Optimal Contracts with Enforcement Risk

Nicola Gennaioli*

CREI and Universitat Pompeu Fabra.

March 2011

Abstract

I build a model where potentially biased judges verify complex states by interpreting an imperfect signal whose noise captures factual ambiguities. In a sales and a financial transaction I show that judicial biases amplify and distort factual ambiguities, creating enforcement risk. To insure against such risk, parties write simple non-contingent contracts that optimally protect the party that is most vulnerable to judicial error. These results shed light on the empirical association between law and finance and rationalize salient features of real world enforcement regimes.

*Email: nicola.gennaioli@crei.cat. Several ideas of this paper are based on the first chapter of my PhD thesis. I am indebted to Philippe Aghion and Andrei Shleifer for their invaluable support. I wish to thank Gary Becker, Francesco Caselli, Oliver Hart, Louis Kaplow, Michael Kremer, Casey Mulligan, Richard Posner, Ilia Rainer, Stefano Rossi, Jaume Ventura, Fabrizio Zilibotti (the editor), two anonymous referees and especially Giacomo Ponzetto for very useful comments. I also benefitted from comments by seminar participants at Chicago, Columbia GSB, Harvard, LSE, Kellogg, Pittsburgh, UCLA, UCSD.

1 Introduction

Many key ideas in economics rely on the ability of courts to enforce contracts. In the Arrow-Debreu model, perfectly enforced contracts enable optimal risk sharing. In the Coase Theorem, they solve market failures. In asymmetric information models, they allow for incentive provision. Perfect enforcement requires courts to be idealized agents who are able and willing to read, verify and enforce complex contract clauses. Beyond its limited realism, this assumption limits our understanding of many phenomena. For example, can enforcement quality explain why Common Law systems foster the use of contingent financial contracts (Lerner and Schoar 2005) and financial development (La Porta et al. 1998)? Is the use of different labor contracts shaped by judicial enforcement of "just cause" dismissal clauses (Ichino et al. 2006)? Finally, if firms arise when contracting is limited (Grossman and Hart 1986), how does imperfect enforcement of contracts and ownership affect organizations? To address these and other issues, we need a model of court enforcement. In such a model, there must be judges, these judges must be able to make decisions based on their preferences and information, and contracts must be allowed to adjust to courts' behavior.

This paper addresses these issues by building a model of judicial state verification and contracting. I am not the first to stress the role of state verification. Costly state verification (Townsend 1979) and incomplete contracts (Grossman and Hart 1986) models stress that contracts are often less contingent than standard theory would predict because state verification is costly or impossible. However, these analyses abstract from courts (Bolton and Dewatripont 2005, p. 3). As I will show, by modeling courts' behavior one can shed light on what drives the use of contingent vs. simple contracts and how law affects welfare.

My model of state verification relies on two assumptions. First, I assume that certain states are hard to verify because information about them is noisy and subject to interpretation. In litigating over a warranty, a seller and buyer may present conflicting pieces of evidence on whether the product was defective. In litigating a financial contract, the debtor and the investor may present conflicting earnings measures. The judge must then decide which of these conflicting arguments to believe based on his limited knowledge. I formalize this idea by assuming that judges discretionally choose what to find based on an imperfect signal whose noise θ captures the "physical" difficulty to verify the state.

Second, I assume that when resolving ambiguities judges are swayed by personal biases. Bias may be due to policy views (Frank 1930, Posner 2004):[1] some judges believe that consumers or investors must be protected from firms, other judges believe that firms should not go bankrupt or that employment must be preserved. Chang and Schoar (2006) document the role of judicial views in bankruptcy. But bias can also reflect idiosyncrasies and arbitrariness, due to the judge's sympathy for a party, or to his familiarity with a specific legal argument. I assume that judges are distributed according to their biases around an average, unbiased, judge. The dispersion σ of biases captures the distinct noise introduced by judges in state verification on top of physical unverifiability θ.

I study the impact of judicial state verification in a sales and a financial transaction. In the former, the first best contract stipulates that the seller must compensate the buyer if the product turns out to be defective. In the latter, the first best contract stipulates that if the firm underperforms its control should shift to the investor.

In this analysis, two general principles stand out. First, factual ambiguities and biases interact to create enforcement risk. Absent ambiguities ($\theta = 0$), judges have no leeway to express their biases: here state verification is perfect regardless of judicial dispersion σ. When instead $\theta > 0$, state verification is imperfect not only because judges face some ambiguities, but especially because these ambiguities open the door for judges to express their biases.

Second, judicial bias greatly reduces the use of contingent contracts. If $\sigma = 0$ optimal contracts can be very contingent or even first best despite the presence of some ambiguities ($\theta > 0$). Indeed, parties rely on state verification if judges can be trusted to use their information in the parties' mutual interest, even if such information is quite limited. This helps explain why many commercial contracts contain "best efforts" or "good faith" provisions despite the difficulty of verifying them ex-post. By contrast, if factual ambiguities are coupled with biased judges, then parties are afraid of writing very contingent contracts. On the one hand, biases *amplify* factual ambiguities, boosting the overall probability of ju-

[1] As an alternative to bias, Glaeser and Shleifer (2002) consider judicial bribe-taking. Bond (2009) shows that if judges take bribes high powered incentive contracts are suboptimal because they allow judges to extract wealth from the parties. Bribe taking may be relevant in developing countries, but it is clearly not the only factor affecting courts and contracts. Judicial biases allow me to stress the causes and consequences of the unpredictability attached to the verification of complex events.

dicial error. Additionally, biases *distort* the ratio of different errors (for one party or the other), increasing the frequency of very costly errors. The only way for parties to insure against the enforcement risk so created is to write a less contingent contract, which avoids interpretive uncertainties. This contract optimally protects the "vulnerable" party, namely the party that would suffer most from adverse judicial errors. As σ becomes large, simple non-contingent contracts are optimal. In the sales transaction, the buyer pays a spot price for the product but no compensation is stipulated in case of product defects. In the financial transaction, the separation between ownership and control breaks down. In both cases, there is a welfare loss.

My model shows that the interplay between factual ambiguities and judicial biases is a powerful driver of the use of non-contingent contracts, because biases boost enforcement risk precisely when facts are more uncertain. In this sense, the distinct errors introduced by biases greatly distort contracts towards rigid forms. One implication is that complex/innovative transactions, where factual ambiguities are probably larger, should witness the use of rigid contracts but especially so in court systems plagued by bias. This notion rationalizes why private and public courts often forbid the use of ambiguous evidence in contract litigation. Even if such evidence can well improve judicial information, its use might reduce welfare by allowing biased judges to distort state verification and contracts.

More broadly, by showing that enforcement risk may cause departures from the Coase theorem, my model sheds new light on why law matters for economic efficiency. For instance, the usual explanation for the superiority of Common Law in financial transactions is that these legal systems provide greater statutory protection to investors than Civil Law ones (La Porta et al. 1998). If Coasian forces were at work, though, parties could remedy the deficiencies of the law by enhancing investor protection by contract, as they are often allowed to do (Easterbrook and Fischel 1991). My model suggests that this contractual solution may be infeasible, and thus statutory rights may matter, precisely due to the enforcement risk plaguing innovative and nonstandard financial contracts.

The paper proceeds as follows. Section 2 highlights the basic effects of enforcement risk in a sales transaction. Section 3 builds an explicit model of judicial state verification in a financial transaction. Section 4 studies the impact of court behavior on the optimal financial contract and welfare. Section 5 discusses the law and finance evidence in light of the financial contracting model, and applies the judicial state verification model to the sales transaction of Section 2, highlighting its implications for the law and economics of contracts. Section 6 concludes. Proofs and extensions are in the online appendix.

2 A Simple Sales Transaction

Consider the trade of a widget between consumer B and firm F. The firm is risk neutral, the consumer is risk averse with concave utility $u(\cdot)$. Markets are competitive, so the firm makes zero profits. At $t = 0$ the firm bears a production cost c. A $t = 1$, the consumer values the widget at $\overline{v}$; with probability 0.5, though, the consumer is harmed and values the widget only $\underline{v} < \overline{v}$ because the latter is inappropriate or defective. The value of the widget at $t = 1$ is observed by B but not by F, which precludes ex-post bargaining between parties.

A sales contract consists of a pair (p_0, d_1) where p_0 is the price paid by B at $t = 0$ and d_1 the damages that F commits to pay at $t = 1$ if B is harmed. If courts perfectly verify harm, the optimal contract (p_0, d_1) solves:

$$\max_{(p_0,d_1)} \; u(\overline{v} - p_0) + u(\underline{v} + d_1 - p_0), \tag{1}$$

$$s.t. \qquad p_0 - (0.5)d_1 = c. \tag{2}$$

Objective (1) is proportional to B's expected utility, constraint (2) is F's zero profit condition. At the optimum, F fully insures B by setting $d_1^{FB} = (\overline{v} - \underline{v})$ and $p_0^{FB} = c + (0.5)(\overline{v} - \underline{v})$.

