-examination of student accusers is not required. However, in Doe vs. Baum[4], the Sixth Circuit in 2018 held that either the accused or his agent must have the opportunity to directly cross-examine the accuser and adversarial witnesses when a school disciplinary proceeding turns upon the credibility of the two parties.

Whether cross-examination should be part of the Title IX adjudication process continues to be a contentious and political issue: after it was banned in 2011-2014 under the Obama administration, it became mandatory in 2020 under the first Trump administration, and then changed to being not mandatory in 2024 under the Biden administration, and then back to being mandatory in 2025 under the second Trump administration.[5] While the politicians might have been largely motivated by doing simply the opposite of what the opposing parties have done, it is important for law and economics scholars to seek clarity of the merits of these policies.

The proponents of eliminating the cross-examination all pointed to the cost burden imposed on the accusers by the cross-examination as a major justification for eliminating it. In response to Trump Administration's proposal to introduce the requirement of cross-examination in 2018, over 900 mental health professionals submitted a comment

[3]Newsome v. Batavia Loc. Sch. Dist., 842 F.2d 920, 924-26 (6th Cir. 1988)

[4]Doe v. Baum, 903 F.3d 575, 578 (6th Cir. 2018).

[5]"U.S. Department of Education to Enforce 2020 Title IX Rule Protecting Women" Press Release, Jan 31, 2025.

arguing that requiring cross-examination "would exacerbate psychological harms to victims." In additional to the cost of the psychological pain, Dowling (2020) argued that accusers cannot afford legal counsel to effectively navigate the cross-examination process. These opinions concluded that allowing cross-examination will deter reporting from the victims. Brett Sokolow, President of Association of Title IX Administrators, asserted in 2018 "that the requirement for cross-examination in live hearings –even with accommodations like questioning from a separate room – would lead to a 50 percent drop in the reporting of misconduct."[6] A second argument for banning cross-examination is that cross-examination does not add much value. In Haidak v. Univ. of Mass.-Amherst, the First Circuit noted in 2019 that "[c]onsiderable anecdotal experience suggests that cross-examination in the hands of an experienced trial lawyer is an effective tool," but "(i)n the hands of a relative tyro, cross-examination can devolve into more of a debate." and thus considered not very valuable.[7]

This paper develops a theoretical model to address this debate. It recognizes that the accusers are not only influenced by the cost of lodging an accusation, but also by the prospect of reaching a favorable outcome: having the accused sanctioned and punished. The necessity of any adjudication process stems from the fact that not all reports merit an automatic sanction of the accused and the underlying facts of some accusations are stronger than the others. Adjudication processes, including criminal trials, have the due objectives of not letting go a true offender, but also avoiding punishing the innocent. The accusers typically have superior knowledge than the general public. The relative ratio of reporting from the true victims and lying/exaggerating from non-victims determines the credibility of the initial accusation. This initial credibility then influences the credibility of an unrefuted accusation after the process' attempt to eliminate lies/exaggerations and

[6]Andrew Kreighbaum, New Uncertainty on Title IX, INSIDE HIGHER ED (Nov. 20, 2018).
[7]Haidak v. Univ. of Mass.-Amherst, 933 F.3d 56, 69 (1st Cir. 2019).

thus the eventual chance of success of the accusers, which in turn endogenously influences the ex ante motivation to accuse. Therefore, the interrelatedness of the incentive to accuse and the success rate of the accusation calls for a careful equilibrium analysis that falls in the realm of theoretical models of information economics.

For general distributions of private costs of the accusers, the paper shows that increasing the cost burden on all accusers improves the credibility of the initial accusation through the different incentives of the true victims and the non-victims for any given level of success rate of an unrefuted accusation. This credibility-boosting effect translates into a higher success rate of an unrefuted accusation given a standard of proof. This has interesting implication for the effect of adding cross-examination into the process: the cost burden from cross-examination directly discourages reporting, but the indirect effect of a higher success rate dominates the direct effect, encouraging reporting and reducing the type 2 error of not punishing an offender. Moreover, a carefully calibrated policy of increasing the cost burden by adding cross-examination while simultaneously increasing the standard of proof can reduce both the error of wrongful sanction and the error of leaving criminals unpunished. This double benefit can be achieved despite that we are stacking the odds against cross-examination by assuming that it is useless in detecting a lie presented to it.

Literature

Imposing costs can help information transmission has been a central insight of signaling and screening models in information economics (Riley 2001). In the context of administrative law, Masur (2010) has argued that higher administrative costs can be beneficial in screening out bad applicants in many setting: patent approval, employee termination hearings, housing eviction, environmental permits, immigration and naturalization approvals. Masur's work showed that the costs can screen out bad types from entering the process, this paper goes further to show that costs can encourage the good types to enter

the process more by endogenizing the process outcome with a formal model.

The credibility of crime allegations has been studied in multiple theoretical works by incorporating the incentives to wrongly accuse. Lee and Suen (2020) studied the case where the credibility of allegations comes from being corroborated and the offenders' tendency to repeatedly offend. In Pei and Strulovici (2025), the credibility comes from the fact that the truth teller gets an additional benefit from a conviction than the libeler. In this paper, the credibility comes from a weak lie-detecting ability of the adjudication process, but can be amplified by the common cost burden.

Even though this paper studies the credibility of the accusers, the methodology is similar to works that study the credibility of the witnesses: Lee (2025) and Lee and Wickelgren (2025). Here, the prospect of success motivates the accusers to accuse, whereas in Lee and Wickelgren (2025), the prospect of receiving leniency contingent on the prosecutor's success motivates the witnesses to testify.

Under-reporting is a phenomenon that is also theoretically explained through other channels. First, a lack of reporting can be due to a free-riding/ public good provision problem (Bergstrom 2017). Second, a lack of reporting can be due to a coordination failure where reporters have low confidence that others will corroborate (Cheng and Hsiaw 2022).

