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Harmful, Harmless, and Beneficial Uncertainty in Law

Scott Baker and Alex Raskolnikov

ABSTRACT

This article examines the impact of four types of law-related uncertainty on the utility of risk-neutral agents. We find that greater legal or factual uncertainty makes agents worse off if enforcement is targeted (which means that greater deviations from what the law demands lead to a greater probability of enforcement) or if sanctions are graduated (which means that greater deviations from what the law demands result in higher sanctions). In contrast, agents are indifferent to changes in uncertainty about detection induced by variation in enforcement resources or to changes in uncertainty about sanctions arising from legally irrelevant factors. Finally, risk-neutral agents benefit from greater legal uncertainty if they act only on preapproval by a cautious regulator. Our findings shed light on policy debates about the appropriate specificity of legal standards, the reform of corporate criminal liability, and the government's reluctance to clarify the details of tax law and tax enforcement.

1. INTRODUCTION

Few things are certain in life, and the legal system is not one of them. In a perfectly certain world, all laws would be clear, their application to the facts in each case would be unambiguous, as would the facts themselves, all violations would be detected and punished, and sanctions would be fixed and known to everyone in advance. The reality, of course, is very different.

We investigate how various types of uncertainty that exist in every legal system affect the utility of risk-neutral agents. The answer turns out

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to be more complicated than expected and different from what appears in the literature.

Our model shows that uncertainty is harmful if the expected sanction depends on the extent to which the agent's compliance effort deviates from the regulator's view of what the law demands. Uncertainty is harmless when the expected sanction is independent of the agent's compliance decision. Uncertainty is beneficial when the agent must seek pre-approval from a cautious regulator before engaging in conduct governed by a vague standard. Finally, and consistent with the literature, the cost of uncertainty to the agent is itself uncertain if the probability of sanction depends on the agent's compliance decision but not on the extent of the violation.

These findings suggest that risk-neutral agents such as business firms benefit from reforms that clarify legal standards and reduce factual errors in the legal process. In contrast, firms are indifferent to the variation in the rate of detection associated with periodic shifting of enforcement priorities or variance in the magnitude of sanctions that is unrelated to the merits of a particular case.

Before explaining these results, we emphasize that uncertainty in law has many causes. To start, law itself is often vague. Think of the reasonable-person standard in torts, the entire-fairness standard in corporate law, the due-process standard of the US Constitution, or such common legal terms as primary, significant, substantial, principal, and the like. Every time the law uses these and similar ambiguous formulations, every time it relies on a standard rather than a rule, law's subjects face legal uncertainty. They cannot be sure about the precise meaning of the law.

Even if the law is perfectly clear, its application to a particular set of facts is frequently uncertain. A speed limit may be set at precisely 60 miles per hour, but police radar guns may err, police officers may make mistakes in reading their radar guns, car speedometers may be miscalibrated or defective, eye witnesses may be confused, records may be lost or mixed up, and so on. All these are examples of factual uncertainty. Just like legal uncertainty, factual uncertainty is endemic and unavoidable in any legal system.

Legal and factual uncertainty are obviously important, but uncertainty about detection (hereafter, detection uncertainty) may be the one most familiar. Not all speeding drivers get a ticket, not all parking violations are detected, not all tax returns are audited (and not all tax evasion

is detected on audit), and even the most serious crimes occasionally go unresolved.

Finally, punishment is rarely fixed in advance. Tort damages depend on the magnitude of harm that is rarely known until after the harm occurs. Contract damages are often speculative until the contract is breached. Fines for many statutory violations leave room for significant judicial discretion (Securities Exchange Act of 1934, 15 U.S.C. sec. 78u-1[2]). And even though criminal sanctions are specified by an elaborate grid, plenty of uncertainty remains. The grid prescribes fairly wide ranges (US Sentencing Commission 2015, ch. 5) that are not binding on courts in any case (*United States v. Booker*, 543 U.S. 220 [2005]). All these are examples of uncertainty about sanctions (hereafter, sanction uncertainty). Without purporting to offer a comprehensive list, we investigate how legal uncertainty, factual uncertainty, detection uncertainty, and sanction uncertainty affect the utility of risk-neutral actors in various enforcement environments.

The first such environment is targeted enforcement. Regulators, prosecutors, and private plaintiffs (or their lawyers) do not pursue all possible violations with equal zeal. Instead, they tend to target their efforts at the most egregious transgressions—acts that reveal the least effort to comply with the law by the regulated party. Such targeting may occur because more egregious violations are easier to prove in court, because they produce greater recoveries if sanctions are graduated, because they offend the enforcers' sense of justice, or for some other reason.¹ We are not the first ones to suggest that targeted enforcement reflects many real-world regulatory regimes (Craswell 1999; Calfee and Craswell 1984; Lemos and Stein 2010; Osofsky 2014; Stigler 1970; Wu 2009; Young and Myles 2016).

Second, the magnitude of sanctions may rise as behavior increasingly deviates from the line separating legal and illegal conduct. Tort law imposes punitive damages for particularly egregious acts (Sharkey 2013). Tax law and environmental law prescribe higher statutory penalties for increasingly aggressive violations (Raskolnikov 2014). And we all know what happens to fines when drivers exceed the speed limit by a greater

1. Note that targeted enforcement is possible only if enforcement is uncertain. If all detected violations are pursued by private or public enforcers, there is nothing to target. But such comprehensive, universal enforcement is unrealistic. When it does not occur, targeted enforcement is both possible and plausible.

margin. We refer to this feature of sanctions as aggressiveness-based graduation (or graduation for short).²

1.1. Summary of the Results

Our model shows that increases in legal or factual uncertainty make risk-neutral agents worse off if enforcement is targeted or if sanctions are graduated. Take targeted enforcement of a legal standard as an example. Targeted enforcement creates an asymmetry in payoffs after the uncertainty is resolved. If the regulator (or some other law enforcer) concludes that an agent complied with the law, the agent is not sanctioned. Notably, it makes no difference whether the agent barely cleared the compliance threshold or took an unassailable position. If, however, the agent is found to violate the law, it matters whether the violation is slight or egregious. Greater legal uncertainty (in the mean-preserving-spread sense) makes any given violation more likely to be egregious. This increases the chance of a sanction when enforcement is targeted, which harms the agent. To be sure, greater uncertainty also makes any given compliance effort more likely to be unassailable—to exceed what the law requires by a wide margin. This, however, yields no benefit for the agent.