Now suppose that the verification of harm entails ambiguities so that contract (p_0, d_1) is subject to the discretion of courts. With probability $\pi_B \in [0, 1]$ courts enforce d_1 in state $\overline{v}$ despite the absence of harm. This is a pro-consumer error. With probability $\pi_F \in [0, 1]$ courts fail to enforce d_1 in state $\underline{v}$ even though harm is present. This is a pro-firm error. Here $(\pi_B - \pi_F)$ captures the ex-ante systematic bias of courts for the consumer, while $(1 - \pi_B - \pi_F)$ captures the overall precision of adjudication. If $\pi_B + \pi_F = 1$ adjudication is fully uninformative, so we assume $\pi_B + \pi_F \leq 1$. When judicial errors are taken into account, the optimal contract solves:

$$\max_{(p_0,d_1)} u(\overline{v}-p_0)+u(\underline{v}+d_1-p_0)+\pi_B\left[u(\overline{v}+d_1-p_0)-u(\overline{v}-p_0)\right]+ \\ +\pi_F\left[u(\underline{v}-p_0)-u(\underline{v}+d_1-p_0)\right], \quad (3)$$

$$s.t. \qquad p_0-(0.5)(1+\pi_B-\pi_F)d_1=c. \quad (4)$$

The objective in (3) is proportional to B's utility under perfect enforcement plus his expected gain from pro-consumer errors minus his expected loss from pro-firm errors. Equation (4) instead says that the firm demands an ex-ante compensatory increase in p_0 when errors systematically favour B, i.e. when $(\pi_B-\pi_F)>0$.

Suppose that judges resolve factual ambiguities by internalizing only the welfare of the consumer, so that damages are always enforced, even if there is no harm ($\pi_B=1$, $\pi_F=0$). Anticipating this, the firm demands contractual protection by setting zero damages $d_1=0$. Then, to compensate the consumer, the firm lowers the sale price to $p_0=c$. Despite these contractual safeguards, there is a net social loss because B does not obtain any insurance.

Suppose conversely that judges only internalize the welfare of firms, so that damages are never enforced, even if harm is present ($\pi_B=0$, $\pi_F=1$). Now the only way to contractually protect the consumer is to reduce the sale price of the widget to $p_0=c$. Also in this case, the presence of judicial discretion induces parties to adjust contract terms to protect the vulnerable party but courts reduce welfare by destroying B's ability to insure.

In the previous examples, there was an ex-ante systematic bias for B or F. Suppose now that judges are ex-ante equally likely to err for the consumer and the firm, i.e. $\pi_B=\pi_F=\pi\in[0,1/2]$. To solve for the optimal contract, suppose also that B's utility is quadratic, namely $u(c)=c-(\gamma/2)c^2$. At the optimum we then have:

$$d_1 = (\overline{v}-\underline{v})(1-2\pi), \quad (5)$$

$$p_0 = c+(0.5)(\overline{v}-\underline{v})(1-2\pi). \quad (6)$$

Judicial errors, even if unsystematic, reduce the extent to which the contract is state contingent.[2] As π becomes higher, judges verify harm in a noisier fashion. If damages are large, this exposes the risk averse consumer to substantial enforcement risk. The only way to insure the consumer against such risk is to reduce damages below the first best level $d_1^{FB} = (\overline{v} - \underline{v})$. The firm also sets a base price below the first best level $p_0^{FB} = c + (0.5)(\overline{v} - \underline{v})$.

As judicial errors become extreme, formally as $\pi = 1/2$, the optimal contract becomes fully non contingent, namely $d_1 = 0$. Now, as in the previous cases, the contract forgoes any attempt at dealing with late information arrival about the state of the world, the very purpose of state contingent contracts in a world with perfect enforcement. The reason is that, by accommodating information arrival, such contract also leaves open the door to judicial preferences. Judicial preferences enhance the ex-ante uncertainty of the parties by exploiting the uncertainty in contract terms that is intrinsic in state-contingent arrangements. This constitutes the basis of enforcement risk, against which the parties try to protect themselves by writing a rigid contract.

By taking the probabilities of error (π_B, π_G) as exogenously given, the current setup does not allow us to analyze how judges express their biases and how this interacts with factual ambiguity. To analyze the role of these factors in shaping contracts, we must explicitly model state verification as the result of the optimizing behavior of imperfectly informed and potentially biased judges. We now build such model and explore its implications for financial contracting. Section 5.2 applies such model to the sales transaction.

3 The Model

3.1 The Financial Transaction

Consider a model of credit in the spirit of Aghion and Bolton (1992). A risk neutral investor I finances the project of a penniless risk neutral entrepreneur E. The project requires an

[2] For a generic error pattern (π_B, π_F), the optimal contract under quadratic utility sets:

$$d_1 = (\overline{v} - \underline{v}) \left[\frac{1 - \pi_B - \pi_F}{1 - (\pi_B - \pi_F)^2} \right], \tag{7}$$

$$p_0 = c + (0.5)(\overline{v} - \underline{v}) \left(\frac{1 - \pi_B - \pi_F}{1 - \pi_B + \pi_F} \right). \tag{8}$$

Note that $d_1 < d_1^{FB}$ and $p_0 < p_0^{FB}$, confirming that judicial errors reduce both damages and the sale price.

investment $k > 0$ at $t = 0$ and yields a positive cash flow at $t = 1$. Under entrepreneur control (E-control henceforth) such cash flow is equal to r, which takes value $\overline{r}$ with probability μ and $\underline{r}$ with probability $1 - \mu$, where $\overline{r} > \underline{r}$. The investor can be repaid at most $\alpha \cdot r$ because $(1 - \alpha) \cdot r$ is kept by E as a private benefit of control. Under investor control (I-control henceforth) the cash flow is deterministic, equal to λ, and can be repaid to I in full. The realization of r is privately observed by the entrepreneur before control is allocated. After control is allocated, the cash flow is realized and observed by all. I assume:

A1: $\overline{r} > \lambda > \underline{r} > 0$ *and* $\lambda \geq k$.

The first best sets E-control if $r = \overline{r}$ and I-control otherwise. I-control is not always ex-post efficient, but it ensures break-even, as $\lambda \geq k$. This latter condition only simplifies the exposition, what is important is that I-control fosters break even by reducing E's private benefits. One can view this model as a bankruptcy setting, where E-control corresponds to continuation, I-control to liquidation. The first best is ex-ante feasible, namely:

A2: $\mu\alpha\overline{r} + (1 - \mu)\lambda \geq k$.

Thus, if courts perfectly verify r the first best is attained under a fully contingent contract setting E-control if and only if $r = \overline{r}$. In reality, an objective measure of r is lacking and proxies for E's ability or the project's earnings are subject to manipulation. In these cases, courts play a key role in verifying r and in enforcing the fully contingent contract.

Parties choose among financial contracts whereby I lends $D \geq k$ to E at $t = 0$ and E-control is set with probability $x(\widehat{r})$ if state $\widehat{r} \in \{\overline{r}, \underline{r}\}$ is reported. Under a *state verification* contract $\widehat{r}$ is reported by a judge.[3] The "fully contingent" contract described above is a state verification contract where $x(\overline{r}) = 1$ and $x(\underline{r}) = 0$, and must be distinguished from less contingent contracts where the control allocation varies less across judicial reports, i.e. where $|x(\overline{r}) - x(\underline{r})| < 1$. I also consider truthful revelation contracts in which $\widehat{r}$ is reported by E, the informed party. This latter contract may allow parties to implement the ex-post efficient allocation of control even if judicial verification is poor.

Besides specifying $x(\widehat{r})$ and the nature of report $\widehat{r}$, the contract sets a repayment schedule $[d_E(r), d_I]$, contingent on the realized state r and on whether E or I controls the project.

[3] A more detailed portrayal of the working of a *state verification* contract is that after receiving private inforation about r, E claims control by arguing that $r = \overline{r}$. Then, I challenges E's claim in court and the judge resolves the conflict by verifying r, which produces his announcement $\widehat{r}$.

