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ABSTRACT

Optimal Contracts with Enforcement Risk*

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.

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1 Introduction

The central role of private contracting in fostering economic efficiency (Coase 1960) relies, among other assumptions, on proper contract enforcement. For contracting to work, judges must be able to interpret contract clauses and verify whether the events triggering them have actually occurred. Building on this premise, the costly state verification (Townsend 1979) and incomplete contracts (Grossman and Hart 1986) literatures stress that contracts often include fewer contingencies than standard theory would predict because many states are so complex that judicial verification of them is costly or outright impossible.

This dichotomy between verifiable and unverifiable states sheds light on the economic effects of limited contracting but does not explain why, contrary to basic intuition, many real world contracts are contingent on states that are hard to verify. Many financial contracts require managers to disclose "material" information to investors, licensing contracts require distributors to exert their "best efforts", and sales contracts often excuse non-performance if the seller cannot avoid it by exerting "due care." Why are such hard to verify clauses sometimes used? Why, on the other hand, are contracts often not contingent on states of apparently easier verification, especially in certain legal regimes, as shown by the lower use of convertible financial contracts in Civil Law systems (Lerner and Schoar 2005)?

This paper addresses these issues by explicitly modelling judicial state verification in an otherwise standard contracting setup. Existing formal work has paid little attention to the effect of courts on contracts (Bolton and Dewatripont 2005, p.3). I show that, by looking at courts' verification behavior one can shed light on: i) what economic factors/legal systems foster contracting on hard to verify states, ii) what specific terms are written if parties choose not to contract on such states, and iii) the welfare impact of courts.

I study a financial contracting model in the spirit of Aghion and Bolton (1992) where a risk neutral investor finances the project of a risk neutral entrepreneur under a contract allocating control over the project. The entrepreneur prefers to be in control, as he derives private benefits from doing so, but in some states investor control is socially efficient. Parties can either write a non-contingent contract always giving control to one of the parties or a contingent contract setting entrepreneur control if and only if the return r so generated is sufficiently high. Given the parties' conflict of interest over the allocation of control, the enforcement of the latter contract requires a court to step in and verify r.

I make two assumptions about state verification. First, I assume that r is hard to verify, in the sense that the evidence presented in court about it is noisy and subject to interpretation. For instance, the contract may be contingent on the project's earnings or the entrepreneur's relative performance, inducing parties to present conflicting earnings or market performance 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 verify r based on an imperfect signal whose noise θ captures the "physical" difficulty to verify r.

Second, I assume that when resolving factual ambiguities judges are swayed by personal biases. In line with legal realists (Frank 1930), bias may be due to policy views:[1] some judges believe in risk taking or in preserving employment, leaving the entrepreneur in control unless the evidence of his ineptitude is abundant; other judges believe in fostering repayment, shifting control to the investor as soon as the project's prospects worsen. Chang and Schoar (2006) document the important role of judicial views in bankruptcy. But bias can also reflect idiosyncrasies and arbitrariness, due for instance to the judge's sympathy for a party, or to his familiarity with a specific legal argument or piece of evidence. Regardless of the nature of bias, I assume that pro-entrepreneur and pro-investor judges are distributed 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.

In this setting, if the return r is easy to verify, i.e. $\theta = 0$, parties attain the first best by using a contingent contract regardless of the dispersion of biases σ. When state verification entails no ambiguities, contingencies are written not only despite biased judges, but perhaps precisely to constrain them. When instead $\theta > 0$ and state verification necessarily entails some ambiguities, how do optimal contracts look like? I find two main results.

First, if judges are unbiased ($\sigma = 0$) parties continue to use the contingent contract, even if physical unverifiability θ is extremely high. The intuition is that, when enforcing

[1] As an alternative to bias, Glaeser and Shleifer (2002) consider judicial bribe-taking. Bond (2004) 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.

the contingent contract, unbiased judges resolve factual ambiguities so as to protect parties against costly errors. Concretely, if pro-investor errors are very costly, judges set entrepreneur control unless the signal strongly favors the investor. If instead pro-entrepreneur errors are very costly, judges set investor control unless the signal strongly favors the entrepreneur. By avoiding costly errors, this enforcement strategy encourages the use of the contingent contract because the latter allows judges to efficiently set control when they obtain a strong signal. Thus, if judges are unbiased, physical unverifiability hinders welfare by reducing the precision of state verification but does not hinder the use of the contingent contract.

Second, judicial bias is what triggers the use of non-contingent contracts. When judicial dispersion σ is low, biases only reduce the accuracy of state verification but parties continue to use contingent contracts. As σ becomes sufficiently large, though, parties switch to using non-contingent contracts. The reason is that, instead of minimizing error costs, biased judges exploit factual ambiguities to express their views. As a result, higher σ boosts the incidence of *both* pro-entrepreneur and pro-investor errors, even if one of the two error types is very costly. Non-contingent contracts precisely allow parties to reduce error costs by giving full control to the "vulnerable" party, namely the party suffering from the most costly error type. This notion helps explain which non-contingent contract is used. If σ is moderately high, ex-ante break even is not a concern and minimizing error costs is equivalent to giving full control to the party maximizing the project's average return, typically the entrepreneur. As σ increases further, though, pro-entrepreneur errors increase and so does private benefit extraction, to the point of hindering repayment. At this point, additional pro-entrepreneur errors are very costly and the investor is the "vulnerable" party. To protect the latter and secure financing, parties increase the extent of investor control in the contract. As biases get strong, the investor exerts full control, breaking the separation of ownership and control. In this range, judicial biases σ hinder welfare not only by reducing the accuracy of state verification, just as physical unverifiability θ does, but also - and most distinctively - by forcing parties to use inflexible, inefficient, contracts.