Given this asymmetry, a rational agent might respond to an increase in uncertainty by slightly increasing or decreasing its compliance effort (as is well known since Craswell and Calfee [1986] and Shavell [1987]). But because the original position was optimal, the benefit from this slight change is second order. In contrast, the increased chance of a regulator's disapproval has the first-order effect of reducing the agent's payoff. Thus, we should not be surprised when large, well-advised, sophisticated corporations not only lobby government agencies to clarify vague legal standards but are willing to accept less advantageous rules as long as the rules are clear, as discussed below. The analysis is similar if the uncertainty is factual rather than legal and if the enforcement is not targeted but sanctions are graduated.

The analysis changes if neither targeted enforcement nor graduated sanctions are present but the probability of enforcement is uncertain. This is the environment studied by Craswell and Calfee (1986). In this enforcement environment, an increase in legal or factual uncertainty has an ambiguous effect on the agent's utility because such an increase may increase or decrease the probability of enforcement.

2. It is important to remember that sanctions can be, and often are, graduated in many ways other than on the basis of aggressiveness (Raskolnikov 2016).

What if uncertainty is unrelated to the level of the agent's compliance? Not surprisingly (and by the definition of risk neutrality), an agent is indifferent to changes in uncertainty in this case. For instance, the likelihood of detection may vary (more or less broadly) with resources available to the police, Internal Revenue Service (IRS) auditors, or environmental inspectors at any given time. A judge may impose harsher or milder sanctions within a given range (which may be broad or narrow) depending on factors unrelated to the case at hand (Eren and Mocan 2016; Leibovitch 2016). These types of detection and sanction uncertainty are unrelated to the agent's compliance decisions or the presence of targeted enforcement and graduated sanctions, so they neither harm nor benefit risk-neutral agents.

Our final inquiry examines the impact of uncertainty on agents seeking a preapproval from a regulator who is cautious in interpreting an uncertain legal command. An agent may request a preapproval because the relevant legal standard is vague and the agent may wish to avoid legal uncertainty. Or the legal command may appear clear but the agent may request an exception from the rule by appealing to a higher-order principle, such as the rule's "spirit" or the "public interest" (Standard State Zoning Enabling Act of 1926). Think of an application for a zoning variance, a Securities and Exchange Commission (SEC) no-action letter, or a private-letter ruling from the IRS. A preapproval request may be mandatory (zoning variance) or optional (no-action letter), but without it the desired action will not take place.

We posit that a cautious regulator is more likely to grant a preapproval if the proposed action easily satisfies the relevant legal standard.³ We show that when the regulator grants preapprovals cautiously, the agent prefers greater legal uncertainty. This result is the inverse of the one in the targeted-enforcement case. The regulator never approves an agent's compliance efforts that fall short of the legal standard. Even if the compliance effort exceeds the standard slightly, the regulator is likely to reject the request. But when the effort greatly surpasses the standard, the regulator grants the preapproval.

The payoff again is asymmetric. The agent benefits—it is more apt

3. A regulator may adopt this cautious preapproval strategy to avoid regretting its permissive interpretation later, to acquire more information about the relevant behavior, to avoid making a close call, or to make a later judicial reversal less likely (judicial challenge may come, for instance, after a regulator approves a zoning variance; Cohen 1995). Our numerous conversations with practicing lawyers and former regulators suggest that cautious preapproval and targeted enforcement are common regulatory strategies.

to get its action preapproved—if the regulator determines that the law requires very little. Greater legal uncertainty makes this determination more likely. At the same time, whether the law requires a great deal more or just a shade more compliance than the agent proposes is immaterial. Either way, the regulator denies the agent's request, so an increase in legal uncertainty makes no difference to the agent whose request is denied. Overall, the agent gains from more uncertain law.

As with targeted enforcement, this result holds only if the regulator acts cautiously. If, in contrast, the regulator is equally likely to preapprove any proposed compliance effort that exceeds the regulator's view of what the law demands, the impact of increased uncertainty on the agent's utility is ambiguous.

One may summarize our results by saying that risk-neutral agents may like, dislike, or not care about the law-related uncertainty depending on the circumstances. While true, this summary would be misleading. Few legal regimes are free from both legal and factual uncertainty. If one believes that targeted enforcement is common, one would conclude that risk-neutral agents are often harmed by legal and factual uncertainty. One would also conclude that concerns about some forms of detection and sanction uncertainty are less severe.

Our findings have a number of direct policy implications. First, they inform the choice between competing regulatory approaches that differ in the levels of specificity of legal commands. The competition between these rules-based and standards- or principles-based approaches has embroiled the SEC and the Commodity Futures Trading Commission (D'Souza, Ellis, and Fairchild 2010), the supporters of the generally accepted accounting principles (GAAP) and those who favor the international financial reporting standards (IFRS) (Gelter and Eroglu 2014), as well as the Court of Appeals for the Federal Circuit and the US Supreme Court (Olson and Fusco 2013). Our analysis points to one factor that favors more certain legal rules.

Second, our findings suggest that even if the regulator lacks authority to reduce legal uncertainty, it may benefit the regulated parties by reducing the related factual uncertainty—something that it typically has the authority to do. Third, our results support the relative lack of graduated sanctions in the US legal system despite abundant opportunities to create graduated-punishment regimes (Raskolnikov 2014). Fourth, if one were choosing whether to focus a law-reform effort on reducing legal or factual uncertainty on the one hand or detection or sanction uncertainty on the other (for instance, if one were thinking about reforming the substan-

tive rules or the sentencing guidelines for corporate crime), our model offers a strong reason to concentrate the reform effort on making the substantive law less uncertain and its enforcement less error prone.