Repayments are feasible, i.e. $d_E(r) \leq \alpha r$, $d_I \leq \lambda$, and depend on the true r (rather than on report $\widehat{r}$) because the cash flow is observed by all ex-post. The Appendix proves that my main results do not change by considering more exotic contracts.[4]

At $t = 0$, parties contract by taking courts' state verification as given. For now I assume that parties always end up in court, but the Appendix shows that my analysis extends if one allows for out of court renegotiation. The timing is:

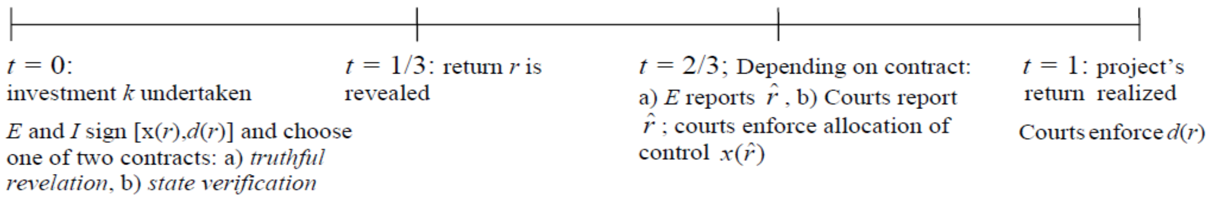

Figure 1

.

3.2 Judicial State Verification

Judges verify return r in light of a signal s that is normally distributed with mean r and variance θ^2. The signal, which summarizes the information acquired by the judge in court, is on average correct but noisy, and θ captures the "physical" difficulty to verify r: when $\theta = 0$ state verification is straightforward, when $\theta > 0$ state verification involves some factual ambiguities due to the transaction's complexity or innovativeness. Signal s is observed only by the judge, who has full discretion to issue a report $\widehat{r} \in \{\overline{r}, \underline{r}\}$.

Given the parties' contract, the judge selects $\widehat{r}$ to minimize his *personal* cost of setting an erroneous allocation of control. To see how this works, suppose that the contract is fully contingent, mandating E-control in $\overline{r}$ and I-control otherwise. The judge then realizes that if he reports $\overline{r}$ he must enforce E-control, which constitutes a pro-enterpreneur error if the true state is $\underline{r}$ (in this latter state I-control is efficient). If instead the judge reports $\underline{r}$ he must enforce I-control, which constitutes a pro-investor error if the true state is $\overline{r}$ (in this

[4]The Appendix considers: i) randomizations between state verification and truthful revelation contracts, ii) an open-ended contract saying "the judge can set control the way he wants," iii) contracts where judges are given the incentive to reveal their information. Interestingly, contracts ii) and iii) become costly precisely in the presence of judicial bias. The main restriction I impose in the analysis is limited liability.

latter state E-control is efficient).[5] After observing s, the judge knows that by reporting $\overline{r}$ he makes a pro-entrepreneur error with probability $\Pr(\underline{r}\,|s)$, while by reporting $\underline{r}$ he makes a pro-investor error with probability $\Pr(\overline{r}\,|s)$. Since the ex-post social cost of the former error is $(\lambda - \underline{r})$ and that of the latter error is $(\overline{r} - \lambda)$, the expected social cost of reporting $\overline{r}$ is equal to $\Pr(\underline{r}\,|s) \cdot (\lambda - \underline{r})$, that of reporting $\underline{r}$ is equal to $\Pr(\overline{r}\,|s) \cdot (\overline{r} - \lambda)$. An impartial judge issues the report associated with the lowest expected cost.

Judges depart from this rule because of their bias for E or I. I assume that a judge's *personal* cost of reporting $\underline{r}$ is equal to $\beta_E \Pr(\overline{r}\,|s) \cdot (\overline{r} - \lambda)$, that of reporting $\overline{r}$ is equal to $\beta_I \Pr(\underline{r}\,|s) \cdot (\lambda - \underline{r})$, where $\beta_E, \beta_I \geq 0$. The judge reports $\overline{r}$ if and only if:

$$\beta \Pr(\overline{r}\,|s) \cdot (\overline{r} - \lambda) \geq \Pr(\underline{r}\,|s) \cdot (\lambda - \underline{r}), \tag{9}$$

where $\beta \equiv \beta_E/\beta_I$ captures the judge's bias in favor of E-control. If $\beta = 1$, the judge is unbiased and seeks to minimize society's expected error costs. If $\beta > 1$, the judge is biased in favor of E-control: he over-weights the cost of finding $\underline{r}$, reporting $\overline{r}$ too often. If instead $\beta < 1$, the judge is biased in favor of I-control: he under-weights the cost of finding $\underline{r}$, reporting it too often.[6] To study Equation (9), I introduce the following definition:

Definition 1: *The expected loss from setting I–control relative to that of setting E-control is* $\eta \equiv \frac{\mu(\overline{r}-\lambda)}{(1-\mu)(\lambda-\underline{r})}$.

η is the social cost of setting I-control relative to that of setting E-control for someone having only prior information about r (i.e. not observing s). I later extend this definition to include also the cost of E-control in terms of ex-ante investor break-even. Parameter η shapes the optimal contract, for it captures the parties' "vulnerability" to judicial errors. When $\eta > 1$, errors against E are socially more costly than errors against I, so that E is the vulnerable party. When $\eta < 1$ the reverse is true, so I is the vulnerable party. Equation (9)

[5] Errors favor different parties because a party gains from holding control. The only exception is when α is so large ($\alpha\overline{r} > \lambda$) that I-control in $\overline{r}$ can make I worse off. In this case, the latter error might be called "anti-entrepreneur." I call this error "pro-investor" to simplify terminology and because, as Section 4 shows, state verification is used when α is small and I gains from control.

[6] The Appendix shows how (9) is derived from judicial preferences over the control allocation and extends to: i) general contracts $[x(\overline{r}), x(\underline{r})]$, and ii) policies where the judge reports $\overline{r}$ with probability $\psi(s)$.

implies that the judge reports $\overline{r}$ if and only if:

$$s \geq \frac{\overline{r} + \underline{r}}{2} - \frac{\theta^2}{\overline{r} - \underline{r}} \ln \beta \cdot \eta. \tag{10}$$

If the signal is larger than a threshold, the judge reports $\overline{r}$ and sets E-control because $\Pr(\overline{r}\,|s)$ is high and thus the cost of finding $\underline{r}$ is high, too. Otherwise, the judge reports $\underline{r}$ because $\Pr(\underline{r}\,|s)$ is high and so is the cost of setting E-control. With a perfect signal ($\theta = 0$), judges find the true r: this is the perfect verifiability case. When $\theta > 0$ judicial errors are inevitable, and in (10) the judge views a given signal s as evidence of $\overline{r}$ or $\underline{r}$ depending on his bias β and on the relative cost η of I-control.

A judge having a higher β is more likely to view signal s as evidence of $\overline{r}$ and to set E-control. Thus, pro-entrepreneur judges may report $\overline{r}$ even if the signal is objectively quite informative about $\underline{r}$. Biased judges neglect valuable information in order to rule for their preferred party. This is evident if judges are extremists: pro-entrepreneur judges with $\beta = +\infty$ and pro-investor judges with $\beta = 0$ never follow the signal, only their bias. Because extremist judges only care about avoiding errors against their preferred party, they interpret the slightest ambiguity favour of the latter, wasting a lot of information.

Moderately biased judges having $|\ln \beta| < \infty$, are averse to making *both* pro-investor and pro-entrepreneur errors, although to different extents. These judges sometimes follow the signal, especially if strong (i.e. if s is very high or low). As θ increases, though, judges pay attention to fewer and fewer signals. As the signal gets noisier, judges are aware that their adjudication is more vulnerable to errors. Thus, they distort adjudication toward their biases so as to avoid erring against their preferred party. This yields an important property, namely that judicial bias β exerts a stronger impact on state verification when physical unverifiability θ is higher. This is due to the fact that when θ is higher judges' return to listening to the signal is lower, not because unverifiability is abused by judges.

Consider now the cost η of I-control. As η goes up, E becomes more vulnerable and judges are more likely to rule for him (i.e. to report $\overline{r}$) regardless of their biases. Judges to some extent internalize the social cost of errors, so the direction of adjudication depends on the stakes. This may lead judges to neglect some informative signals but, unlike in the case of bias, this neglect efficiently reduces the risk of making a very costly error.