The remainder of the paper is organized as follows. Section 2 provides a numeric example that illustrates the credibility-improving ability of the cost burden. Section 3 lays out the formal model. Section 4 shows how cost burden encourages reporting from the victims and reduces type 2 errors. Section 5 investigates the policy choice of deciding the cost burden and the standard of proof simultaneously and shows that the benefit of a higher cost burden is robust. Section 6 concludes.

2. Illustration of the screening function of the cost burden

Consider the following situation. If an offender is punished, the victim's win gives the victim a value equivalent to \$10,000. If a libeler (who holds a grudge) wins, the value is also equivalent to \$10,000. The cost of filing a complaint ranges from \$1,000 to \$11,000, uniformly distributed, the same for both a victim and a libeler. This can be the suffering from retaliation or unwelcome attention, the effort cost, or the financial cost of consulting a lawyer. The adjudication process will be able to detect a lie with probability 20%. An exposed libeler faces a reputation loss that is equivalent to a loss of \$10,000. An detected lie never wins.

First, suppose that one expects to win with probability 50% if one's complaint is not detected to be a lie. Then the expected gain from filing a complaint is $50\% \times 10000 = 5000$ for a victim. The uniform distribution of the cost implies that the chance that a victim reports is $\frac{5000-1000}{11000-1000} = 40\%$. On the other hand, a libeler's expected benefit from accusing is $(1-20\%) \times 50\% \times 10000 - 20\% \times 10000 = 2000$ because of the lie detecting ability of the adjudication process. Therefore, a libeler accuses with probability $\frac{2000-1000}{11000-1000} = 10\%$. The lower chance of accusation by the libeler than by the victim creates credibility for the initial accusation — the larger the ratio of victim's reporting rate over the libeler's reporting rate, the more credible the initial accusation is. Here the ratio is $\frac{40\%}{10\%} = 4$.

Now, suppose there is a requirement of cross-examination that will impose a cost of \$500 to all accusers either in the form of more effort and discomfort or more costs of consulting lawyers. Also assume for now that all potential accusers still think the conviction rate is 50% if one's complaint is not detected to be a lie. This cross-examination is useless in detecting lies so the lie detection probability stays at 20%. Then, the victim's reporting rate becomes $\frac{5000-1500}{11500-1500} = 35\%$ and the libeler's reporting rate becomes $\frac{2000-1500}{11500-1500} = 5\%$.

While both types of accusers are discouraged by this cross-examination, the ratio of the reporting rate of the victim over that of the libeler improves: $\frac{35\%}{5\%} = 7 > 4$. While this example uses specific numbers and the uniform distribution, this insight that a cost burden can improve the credibility given a fixed conviction rate holds true for general distributions.

The above is far from an equilibrium analysis because the rational belief about the conviction rate will not stay constant before and after cross-examination is added, because the accusers are smart enough to know that the decision maker will form the belief of guilt based on the credibility of the initial accusation. As the formal model will show, the increased credibility of the initial accusation increases the conviction rate and the higher conviction rate will motivate both victims and libelers to report more, not less.

3. The model

The state of the world, ω, is whether a person is guilty or not: $\omega \in \{g, i\}$. The common prior on a person being guilty is $\lambda \in (0, 1)$.

If the state is guilty, there is a victim who knows the state and can make a report of the crime. If the state is not guilty, there is a non-victim who holds a grudge against the person with probability $q \in (0, 1)$ and can choose to falsely report a crime. We call a non-victim who holds a grudge a potential libeler or simply a libeler for short. Anyone (a true victim or a libeler) who makes a report of crime is called an accuser. An accusation triggers a process where a decision maker, which can be a jury in a trial or a university committee tasked with deciding the outcome of a Title IX case, will make a decision on whether to sanction the accused. The victim seeks justice and gets a payoff normalized to 1 if the accused is sanctioned. The libeler seeks damage done to the accused, normalized to $\delta \leq 1$ if the accused is sanctioned. That is, the libeler is not more motivated than the true victim

to see the accused punished.[8]

One thing to note that, even though this model setup assumes, for simplicity, that the mistakes in accusation are coming from an ill intention to libel, the results do not change if instead the mistakes are coming from misunderstandings. For examples, instead of classifying accusers into victims and libelers, we can classify them as ones with strong evidence and ones with weak evidence, as long as the weak evidence accusers know that they have weak evidences, by knowing, for example, that they were really drunk during the alleged incidents or they exchanged friendly text messages after the alleged incidents.

The hearing/trial is informative in the sense that it commits to some fact finding and deliberation so that it detects lies with probability $p > 0$. That is, p is the quality of the process. If the accusation is not exposed to be a lie (called an "unrefuted accusation"), The decision maker forms posterior β as to the probability of guilt using the Bayes Rule. There is an pre-committed standard of proof $s \in (0, 1)$. The decision maker sanctions/convicts the accused if the posterior belief β is strictly above s, does not sanction if the posterior belief is strictly below s, and may randomize if the posterior belief is right at s.

The process makes the accuser bear a basic unavoidable cost of accusing c, which is distributed according to a continuous distribution with a CDF denoted by F over $[0, \bar{c}]$ with $\bar{c} \leq 1$. This heterogeneous cost captures that some accusers may be more sensitive to the unpleasant attention caused by the process or the retaliation on the accuser, or may be less financially able to hire a lawyer to navigate the process. Assume that this distribution F satisfies *Decreasing Generalized Reversed Hazard Rate* (DGRHR), i.e., $\frac{cf(c)}{F(c)}$ is decreasing in c. This implies $\frac{f(c)}{F(c)}$ is strictly decreasing in c, which means F is log concave.[9] If an

[8]Pei and Strulovici (2025) uses a strict difference in this gain from punishment between the victim and the libeler to generate credibility. This paper does not rely on that and instead uses the lie detection ability of the process. We can have $\delta = 1$.