1.2. Related Literature

The most closely related literature studies the effect of uncertainty on optimal deterrence. It does not consider the impact of uncertainty on the payoffs or utility of the regulated parties. Craswell and Calfee (1986) show that the effect of uncertainty on optimal deterrence is ambiguous if the imposition of liability leads to a discontinuous increase in sanctions. They, as well as Kahan (1989), also demonstrate that uncertainty leads to underdeterrence if sanctions increase gradually. Shavell (1987) proves that uncertainty may lead to under- and overcompliance with an exogenously set certain legal threshold. More recently, Dari-Mattiacci (2005) concludes that uncertainty may have an ambiguous or unambiguous effect on efficiency given the particular features of tort law.

Our findings neither contest nor elaborate on these results. Sharing with others some skepticism about the degree to which real-world legal regimes may plausibly approximate welfare maximization (Craswell 2003; Niblett, Posner, and Shleifer 2010; Posner 2003; Raskolnikov 2013), and similar to models of tax compliance (Beck and Jung 1989; Scotchmer 1989; Kaplow 1998; Krause 2000), we focus on the effect of uncertainty on actors' utility rather than on social welfare.

Raskolnikov (2017) examines the effect of legal uncertainty on the probability of success and private gains. Relying on simulations, the paper argues that greater certainty induces agents to take stronger legal positions and tends to increase private gains under certain assumptions. In contrast with our study, that paper does not model targeted enforcement, cautious preapproval, or graduated sanctions and does not offer a general solution to the optimization problem. On the other hand, we do not consider the effects of diverging interpretations of ambiguous terms by private actors and the enforcement agency or the use of the penalty multiplier in conjunction with various types of uncertainty, as that paper does.

Several tax scholars have focused on the impact of uncertainty on the utility of private actors. Beck and Jung (1989), Scotchmer and Slemrod (1989), Jung (1991), and Kaplow (1998) conceptualize uncertainty as a random variation of taxable income around the mean. Their analyses do not incorporate the agent's effort to comply with the law—our focus here. Beck and Jung (1989), Scotchmer (1989), Kaplow (1998), and

Krause (2000) interpret legal uncertainty as the actor's lack of knowledge of the legal consequences. This ignorance may be reduced or eliminated by learning the rules or acquiring legal advice. We focus on legal uncertainty that may not be resolved in this manner. Alm (1988) focuses on uncertainty due to possible future legislative changes. While rational actors are surely aware that legal reforms are possible, they must choose their compliance efforts under the existing law—the choice we investigate here. Krause (2000), Mills, Robinson, and Sansing (2010), and Graetz, Reinganum, and Wilde (1989) interpret legal uncertainty as we do but treat the actor's compliance effort as exogenous. Actors in their models “observe” (Mills, Robinson, and Sansing 2010, p. 1727) their positions and choose how to act given this observation. In contrast, we investigate how actors choose their efforts given other considerations. Furthermore, no contributions discussed in this paragraph study the targeted enforcement, graduated sanctions, or cautious preapproval regimes.

A number of studies discuss the enforcement and penalty structures that we use in our model. Craswell (1999) focuses on the interaction of the damages multiplier and targeted enforcement. Lemos and Stein (2010) argue informally that targeted enforcement should increase compliance. Osofsky (2014) takes targeted enforcement as a given and critiques its efficacy. Raskolnikov (2014) investigates when graduated sanctions are likely to be efficiency enhancing. None of these studies offer a formal model, and none consider the effect of varying uncertainty on an agent's utility.

Finally, models investigating the incentive or welfare effects of uncertainty in the legal system often combine several types of uncertainty that we study here into a single variable. Becker's canonical treatment models a “probability of conviction” that includes “the probability that an offense is discovered and the offender apprehended and convicted” (Becker 1968, p. 204).⁴ Craswell and Calfee (1986) discuss legal uncertainty but note that “[u]ncertainty can arise from many sources, ranging from prosecutorial discretion and other enforcement decisions to the manner in which an appellate court eventually interprets a vague statute. Each kind of uncertainty produces a similar qualitative effect” that they identify (Craswell and Calfee 1986, p. 283). More recently, Hoepfner and Lyhs (2016) offer an experimental test of Craswell and Calfee's (1986) findings. Although Hoepfner and Lyhs (2016) consistently refer to their

4. Importantly, Becker (1968, p. 117) recognizes that this combined probability is itself uncertain.

key variable as legal uncertainty, their experiment offers subjects a sliding scale accompanied by a numerical and graphical representation of payoffs corresponding to any chosen position of the slider on that scale. This abstract presentation may reflect every kind of uncertainty that we discuss here. Hylton and Lin (2010) investigate the incentive effects of uncertain enforcement, recognizing that “[i]n a more disaggregated model the probability of enforcement [the variable they study] would be broken down into the product of three components: the probability of detection, the probability of an enforcement action, and the probability of liability” (Hylton and Lin 2010, p. 254).⁵ Harel and Segal (1999) discuss the efficiency consequences of uncertain sanctions compared with uncertain sentencing. The probability of sentencing, they explain, includes the probability of detection as well as conviction (Harel and Segal 1999, p. 278). Ulph (2009, p. 9) studies the “probability that the tax authority successfully challenge[s] the scheme.” He recognizes that this probability “is the product of 3 underlying probabilities” but concludes that he can combine all three into a single variable.⁶

In contrast to these contributions, we disentangle the various types of uncertainty. Our point is that if a risk-neutral agent faces an uncertain probability of enforcement that depends on the extent to which the agent’s compliance effort deviates from the authoritative interpretation of a legal standard, greater uncertainty harms the agent. Legal and factual uncertainty have this effect when combined with targeted enforcement or graduated sanctions. If the uncertainty depends on factors unrelated to the agent’s compliance choice, the uncertainty is harmless for a risk-neutral agent. Detection uncertainty arising from periodic fluctuations in enforcement resources is one example of such harmless uncertainty. Sanction uncertainty produced by the influence of extraneous factors on the exercise of judicial discretion is another. Ignoring these differences in the types of uncertainty and the institutional settings is likely to obscure the important consequences of various types of uncertainty in law.

The article proceeds as follows. Sections 2 and 3 demonstrate the detrimental effects of legal and factual uncertainty on a risk-neutral agent who is facing targeted enforcement. Section 4 extends the analy-

5. The authors suggest that one way of interpreting their model is to assume that enforcement is perfect and legal uncertainty is absent (Hylton and Lin 2010, p. 254).