Disputes are randomly allocated to a measure one of judges who are distributed according to their bias β. Each judge verifies r by following rule (10), evaluated at the judge's own bias β. Variation in biases creates variation in state verification. Formally, I assume that β is lognormally distributed with mean 0 and variance σ^2. The assumption that judges are not ex-ante biased against any party allows me to show that judicial idiosyncrasies shape contracts by creating a distinct source of errors on top of those created by physical unverifiability θ. The assumption of normality yields closed form expressions for the probabilities $p_{\overline{r}}$ and $p_{\underline{r}}$ with which judges correctly verify $\overline{r}$ and $\underline{r}$. These are equal to:

$$p_{\overline{r}} = G\left[\frac{(\overline{r}-\underline{r})^2 + 2\theta^2 \ln \eta}{2(\overline{r}-\underline{r})\theta\sqrt{1+\frac{\theta^2\sigma^2}{(\overline{r}-\underline{r})^2}}}\right], \tag{11}$$

$$p_{\underline{r}} = G\left[\frac{(\overline{r}-\underline{r})^2 - 2\theta^2 \ln \eta}{2(\overline{r}-\underline{r})\theta\sqrt{1+\frac{\theta^2\sigma^2}{(\overline{r}-\underline{r})^2}}}\right], \tag{12}$$

where $G(.)$ is the standard normal c.d.f. If $\theta \to 0$ state verification is perfect regardless of the dispersion of biases σ. Biases begin to matter in the presence of factual ambiguities, namely as $\theta > 0$. In this case, if $\sigma \to +\infty$ half of the judges are pro-entrepreneur extremists (i.e. $\beta = +\infty$), the other half pro-investor extremists (i.e. $\beta = 0$) and state verification is a coin toss (i.e. $p_{\overline{r}} = p_{\underline{r}} = 1/2$). I focus on the more interesting case $\sigma < \infty$ where most judges are moderate, which allows me to study how contracting depends on the interaction between physical unverifiability θ, biases σ, and error costs η.

In (11) and (12) the quality of state verification is determined by its *precision* $p_{\overline{r}} + p_{\underline{r}}$, i.e. the total probability that a correct decision is taken, and by its *pro-investor stance* $(1-p_{\overline{r}})/(1-p_{\underline{r}})$, i.e. the ratio between pro-investor errors in $\overline{r}$ and pro-entrepreneur errors in $\underline{r}$. Inspection of (11) and (12) shows:

Proposition 1 *Judicial state verification is at least as informative as a coin toss (i.e.* $p_{\overline{r}} + p_{\underline{r}} \geq 1$*). Parameters* η *and* σ *affect the quality of state verification as follows:*

1. *A higher* η *lowers pro-investor stance by increasing* $p_{\overline{r}}$ *and reducing* $p_{\underline{r}}$*.*

2. *There are two thresholds* η_1, η_2 *with* $\eta_1 \leq 1 \leq \eta_2$ *such that:*

   (a) *if the cost of I-control is intermediate, namely if* $\eta \in (\eta_1, \eta_2)$, *higher* σ *reduces precision by reducing* $p_{\overline{r}}$ *and* $p_{\underline{r}}$,

   (b) *if the cost of I-control is low, namely if* $\eta \leq \eta_1$, *higher* σ *reduces pro-investor stance by increasing* $p_{\overline{r}}$ *and reducing* $p_{\underline{r}}$,

   (c) *if the cost of I-control is high, namely if* $\eta \geq \eta_2$, *higher* σ *boosts pro-investor stance by reducing* $p_{\overline{r}}$ *and increasing* $p_{\underline{r}}$.

Once more, result 1 says that since judges are responsive to error costs, when E becomes more vulnerable (i.e. as η goes up) adjudication becomes more favorable to him. Result 2 instead says that judicial dispersion σ exerts two adverse effects on state verification. First, it reduces precision. This is best seen in case a), when error costs are similar. Here higher σ induces all judges to neglect more information to favour their preferred party, boosting pro-investor and pro-entrepreneur errors. Higher dispersion σ here reduces the accuracy of state verification, much like physical unverifiability θ.

Second, higher σ distorts the ratio between error types. This is evident if error costs are sufficiently asymmetric. In case b), pro investor errors are cheap but higher σ reduces their relative incidence. In case c), pro-investor errors are expensive but higher σ boosts their relative incidence. That is, judicial dispersion σ moves state verification in the *wrong* direction, increasing the likelihood of the socially more costly error. Even if biases are not systematic, they distort state verification away from the efficient error pattern. In this specific way, biases exert a very different effect from limited information θ. We now show that this effect has far reaching implications for contracting.

4 The Optimal Contract under Enforcement Risk

Section 4.1 highlights the tradeoff entailed in the choice of an optimal state verification contract, the key focus of my analysis. Section 4.2 considers the truthful revelation contract. Sections 4.3 and 4.4. derive the optimal contract and welfare as a function of σ.

4.1 The State Verification Contract

The optimal state verification contract solves:

$$\max_{x(r),d_E(r)\leq\alpha r,d_I\leq\lambda} E\left\{\omega(r)\left[r-d_E(r)\right]+\left[1-\omega(r)\right](\lambda-d_I)\right\}, \tag{13a}$$

$$s.t. \quad E\left\{\omega(r)d_E(r)+\left[1-\omega(r)\right]d_I\right\}\geq k, \tag{13b}$$

$$\omega(\overline{r})=p_{\overline{r}}x(\overline{r})+(1-p_{\overline{r}})x(\underline{r}), \tag{13c}$$

$$\omega(\underline{r})=p_{\underline{r}}x(\underline{r})+(1-p_{\underline{r}})x(\overline{r}). \tag{13d}$$

$\omega(r)$ is the probability with which judges set E-control in state r. The contract maximizes E's profit (13a) subject to the break-even constraint (13b). Constraints (13c) and (13d) capture the impact of state verification on contract enforcement. Constraint (13c) says that E-control is set in state $\overline{r}$ if: i) judges correctly find $\overline{r}$, which occurs with probability $p_{\overline{r}}$, and enforce $x(\overline{r})$, or ii) if judges erroneously find $\underline{r}$, which occurs with probability $(1-p_{\overline{r}})$, and enforce $x(\underline{r})$. Equation (13d) shows the same idea with respect to $\underline{r}$.

To highlight the tradeoff shaping the optimal state verification contract, consider the case where investor break even (13b) is slack, in the sense that for any allocation of control E can find repayments allowing I to break even. By substituting (13c) and (13d) into (13a) and taking derivatives with respect to $x(\overline{r})$ and $x(\underline{r})$ one finds that a fully contingent contract $\{x(\overline{r}), x(\underline{r})\}=\{1,0\}$ is optimal provided:

$$\frac{1-p_{\underline{r}}}{p_{\overline{r}}}\leq\eta\leq\frac{p_{\underline{r}}}{1-p_{\overline{r}}}, \tag{14}$$

namely when η is close to 1. Equation (14) reflects the tradeoff between contingent and non contingent contracts. On the one hand, a contingent contract beneficially allows judges to set control based on the signal s; on the other hand, such contract is vulnerable to costly judicial errors, which arise when different errors have asymmetric costs. If adjudication is perfect ($p_{\underline{r}}=p_{\overline{r}}=1$), the contingent contract is costless and (14) always holds. If adjudication is uninformative ($p_{\underline{r}}+p_{\overline{r}}=1$), the contingent contract has no benefit and (14) holds only if error costs are fully symmetric ($\eta=1$). If adjudication is partially informative, the contingent contract $\{1,0\}$ is used if its cost is small, namely when error costs are sufficiently symmetric.

Otherwise, parties use non-contingent contracts to prevent judges from making costly errors. If $\eta > p_{\underline{r}}/(1-p_{\overline{r}})$, the relative cost of pro-investor errors is large and non-contingent E-control $\{1,1\}$ avoids them. If instead $\eta < (1-p_{\underline{r}})/p_{\overline{r}}$, the relative cost of pro-entrepreneur errors is large and non-contingent I-control $\{0,0\}$ avoids them. Overall, the optimal contract as a function of (η, θ, σ) fulfills:

Proposition 2 *With a slack break even constraint, parties use $x(\overline{r}) = 1$, $x(\underline{r}) = 0$ for all η if and only if $\theta = 0$ or $\sigma = 0$. If $\theta > 0$ and $\sigma > 0$, there is a function $\kappa(\sigma) \geq 1$, with $\kappa'(\sigma) < 0$, and $\lim_{\sigma \to +\infty} \kappa(\sigma) = 1$, such that parties use:*

1. *Non-contingent I-control $\{0,0\}$ if pro-investor errors are cheap, i.e. if $\eta < 1/\kappa(\sigma)$,*
2. *Contingent contract $\{1,0\}$ if η is intermediate, i.e. $1/\kappa(\sigma) \leq \eta \leq \kappa(\sigma)$,*
3. *Non-contingent E-control $\{1,1\}$ if pro-investor errors are expensive, i.e. if $\eta > 1/\kappa(\sigma)$.*

If $\theta = 0$, return r can be perfectly verified. Here parties trust judges and always write a contingent contract. When instead $\theta > 0$, return r is hard to verify and the contingent contract is inevitably vulnerable to judicial errors. In this case, the optimal contract depends on the cost of different misallocations and on judicial polarization as illustrated below:

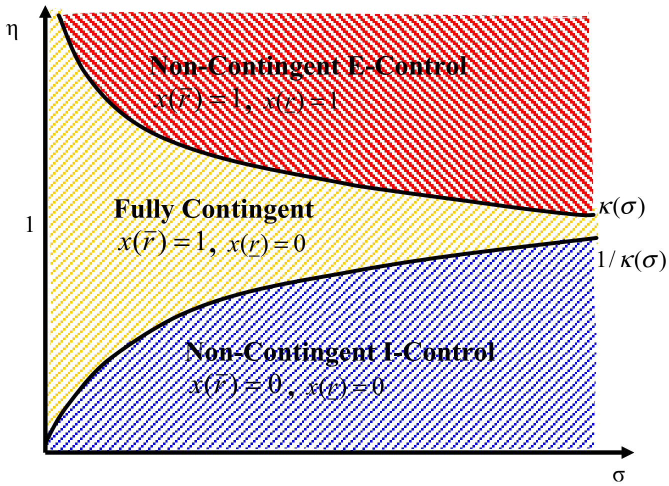

Figure 2

.