[9]The DGRHR is a key regularity condition in papers such as Che, Dessein, and Kartik (2013), Faravelli, Man, and Walsh (2015), and Herrera, Morelli, and Nunnari (2016). Che, Dessein, and Kartik (2013) verified

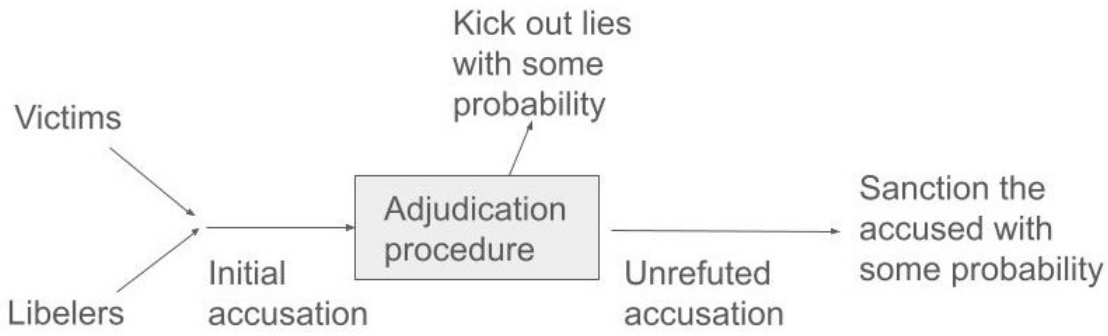
accusation is found out to be a lie, the libeler incurs an additional cost $k \in (0,1)$.

The process can pre-commit to an additional cost imposed on all accusers at the amount $b \in (0,1)$ (by for example by requiring a useless cross-examination). The accuser gets payoff normalized to 1 if the accused is sanctioned regardless of whether the accuser is a truth teller or a non-victim. That is, the cost burden b is relative to the benefit of a win.

The timing is the following:

1. Policy (b,s) is committed to.
2. The state ω realizes. The private cost c is realized.
3. The victim or the non-victim decides whether to accuse.
4. If there is an accusation, a lie is detected with probability p.
5. The decision maker convicts with probability x when there is an unrefuted accusation.

This is illustrated with the following figure:



All players are risk neutral. The equilibrium concept is Perfect Bayesian Equilibrium with Universal Divinity Refinement (Banks and Sobel 1987). Let θ_1 denote the probability

that a variety of familiar classes of distributions, including Pareto distributions, power function distributions (which subsume uniform distributions), Weibull distributions (which subsume exponential distributions), and gamma distributions, satisfy this condition in their Appendix G.

of convicting one who is innocent (conditional on the innocent state) and let θ_2 denote the probability of letting go one who is guilty (conditional on the guilty state). They are measures of type 1 and type 2 errors.

4. Cost burden under a fixed standard of proof

Let x denote the probability of conviction/sanction given an unrefuted accusation, which we will also call the "conviction rate" or the "success rate" (for the accusers). When an unrefuted accusation is expected to lead to a conviction with probability x, the payoff of accusing for a victim is $x-c-b$. Therefore, $F(x-b)$ is the probability that a victim accuses (the "participation" of a victim). On the other hand, the payoff of accusing for a libeler is $(1-p)\delta x-pk-c-b$, so the probability that a non-victim accuses is $qF((1-p)\delta x-pk-b)$ for $x > \frac{pk+b}{(1-p)\delta}$ and 0 for $x \leq \frac{pk+b}{(1-p)\delta}$ (the "participation" of a non-victim). Denote the likelihood ratio of truth over lie in the initial accusation itself (before any lie-refuting through the adjudication process) for $x > \frac{pk+b}{(1-p)\delta}$ by l_a where the subscript a indicates accusation. Then,

$$l_a = \frac{F(x-b)}{qF((1-p)\delta x - pk - b)}$$

We will refer to this likelihood ratio directly as the credibility of the initial accusation, because a higher likelihood ratio will lead to a higher posterior β of an unrefuted accusation through the Bayes Rule:

$$\frac{\beta}{1-\beta} = \frac{\lambda}{1-\lambda}\frac{1}{1-p}l_a \tag{1}$$

Lemma 1. *The credibility of the initial accusation l_a is strictly decreasing in x for $x \in (\frac{pk+b}{(1-p)\delta}, 1)$.*

The proof is in the Appendix. This says that a higher conviction rate decreases the credibility of an initial accusation. This is because convicting more disproportionally en-

tices liars more than the truth-tellers given that the penalty for being caught lying k stays constant. This result was present in slightly different forms in Lee (2025) and Lee and Wickelgren (2025). This implies that the credibility of an initial accusation is the lowest when $x = 1$ (full conviction with an unrefuted accusation).

Lemma 2. *The credibility of the initial accusation l_a is increasing in b for any $b \in (0, (1-p)\delta x - pk)$.*

The proof is in the appendix. The higher cost burden creates a better screening on the initial accusation. Given x, it discourages reporting from both victims and liars but disproportionally more so from liars in a ratio sense.

If the adjudication process is completely uninformative ($p = 0$) and the initial accusation is the weakest ($x = 1$ and $b = 0$), then it is reasonable that the decision maker is not convinced enough to sanction the accused. That is, we have the following assumption that the standard of proof is sufficiently high (or the society cares enough about the type 1 error of sanctioning innocent people):

Assumption 1. *The standard of proof is sufficiently high:*

$$\frac{s}{1-s} > \frac{\lambda}{1-\lambda}\frac{1}{qF(\delta)}$$

If this assumption does not hold, then there is no need for any adjudication process: anyone who is accused should be automatically sanctioned.