6. The three probabilities are “that the tax authority investigates the taxpayers; if it investigates, that it discovers the scheme has been used; if it discovers, it successfully demonstrates that the scheme fails and collects all the tax plus interest plus penalties” (Ulph 2009, p. 9).

sis to graduated sanctions. Section 5 shows that detection and sanction uncertainty do not give rise to similar detrimental effects. Section 6 demonstrates that risk-neutral agents benefit from greater legal uncertainty when requesting a preapproval from a cautious regulator. A short conclusion follows.

2. LEGAL UNCERTAINTY WITH TARGETED ENFORCEMENT

Consider a risk-neutral agent, a firm, operating a business subject to regulation. Throughout the discussion, we will assume that the firm is an animal-feeding operation regulated under the Clean Water Act.

Under the act, if the regulator designates the firm as a concentrated animal feeding operation (CAFO), the firm is required to obtain a permit and to produce a waste management plan. For small operations, a business is a CAFO if “[t]he appropriate authority . . . determin[es] that [the business] is a significant contributor of pollutants to waters of the United States” (40 C.F.R. 122.23[c]).

To avoid designation as a CAFO (and, with it, more invasive regulation), the firm must decide how much to spend on pollution control so as not to contribute “significant” pollutants to the waterways. The firm’s compliance effort lies between 0 and 1. For instance, the firm might choose what fraction of waste to capture in an anaerobic lagoon, ranging from capturing no waste to capturing all of it.

Denote the firm’s compliance effort x , with an associated cost of $c(x)$. The cost of compliance increases at an increasing rate ($c'(x) > 0$; $c''(x) > 0$; also $c'(0) = 0$ and $c'(x) \rightarrow \infty$ as $x \rightarrow 1$). If the firm’s compliance effort fails to satisfy the legal standard, the firm will have to pay sanction S with certainty. The regulator’s interpretation of a “significant contributor of pollutants” standard is unknown: the standard is a source of legal uncertainty.

The standard is a random variable. It can take on values between 0 and 1. For instance, the regulator could decide that a firm capturing 50 percent, or 25 percent, or 90 percent of the waste in a lagoon is not a “significant” polluter. However, the firm realizes that the more waste it captures, the more likely it will avoid the “significant polluter” designation.

Denote a realization of the random variable (here, the percentage of waste captured) as a . Legal uncertainty is distributed according to the

distribution $F(a)$, with a strictly positive density $f(a)$. This vague standard might be set optimally to offset externalities or suboptimally as a result of lobbying efforts, legislators' lack of information, or any other reason. Our focus is exclusively on the impact of the legal standard on the firm's behavior and profit.

The firm earns a fixed benefit from operating the feedlot. Given this fixed benefit, the firm seeks to minimize its total cost of operation.⁷ This cost is the sum of the compliance cost $c(x)$ and the expected sanction.

The regulator cares about whether the firm failed to comply with the legal standard and about the extent of noncompliance. The likelihood of enforcement depends on the distance between the firm's compliance effort x and the regulator's ex post view of what the law demands a .⁸ This is targeted enforcement.

Given the realization of the legal standard a and the compliance effort x , the probability of enforcement is given by

$$P(\text{enforcement} \mid a) = \begin{cases} a - x & \text{if } a > x \\ 0 & \text{otherwise} \end{cases}. \quad (1)$$

With all the possible realizations of the legal standard taken into account, if the firm chooses compliance effort x , the unconditional probability of enforcement is

$$P(\text{enforcement}) = F(x)0 + \int_x^1 (a - x)f(a)da. \quad (2)$$

Anticipating this enforcement level, the firm selects its compliance effort to minimize its operation cost, or

$$c(x) + S \int_x^1 (a - x)f(a)da. \quad (3)$$

Integrate the second term by parts and the operation cost becomes

$$c(x) + S \int_x^1 [1 - F(a)]da. \quad (4)$$

7. We assume that benefit is sufficiently high so that operating the feedlot is profitable at the optimal (interior) compliance choice.

8. Indeed, the Environmental Protection Agency (EPA) notes this as an express practice, stating, "In those cases where a facility has not been designated as a CAFO [concentrated animal feeding operation] but the NPDES [National Pollutant Discharge Elimination System] permitting authority has identified areas of concern, the authority should note those areas in the letter. The letter should state that if the concerns are not corrected, the facility could be designated as a CAFO in the future" (US Environmental Protection Agency 2012, sec. 2-15).

The first-order condition that determines the privately optimal compliance effort is

$$c'(x) - S[1 - F(x)] = 0. \quad (5)$$

This expression instructs the firm to balance the marginal cost of an additional unit of compliance against its marginal benefit.⁹ The marginal benefit is the 1-unit reduction in the probability of enforcement whenever compliance effort falls short of the legal standard. That value is $1 - F(x)$. The marginal cost is $c'(x)$.

Now consider the change in the firm's payoff from a small (mean-preserving) change in the riskiness of the distribution.¹⁰ A simple application of the envelope theorem leads to the first proposition.

Proposition 1. A risk-neutral firm operating in a regulatory environment with legal uncertainty and targeted enforcement is worse off when uncertainty increases in a way that preserves the mean.

Proof. Let $F(a, r)$ be the distribution reflecting legal uncertainty, where r is a parameter that captures the riskiness of the distribution. An increase in r corresponds to a mean-preserving increase in risk when $\int_0^1 F_r(a, r) da = 0$ and $\int_0^y F_r(a, r) da \geq 0$, where $y \in [0, 1]$ (Ljungqvist and Sargent 2012, p. 163). Evaluated at the privately optimal compliance effort, x^* , the firm's total cost of operating the feedlot is

$$c(x^*) + S \int_{x^*}^1 [1 - F(a, r)] da. \quad (6)$$

Adding and subtracting $S \int_0^{x^*} [1 - F(a, r)] da$ yields

$$c(x^*) + S \int_0^1 [1 - F(a, r)] da - S \int_0^{x^*} [1 - F(a, r)] da. \quad (7)$$

The second term, $S \int_0^1 [1 - F(a, r)] da = S \int_0^1 af(a) da$, is the expected value of the legal standard times the sanction. By the definition of a mean-preserving spread, this term does not change when the parameter r changes. The change in the expected total cost of the operation is

9. The second-order condition is $c''(x) + Sf(x) > 0$, which is satisfied, ensuring that the compliance effort that solves the first-order condition identifies a minimum.