Going back to the initial questions then, non-contingent contracts are used when judicial biases introduce distinct enforcement risk on top of factual ambiguities. In this precise sense then, courts create a specific inefficiency: the distortion of contracts toward rigid forms.

Crucially, I find that the biases of courts powerfully interact with physical unverifiability, for it is precisely when facts are ambiguous that judges have greater leeways to distort state verification. As a result, court systems plagued by bias should be more costly for complex/innovative transactions, where large factual ambiguities allow biased judges not only to reduce the precision of enforcement but also to distort contracts. Using this idea, section 5 provides a novel rationale for legally restricting the evidence parties can present in court: somewhat paradoxically, these restrictions may facilitate rather than hinder the use of contingent contracts by reducing the ability of judges to express their biases. I use this idea also to argue that the empirical link between law and financial development (e.g., La Porta et. al 1998) may be due to the greater ability of certain court systems to protect parties against judicial bias, enabling the use of flexible and innovative financial contracts.

2 The Model

2.1 The Financial Transaction

I study 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 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 allocation 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. I assume that the first best allocation of control is ex-ante feasible by imposing:

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. Report $\widehat{r}$ can be of two types. Under a *state verification* contract $\widehat{r}$ is reported by a judge.[2] 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 $|x(\overline{r}) - x(\underline{r})| < 1$. Under a *truthful revelation* contract $\widehat{r}$ 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 also sets a repayment schedule $[d_E(r), d_I]$, contingent on the realized state r and on whether E or I controls the project. 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. Appendix 2 proves that my main results do not change by considering more exotic contracts.[3]

At $t = 0$, parties contract by taking courts' state verification as given. For now I assume that parties always end up in court, but Section 6.1 shows that my analysis extends to the

[2] A more detailed portrayal of the working of a *state verification* contract is that after receiving private inforation about r, the entrepreneur 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 $\widehat{r}$.

[3] In particular, Appendix 2 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 bias. The main contractual restriction I impose in the analysis is limited liability, so that a party (be it E or the judge) cannot be imposed a large fine or another criminal penalty for reporting $\widehat{r}$ when the future return turns out to be $r \neq \widehat{r}$.

case where out of court renegotiation is allowed. The overall timing is:

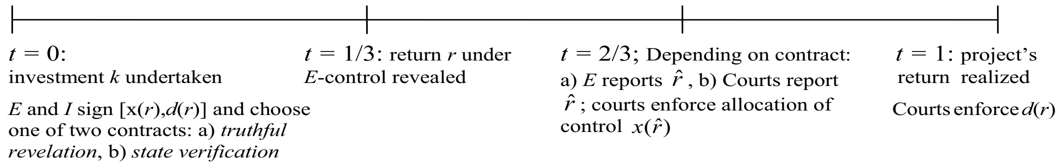

Figure 1

2.2 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 factual 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 latter state E-control is efficient).[4] 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

[4] In other words, since in equilibrium a party always gains from holding control, I call "pro-entrepreneur" the error where the judge sets excessive E-control and "pro-investor" the error where he sets excessive I-control. If α is large (i.e. if $\alpha\overline{r} > \lambda$) setting I-control in $\overline{r}$ can make I worse off. In this range, it is thus more precise to call such error "anti entrepreneur" rather than pro-investor. I keep using the latter term to simplify terminology and because - as we will see in Section 4 - state verification is only used when α is small and thus when I-control indeed benefits the investor.

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, for this is the way parties would want different errors to be traded off.

Judges may depart from this ideal rule because of their bias for one party or the other. Formally, 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 $\beta_E, \beta_I \geq 0$. Given these preferences, the judge reports $\overline{r}$ if and only if the cost for him of erroneously setting I-control is larger than that of erroneously setting E-control, namely when:

$$\beta \Pr(\overline{r}\,|s) \cdot (\overline{r} - \lambda) \geq \Pr(\underline{r}\,|s) \cdot (\lambda - \underline{r}), \tag{1}$$

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, just as the parties would like him to do. 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 over-weights the cost of finding $\overline{r}$, reporting $\underline{r}$ too often.[5] To study Equation (1), let me introduce the following definition:

Definition 1: *The relative average ex-post cost of pro-investor errors is* $\eta \equiv \frac{\mu(\overline{r}-\lambda)}{(1-\mu)(\lambda-\underline{r})}$.

η is the ex-post cost of erroneously setting I-control relative to that of erroneously setting E-control as perceived by someone having only prior information about r (i.e. not observing s). Section 3.1.2 extends the definition of η to include also the cost of control misallocations in terms of ex-ante investor break-even. Parameter η plays a key role in determining the optimal contract, for it captures the parties' "vulnerability" to judicial errors. When $\eta > 1$, errors against E (i.e. pro-investor errors) 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. One can find that Equation (1) implies that the judge reports $\overline{r}$ if and only if:

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

[5] Appendix I shows how (1) 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 $\psi(s)$.

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 sets I-control because $\Pr(\underline{r}\,|s)$ is high and so is the cost of finding $\overline{r}$. With a perfect signal ($\theta = 0$), judges find the true r: this is the perfect verifiability case. In the presence of physical unverifiability (i.e. $\theta > 0$) judicial errors are inevitable, but the key point of (2) is that in this case the judge views s as evidence of $\overline{r}$ or $\underline{r}$ depending on his bias β and on the relative cost of pro-investor errors η. I now consider these comparative statics in detail.