Define p_s to be the level of process quality that exactly makes a unrefuted accusation strong enough for conviction with the weakest initial accusation (under $x = 1$ and $b = 0$). That is,

$$\frac{s}{1-s} = \frac{\lambda}{1-\lambda}\frac{1}{1-p_s}\frac{1}{qF((1-p_s)\delta - p_s k)}$$

Note that $p_s \in (0,1)$ is well defined and unique because of the above assumption.

Lemma 3. *When $b = 0$, a victim will always report under a sufficiently informative adjudication process with $p \geq \min\left\{p_s, \frac{\delta}{\delta+k}\right\}$.*

The proof is in the appendix. This outcome is clearly too good to be true. Therefore, we assume that the adjudication process we study is not so informative:

Assumption 2. *The adjudication process is not very informative:*

$$p < \min\left\{p_s, \frac{\delta}{\delta+k}\right\}.$$

This assumption is motivated by the he-say-she-says accusations where there is rarely any hard evidence and the lack of reporting by victims is a major concern. This assumption implies that full conviction ($x = 1$) cannot be part of an equilibrium if $b = 0$.

Let b_s be defined by:

$$\frac{s}{1-s} = \frac{\lambda}{1-\lambda}\frac{1}{1-p}\frac{F(1-b_s)}{qF((1-p)\delta - pk - b_s)}$$

Note that this b_s is unique and $b_s \in (0, (1-p)\delta - pk)$. This is because the right hand side as a function of b is continuous and strictly increasing over this range by Lemma 2. Also, when $b = 0$, the right hand side is strictly less than the left hand side because $p < p_s$, and when $b = (1-p)\delta - pk$, the right hand side is infinity which is strictly larger than the left hand side.

Define $x^*(b)$ as below:

$$
\begin{aligned}
&x^*(b) = 1 && \text{for } b \geq b_s \\
&x^*(b) \text{ is the solution to } \frac{s}{1-s} = \frac{\lambda}{1-\lambda}\frac{1}{1-p}\frac{F(x-b)}{qF((1-p)\delta x - pk - b)} && \text{for } b < b_s \quad (2)
\end{aligned}
$$

Because $p < p_s$ and by Lemma 1, there is a unique $x^*(b) \in (\frac{pk+b}{(1-p)\delta}, 1)$ satisfying Equality (2).

Proposition 1. *The unique equilibrium is where the unrefuted accusation leads to conviction with probability $x^*(b)$, the victim reports with probability $F(x^*(b)-b)$ and the non-victim reports with probability $qF((1-p)\delta x^*(b)-pk-b)$. The judicial errors are $\theta_1 = x^*(b)(1-p)qF((1-p)\delta x^*(b)-pk-b)$ and $\theta_2 = 1-x^*(b)F(x^*(b)-b)$.*

Proof. Case 1. $b > b_s$. by the definition of b_s, Lemma 1 and Lemma 2, for any x, we have

$$\frac{\beta}{1-\beta} < \frac{\lambda}{1-\lambda}\frac{1}{1-p}l_a$$

Therefore, the decision maker convicts for sure.

Case 2. $b \leq b_s$. This is the case where $x^*(b)$ is defined by the Equality 2 because by the definition of b_s, when $b = b_s$, the solution to Equality 2 is $x^*(b) = 1$. By Lemma 1, if $x > x^*(b)$, the unrefuted accusation is not credible enough, so it leads to no conviction, which is a contradiction. If $0 < x < x^*(b)$, the unrefuted accusation is more credible than necessary, so it leads to full conviction, which is a contradiction as well. If $x = 0$, no one accuses, Universal Divinity refinement says that if one deviates to accuse, such an accuser will be believed to be a victim because a victim would get a higher payoff from accusing than a liar under any probability of conviction. This forms a contradiction as well. Therefore, $x = x^*(b)$.

Dropping the argument b in $x^*(b)$ for ease of notation here. Conditional on guilt, the probability of conviction is $x^*F(x^* - b)$. That is, $\theta_2 = 1 - x^*F(x^* - b)$. Conditional on innocence, the probability of conviction is $x^*(1-p)qF((1-p)\delta x^* - pk - b) = \theta_1$. ■

Lemma 1 and Lemma 2 together imply:

Proposition 2. *The conviction rate $x^*(b)$ is weakly increasing in b.*

That is, for $b < b_s$, $x^*(b)$ is strictly increasing in b and for $b \geq b_s$, $x^*(b)$ is constant at 1. A higher cost burden boosts the credibility of an initial accusation given a conviction rate, and as a result allows a higher equilibrium conviction rate to still maintain enough credibility to meet the standard of proof. The higher conviction rate encourages participation of accusers. This indirect effect of a higher cost dominates the direct effect whenever present (when $x^*(b) < 1$). That is, paradoxically imposing a higher cost burden on the accuser can increase the amount of reporting from the truth teller, contrary to the common worry about the cost burden on the victims. For sufficiently high cost burden b ($b \geq b_s$), the conviction rate reaches 1, and this happens before all non-victims are screened out ($b_s < (1-p)\delta - pk$) because the standard of proof is not extreme ($s < 1$).

Proposition 3. *A higher cost burden b increases reporting from victims and non-victims for any $b < b_s$.*

The proof is in the appendix. In equilibrium the reporting probabilities of both victims and non-victims have to go in the same direction to keep the ratio of truth over lies constant. The higher conviction rate motivates the victim more than the non-victim, so if the reporting rate of the victim drops, then that of the non-victim will drop even more, which will make the ratio of truth over lies drop, which is a contradiction.