The role of bias is crucial: if judges are unbiased ($\sigma = 0$), parties always use a contingent contract regardless of the signal's noise θ and error costs η. Not only does physical unverifiability fail to trigger the use of non-contingent contracts *per se* but this is true even if error costs are very asymmetric. Intuitively, when $\sigma = 0$ judges internalize the parties' social welfare. Thus, since judges are ex-post better informed than the parties ex-ante (provided of course $\theta < \infty$), parties optimally give judges discretion in setting control by writing a contingent contract.[7]

More generally, the contingent contract is optimal if misallocations exact similar costs and judges are not too biased (η is close to 1 and σ is small). As the costs of misallocations become very asymmetric, biases becomes strong, or both, parties switch to using non-contingent contracts. Intuitively, higher dispersion σ reduces the responsiveness of adjudication to error costs, increasing the incidence of socially costly errors. To protect themselves against these costly errors, parties use non-contingent contracts. This is something that physical unverifiability θ alone does not do. The optimal non-contingent contract is designed to protect the vulnerable party by always giving her control. If $\eta < 1$, I is vulnerable and the optimal non-contingent contract is I-control. If $\eta > 1$, E is vulnerable and the optimal non-contingent contract is E-control.

The basic intuition of Proposition 2 does not change under binding investor break even. The only difference is that in (14) the social cost of pro investor errors η is replaced by:

$$\eta_b = \frac{\eta + (\vartheta - 1)\frac{\mu}{1-\mu}\frac{\alpha\overline{r}-\lambda}{\lambda-\underline{r}}}{1 + (\vartheta - 1)\frac{\lambda-\alpha\underline{r}}{\lambda-\underline{r}}}, \tag{15}$$

where ϑ is the Lagrange multiplier attached to (13b) and $\vartheta > 1$ captures a binding break even constraint. When $\vartheta > 1$ the relative cost of I-control *drops* to $\eta_b < \eta$ (this is due to $\alpha < 1$). Intuitively, when investor break even is binding, the cost of setting E-control goes up because, besides the ex-post inefficiency it entails in $\underline{r}$, such control allocation allows E to

[7] In the current risk neutral setting parties grant unbiased judges discretion by writing the first best contract for every θ. In a setting where parties are risk averse, such as the one of Section 2, parties will not typically write the first best contract even if $\sigma = 0$. However, and this is the key point of the analysis, when $\sigma = 0$ even risk averse parties would be willing to give judges dicretion to freely choose from a large menu of transfers. In this sense, even risk averse parties may write a flexible contract giving judges discretion for they know that judges would optimally allocate risks.

extract private benefits, hindering repayment and ex-ante financing. Thus, when $\vartheta > 1$ an I-control contract is more likely to be chosen.[8] Having studied the tradeoff entailed in the choice of the optimal state verification contract, we now briefly consider truthful revelation. We then move to study the optimal contract as a function of σ.

4.2 The Truthful Revelation Contract

The truthful revelation contract does not rely on judicial verification but on the entrepreneur's announcement of r. Since E likes to control the project, the contract must ensure that in state $\underline{r}$ he prefers to set I-control than to falsely report $\overline{r}$ and keep control, namely:

$$\underline{r} - d_E(\underline{r}) \leq \lambda - d_I, \tag{16a}$$

which implies that the contract must compensate E for the private benefits $(1-\alpha)\underline{r}$ lost when he reports $\underline{r}$. The maximum repayments to I under truthful revelation are thus $d_E(r) = \alpha r$ and $d_I = \lambda - (1-\alpha)\underline{r}$, which allow break-even if:

$$\mu\alpha\overline{r} + (1-\mu)\left[\lambda - (1-\alpha)\underline{r}\right] \geq k. \tag{17}$$

This inequality holds provided the informational rent $(1-\alpha)\underline{r}$ is sufficiently small. For instance, if $\underline{r} = 0$ such rent is zero and A2 implies that (17) is always met. The same is true if there are no private benefits (i.e. $\alpha = 1$). When however the informational rent is so large that (17) is violated, the truthful revelation contract is infeasible.

4.3 Judicial Polarization and Optimal Contract Choice

Consider the choice between the truthful revelation and state verification contracts. Since truthful revelation yields ex-post efficiency, a state verification contract is only optimal if it allows I to break-even when (17) is violated. This is true for instance when $\theta = 0$: under

[8] To apply Proposition 2 to the case $\vartheta > 1$ one should replace η_b also in adjudication strategies. For simplicity, we however assume that judges are only concerned with the ex-post consequences of control allocations, not the ex-ante ones (so that adjudication is a function of η, not of η_b). Footnote 11 discusses what happens if we relax this assumption.

perfect verifiability, the fully contingent contract not only implements ex-post efficiency but grants I a repayment of:

$$\mu\alpha\overline{r} + (1-\mu)\lambda, \tag{18}$$

which is more than what I obtains in (17) under truthful revelation (feasibility is ensured by A2). If $\theta > 0$ state verification is imperfect and the contingent contract may become infeasible. The general point, though, is that - unlike E - judges need not be given any rent to reveal r. This is the reason why state verification can boost repayment. To stress the preeminence of I's break even in the use of state verification, I assume:

A3: *The relative expected cost η of I–control is equal to* 1.

This implies that investor break even is the key force shaping contracts. When $\eta = 1$ the fully contingent contract is always optimal provided investor break is slack.[9] We can now study how judicial polarization σ affects contracting. The appendix proves that:

Proposition 3 *There exists a threshold $\lambda^* \in [\underline{r}, \overline{r})$ such that:*

1. *If $\lambda > \lambda^*$, parties write a truthful revelation contract.*
2. *If $\lambda \leq \lambda^*$, parties use state verification. There exist thresholds $\widehat{\lambda}, \widehat{\sigma}$ such that:*
   (a) *If $\lambda \geq \widehat{\lambda}$ or $\sigma < \widehat{\sigma}$ parties set $x(\overline{r}) = 1$, $x(\underline{r}) = 0$*
   (b) *For $\lambda < \widehat{\lambda}$ and $\sigma \geq \widehat{\sigma}$, parties still set $x(\underline{r}) = 0$ but, to attain break-even, they set $x(\overline{r}) < 1$. $x(\overline{r})$ falls in σ. For $\sigma \to +\infty$, setting $x(\overline{r}) = 0$ is optimal.*
   (c) *$\widehat{\lambda}$ falls in α and $\widehat{\lambda} = k$ if $\alpha = 1$. $\widehat{\sigma}$ increases in α and falls in θ.*

If, as in point 1 above, the return λ under I-control is large, the informational rent of E is small relative to what I obtains from controlling the project. Thus, the truthful revelation contract is feasible and parties attain the first best by using it. If instead E's informational

[9] Besides simplifying the algebra, A3 reflects the fact that investor break-even shapes the use of non-contingent contracts also when $\eta \neq 1$. Indeed, if parties are not concerned about pro-entrepreneur errors and always set E-control [i.e. $x(\overline{r}) = x(\underline{r}) = 1$] the investor obtains at most $\alpha E(r)$, which only ensures break even if truthful revelation is also feasible. See footnote 10 for further elaboration of this point.

rent is so large that truthful revelation is infeasible, state verification is necessary to attain break even. Parties rely on courts when informational asymmetries between them are strong.

The form of the optimal state verification contract depends on circumstances. If, as in point 2.a, the cash flow λ under I-control is high or judicial dispersion σ is low, the fully contingent contract is feasible and parties use it to maximize ex-post efficiency. When λ is sufficiently high, the prospect of controlling the project at least some of the times protects the investor against private benefits extraction by E, even if judicial biases are strong. When on the other hand dispersion σ is low, adjudication is sufficiently accurate that it protects the investor under the fully contingent contract, even if λ is low. In other words, either a high λ or a low σ keep the ex-ante social cost of judicial errors against the investor at a tolerable level, allowing parties to use the fully contingent contract. In this range, dispersion σ introduces noise (and thus ex-post inefficiencies) in the allocation of control, but it does not hinder the use of the contingent contract. Parties prefer the noisy enforcement of contingent control to a predictably enforced but rigid control allocation.