In Equation (2) a more pro-entrepreneur judge having a higher β is more likely to view any signal s as evidence of $\overline{r}$ and set E-control. This implies that pro-entrepreneur judges may report $\overline{r}$ even if the signal is objectively quite informative about $\underline{r}$. Biased judges tend to disregard 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 $\beta = -\infty$ never pay attention to the the signal, only to 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 (i.e. having $|\beta| < \infty$) are instead averse to making *both* pro-investor and pro-entrepreneur errors, although to different extents. Thus, 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. Indeed, as the signal gets noisier judges are aware that their adjudication is more vulnerable to errors. As a result, 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.

For a given bias β, Equation (2) says that when the relative social cost of pro-investor errors η goes up, judges become more likely to rule for the entrepreneur (i.e. report $\overline{r}$) regardless of their biases. In other words, Since in (1) judges to some extent internalize the social cost of errors, the bias of adjudication depends on the stakes. In particular, as E becomes more vulnerable, adjudication moves in his favour. This may lead judges to neglect some informative signals but, unlike in the case of bias, this neglect now 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 (2), 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 on average unbiased allows me to show that judicial idiosyncrasies shape contracts by introducing 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:

$$p_{\overline{r}} = G\left[\frac{(\overline{r}-\underline{r})^2 + 2\theta^2 \ln \eta}{2(\overline{r}-\underline{r})\theta\sqrt{1+\frac{\theta^2\sigma^2}{(\overline{r}-\underline{r})^2}}}\right], \tag{3}$$

$$p_{\underline{r}} = G\left[\frac{(\overline{r}-\underline{r})^2 - 2\theta^2 \ln \eta}{2(\overline{r}-\underline{r})\theta\sqrt{1+\frac{\theta^2\sigma^2}{(\overline{r}-\underline{r})^2}}}\right], \tag{4}$$

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 my analysis 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.

Given Equations (3) and (4), 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 (3) and (4) 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 exist thresholds η_1, η_2 with $\eta_1 \leq 1 \leq \eta_2$ such that: i) if $\eta \in (\eta_1, \eta_2)$ higher σ*

lowers precision by reducing $p_{\overline{r}}$ *and* $p_{\underline{r}}$*, ii) if* $\eta \leq \eta_1$ *higher* σ *lowers pro-investor stance by increasing* $p_{\overline{r}}$ *and reducing* $p_{\underline{r}}$*, iii) if* $\eta \geq \eta_2$ *higher* σ *boosts pro-investor stance by reducing* $p_{\overline{r}}$ *and increasing* $p_{\underline{r}}$*.*

According to result 1, the pro-investor stance of state verification falls with the relative cost of pro-investor errors: higher η reduces the incidence of pro-investor errors and increases that of pro-entrepreneur errors. The intuition is that higher η makes E more vulnerable, inducing even biased judges to become more favorable to him. When $\eta \to \infty$ the entrepreneur is so vulnerable to errors that judges always set E-control, namely they set $p_{\overline{r}} = 1$ and $p_{\underline{r}} = 0$. When instead $\eta \longrightarrow 0$ the investor is so vulnerable that judges always set I-control, namely they set $p_{\overline{r}} = 0$ and $p_{\underline{r}} = 1$.

Result 2 says that the dispersion of biases σ exerts two adverse effects on state verification. First, it intuitively reduces precision. This is best seen in case i) above, namely when error costs are similar [i.e. $\eta \in (\eta_1, \eta_2)$]. Here higher σ induces pro-entrepreneur and pro-investor judges to neglect more informative signals to favour their preferred party, increasing pro-investor and pro-entrepreneur errors and thus reducing overall accuracy. Through this effect, higher dispersion σ reduces the accuracy of state verification, just like a higher θ.

Second, higher dispersion σ distorts the ratio between different error types. This is evident if error costs are sufficiently asymmetric, i.e. in cases ii) and iii) above. In case ii), pro-investor errors are cheap (i.e. $\eta \leq \eta_1$) and greater polarization σ reduces their incidence relative to pro-entrepreneur ones. In case iii) instead, pro-investor errors are costly (i.e. $\eta \geq \eta_2$) and greater polarization σ boosts their incidence relative to pro-entrepreneur ones. The key point is that higher dispersion σ moves state verification in the *wrong* direction, increasing the likelihood of the socially more costly error. Thus, even if judges are on average unbiased, biases systematically distort state verification away from the efficient error pattern. In this respect, judicial biases σ are very different from limited information θ.

3 The Working of Alternative Contracts

Section 3.1 studies the state verification contract, the key focus of my analysis. Section 3.2 studies the truthful revelation contract. Section 4 derives the optimal contract.

3.1 The State Verification Contract

An optimal state verification contract specifies repayments $d_E(r)$, d_I and a control allocation $x(\widehat{r})$ contingent on the return $\widehat{r}$ verified by courts, that solve:

$$\max_{x(r),d_E(r)\leq \alpha r,d_I\leq \lambda} E\left\{\omega(r)\left[r-d_E(r)\right]+\left[1-\omega(r)\right](\lambda-d_I)\right\}, \tag{5a}$$

$$s.t. \qquad E\left\{\omega(r)d_E(r)+\left[1-\omega(r)\right]d_I\right\}\geq k, \tag{5b}$$

$$\omega(\overline{r})=x(\overline{r})p_{\overline{r}}+x(\underline{r})(1-p_{\overline{r}}), \tag{5c}$$

$$\omega(\underline{r})=x(\underline{r})p_{\underline{r}}+x(\overline{r})(1-p_{\underline{r}}). \tag{5d}$$

$\omega(r)$ is the probability with which judges *enforce* E-control in state r. The contract maximizes the entrepreneur's profit (5a) subject to the break-even constraint (5b). Constraints (5c) and (5d) capture the impact of state verification on contract enforcement. Constraint (5c) says that E-control is set in state $\overline{r}$ in two cases: i) if 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 $x(\underline{r})$. Expression (5d) illustrates the same idea with respect to state $\underline{r}$. Thus, the allocation of control in r is an average, according to the state verification policy p_r, of the allocations stipulated by parties for different states.