Consider the following numeric example, $s = 0.8$, $\lambda = 0.04$, $q = \frac{1}{6}$, $\delta = 1$, F is uniform over $[0, 1]$, $p = 0.2$ and $k = 1$. In this case, $p_s \approx 0.44 > p$.

$$16 = \frac{1}{1-0.2}\frac{x^* - b}{0.8x^* - 0.2 - b} \Rightarrow x^*(b) = \frac{295b + 64}{231}$$

The following graph plots the change in the conviction rate, the reporting rate of the victims ($F(x^*(b) - b)$) and the reporting rate of the libelers ($F((1-p)\delta x^*(b) - pk - b)$) as the cost burden increases for the numeric example.

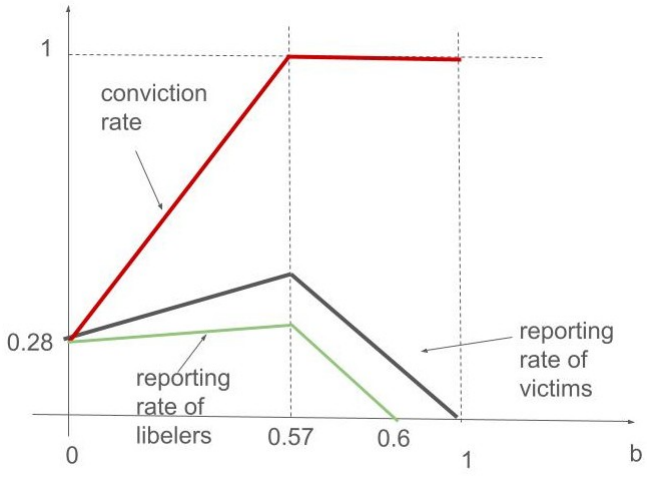


Figure 1. *How the conviction rate, reporting rate of the victims and non-victims change when the cost burden increases in the numerical example. (Not proportional to make the change more visible.)*

That is, when there is no additional cost burden, the conviction rate $x^*(0)$ is $\frac{64}{231} \approx 0.28$. It increases with higher b and for $b \geq \frac{167}{295} \approx 0.57$, the conviction rate is full. After the conviction rate is full, further increasing the cost burden discourages the participation of both victims and non-victims. Increasing the participation directly implies a welfare improvement:

Proposition 4. *For $b < b_s$, increasing the cost burden b increases the expected payoff of the*

victims.

Proof. The expected payoff of the victim is:

$$U \equiv \int_0^{x^*(b)-b} x^*(b) - b - c \, dF(c)$$

The proof of Proposition 3 shows that $x^*(b) - b$ is strictly increasing in b for $b < b_s$. Therefore, U is strictly increasing in b for $b < b_s$. ∎

The following corollary follows immediately by the definitions of type 1 and type 2 errors and Proposition 3: $\theta_1 = qF((1-p)\delta x^*(b) - pk - b))x^*(b)$, $\theta_2 = 1 - x^*(b)F(x^*(b) - b)$.

Corollary 1. *A higher cost burden b increases type 1 error, decreases type 2 error for $b < b_s$. A higher cost burden b decreases type 1 error and increases type 2 error for $b > b_s$.*

The following figure shows how type 1 and type 2 errors change non-monotonically with the amount of cost burden. These corollaries hold because the indirect effect from b through $x^*(b)$ always overpowers the direct effect when $b < b_s$. As shown by Figure 2 for the numeric example, when the indirect effect disappears (when $b > b_s \approx 0.57$), the direct effect of increasing b alone creates the expected effect of decreasing the reporting rate and increasing the type 2 error. Therefore, the beneficial effect of increasing cost burden of reducing type 2 error only exists when b is not too large and the conviction rate is below full. For a local change in the cost burden (under a fixed standard of proof), the two judicial errors would still go in the opposite directions. Higher participation from the truth teller necessarily means higher participation from the non-victims as well.

This figure shows that by moving from $b = 0$ to $b = 0.6$, both type 1 and type 2 errors are reduced for the numeric example. Moreover, the reporting rate of the victim is higher

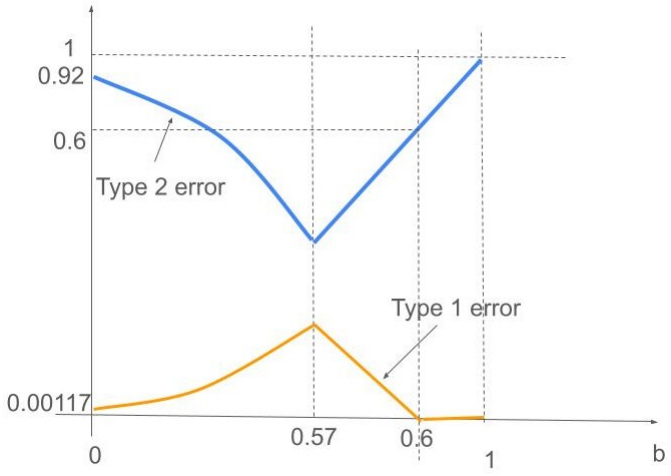


Figure 2. *How the type 1 error of innocent conviction and type 2 error of wrongful acquittal change when the cost burden increases in the numerical example. (Not proportional to make the change more visible.)*

from being at 0.28 to being at 0.4, which implies that the victim's expected payoff is also higher.

One can interpret a higher b as imposing a more extensive cross-examination.[10] The opponents to requiring cross-examination argue that it imposes a higher cost on the accused without improving the information collected, which fits our assumption that p is not increased by the cross-examination. The analysis here shows that one also needs to take into account that a higher cost burden screens out libelers and leads to such a higher success rate for the victims that the victims are more motivated to report knowing that the cost burden is higher.