Suppose however that, as in point 2.b, λ is low *and* σ is large. Then, neither the return from I-control nor adjudication can alone effectively protect the investor against private benefits extraction under the contingent contract. As a result, pro-entrepreneur errors are very costly for they can undermine investor break even. In the previous language, the investor becomes the vulnerable party. To protect him and ensure financing, parties write a less contingent contract tilted in favour of I-control. This contract sets E-control with probability less than 1 if judges report $\overline{r}$ and I-control otherwise. Note that here judicial dispersion σ *endogenously* boosts the social cost of pro-entrepreneur errors and thus the use of the non-contingent contract. Indeed, a higher σ raises the incidence of both pro-entrepreneur and pro-investor errors, but as the former errors become frequent, break even is at stake. This induces parties to enhance investor protection by increasing the extent of investor control in the contract, the more so the higher is σ. When judicial biases become extreme (i.e. as $\sigma \to \infty$), the optimal contract is fully non-contingent and always yields control to I.[10,11] In this range then, stronger biases do not only reduce the ex-post efficiency of control but they also distort contracts, eventually causing a breakdown of the separation of ownership and control.

Point 2.c illustrates two useful comparative static results. First, conditional on the use of state verification, the contract becomes ceteris paribus more contingent the lower are private benefits $(1-\alpha)$. Lower private benefits allow E to pledge more of the project's cash flow to I, which reduces the cost of pro-entrepreneur errors, rendering the contingent contract more appealing. When there are no private benefits, i.e. $\alpha = 1$, this effect is so strong that parties always write the fully contingent contract regardless of σ and λ.[12] Second, when judges are biased ($\sigma > 0$) the use of the contingent contract goes up as physical unverifiability θ falls. By reducing the ambiguities entailed in state verification, lower θ reduces the extent to which judges express their biases, inducing parties to use a more contingent contract. This effect points to an interesting interaction between physical unverifiability and judicial biases that I analyze in the next section.

4.4 Judicial Biases and Social Welfare

Consider the welfare impact of judicial biases. To begin, note that when $\eta = 1$ the probability of correct verification is the same in the two states, namely:

[10] The main results above go through also when A.3 does not hold. If $\eta < 1$, the analysis is basically the same, except that parties may deterministically set I-control even before investor break-even gets binding under the fully contingent contract. If $\eta > 1$, a high σ may initially induce parties to set $x(\underline{r}) > 0$ and $x(\overline{r}) = 1$ so as to minimize the ex-post cost of pro-enterpreneur errors (I already showed that always setting E-control by writing contract $x(\underline{r}) = x(\overline{r}) = 1$ is infeasible). As σ increases further, though, break-even becomes the main concern. In particular, if $\lambda < \widehat{\lambda}$, increases in σ eventually lead parties to reduce $x(\underline{r})$ to zero, and to reduce $x(\overline{r})$ below one. For $\sigma \to \infty$ the optimal contract tends to $x(\underline{r}) = x(\overline{r}) = 0$. In this sense, case ii) of Proposition 2 as describing contract choice for a general η when σ is large enough.

[11] In principle, and in line with Section 4.1, if judges internalize the ex-ante cost of errors, parties always write the fully contingent contract. This cannot occur in this model (even if $\sigma = 0$) because, as previously argued, judges are only concerned about *ex-post* efficiency (i.e. use relative cost η instead of η_b). As a result, the threshold $\widehat{\sigma}$ may be equal to zero, implying that (if θ is very large) as λ falls below $\widehat{\lambda}$ parties immediately jump to a contract that is less contingent than in the first best.

[12] The intuition is that in the current case where $\eta = 1$ and thus $E(r) = \lambda$, if there are no private benefits of control the investor receives on average the same under E-control and I-control. As a result, the symmetric noise caused by σ neither affects repayment nor, a fortiori, whether break even is attained or not.

$$p_{\overline{r}} = p_{\underline{r}} \equiv p = G\left[\frac{\overline{r}-\underline{r}}{2\theta\sqrt{1+\frac{\theta^2\sigma^2}{(\overline{r}-\underline{r})^2}}}\right]. \tag{19}$$

Under a state verification contract, social welfare is equal to the return λ under I-control plus the expected gain from setting E-control in $\overline{r}$, minus the expected loss from setting E-control in $\underline{r}$. Using A.3, one finds that this is equal to:

$$\mathbf{W} = 2x(\overline{r})\,(p-1/2)\,\mu(\overline{r}-\lambda)+\lambda. \tag{20}$$

Since $p > 1/2$, a higher $x(\overline{r})$ increases welfare by allowing judges to efficiently set E-control in $\overline{r}$. Equation (20) allows to decompose the welfare impact of higher adjudication accuracy p in two components:

$$\frac{d\mathbf{W}}{dp} = 2x(\overline{r})\mu(\overline{r}-\lambda)+2\frac{dx(\overline{r})}{dp}\,(p-1/2)\,\mu(\overline{r}-\lambda)>0. \tag{21}$$

Contrary to standard accounts [e.g. Kaplow and Shavell (1996)], in my model judicial errors hinder welfare even though judges are not ex-ante biased against a specific party.[13] The first component shows that higher p improves the enforcement of allocation $[x(\overline{r}),0]$, the second component shows that higher p fosters break even, allowing parties to write a more contingent contract [as $dx(\overline{r})/dp > 0$]. By exploiting the thresholds of Proposition 3 it is immediate to find:

Corollary 1 *When state verification is used, higher σ reduces social welfare. There are two regimes: i) if $\lambda \geq \widehat{\lambda}$, or $\sigma < \widehat{\sigma}$, or both, higher σ reduces welfare only by reducing p, and ii) if $\lambda < \widehat{\lambda}$ and $\sigma \geq \widehat{\sigma}$, higher σ reduces welfare also by reducing $x(\overline{r})$. For given $\sigma > 0$, parties are more likely to be in regime ii) if θ is higher.*

My model highlights an interaction between physical unverifiability and judicial bias whereby a given extent of judicial dispersion σ is socially more costly when physical unverifi-

[13]The appendix shows that bias causes misallocations of control even if one allows for ex-post renegotiation. The intuition is that at the rengotiation stage (i.e. at $t = 1/3$) E is better informed than I about the return r under E-control. This feature, coupled with the fact that not all of the return r can be pledged to I, imply that renegotiation does not allow parties to remove all ex-post inefficiencies.

ability θ is higher. Put differently, judicial biases enhance the cost of physical unverifiability causing a greater distortion of state verification and contracting. The intuition is that the presence of factual ambiguities induces biased judges to distort adjudication more: as we saw in Section 3, when θ is higher *all* judges cater more to their biases. Crucially, then, this also implies that higher θ boosts the costs of bias via two effects. First, it amplifies the adverse effect of σ on the accuracy of state verification. This is regime i) above. Second, it boosts the use of non-contingent contracts, inflicting on the parties also the cost of contractual distortions. This is regime ii) above. These two effects together predict that biases amplify physical unverifiability: transactions characterized by higher θ, perhaps because they are more complex and innovative, are relatively more vulnerable to the distortions created by judicial bias.[14] This suggests that the law should exert a particularly strong impact on the use of innovative and flexible financial contracts.

5 Applications

5.1 The Law and Finance Evidence

The financial contracting model of the previous section suggests that the link between law and financial development may be due to the ability of courts to enforce flexible financial contracts, as in the chain of causation below[15]:

$$\text{Court System} \Longrightarrow \text{Innovative/Flexible Financial Contracts} \Longrightarrow \text{Financial Development.}$$

[14] Another way to see this formally is to consider the expression for p in Equation (19). Using that equation, after some algebra one can find:

$$\left.\frac{\partial^2 p}{\partial\sigma\partial\theta}\right|_{\sigma=0} = -\frac{8}{(\overline{r}-\underline{r})}\cdot\theta^5 < 0. \tag{22}$$

That is, the same increase in judicial bias σ reduces accuracy much more in transactions characterized by higher θ, causing both severe ex-post errors and contractual distortions. Equation (22) shows this property for small biases (i.e. in the neighborhood $\sigma = 0$), but one can check that the same property holds for larger σ. When σ is very large the condition $\frac{\partial^2 p}{\partial\sigma\partial\theta} < 0$ may not hold. This is because when most judges are very biased, they already pay very little attention to the information embodied in the signal s. As a result, if the signal becomes more noisy the errors caused by the neglect of such signal will become *smaller*.

[15] Despite the possibility of softening judicial bias through private arbitration, there are theoretical and empirical reasons to think that judicial bias in the public legal system generates welfare costs. The legal system must ultimately enforce arbitrators' decisions, arbitration awards can be challenged in court and, unlike courts, arbitrators are not subsidized by the government (Posner 2004).