3.1.1 Slack Break Even Constraint

Suppose that the break even constraint (5b) is slack, in the sense that for any chosen allocation of control E can find repayments allowing I to break even (see the proof of Proposition 2). By substituting (5c) and (5d) into (5a), one finds that the marginal benefits for E of raising $x(\overline{r})$ and $x(\underline{r})$ are equal to:

$$x(\overline{r}) \quad : \qquad \eta p_{\overline{r}}-(1-p_{\underline{r}}), \tag{6}$$

$$x(\underline{r}) \quad : \qquad \eta(1-p_{\overline{r}})-p_{\underline{r}}, \tag{7}$$

respectively. The first, positive, term in the above expressions says that both higher $x(\overline{r})$ and $x(\underline{r})$ beneficially reduce pro-investor errors in $\overline{r}$ (sparing a relative cost η). The second, negative, term says that the cost of doing so is to boost pro-entrepreneur errors in $\underline{r}$. Although both higher $x(\overline{r})$ and $x(\underline{r})$ reduce pro-investor errors, they do so in different ways: higher $x(\overline{r})$ exploits the correct verification of $\overline{r}$, higher $x(\underline{r})$ remedies erroneous state verification in $\overline{r}$. Inspection of (6) and (7) reveals that the optimal contract fulfils:

$$\{x(\overline{r}), x(\underline{r})\} = \begin{cases} \{0,0\} & \text{if} \quad \eta < (1-p_{\underline{r}})/p_{\overline{r}} \\ \{\overline{x},0\} & \text{if} \quad \eta = (1-p_{\underline{r}})/p_{\overline{r}} \\ \{1,0\} & \text{if} \quad (1-p_{\underline{r}})/p_{\overline{r}} < \eta < p_{\underline{r}}/(1-p_{\overline{r}}) \\ \{1,\underline{x}\} & \text{if} \quad \eta = p_{\underline{r}}/(1-p_{\overline{r}}) \\ \{1,1\} & \text{if} \quad \eta > p_{\underline{r}}/(1-p_{\overline{r}}) \end{cases} \tag{8}$$

Where $\overline{x}$ and $\underline{x}$ can be any number in $[0,1]$. Given an error pattern $(p_{\underline{r}}, p_{\overline{r}})$, the optimal contract is more contingent, i.e. $|x(\overline{r}) - x(\underline{r})|$ is larger, when η is intermediate, namely when error costs are sufficiently similar. Except for knife edge cases, the optimal contract is either fully contingent or non-contingent, due to the linearity of the objective function in the allocation of control $\{x(\overline{r}), x(\underline{r})\}$. As we will see, intermediate degrees of state contingency arise when the break even constraint is binding, namely when some allocations of control are not ex-ante feasible.

Equation (8) says that an intuitive tradeoff shapes contract choice in my model. On the one hand, a contingent contract beneficially allows judges to allocate control based on signal s; on the other hand, such contract is vulnerable to costly judicial errors. Non-contingent contracts are useful precisely to avoid that these costly errors are made. Because non-contingent E-control $\{1,1\}$ avoids pro-investor errors, it is used when the cost η of these errors is high; because non-contingent I-control $\{0,0\}$ avoids pro-entrepreneur errors, it is used when η is low. The fully contingent contract $\{1,0\}$ is used when error costs are sufficiently symmetric (it is always used if $\eta = 1$). To see how the trade-off of Equation (8) pins down the optimal contract as a function of (η, θ, σ), the appendix proves:

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 $\kappa(\sigma)$, with $\kappa'(\sigma) < 0$, $\kappa(\sigma) \geq 1$, and $\lim_{\sigma \to +\infty} \kappa(\sigma) = 1$, such that parties use: a) non-contingent I-*

control $x(\overline{r}) = x(\underline{r}) = 0$ *if and only if* $\eta < 1/\kappa(\sigma)$, *b) contingent contract* $x(\overline{r}) = 1$, $x(\underline{r}) = 0$ *if and only if* $1/\kappa(\sigma) \leq \eta \leq \kappa(\sigma)$, *and c) non-contingent E-control* $x(\overline{r}) = x(\underline{r}) = 1$ *otherwise.*

If $\theta = 0$, return r can be perfectly verified and parties always write a contingent contract regardless of error costs η and of judicial dispersion σ. When state verification is straightforward, contractual contingencies are written not only despite but perhaps precisely to constrain biased judges.[6] 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 error costs and judicial polarization in the way illustrated by Figure 2 below:

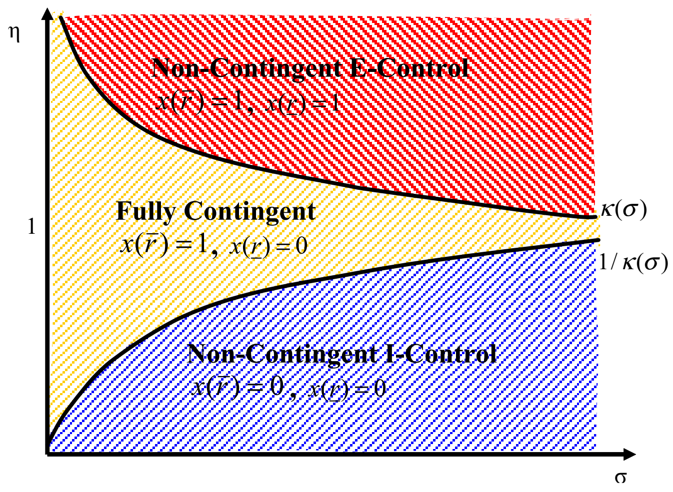

Figure 2

The role of judicial bias is crucial: if judges are unbiased ($\sigma = 0$), parties always use a contingent contract regardless of the signal's noise θ! Not only does physical unverifiability fail to trigger the use of non-contingent contracts *per se* but, in seeming contradiction with Equation (8), this is true even if error costs are asymmetric. To reconcile these results, recall that, in the optimal adjudication rule of Equation (2), an unbiased court most of

[6] In the current version of the model, when θ is close to 0 parties can either write a contingent contract or a very open ended contract allowing the judge "to do what he wants" because in both cases enforcement is basically perfect. This result is however not robust, for even if θ is very small the open ended contract can create additional ambiguities with respect to the parties' intentions that biased judges can use to pursue their views. Section 6.1 formally shows that it is easy to incorporate this aspect in my model. In such case, writing a contingent contract is better than writing an open contract when $\sigma > 0$.

the time gives control to the party vulnerable to judicial error (the investor if η is low, the entrepreneur if η is large) and departs from this ruling only if the signal in favor of the other party is very strong. Clearly, this verification strategy itself protects parties against costly errors, eliminating the need for non-contingent contracts when $\sigma = 0$. Writing a contingent contract then remains strictly optimal for it allows judges to efficiently allocate control when they receive a strong signal.[7]

More generally, the contingent contract remains optimal provided error costs are similar and judges are not too biased (i.e. if η is close to 1 and σ is not too large). By contrast, as error costs become sufficiently asymmetric, judicial dispersion becomes strong, or both, parties switch to using non-contingent contracts. This is true even if physical unverifiability θ is small, suggesting that judicial biases are crucial to trigger the use of non-contingent contracts. The intuition is that higher judicial dispersion σ reduces the responsiveness of adjudication to error costs, increasing the incidence of socially costly errors, which is something that physical unverifiability θ alone does not do. It is precisely to protect themselves against the costly errors caused by biased judges that parties use non-contingent contracts.

This notion sheds light on which specific non-contingent contract is written when σ is large and η is extreme. In particular, the optimal contract protects the party that is most vulnerable to judicial errors by always giving control to her. If $\eta < 1$, pro-investors errors are relatively cheap: I is the vulnerable party and the optimal non-contingent contract is I-control. If $\eta > 1$, pro-investor errors are relatively costly: here E is the vulnerable party and the optimal non-contingent contract is E-control. Because $\eta \geq 1$ if and only if $E(r) \geq \lambda$, when the break even constraint is slack the optimal non-contingent contract gives full control to the party maximizing the project's average return.

3.1.2 Binding Break Even Constraint

Denote by $\vartheta \geq 0$ the Lagrange multiplier attached to the break even constraint; when ϑ is taken into account, the optimal contract follows the same rule of Equation (8) except that

[7] That is, since unbiased judges maximize social welfare, parties allow them to set the allocation of control. I focus on a risk neutral setting, but this reasoning should extend to a risk averse setting. Even in such case, parties are likely to allow unbiased judges to choose from a larger menu of allocations (including transfers), knowing that judge would optimally smooth the parties' consumption.

η is now replaced by:

$$\eta_b = \frac{\eta + (\vartheta - 1)\frac{\mu}{1-\mu}\frac{\alpha\overline{r}-\lambda}{\lambda-\underline{r}}}{1 + (\vartheta - 1)\frac{\lambda-\alpha\underline{r}}{\lambda-\underline{r}}}. \tag{9}$$

If $\vartheta = 1$, we are back to Equation (8); this is the case where E can finance the project without distorting the control allocation and so he sets the minimal repayments to ensure that (5b) is met. Interestingly, even if attaining break even requires E to distort the allocation of control, i.e. $\vartheta > 1$, the tradeoff shaping contract choice does not change. What changes is the relative social cost of pro-investor errors, which *drops* to $\eta_b < \eta$ (this is due to $\alpha < 1$). Intuitively, when investor break even is binding, the cost of setting excessive E-control goes up because, besides the ex-post inefficiency it entails, such error allows E to extract private benefits, hindering repayment and ex-ante financing.

Break even considerations are thus naturally incorporated in the tradeoff of Equation (8). If investor break even is not a concern (i.e. $\vartheta = 1$), the optimal state verification contract is determined by Proposition 1. When investor break even is at stake, parties protect themselves against entrepreneurial private benefit extraction by increasing the extent of investor control in the contract, much in the spirit of what happens in Proposition 1 when η falls.[8] Section 4 shows how break even concerns emerge endogenously in the model as a function of judicial dispersion σ. Before doing that, though, we need to analyze the working of truthful revelation contracts.