[10] Some may argue that the cross-examination adds more cost to the true victim than to the libeler because of the extra pain of remembering the trauma. A counter argument is that the libeler will incur more costs making up stories to answer the questions than a true victim.

5. Cost burden and the standard of proof

The standard of proof alone as a policy variable cannot reduce both type 1 and type 2 errors:

Lemma 4. *When the standard of proof is higher (but still low enough such that $b < b_s$), type 1 error decreases and type 1 error increases. Otherwise, the standard of proof has no impact on the judicial errors.*

Proof. For sufficiently low s, the conviction rate is full. By Lemma 1 and Equality 2, when the standard of proof is higher (but still low enough so that $x^* < 1$), the equilibrium conviction rate of an unrefuted accusation x^* is lower, so θ_1 is lower and θ_2 is higher. ■

In this sense, there is no optimal standard of proof when b is fixed. In this section, we will consider two policy instruments b and s simultaneously. Let $x^*(b,s)$ denote how the conviction rate depends on both the cost burden b and the standard of proof s. Let (b,s) denote a policy that has cost burden b and standard of proof s. We say that a policy can be "improved" if there is another policy that strictly reduces both type 1 and type 2 errors, which is also called an "improvement". By definition, any policy that has 0 type 1 error (with $s = 1$) or has 0 type 2 error (with sufficiently low s and $b = 0$) cannot be improved in any way. Note that there is no policy with both errors equal to 0.

Lemma 5. *A policy that results in $x^*(b,s) = 1$ cannot be improved.*

The following proposition says that a policy with a conviction rate below one can be locally improved by slightly increasing the cost burden if the standard of proof can also be slightly increased.

Proposition 5. *Any policy* (b_1, s_1) *such that* $0 < b_1 < b_{s_1}$ *can be improved by another policy* (b_2, s_2) *with* $b_2 < b_{s_2}$*, where* $b_2 > b_1$ *and* $s_2 > s_1$.

Proof. Because $x^*(b, s_1)F(x^*(b, s_1) - b)$ is increasing in b and $x^*(b_1, s)F(x^*(b_1, s) - b_1)$ is decreasing in s. By the continuity of this expression in both arguments, for any positive ϵ, there exists a pair of b_2 and s_3 such that $b_2 > b_1$ and $s_3 > s_1$, the Euclidean distance between (b_1, s_1) and (b_2, s_3) is strictly below ϵ and that:

$$x^*(b_1, s_1)F(x^*(b_1, s_1) - b_1) = x^*(b_2, s_3)F(x^*(b_2, s_3) - b_2)$$

That is, the type 2 error $\theta_2 = 1 - x^*F(x^* - b)$ is kept constant. Using the equilibrium condition (2), we have:

$$\theta_1 = x^*(b, s)F(x^*(b, s) - b)\frac{\lambda(1-s)}{(1-\lambda)s}$$

Note the because $s_3 > s_1$, θ_1 is strictly lower under b_2 and s_3 than under b_1 and s_1. Then, by continuity, there exists $s_2 \in (s_1, s_3)$ such that both type 1 and type 2 errors are lower under b_2 and s_2 than under b_1 and s_1. ∎

The proof is in the appendix. The idea is that we can let a higher b to reduce type 2 error (and increase type 1 error) and simultaneously let a higher s to reduce type 1 error (and increase type 2 error). Because the adjudication is somewhat informative, there is a wedge of parameter values where the positive effect of an increase in b or s outweighs the negative effect of the other parameter's change. Let's continue with the previous numeric example. Let $\lambda = 0.04$, $\delta = 1$, $q = \frac{1}{6}$, $p = 0.2$, $k = 1$ and F be a uniform distribution.

Policy 1 (circle-policy): $b_1 = 0.1$ and $s_1 = \frac{5}{9}$. This gives an equilibrium conviction rate

$x_1 = 0.5$. This implies:

$$\theta_1 = x_1(x_1 - b_1)\frac{\lambda(1-s_1)}{(1-\lambda)s_1} = \frac{1}{150}$$

$$\theta_2 = 1 - x_1(x_1 - b_1) = \frac{4}{5}$$

Policy 2 (triangle-policy): $b_2 = 0.3$, $s_2 = \frac{25}{37}$. This gives an equilibrium conviction rate $x_2 = 0.7$. This implies:

$$\theta_1 = x_2(x_2 - b_2)\frac{\lambda(1-s_2)}{(1-\lambda)s_2} = \frac{21}{25}\frac{1}{150} < \frac{1}{150}$$

$$\theta_2 = 1 - x_2(x_2 - b_2) = \frac{9}{10}\frac{4}{5} < \frac{4}{5}$$

Both type 1 and type 2 errors are lower under Policy 2 than Policy 1. The victim is equally well-off under the two policies because $x_1 - b_1 = x_2 - b_2$. The following graph illustrates these policies. The space is divided into two parts by the dotted curve of $b = b_s$. That is where the conviction rate just hits full. The upper side of the space is where conviction rate is below one (non-full conviction space) and the lower side of the space is where conviction rate is full (full conviction space). The red curves are the iso-type-2-error curves. Note that for the upper side, the type 2 error increases when b decreases and s increases, whereas for the lower side, type 2 error is independent of s and increases when b increases. The green curves are the iso-type-1-error curves. The impact of b also flips around the two sides of the space. For the upper side, type 1 error increases as b increases, whereas for the lower side, type 1 error decreases as b increases and is independent of s. In this graph, Policy 1 is the circle-policy and Policy 2 is the triangle-policy. The triangle policy is on a lower iso-type-1-error and a lower iso-type-2-error curves.