10. To see that the firm is risk neutral, suppose it captures a benefit b from operating the lot. The firm has a utility function $U(w)$, where w is the total wealth of the firm. Facing an enforcement probability p , the firm's expected utility is $pU[b - S - c(x)] + (1 - p)U[b - c(x)]$. If $U(w) = w$, the firm is risk neutral, and the expression reduces to $b - c(x) - pS$. In the text, the firm selects compliance to minimize $c(x) + pS$, which maximizes $b - c(x) - pS$.

$S \int_0^{x^*} F_r(a; r) da$, which is, by definition, greater than or equal to 0 under a mean-preserving spread. The overall operational cost for the firm increases as legal uncertainty increases. Q.E.D.

This is a novel result. The standard law and economics models of law-related uncertainty do not inquire into the uncertainty's effect on the utility of the affected agents. If, however, a model such as the one offered by Craswell and Calfee (1986) were used to make this inquiry, the result would differ from ours.

Craswell and Calfee (1986) consider a simple enforcement environment without targeted enforcement. In their model, if the firm's compliance effort falls short of the standard, the firm is liable; otherwise, it is not. The extent by which the firm's compliance effort falls short of the standard is immaterial. In this setting, the impact of an increase in uncertainty on the firm's profit is ambiguous.¹¹ The ambiguity arises because an increase in uncertainty may increase or decrease the probability of enforcement. In contrast, if enforcement is targeted as in our model, an increase in uncertainty always increases the probability of enforcement, which harms the firm.

Our focus on targeted enforcement leads to a crisp prediction about how firms are likely to view legal uncertainty. The prediction explains the preferences of large sophisticated firms that appear puzzling otherwise.

Consider a recent comprehensive survey by the global accounting firm Grant Thornton. The study took place amid an unprecedented upheaval in international taxation. The multilateral effort to counter base erosion and profit shifting (BEPS) brought a "change in paradigm" in international tax, according to the director of the Organisation for Economic Co-operation and Development's Center for Tax Policy Administration (Johnston 2015, p. 177).¹² The greatest international tax planning tool—the ability to shift profits around the globe by aggressively using so-called transfer pricing—came under a direct threat from the BEPS initiative

11. In a model like that in Craswell and Calfee (1986), the firm seeks to minimize its compliance costs and the expected sanction, where the sanction is imposed if the compliance effort that the law demands exceeds the firm's compliance effort (formally, the firm minimizes $c(x) + S[1 - F(x, r)]$. Evaluated at the optimal compliance level, the derivative of the expected cost with respect to mean-preserving spread parameter r is $-SF_r(x^*, r)$, a value whose sign is uncertain.

12. The project was sponsored by the Group of 20 leaders, and it led to the publication of a voluminous package of 13 reports (Johnston 2015). The consultations, proposals, and interim drafts that preceded the issuance of the reports have increased legal uncertainty for businesses worldwide.

(US Government Accountability Office 2017, pp. 7–11). It became clear early on that the BEPS project may require significant changes in the international tax planning of multinational enterprises. What exactly these changes would entail remained unclear for some time. It also remained uncertain whether the BEPS project would lead to a multilateral agreement at all.¹³

In this regulatory environment, Grant Thornton queried 2,580 businesses from 35 jurisdictions about whether they would accept higher taxes in exchange for a greater clarity from the tax authorities regarding what constitutes acceptable tax planning (Parillo 2015). Three-quarters of the respondents answered affirmatively. This is exactly what our model predicts. Note that our prediction arises from a plausible assumption about enforcement targeting rather than a questionable assumption that major multinational corporations are risk averse.¹⁴

Our finding also informs the persistent debate over rules and standards that takes place across many regulatory domains. The SEC, for instance, prefers more certain rules (relatively speaking, of course), while the Commodity Futures Trading Commission is a proponent of the principles-based regulation (US Department of the Treasury 2009). The tension between the two approaches leads to gaps and inconsistencies in the regulation of financial instruments (D’Souza, Ellis, and Fairchild 2010). Which agency should prevail? Our result offers one reason to favor relatively more specific rules. To take another example, the US adoption of the IFRS has been delayed, in part, because of the SEC’s concerns that the IFRS would replace relatively clear GAAP rules with relatively vague accounting principles (Gelter and Eroglu 2014). Again, our findings point to one consideration that supports the SEC’s reluctance to make the accounting standards more vague. Regulatory agencies are not the only actors debating the appropriate level of legal certainty. The US Supreme Court has repeatedly rejected efforts by the Court of Appeals

13. To be more specific, it was uncertain whether the then-governing arm’s-length standard would continue to apply to transfer pricing and, assuming it would, how the meaning of arm’s-length price would change as a result of the base erosion and profit shifting project.

14. There are, of course, other reasons why firms may act in a risk-averse manner. Risk-averse managers may impose their personal preferences on the firm. In that case, risk aversion is an agency cost. The firm may be liquidity constrained or may wish to avoid bankruptcy (Stiglitz and Greenwald 1993). We do not dispute any of these explanations. Rather, we show that risk-averse behavior also arises from targeted enforcement (and graduated sanctions) even in the absence of agency costs, credit constraints, or a bankruptcy threat.

for the Federal Circuit to make US patent law more rule-like (Olson and Fusco 2013). Our model offers partial support for the circuit court's side of the debate.

3. LEGAL UNCERTAINTY WITH GRADUATED SANCTIONS

The model offered above accommodates graduated sanctions as well. Suppose that the law is vague (as before), the magnitude of sanctions for noncompliance is certain (as before), but enforcement is not targeted. However, the size of the sanction is no longer S . Rather, the sanction depends on the distance between the firm's compliance effort x and the effort that the regulator views as required under the law a ; the more egregious the violation, the higher the fine. Thus, the sanction is

$$s(a, x) = \begin{cases} (a - x)S & \text{if } a > x \\ 0 & \text{otherwise} \end{cases} \quad (8)$$

One can see that incorporating graduated sanctions into the model yields the same objective function for the firm as the targeted enforcement does.¹⁵ It follows that a mean-preserving increase in legal uncertainty harms the firm facing graduated sanctions even if enforcement is not targeted.