As stressed by the Introduction, Coasian reasoning suggests that the above logic should play a key role in rationalizing the benefit of Common Law for financial development. If entrepreneurs and investors could freely contract about their rights and duties, the law should not matter for financing. This logic however begs the question: why should Common Law systems better enforce innovative financial contracts than Civil law ones? Of course, it may be that Common Law courts are less biased than Civil Law ones, but there is no systematic evidence validating this possibility.[16] Crucially, though, my model says that even if Common and Civil Law systems share the same biases σ, they may differ in enforcement quality insofar as their litigation regimes are different. Luckily, there is systematic evidence on this issue. In financial transactions, La Porta et al. (2008) find that Common Law courts indeed enable shareholders to litigate more effectively over self dealing cases via better disclosure rules or burden of proof allocation. La Porta et al. (2003) also show that for collecting a bounced check and evicting a nonpaying tenant, Common Law courts have better legal procedures, which are associated with more consistency, fairness and less corruption in judicial decisions. According to my model, these differences in the litigation process may importantly interact with judicial bias. By reducing the extent to which judicial decisions are based on ambiguous and unverifiable factors (i.e. by reducing θ), the disclosure and procedural rules of Common Law regimes may reduce the cost of judicial bias, fostering the use of flexible contracts.[17]

If this conjecture is correct, we should then observe greater use of innovative/flexible financial contracts in Common Law systems. Some evidence supports this notion. Lerner and Schoar (2005) find that private equity investments in Common Law countries are more likely to use convertible preferred stock, whereby control shifts from the entrepreneur to the investor when the investment performs poorly, as opposed to the investor owning control stakes of common stock. As in Proposition 3, the non-contingent investor-control attained with common stocks may be the optimal response by parties to the enforcement risk plaguing a more flexible contract such as convertible debt. Indeed, Lerner and Schoar report that in Peru, a private equity group in their sample turned to using common stocks after a litigation

[16] One informal piece of evidence is offered by Pistor (2005), who stresses that Common Law judges enforce contracts primarily by interpreting the parties' intent, Civil Law judges also in light of social norms.

[17] Of course, the quality of courts is only one of the many reasons for why law may matter empirically. Another channel stresses the adaptability of Common Law (Gennaioli and Shleifer 2007).

in which they proved "unable to convince the judge that their preferred stock agreement gave them the right to replace a third generation founder of the company." In a related vein, Qian and Strahan (2008) find that in Common Law countries bank loans are more likely to include clauses transferring collateral to lenders upon default.[18] Since in these papers the use of rigid contracts in Civil law regimes is not due to legal restrictions, the evidence is consistent with the notion that Common Law may spur financial development also due to its greater ability to support flexible and innovative financial contracts.

5.2 Contract Interpretation and Litigation

Existing work on contract interpretation and litigation (e.g. Hermalin et al. 2007) stresses that judges should remedy contract incompleteness by filling contractual gaps ex-post. This prescription is however inappropriate if – as in my model – the use of non-contingent contracts, rather than reflecting writing costs or unforeseeability, reflects the deliberate attempt to protect the vulnerable party from judicial errors. In such case, ex-post gapfilling allows judges to re-introduce their biases into non-contingent contracts, lowering welfare. My model thus suggests that while such gapfilling may be optimal in developed legal systems, literal interpretation and enforcement of standard contracts is more desirable in undeveloped legal systems, for in the latter the use of non-contingent contracts is more likely to reflect judicial bias (e.g. due to the lower quality of information/accounting standards).

Accordingly, my model implies that it may be desirable to forbid courts from enforcing contracts based on ambiguous evidence. If judges are unbiased, the use of such evidence can only improve judicial information and thus adjudication. Absent other problems, it would thus be surprising to observe restrictions in the evidence that courts can consider. If instead judges are biased, the use of such evidence may allow them to strategically distort interpretation and fact finding, providing a justification for the presence of evidence restrictions.

I now show this point formally by using the exchange transaction of Section 2. To apply in this context the state verification model of Section 3.2 I assume that: i) judges observe

[18] The evidence also suggests that the inability to use flexible financial contracts has economic costs. Lerner and Schoar (2005) find that private equity funds investing in Common Law nations enjoy higher returns. Qian and Strahan (2008) find that interest rates on bank loans are lower in Common Law countries.

a noisy signal $s \rightsquigarrow N(v,\theta^2)$ where $v \in \{\overline{v},\underline{v}\}$ is the value of the widget for the consumer, and ii) judges seek to minimize the probability of error.[19] In Equation (10) this is akin to replacing r with v and setting $\eta = 1$ (as well as $\mu = 1/2$). It is easy to see that in this case the probability that judges find the true state is equal to:

$$p = G\left[\frac{\overline{v}-\underline{v}}{2\theta\sqrt{1+\frac{\theta^2\sigma^2}{(\overline{v}-\underline{v})^2}}}\right], \tag{23}$$

which follows from (19). Given Equations (5) and (6), the optimal contract is then equal to:

$$d_1 = (\overline{v}-\underline{v})(2p-1), \tag{24}$$

$$p_0 = c + (0.5)(\overline{v}-\underline{v})(2p-1). \tag{25}$$

Also in this sales transaction, higher σ reduces the extent to which the contract is state contingent, the more so the higher is unverifiability θ, by shaping the precision p of state verification. As in Corollary 1 then, judicial dispersion σ amplifies the presence of physical unverifiability, thereby reducing welfare by: i) rendering enforcement noisier, and ii) inducing parties to use less flexible contracts.

In this setup, evidence restrictions can be studied by mapping the evidence used by judges on the probability p of correct state verification. Suppose that there are two pieces of evidence. The first one is a "hard" signal s_h normally distributed with mean v and variance γ^2. This may constitute an estimate of the widget's value formed by a pre-selected expert. The key point is that judges have no discretion in interpreting such signal, they simply report its value. The second piece of evidence available is a "soft" signal s_u normally distributed with mean v and variance $\gamma^2\theta^2/(\gamma^2-\theta^2)$ where $\gamma^2 \geq \theta^2$. This signal may concern the competence or integrity of the expert who assessed the widget's value. Its verification is subjective, undertaken by the judge with full discretion. The variances of signals s_h and s_u have been judiciously chosen in such a way that the use of both of them is equivalent

[19] Thus, the judge finds $\overline{v}$ iff $\beta\Pr(\overline{v}\,|s) \geq \Pr(\underline{v}\,|s)$, where β is the pro-firm bias. One could alternatively let judges internalize the ex-post welfare consequences of different allocations, but the analysis would be more complicated due to the curvature of $u(\cdot)$.

to the judge observing the original "soft" signal s, normally distributed with mean 0 and variance θ^2.[20] In words, the soft information generating the adjudication in (23) consists of a combination of a hard and soft signal. This combination is soft because the judge can always manipulate the interpretation of the unverifiable piece of evidence so as to achieve his overall preferred outcome.

As a result, if both pieces of evidence are allowed, state verification is identified by Equation (23). If instead the use of evidence is restricted ex-ante only to the verifiable signal s_h, parties can for instance write a contract instructing judges to enforce damages if and only if $s_h < (\overline{v} + \underline{v})/2$. Crucially, if parties choose to do so, then judicial biases no longer affect adjudication and the probability of correct verification is equal to:

$$p = G\left(\frac{\overline{v} - \underline{v}}{2\gamma}\right). \tag{26}$$

By comparing Equations (26) and (23) it is easy to find that forbidding the use of "soft" evidence by judges will indeed improve the precision of state verification provided:

$$\sigma \geq (\overline{v} - \underline{v})\,\frac{\gamma^2 - \theta^2}{\theta^3}. \tag{27}$$

If σ is small, (27) is violated and it is always optimal to use both hard and soft information because, consistent with conventional wisdom, doing so improves the quality of judicial information (this is because $\gamma^2 \geq \theta^2$). If instead σ is large, the use of s_u *increases* enforcement risk and *reduces* damages d_1 in (24). Somewhat paradoxically, the use of more evidence at trial can reduce the use of contingent contracts: when such evidence is ambiguous it allows judges to express their bias, inducing parties to protect themselves against such enforcement risk by writing a less contingent contract.

These observations helps explain the organization of private arbitration tribunals.[21] In

[20] Simple signal extraction shows that a judge's information upon seeing (s_h, s_u) is summarized by a linear combination $s = \rho_0 + \rho_1 s_h + \rho_2 s_u$ of the signals whose variance is θ^2. The combined signal s is "soft" because the judge can always fit a value of s_u to find the value of s inducing his desired allocation.