[8]Proposition 2 does not strictly apply if $\vartheta > 1$. Indeed, although a binding break even constraint affects the social cost of errors faced by parties in (8), it does not affect judicial state verification p_r, which continues to reflect only the ex-post cost of errors η. The adjudication strategy used in Proposition 2 is in fact obtained when judges are only concerned with the ex-post consequences of control allocations, not the ex-ante ones (as captured by η_b). Footnote 10 discusses what happens if we relax this assumption.

3.2 The Truthful Revelation Contract

The truthful revelation contract does not rely on judicial verification but on the entrepreneur's announcement of r. Such contract solves:

$$\max_{x(r),d_E(r)\leq \alpha r,d_I\leq\lambda} E\left\{x(r)\left[r-d_E(r)\right]+\left[1-x(r)\right](\lambda-d_I)\right\} \tag{10a}$$

$$s.t. \qquad E\left\{x(r)d_E(r)+\left[1-x(r)\right]d_I\right\}\geq k \tag{10b}$$

$$\overline{r}-d_E(\overline{r})\geq\lambda-d_I \tag{10c}$$

$$\underline{r}-d_E(\underline{r})\leq\lambda-d_I, \tag{10d}$$

that is, it maximizes E's profit (10a) subject to I's break-even (10b) and incentive constraints (10c) and (10d). The latter constraints imply that E truthfully reports state $\overline{r}$ and $\underline{r}$, respectively, and are written for the case where $x(\overline{r})\geq x(\underline{r})$, which holds at the optimum.

Consider parties' ability to implement the first best allocation $x(\overline{r})=1$, $x(\underline{r})=0$. It is easy to induce E to reveal $\overline{r}$ because in this state he keeps control, getting a private benefit of $(1-\alpha)\overline{r}$. If instead E reveals $\underline{r}$, he must transfer control to I, which entails a loss in private benefits. To compensate such loss and induce truthful reporting, E must be promised an amount $(1-\alpha)\underline{r}$ of the return under I-control for reporting $\underline{r}$. Thus, the maximum repayments to I under truthful revelation are $d_E(r)=\alpha r$ and $d_I=\lambda-(1-\alpha)\underline{r}$, which guarantee break-even if:

$$\mu\alpha\overline{r}+(1-\mu)\left[\lambda-(1-\alpha)\underline{r}\right]\geq k \tag{11}$$

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 (11) 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 (11) is violated, the truthful revelation contract is infeasible.

4 The Optimal Contract with Enforcement Risk

4.1 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 (11) is violated. This is true for instance when $\theta = 0$: under perfect verifiability, the fully contingent contract not only implements ex-post efficiency but grants I a repayment of:

$$\mu\alpha\overline{r} + (1-\mu)\lambda, \tag{12}$$

which is more than what I obtains in (11) under truthful revelation (and sufficient to guarantee feasibility by A2). If $\theta > 0$, state verification is imperfect and the contingent contract may become infeasible. The general point, though, is that, unlike the entrepreneur, judge need not be given any rent to reveal r. This is why state verification can boost repayment. To highlight the preeminence of I's break even in the use of state verification, I assume:

A3: *The relative average ex-post cost of pro-investor errors* η *is equal to* 1.

This implies that investor break even also shapes non-contingent contracts. Indeed, in Equation (8) and in Figure 2 when $\eta = 1$ the fully contingent contract is always optimal if the break even constraint 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:*

[9] Besides greatly simplifying the algebra, assumption A3 reflects the fact that investor break-even plays a key role in shaping the use of non-contingent contracts also when $\eta \neq 1$. To see this, note that 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 is less than what he gets under truthful revelation. As a result: a) such non-contingent contract is not used in equilibrium because if $\alpha E(r) > k$ also the truthful revelation contract is feasible (and used), and b) *any* state verification contract used by parties will try to avoid making too many pro-entrepreneur errors, and thus to foster break even.

(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 if* $\alpha = 1$, *then* $\widehat{\lambda} = k$. $\widehat{\sigma}$ *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 the entrepreneur is small relative to what I obtains from controlling the project. Thus, the truthful revelation contract is ex-ante feasible and parties attain the first best by using it. Here judicial biases σ neither affect contracting nor welfare. If instead E's informational 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 now very costly for they can undermine investor break even. In the previous language then, 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 increases 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 opportunities for judges to 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.

[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 predominant issue. 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. In this case, 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 3.1.1, if judges are unbiased and 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.

4.2 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:

$$p_{\overline{r}} = p_{\underline{r}} \equiv p = G\left[\frac{\overline{r} - \underline{r}}{2\theta\sqrt{1 + \frac{\theta^2\sigma^2}{(\overline{r}-\underline{r})^2}}}\right]. \tag{13}$$

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:

$$\mathbf{W} = 2x(\overline{r})\,(p - 1/2)\,\mu(\overline{r} - \lambda) + \lambda. \tag{14}$$

Since $p > 1/2$, a higher $x(\overline{r})$ increases welfare by allowing judges to efficiently set E-control in $\overline{r}$. Equation (14) allows to decompose the welfare impact of higher adjudication accuracy p in two components:

$$\frac{d\mathbf{W}}{dp} = 2x(\overline{r})\mu(\overline{r} - \lambda) + 2\frac{dx(\overline{r})}{dp}\,(p - 1/2)\,\mu(\overline{r} - \lambda) > 0. \tag{15}$$

Contrary to standard accounts [e.g. Kaplow and Shavell (1996)], in my model judicial errors hinder welfare even though judges are on average unbiased.[13] According to the first component, higher p improves the enforcement of a given allocation $[x(\overline{r}), 0]$. According to the second component, higher p fosters break even, allowing parties to write a more contingent contract [indeed, $dx(\overline{r})/dp > 0$]. 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*

[13] Section 6.1 shows that the ex-post cost of judicial bias, namely the possibility that the allocation of control set by judges is ex-post inefficient, remains 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.