Graduated sanctions certainly exist. Tort damages (Sharkey 2013), environmental penalties (US Environmental Protection Agency 2003b), and tax fines (Raskolnikov 2014) all rise as behavior increasingly deviates from a vague legal threshold. In these settings, greater legal uncertainty harms risk-neutral agents. But graduated sanctions are relatively rare. The Securities Exchange Act's sanction for insider trading all but invites aggressiveness-based graduation (15 U.S.C. 78u-1[2]). Yet the SEC has not accepted the invitation (Laby and Callcott 1994). Many regulatory regimes create elaborate schemes of varying sanctions yet eschew aggressiveness-based graduation.¹⁶ Our model supports these regulatory design choices.

15. Compare equation (8) with equations (1)–(3).

16. These include the Securities Exchange Act's general sanctions schedule (15 U.S.C. 78u), the US Sentencing Guidelines (US Sentencing Commission 2015, sec. 2R1.1), and the Criminal Fines Improvement Act (18 U.S.C. 3571[d], 3572[a]).

4. FACTUAL UNCERTAINTY WITH TARGETED ENFORCEMENT OR GRADUATED SANCTIONS

We now turn from legal to factual uncertainty. Assume that the firm running the feedlot has been designated a CAFO and, as a result, must obtain a permit for the firm's waste disposal process. To do so, the firm must develop a "nutrient management plan" (40 C.F.R. 122.42[e][1]). Failure to comply with the plan can lead to sanctions.

The plan offered by the firm and approved by the regulator specifies the exact level of a particular chemical in the soil.¹⁷ The regulator monitors this level, but the monitoring is subject to error. For example, the regulator might mismeasure the level of the chemical in a soil sample or misattribute the test result from one feedlot operator to another. On the basis of these and similar errors, the regulator might conclude that the firm violated the nutrient management plan even if in fact the firm complied, or vice versa. Thus, the firm faces factual uncertainty.

As before, the firm wishes to minimize its operation costs. The firm knows that it will be held liable if its compliance effort fails to satisfy a legal command a^* . Notably, a^* is no longer a random variable as in the previous section; it is now a clear rule. In our example, a^* is a specific number—the level of the chemical in the soil sample.

The firm chooses the compliance effort x . The regulator observes this effort with error. To model this error, consider a random variable K that is distributed on the interval $[0, \bar{k}]$ according to a distribution $G(k)$ with strictly positive density $g(k)$. If the firm chooses compliance effort x , the regulator observes compliance effort kx , where k is the realization of the random variable. The lowest level of observable compliance is 0; the highest is $\bar{k}x$. Following its observation, the regulator decides whether to impose the sanction.¹⁸

Given an observed compliance level, kx , and targeted enforcement, the probability of enforcement is

$$P(\text{enforcement} \mid k) = \begin{cases} a^* - kx & \text{if } a^* > kx \\ 0 & \text{otherwise} \end{cases}. \quad (9)$$

17. Most waste disposal occurs via land application, that is, taking the waste and applying it to the fields.

18. By modeling the regulator's error as a multiple of the firm's effort rather than an additive term, as is typically done (Shavell 1987), we avoid the implausible possibility that the regulator might observe a negative compliance effort. Because K is a random variable, our modeling choice does not establish any particular proportionate relationship between the actual compliance effort and the regulator's observation of that effort.

Integrating over all realizations of the factual error, the unconditional probability of enforcement becomes

$$P(\text{enforcement}) = \left[1 - G\left(\frac{a^*}{x}\right) \right] 0 + \int_0^{a^*/x} (a^* - kx)g(k)dk. \quad (10)$$

The firm sets compliance to minimize

$$c(x) + S \int_0^{a^*/x} (a^* - kx)g(k)dk. \quad (11)$$

Mirroring proposition 1, the next proposition formalizes how factual uncertainty affects the firm's payoff.

Proposition 2. A risk-neutral firm operating in a regulatory environment with factual uncertainty and targeted enforcement is worse off when uncertainty increases in a way that preserves the mean.

Proof. Parameterize the distribution G by r . A small increase in r represents a mean-preserving increase in risk. Integrate the second term of the firm's objective function by parts, which yields

$$c(x) + xS \int_0^{a^*/x} G(k, r)dk. \quad (12)$$

Evaluated at the optimal compliance, the firm's total cost is

$$c(x^*) + x^*S \int_0^{a^*/x^*} G(k, r)dk. \quad (13)$$

Applying the envelope theorem, we find that the change in total cost with respect to r is

$$x^*S \int_0^{a^*/x^*} G_r(k, r)dk \geq 0, \quad (14)$$

which completes the proof. Q.E.D.

Two further results regarding factual uncertainty mimic those for legal uncertainty. First, if sanctions are graduated, greater factual uncertainty makes the firm worse off even in the absence of targeted enforcement. Suppose that the size of the sanction depends on the extent of noncompliance that is observed by the regulator with error, that is, on $(a^* - kx)$. The sanction is

$$s(k, x) = \begin{cases} (a^* - kx)S & \text{if } a^* > kx \\ 0 & \text{otherwise} \end{cases}. \quad (15)$$

This formulation leads to the same objective function as the one described in equation (11), and the result of proposition 2 carries over.

Second, an increase in factual uncertainty has an ambiguous effect on the firm's utility in the case considered in the prior literature (Craswell and Calfee 1986). The reason is the same as the one discussed in connection with legal uncertainty: greater factual uncertainty may increase or decrease the probability of enforcement in that model.

Even though our model yields identical results for legal and factual uncertainty, some of the policy implications differ. On the one hand, lawmakers may be in a position to choose among several regulatory approaches with varying factual uncertainty. This is similar to the choice between rules-based and standards-based regulation discussed above. On the other hand, a regulator lacking authority to reduce legal uncertainty may have authority to diminish factual uncertainty. We illustrate these points in turn.