[21] Another possibility to deal with judicial bias is for the parties to contract ex-ante on the procedural rules governing contract enforcement. For example, most U.S. courts allow parties to waive through contract the right to jury trial. Unfortunately, public courts often refuse to enforce contract terms dealing with procedure, so this private solution is somewhat limited.

a study of private arbitration in the U.S. cotton industry, Bernstein (2001) shows that resolution of disputes between merchants and mills obeys three principles. First, tribunals do not hold hearings, they decide cases solely on the basis of briefs and documentary evidence. Second, tribunals deal with issues of quality, damages and the like by using clear bright-line rules that, unlike those of the Uniform Commercial Code, do not contain for the most part standard-like words such as "reasonable" or "good faith". Third, unlike public courts, tribunals follow a formalistic approach that does not permit custom or trade usage to trump explicit contractual provisions. By committing courts to enforce contracts on the basis of objectively verifiable evidence, these rules may precisely serve the purpose of reducing courts' discretion in resolving factual and interpretive ambiguities, reducing enforcement risk and boosting parties' ability to contract.

6 Conclusions

I built a contracting model where potentially biased judges play an important role in verifying complex, ambiguous, states. The analysis shows that the combination of factual ambiguity *and* judicial bias is a powerful driver of the use of rigid, non-contingent contracts. Judicial biases alone are not enough: if state verification entails no ambiguities, judges cannot express their biases and parties use contingent contracts, which are perfectly enforced. But even if factual ambiguity is present, parties still value the flexibility of contingent contracts provided judges are unbiased and resolve ambiguities in the parties' best interest. Problems become severe when factual ambiguities and judicial biases coexist: now the uncertainty entailed in state verification induces judges to express their biases and enforcement becomes fraught with socially costly errors. Parties react by using non-contingent contracts that protect the "vulnerable" party that stands to lose most from judicial error. In this respect, judicial bias is only superficially similar to limited information. Both of these frictions reduce accuracy and welfare, but bias exerts a stronger distortion of contracts.

The model suggests that the willingness to contract on hard to verify events such as a party's "best efforts" or "good faith" should be lower in areas of law where judges are more biased and polarized, perhaps due to political beliefs or moral concerns; the employment relationship, or product and workplace safety may be cases in point. At the same time, greater factual ambiguity, perhaps due to the complexity of a transaction or to poor judicial expertise, will amplify the costs of judicial bias, paving the way for the use of non-contingent contracts. This may help rationalize why countries with more developed legal systems appear to have a comparative advantage at producing complex goods (e.g. Nunn 2007).

Beyond contract design, the model of biased adjudication presented here has already been used to shed new light on a variety of issues. Some of them delve on classical law and economic topics such as Common Law evolution (e.g. Gennaioli and Shleifer 2007, Ponzetto and Fernandez 2008), enforcement of legal rules (Gennaioli and Shleifer 2008), and regulation (Shleifer 2010). With biased courts, not only torts and legal evolution work differently, but also the properties of different interventions against market failures are affected, as the Coase Theorem no longer holds. Other applications delve on traditional economic topics such as the working of U.S. Bankruptcy (Gennaioli and Rossi 2011), and the causes and consequences of commercial innovation (Gennaioli and Perotti 2011).

Needless to say, much remains to be done in order to deepen our understanding of the economic effects of legal systems. For example, it would be useful to endogeneize at a micro level how the quality of judicial information and the severity of biases depend on factors such as litigation rules (e.g. adversarial vs. inquisitorial systems), persuasion tactics, or rules of judicial appointment (e.g. lay vs. professional judges).

Another natural application of my setup is the theory of the firm. The leading theory here (Grossman and Hart 1986) argues that when contracts are incomplete asset ownership protects a party by giving her residual control rights. As we have seen, though, non-contingent contracts may be designed precisely to protect vulnerable parties. This similarity between the roles of contracts and ownership implies that rather than being exogenously determined as in standard theory, the ability of parties to write flexible contracts may itself depend on asset ownership. In particular, a protective allocation of residual property rights over assets may enable parties to contract flexibly over alternative but still hard to verify rights. Insofar as the law delineates what rights judges are more likely to "bundle" with property, this intuition opens the possibility for a joint determination of contractual flexibility and asset ownership based on enforcement risk.

Finally, at a more macro level my model can be used to study the link between enforcement risk and economic development. On the one hand, enforcement risk may affect which investments are financed depending on their innovativeness/complexity. On the other hand, economic development may allow agents to diversify some enforcement risk away in large, standardized, financial markets. I believe that studying whether these effects imply a complementarity or a substitutability between legal and economic development is an interesting topic for future research.

References

Aghion, Philippe and Patrick Bolton, 1992, "An Incomplete Contracts Approach to Financial Contracting". *Review of Economic Studies* 52, 473-494.

Bernstein, Lisa, 2001, "Private Commercial Arbitration Law in the Cotton Industry: Creating Cooperation Through Rules, Norms, and Institutions," *Michigan Law Review*, 99.

Bond, Philip, 2009, "Contracting in the Presence of Judicial Agency", *The B.E. Journal of Theoretical Economics*, vol 9, issue 1.

Chang, Tom and Schoar, Antoinette 2006, "The Effect of Judicial Bias in Chapter 11 Reorganization", mimeo.

Coase, Ronald, 1960, "The Problem of Social Cost", *Journal of Law and Economics* 3, 1-44.

Djankov, Simeon, Rafael La Porta, Florencio Lopez-de-Silanes and Andrei Shleifer, 2008, "The Law and Economics of Self-Dealing", *Journal of Financial Economics*, forthcoming.

Easterbrook, Frank and Daniel Fischel, 1991, *The Economic Structure of Corporate Law*, Cambridge, MA: Harvard University Press.

Frank, Jerome, 1949, *Courts on Trial*, Princeton University Press.

Gennaioli, Nicola, 2003. Contracting in the Shadow of the Law, Harvard University, mimeo.

Gennaioli, Nicola and Andrei Shleifer, 2007, The Evolution of Common Law, *Journal of Political Economy*, 115, 43-68.

Gennaioli, Nicola and Andrei Shleifer, 2008, Judicial Fact Discretion, Journal of Legal Studies, 37 (1), 1-35.

Gennaioli, Nicola and Enrico Perotti, 2010, Standardized Enforcement: Access to Justice vs. Contractual Innovation, mimeo.

Glaeser, Edward and Andrei Shleifer, 2002, "Legal Origins", *Quarterly Journal of Economics* 117, 1193-1230.

Grossman, Sanford and Oliver Hart, 1986, "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration," *Journal of Political Economy*, 94, 691-719.

Hart, Oliver, 1995, *Firms Contracts and Financial Structure*, Oxford University Press.

Hermalin, Benjamin, Avery Katz, and Richard Craswell, "The Law and Economics of Contracts," *Handbook of Law and Economics*, North Holland, 2007.

Ichino, Andrea, Michele Polo, and Enrico Rettore, 2003 "Are Judges Biased by Labor Market Conditions?", *European Economic Review*, October, 47 (5), 913-944.

Benjamin, Avery Katz, and Richard Craswell, "The Law and Economics of Contracts," *Handbook of Law and Economics*, North Holland, 2007.

Kaplow, Louis and Steven Shavell (1996), "Accuracy in the Assessment of Damages," *Journal of Law and Economics* 39, 191-210.

La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer, and Robert Vishny, 1998, "Law and Finance", *Journal of Political Economy* 106, 1113-1155.

La Porta, Rafael, Florencio Lopez-de-Silanes, and Andrei Shleifer, 2003, "Courts", *The Quarterly Journal of Economics*, May.

Lerner, Josh and Antoinette Schoar, 2005, "Does Legal Enforcement Affect Financial Transactions? The Contractual Channel in Private Equity", *Quarterly Journal of Economics*, 120, 223-46.

Nunn, Nathan, 2007, "Relationship-Specificity, Incomplete Contracts, and the Pattern of Trade", *Quarterly Journal of Economics*, 122-2, p. 569-600.

Pistor, Katharina, 2006, "Legal Ground Rules in Coordinated and Liberal Market Economies", In *Corporate Governance Context: Corporations, States, and Markets in Europe, Japan, and the U.S.*, edited by K.J. Hopt et al. Oxford, UK: Oxford University Press.

Ponzetto, Giacomo and Patricio Fernandez, 2008, Case Law versus Statute Law: An Evolutionary Comparison, Journal of Legal Studies, 37 (2), 379-430.

Posner, Richard, 2004, "Judicial Behavior and Performance: an Economic Approach", mimeo.

Qian, Jun and Philip E. Strahan 2008, "How law and institutions shape financial contracts: the case of bank loans", *Journal of Finance*.

Shleifer, Andrei, 2010, Efficient Regulation, in *Regulation vs. Litigation*, Daniel Kessler ed., NBER and University of Chicago Press.

Townsend, Robert, 1979, "Optimal Contracts and Competitive Markets with Costly State Verification", *Journal of Economic Theory* 21, 265-293.