One can contrast with Figure 2 where a large cost burden increase is needed to reduce

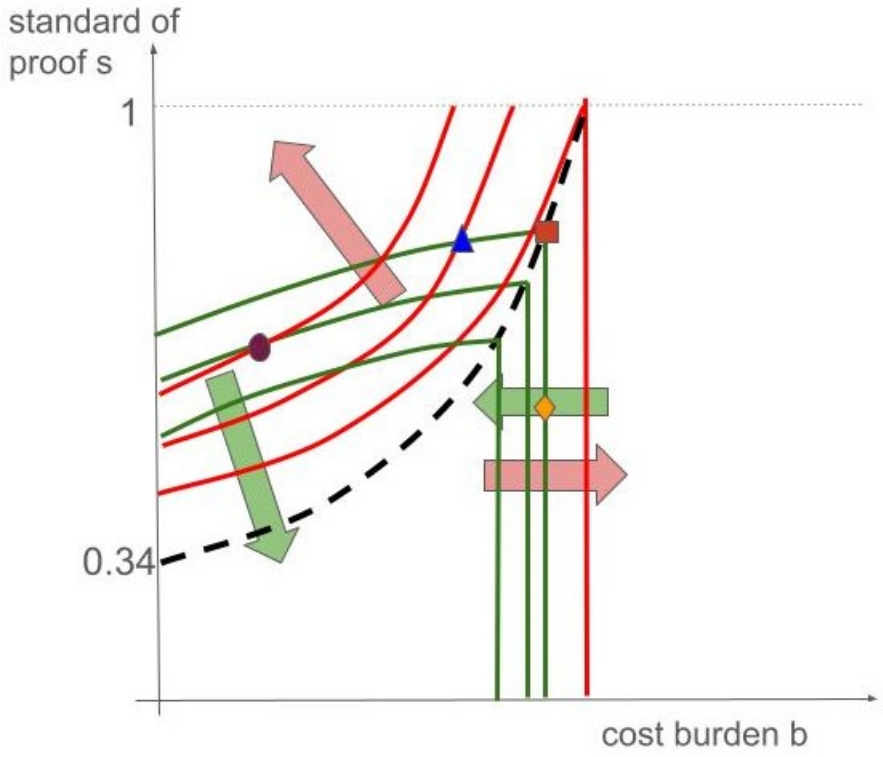


Figure 3. *Green lines are iso-type-1-error curves and red lines are iso-type-2-error curves with arrows indicating the direction in which the errors are increasing. Both type 1 and type 2 errors are reduced (1) moving from the circle-policy to the triangle-policy and also (2) moving from the circle-policy to the diamond policy.*

both type 1 and type 2 errors. When the standard of proof can be increased, locally a infinitely small amount of increase in the cost burden can reduce both type 1 and type 2 errors.

Within the space of non-full-conviction, the standard of proof has to be increased to reduce both type 1 and type 2 errors, but because a sufficiently low standard of proof does not affect the errors, a lower standard of proof can be part of an improvement if the cost burden of the policy is in the full conviction space.

Proposition 6. *A policy can only be improved by increasing the cost burden. If the improvement comes from a policy with a lower standard of proof, then there is another policy that*

creates an equal improvement (reduction in type 1 and type 2 errors), but with a higher standard of proof.

The proof is in the appendix. Let the diamond-policy in the graph represent the following policy.

Policy 3 (diamond-policy): $b_3 = \frac{104}{625}$, $s_3 = 0.5$. This implies $b > b_{s_3}$, so conviction rate $x_3 = 1$.

$$\theta_1 = qx_3((1-p)x_3 - pk - b_3) = \frac{21}{3750}$$

$$\theta_2 = 1-(1-b_3) = b_3 = \frac{104}{625}$$

Policy 4 (square-policy): $b_3 = \frac{104}{625}$, $s_3 = \frac{271}{355}$. This is where $b = b_s$, and gives conviction rate $x_4 = 1$. This policy is equivalent to Policy 3 above in terms of type 1 and type 2 errors.

In Figure 3, the diamond-policy is an improvement from the circle-policy with a lower standard of proof, but there is another square-policy at the intersection of the vertical line going through the diamond-policy and the dotted dividing line where $b = b_s$ that shares the same errors as the diamond-policy but a standard of proof that is higher than that at the circle-policy. In this sense, the lower standard of proof as part of the improvement is artificial.

The above results offer a critique on the Obama-era policy that reduces both b and s by eliminating cross-examination and reducing the standard of proof down to "preponderance of evidence" simultaneously. Such a policy change can never be an improvement that reduces both errors, and moreover such a policy may increase both judicial errors.

6. Conclusion

This paper shows that contrary to common intuition, a higher cost burden on the accuser does not necessarily discourage crime reporting. In fact, it is a valuable screening device and allows a higher equilibrium rate of conviction based on an unrefuted accusation. This higher conviction rate induces the victims to report more and reduces the type 2 error of letting go a guilty offender. A policy of requiring cross-examination can reduce both type 1 and type 2 errors even if the cross-examination does not directly provide more information.

While the paper is motivated by the policy debate regarding the adjudication of Title IX cases, its results bring insights to a wide range of processes where the decision maker's belief about the quality of the initiators of the process depends on as well as influences the composition of the initiators. For example, increasing the cost of application (to a job, to an award, or to an approval) can increase the success rate of the applicants and in turn encourage more applicants given a fixed standard of approval. In some processes, such a cost burden can simply be a fee charged to the applicants such that the fee does not become a social waste.

Appendix

Proof of Lemma 1.

This is a reproduction of the same proof in Lee (2025) using slightly different notations to fit this setting.

Proof. We prove a general result: DGRHR implies that given any $a \in (0,1)$ and any $\pi > 0$, $\frac{F(x)}{F(ax-\pi)}$ is strictly decreasing in x for $x > \frac{\pi}{a}$.