A regulator may have a choice between alternative legal commands that involve different levels of factual uncertainty. Consider the choice between design and performance standards in environmental law. In general, performance standards are viewed as preferable because they encourage technological innovation (Revesz and Kong 2011). In enacting the Clean Air Act, for example, Congress indicated a "strong preference for numerical emission limitations" (*Adamo Wrecking v. United States*, 434 U.S. 275, 289 [1978]). At the same time, the act permits the EPA to enact design standards when "it is not feasible . . . to prescribe or enforce an emission standard" (42 U.S.C. 7412[h][1]; 434 U.S. 286). This feasibility exception is typically interpreted to apply when "it is very difficult (or even impossible) to measure the pollution being emitted" (Revesz and Kong 2011, p. 1597). Our analysis suggests that the meaning of "feasibility" should also include settings where measurements required by a performance standard are error prone.

Even if a regulator has no authority to choose the type of legal command, the regulator may reduce factual uncertainty. Tax law, to take one example, is full of provisions that base consequences on the share of the assets retained or transferred by a firm. For instance, some corporate reorganizations turn on whether the firm transfers "substantially all" of its assets (I.R.C., sec. 368[a][1][C]). Other transactions must satisfy specific percentage tests for the relevant asset shares (I.R.C., sec. 851[b][3]). The "substantially all" test is vague, the specific percentage test is precise, but both require asset valuation. Needless to say, valuation is subject to er-

ror and disagreement. While the IRS has no authority to change statutory tests like the ones just described, it may—and does—issue regulations clarifying the details of valuation measurements (Treas. Reg., secs. 1.412[c], 1.471-4, 1.482-6, and numerous others). Our result suggests that, to the extent that these clarifications reduce factual uncertainty, firms benefit from them even if the meaning of the underlying legal standard remains the same.

5. SANCTION AND DETECTION UNCERTAINTY

Thus far, we have assumed that either the probability of a sanction or its magnitude depends on the distance between the firm's compliance effort and the realization of the legal standard. That is the key feature of the model. To see why, consider one alternative: uncertainty that is unrelated to the firm's compliance choice. Detection uncertainty and sanction uncertainty fit this description in some circumstances.

Continuing with our example, we note that the EPA and its state counterparts operate an inspection program to ensure compliance with the Clean Water Act.¹⁹ Suppose our firm has become a permitted CAFO and is now facing possible inspections to determine its compliance with its permit. The rate of inspection is uncertain. Perhaps this is because the inspector's budget varies from period to period and the firm does not know whether the inspector is going to have more or fewer funds at any given time. Consider a mean-preserving increase in the variation of the inspection rate perceived by the firm. Such an increase may happen because the firm learns that the budget fluctuations at the agency are greater than the firm realized or because these fluctuations escalate as a result of exogenous political considerations. It is easy to show that such changes do not affect the firm's utility. The lack of impact arises because of the definition of risk neutrality.

Now consider sanction uncertainty. Assume that, on enforcement, there is a high or low sanction, each arising with equal probability. Per-

19. According to the EPA, "[The EPA] might inspect your operation because it was the subject of a citizen complaint or tip, because it was randomly selected, or because it was targeted for inspection based on your state's targeting method. EPA and the state permitting authorities conduct two main types of inspections at AFOs: 1. Inspections that help to decide whether a facility is a CAFO and should have a permit. 2. Inspections to determine whether a permitted CAFO is in compliance with its NPDES permit" (US Environmental Protection Agency 2003a, p. 42).

haps judges are required to choose a sanction within a certain range, and some judges are lenient while others are harsh. The expression for the firm's payoff looks identical to the one reflecting uncertain detection, with the expected sanction replacing the expected inspection rate. Thus, the same result obtains: changes in the sanction uncertainty that preserve the mean—for example, because of an increase in the permissible sanctioning range—have no effect on the firm's utility in the presence of targeted enforcement.

These results have a clear policy payoff. If, for whatever reason, the government prefers greater uncertainty in a legal regime that governs plausibly risk-neutral agents such as corporations, it should not treat all uncertainty the same. Rather, it should be more reluctant to create or increase legal or factual uncertainty while being more willing to create or increase sanction or detection uncertainty. Yet in two important regulatory areas the government appears to ignore the difference between harmful and harmless types of uncertainty.

The first such area is corporate taxation.²⁰ It would be quite an understatement to say that the IRS has been reluctant to clarify vague corporate tax rules. All informal or internal IRS guidance addressing numerous uncertain corporate tax provisions is available to the public only as a result of the decades of persistent litigation by *Tax Analysis (Tax Analysis and Advocates v. IRS, 505 F.2d 350 [D.C. Cir. 1974]; Field 1998)*. The IRS has been similarly secretive about its enforcement. The statistics related to audits, civil penalties, and criminal prosecutions are public solely as a result of long-standing litigation by the founders of the Transactional Records Access Clearinghouse (*Long v. IRS, 596 F.2d 362 [9th Cir. 1979]; Tax Analysts 2006*). In its efforts to keep as much information as possible out of the public eye, the tax agency does not appear to recognize the varying costs of uncertainty. Yet by refusing to clarify the law, the IRS imposes a cost even on risk-neutral taxpayers, a cost that does not arise from maintaining uncertainty regarding detection.

The second example is corporate criminal liability. Federal criminal statutes affecting corporations—such as the mail and wire fraud statute, the Foreign Corrupt Practices Act, and Racketeer Influenced and Corrupt Organizations Act—are notoriously broad and vague (Golumbic

20. The discussion in this paragraph applies to taxation across the board. We limit it to corporate taxation because corporations are plausibly assumed to be risk neutral while individuals are often risk averse. We limit the discussion in the following paragraph to corporate crime for the same reason.

and Lichy 2014, pp. 1313–14; Lynch 1997, pp. 36–38; Strader 2007, pp. 94–96). So companies face significant legal uncertainty. Vast prosecutorial discretion makes targeted enforcement highly plausible. Sanction uncertainty is substantial as well. The sentencing guidelines for organizations prescribe fairly wide ranges (U.S. Sentencing Commission 2015, ch. 8), and these guidelines are only advisory in any event (*United States v. Booker*, 543 U.S. 220 [2005]). Moreover, empirical evidence suggests that legally irrelevant considerations do affect the severity of sanctions (Eren and Mocan 2016; Leibovitch 2016) and that judicial decisions more broadly are impacted by a range of extraneous factors (Chen, Moskowitz, and Shue 2016). Our model suggests that in this setting, both harmful legal uncertainty and harmless sanction uncertainty are all but inevitable. Yet neither the government nor criminal law scholars appear to recognize the difference between the two in terms of the costs they impose on American businesses.