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 unverifiability θ is higher. The intuition is that the presence of more factual ambiguities offers biased judges greater opportunities to distort adjudication: as we saw in Section 2, when θ is higher *all* judges cater more to their biases. Crucially, then, 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 transactions characterized but higher θ, perhaps because they are more complex and innovative, are relatively more vulnerable to the adjudication and contractual distortions created by judicial bias.[14]

4.3 Discussion

I have shown how contractual "incompleteness" or more precisely the lack of state-contingecy of contracts can be viewed as the result of courts' difficulty to verify states rather than of ex-ante writing costs or unforeseeability. In my model, non-contingent contracts are used when state verification entails factual ambiguity *and* judicial bias introduces additional enforcement risk on top of it. Judicial biases alone are not enough: if state verification entails no ambiguities, judges cannot express their biases and parties always use contingent contracts, as the latter are perfectly enforced. Interestingly, physical unverifiability alone is not enough either: if judges are unbiased, parties keep using contingent contracts even if factual ambiguity is large, helping to explain why commercial contracts are often contingent

[14] Another way to see this formally is to consider the expression for p in Equation (13). Using that equation, after some algebra one can find:

$$\left.\frac{\partial^2 p}{\partial \sigma \partial \theta}\right|_{\sigma=0} = -\frac{8}{(\overline{r}-\underline{r})} \cdot \theta^5 < 0. \tag{16}$$

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 (16) 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*.

on a party's "best efforts" or "good faith." Although these terms are hard to verify, the ex-post flexibility they afford remains valuable if judges resolve ambiguities trying to reduce the incidence of socially costly errors.

Problems instead arise when unverifiability and judicial biases coexist: now factual ambiguities allow judges to express their biases and state verification becomes fraught with socially very costly errors. Parties protect themselves against these errors by using non-contingent contracts. In this range, the optimal non-contingent contract provides extra protection to the "vulnerable" party, namely the party that loses most from adverse judicial errors. Note that in my model the non-contingent contract seeks to protect the investor even though there is no systematic anti-investor bias in adjudication. Indeed, even if the disparate biases of judges introduce mistakes against both parties, the non-contingent contract makes sure that the most vulnerable party (which is eventually the investor) is not harmed too often. Judicial bias is thus only superficially similar to limited information. Both of these frictions reduce accuracy and welfare, but only bias systematically distorts contracts.

There is a fundamental distinction between a non-contingent contract in my model and the standard notion of an incomplete contract. Indeed, while the latter notion does not predict what contract terms are written for states that are hard to contract about (being essentially equivalent to the absence of a contract), the notion of non-contingent contract in my model pins down the precise terms parties write to regulate what happens in hard to verify states; in particular, such terms reflect the deliberate attempt of parties to provide contractual protection to the most vulnerable of them. The distinction between these two reasons for a contract's lack of state dependence is novel in the literature and, as I will discuss in Section 6, has important implications for the way we think about contract enforcement and interpretation.

More generally, the interaction between physical unverifiability and judicial bias can shed light on the impact of courts on contracting. First, it implies that legal systems more prone to judicial bias, perhaps because of poor selection/training of judges, are not only plagued by less accurate enforcement but also by the distortion of contracts toward more rigid forms. This is a distinct source of inefficiency created by the law. In line with this idea, my model predicts that parties' willingness to contract on hard to verify events 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. Second, my model suggests that transactions characterized by greater factual ambiguity, perhaps because they are more complex or innovative, will suffer more from judicial bias, thus being prone to the use of non-contingent contracts. Over and above financial contracting, this idea can rationalize why countries with more developed legal systems appear to have a comparative advantage at producing complex goods (e.g. Nunn 2007). The next section shows that this idea can shed light on the law and finance evidence and on the law and economics of contracts.

5 Applications

5.1 The Law and Economics of Contracts

My enforcement-based rationale for the use of non-contingent contracts has implications for the law and economics of contract interpretation and litigation (see Hermalin et al. 2007 and Spier 2007 for good reviews). This literature builds on the notion that contractual incompleteness stems from the parties' inability to contract in the first place, due to ex-ante writing costs (Shavell 2004) or unforeseeability (Anderlini et al. 2007). In this view, judges should provide a remedy to these ex-ante problems by filling contractual gaps ex-post. This prescription is however inappropriate if non-contingent contracts are deliberately used 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 social welfare. My model therefore suggests that while flexible gapfilling strategies may be optimal in developed legal systems, where contractual incompleteness is likely to reflect unforeseeability or writing costs, literal interpretation and enforcement of standard contracts is more desirable in undeveloped legal systems, because in the latter judicial idiosyncrasies are likely to be at the heart of contract design (for instance due to the lower quality of information/accounting standards).

The same principle can be applied to the regulation of litigation proceedings, with particular reference to evidence law. My model can rationalize why it may be desirable to forbid courts from using in contract enforcement evidence that is ambiguous or of dubious quality. In a world of unbiased judges the use of such evidence can improve judicial information and thus adjudication. Absent other problems, it would thus be surprising to observe restrictions in the kind of evidence that courts can consider. If instead judges are biased, the use of such evidence may reduce enforcement quality by allowing them to strategically distort interpretation and fact finding. As a result, forbidding the use in court of evidence that is ambiguous or of dubious quality may improve adjudication by limiting the extent to which judges can express their biases. Section 6.2. formalizes this argument and shows that the introduction of these restrictions to admissible evidence may actually improve, rather than reduce, the parties' ability to write contingent contracts.