DGRHR says $\frac{xf(x)}{F(x)}$ is decreasing. Then, for any $0 < a < 1$

$$\frac{axf(ax)}{F(ax)} \geq \frac{xf(x)}{F(x)} \Rightarrow \frac{f(ax)}{F(ax)} \geq \frac{f(x)}{aF(x)}$$

DGRHR also implies $\frac{f(x)}{F(x)}$ is strictly decreasing, so for positive b and $x > \frac{\pi}{a}$,

$$\frac{f(ax-b)}{F(ax-\pi)} > \frac{f(ax)}{F(ax)}$$

Therefore,

$$\frac{f(ax-b)}{F(ax-\pi)} > \frac{f(x)}{aF(x)}$$

Then,

$$\frac{d}{dx}\left(\frac{F(x)}{F(ax-\pi)}\right) = \frac{1}{F(ax-\pi)^2}[f(x)F(ax-\pi) - af(ax-\pi)F(x)] < 0$$

That is, $\frac{F(x)}{F(ax-\pi)}$ is strictly decreasing in x. Replacing a with $(1-p)\delta$ and π with $pk+b$ gives this lemma. ∎

Proof of Lemma 2.

Proof. DGRHR implies decreasing hazard rate: that is $\frac{f(x)}{F(x)}$ is decreasing. Therefore,

$$\frac{f((1-p)\delta x - pk - b)}{F((1-p)\delta x - pk - b)} > \frac{f(x-b)}{F(x-b)}$$

Then,

$$\frac{d}{db}\frac{F(x-b)}{F((1-p)\delta x - pk - b)} = \frac{[f((1-p)\delta x - pk - b)F(x-b) - f(x-b)F((1-p)\delta x - pk - b)]}{F((1-p)\delta x - pk - b)^2} > 0$$

■

Proof of Lemma 3.

Proof. Case 1. $p \geq \frac{\delta}{\delta+k}$. This implies: $\frac{pk}{(1-p)\delta} \geq 1 \geq x$. Therefore, a libeler does not report, so $\beta = 1 > s$, so $x = 1$. Case 2. $p \geq p_s$, for any $x < 1$, by Lemma 1 we have:

$$\frac{\beta}{1-\beta} = \frac{\lambda}{1-\lambda}\frac{1}{1-p}\frac{F(x)}{qF((1-p)\delta x - pk)} > \frac{\lambda}{1-\lambda}\frac{1}{1-p_s}\frac{1}{qF((1-p_s)\delta - p_s k)} = \frac{s}{1-s}$$

The last equality is by the definition of p_s. Therefore, $\beta > s$, so $x = 1$, which forms a contradiction. Therefore, $x = 1$. Then, a victim reports with probability $F(1) = 1$. ■

Proof of Proposition 3.

Proof. Let $y = x - b$, then we can rewrite the likelihood ratio as a function y and b by:

$$l_a = \tilde{l}(y, b) \equiv \frac{F(y)}{qF((1-p)\delta y - pk - (1-(1-p)\delta)b)}$$

By Lemma 1, $\tilde{l}$ is strictly decreasing in y for $y \in (\frac{pk+(1-(1-p)\delta)b}{(1-p)\delta}, 1-b)$. Also, it is clear that $\tilde{l}$ is strictly increasing in b. In equilibrium, for $b < b_s$, $l_a = \tilde{l}(y, b)$ is a constant defined

by:

$$\frac{s}{1-s} = \frac{\lambda}{1-\lambda}\frac{1}{1-p}\tilde{l}(y,b)$$

Therefore, y is strictly increasing in b. The constant likelihood ratio also implies that $F((1-p)\delta y - pk - (1-(1-p)\delta)b)$ is also strictly increasing in b. ∎

Proof of Proposition 6.

Proof. Let the original policy be (b_1, s_1) and the improvement be (b_2, s_2). Let x_i denote the conviction rate under policy (b_i, s_i) for $i \in \{1, 2\}$. Case 1. The original policy satisfies $b_1 \leq b_{s_1}$. Case 1a. The improvement is by another policy with $b_2 \leq b_{s_2}$. Note that $\theta_1 = (1-\theta_2)\frac{\lambda}{1-\lambda}\frac{1-s}{s}$. So if θ_1 and θ_2 both drops, it must be that $\frac{1-s}{s}$ drops. Therefore, $s_2 > s_1$. The drop in θ_2 implies:

$$x^*(b_2,s_2)(x^*(b_2,s_2)-b_2) > x^*(b_1,s_1)(x^*(b_1,s_1)-b_1) \tag{3}$$

Recall that $x^*(b,s)(x^*(b,s)-b)$ is increasing in b and decreasing in s. Because $s_2 > s_1$, the above inequality (3) can only hold if $b_2 > b_1$.

Case 1b. The improvement is by another policy with $b_2 > b_{s_2}$. Prove by contradiction. Suppose $b_2 \leq b_1$, then there exists a policy (b_2, s_3) such that $b_2 = b_{s_3}$. The two policies (b_2, s_2) and (b_2, s_3) have the exact same type 1 and type 2 errors. This forms a contradiction with Case 1. Therefore, $b_2 > b_1$. Case 2. The original policy satisfies $b_1 > b_{s_1}$. When $b \geq b_s$, the errors do not depend on s when b is fixed, and θ_1 is decreasing in b while θ_2 is increasing in b, a policy with $b \geq b_s$ cannot improve on (b_1, s_1). Therefore, $b_2 < b_{s_2}$. Then there exists a policy (b_1, s_3) such that $b_1 = b_{s_3}$. This policy has the same errors as (b_1, s_1). Prove by contradiction. Suppose $b_2 \leq b_1$. This policy (b_2, s_2) is an improvement upon (b_1, s_3) and both policies are in the space with $b \leq b_s$. This is a contradiction to Case

1a. Therefore, $b_2 > b_1$.

■

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