Persistent calls for criminal justice reform raise two objections to the status quo that are related to this article's inquiry. First, commentators critique numerous criminal law provisions as unacceptably vague (Strader 2007). Second, uncertainty (some would say unpredictability or randomness) in criminal sentencing is also of great concern (Garrett 2014). The implications of our analysis are clear: where it is plausible to assume that the relevant actors are risk neutral (such as for white-collar crimes involving entities), making the law more certain would benefit the regulated parties more than reducing the range of possible sanctions, where the breadth of the range is unrelated to the conduct of the actor.

6. CAUTIOUS PREAPPROVAL

In this section, we consider a firm that requests that the agency interpret a vague legal standard before the firm incurs the cost of complying with it. For example, a firm operating as a large CAFO applies for a permit and submits a waste management plan to the EPA. The regulator interprets the requirements of the Clean Water Act and either issues the permit or rejects the application. We assume that without a preapproval the firm does not open the feedlot.

The agency enforces the law cautiously. It does not grant permits to all operators whose plans meet the agency's interpretation of the standard. Rather, it preapproves only plans that surpass the minimum acceptable

compliance effort by a wide margin. This strategy is the mirror image of targeted enforcement. Instead of pursuing only the worst violators, the agency preapproves only the best compliers. That is, the agency engages in cautious preapproval.²¹

In terms of the timing, the firm first proposes a compliance effort x to the regulator. The regulator then observes the realization of an uncertain legal standard a . As before, legal uncertainty is distributed according to the distribution $F(a)$, with a positive density $f(a)$. If the regulator approves the proposal, the firm captures a benefit b and incurs a cost $c(x)$.

If the proposed compliance effort falls short of the realization of the legal standard, the regulator rejects the proposal. But if the proposed compliance effort exceeds the legal standard, the regulator grants a preapproval only with probability $x - a$. Thus, the greater the distance between the proposed compliance effort and what the regulator thinks is necessary, the greater the probability of preapproval. Facing this problem, the firm selects a proposed compliance effort to maximize

$$\left[\int_0^x (x - a)f(a)da \right] [b - c(x)]. \quad (16)$$

The first term is the probability of approval. The second term is the profit to the firm if its compliance proposal is approved. We have our final result.

Proposition 3. When the regulator grants preapproval with caution, a risk-neutral firm benefits from increases in legal uncertainty that preserve the mean.

Proof. Integrate the first term by parts, yielding

$$\left[\int_0^x F(a)da \right] [b - c(x)]. \quad (17)$$

Denote the privately optimal compliance effort x^* . Denote the mean-preserving spread parameter r , so the distribution is indexed as $F(a, r)$. Evaluated at the optimal effort, the firm's profit is

21. It is difficult to prove that when the Internal Revenue Service considers private-letter ruling requests or when the Securities and Exchange Commission takes up no-action-letter requests, the agency refuses to bless transactions that it considers to be legal but close to the line. But we find this behavior highly intuitive, and our private conversations with former government officials suggest that the description offered here is by no means far-fetched.

$$\left[\int_0^{x^*} F(a, r) da \right] [b - c(x^*)]. \quad (18)$$

The derivative of this expression with respect to r is

$$\left[\int_0^{x^*} F_r(a, r) da \right] [b - c(x^*)]. \quad (19)$$

This expression is positive by the definition of the mean-preserving spread. Q.E.D.

A cautious agency approves the firm's proposed compliance effort only if the agency is sure that the effort satisfies the legal standard. What makes the agency sure is a large distance between the compliance effort suggested by the firm and what the agency deems necessary to assure legality of the action. A mean-preserving increase in the distribution's spread means that the agency is more likely to think that the necessary level of compliance effort is very high and that the necessary level of compliance effort is very low. The firm cannot predict which of these alternatives will come to pass. However, it does not matter to the firm whether the agency believes that a high level of compliance effort is required or an extremely high one. Either way, the agency is apt to reject the firm's proposal. Matters differ, however, when the agency thinks that the necessary level of compliance effort is not just low, but very low. In that case, the agency is more likely to preapprove the transaction. This would allow the firm to capture benefit.

In short, the firm is better off under greater uncertainty because an increased chance that the agency will demand a very high level of compliance effort yields no extra cost for the firm, while an increased chance that the agency will require a very low level of compliance effort benefits the firm.

7. CONCLUSION

Uncertainty is pervasive and persistent in any legal system. It comes in many forms, and it frequently reflects lawmakers' choices, whether deliberate or not. Legal uncertainty depends on how legislators and courts choose to formulate legal commands. Factual uncertainty can be increased or reduced by the choice of legally relevant facts. Detection uncertainty is a product of enforcement priorities. And while sanction un-

certainty may be difficult to manage in some cases (such as accidental and environmental harms), lawmakers may decrease it in many settings (such as by narrowing the ranges in the US sentencing guidelines and making the guidelines mandatory).

Given all these design choices, lawmakers should be interested in the effects that various types of uncertainty have on the well-being of the regulated subjects. Our key finding is that greater legal uncertainty and factual uncertainty harm risk-neutral agents if enforcement is targeted. Given that legal and factual uncertainty are all but inevitable in any legal system, and that targeted enforcement is widespread, the harmful effects that we identify are likely to have real practical significance.

Our analysis highlights the benefit of a fairly fine-grained investigation of real-life regulatory regimes. The cost of uncertainty in a legal system depends on the type of uncertainty, the structure of sanctions, and the specifics of enforcement. The literature has largely ignored these distinctions. Economic models of law-related uncertainty often represent it using a single variable. While appropriate for some purposes, this simplification obscures the difference between harmful and harmless uncertainty in law. Far from being a theoretical curiosity, this difference should inform important government policies like the deterrence of corporate crime and the collection of corporate taxes. Thus, the general lesson from our study is that modeling the essential, realistic, and relatively nuanced features of the legal system may produce novel and policy-relevant results.

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