These observations helps explain the organization of private arbitration tribunals.[15] In 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.

5.2 The Law and Finance Evidence

My model suggests that differences across legal systems in the quality of courts may shape parties' ability to write flexible financial contracts and thus financial development[16]. The

[15] 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 (Scott and Triantis 2005). Unfortunately, public courts often refuse to enforce contract terms dealing with procedure, so this private solution is somewhat limited.

[16] 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

chain of causation suggested by my analysis is:

$$\text{Court System} \implies \text{Flexible Financial Contracts} \implies \text{Financial Development}$$

Although it is beyond the scope of this paper to perform a full fledged empirical analysis, the above scheme allows us to reinterpret the law and finance evidence, which shows that Common Law legal systems have more developed financial markets than Civil Law ones (e.g. La Porta et al. 1998). The usual explanation for this evidence is that Common Law systems provide greater statutory protection to investors (La Porta et al. 1998). This explanation is however incomplete, for it overlooks the fact that in many countries entrepreneurs and investors are free to contract around legal rules (Easterbrook and Fischel 1991). If however parties can implement optimal investor protection by contract, then the law should not matter. Why is it then, that the law appears to matter even absent explicit restrictions to contracts? My analysis suggests that even if parties are legally allowed to contract around the law, they might be unable to do so due to enforcement risk. To contract around inefficient legal rules parties need to write innovative and nonstandard contract, which are most likely to be subject to interpretive uncertainty (i.e. high θ in the model). As we saw, it is precisely in these cases that judicial idiosyncrasies are most problematic and their cost is more severe.

But why should Common Law systems better enforce innovative contracts? One possibility suggested by my model is that Common Law courts may be less biased. Unfortunately, the evidence on this channel is scant so there is no direct validation of this possibility.[17] Crucially, however, my model also suggests that systematic differences among Common and Civil Law regimes may arise *even* if they share the same judicial bias (i.e. distribution of judicial preferences) due to the different ways in which they regulate the litigation process. This is in fact a dimension with respect to which systematic evidence has been collected.

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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).

[17] One informal piece of evidence is offered by Pistor (2005), who stresses that Common and Civil Law judges differ in their stance toward contract interpretation: Common Law judges tend to enforce contracts by primarily interpreting the parties' intent, Civil Law judges tend to interpret contracts also on the basis of social or collective norms, not only individual aspirations. In this sense, Common Law judges may be less biased than Civil Law ones due to their greater willingness to pay attention to the parties' interest as opposed to other idiosycnratic motives.

Indeed, La Porta et al. (2008) provide systematic evidence about this possibility precisely in the context of financial contracting: Common Law courts enable shareholders to litigate more effectively over self dealing cases via more appropriate disclosure rules or burden of proof allocations. More generally, La Porta et al. (2003) document that - with respect to the specific issues of collecting a bounced check and evicting a nonpaying tenant - Common Law courts are characterized by better legal procedures that are associated with more consistency, honesty, fairness and less corruption in judicial decisions. My model then suggests that such regulation of litigation may exert a particularly important effect by its interaction with judicial bias. That is, the procedural and disclosure rules characterizing Common Law systems can reduce the ability of judges to base their decisions on ambiguous and scarcely verifiable factors (i.e. effectively reducing θ in my model), thus allowing parties to use more flexible and innovative financial contracts, boosting welfare.[18]

If this conjecture is correct then, beyond contracting around investors' statutory rights, we should more generally observe that parties in Civil Law systems are less likely to write flexible and innovative financial contracts. Is this the case in reality? Some evidence suggests that the answer may be in the affirmative. Lerner and Schoar (2005) find that private equity investments in countries with a Common Law tradition and better law enforcement are more likely to use convertible preferred stock, whereby control rights shift from the entrepreneur to the investor when the performance of the investment is poor, as opposed to the investor owning control stakes of common stock. Consistent with Proposition 3, the non-contingent distribution of control rights to the investor attained with common stocks may be the optimal response by the parties to the enforcement risk characterizing more flexible contractual arrangements such as convertible debt. In line with this view, Lerner and Schoar report that in Peru, a private equity group in their sample turned to using majority stakes of common stocks after a litigation with a company in their portfolio, as they were "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

[18] Of course, the quality of courts is only one of the many potential reasons for why legal origins may matter empirically. The point of this section is to show that not only economic theory but also existing empirical evidence is consistent with the idea that the "contractual channel" can play a relevant role. Another possible channels stresses the adaptability of common law (Gennaioli and Shleifer 2007).

in countries with a Common Law tradition and better law enforcement, bank loans are more likely to include clauses transferring collateral to lenders upon default.[19] In these papers the use of flexible contracts results from the parties' choice and not from legal constraints on contracts, so the evidence is consistent with the idea that the greater ability of Common Law systems to spur financial development may be partly due to their greater ability to support the use of flexible and innovative financial contracts.

6 Extensions

6.1 Enforcement Risk and Admissible Evidence

I now formally prove my claim of Section 4.3 that one way to reduce the cost of judicial dispersion is to restrict the evidence used by judges to enforce contracts. This analysis can also be viewed as providing a rationale for why parties are reluctant to write open ended contracts letting the judge "to do what he wants" when a verifiable piece of evidence is available.

Consider a version of the previous model where judges can use a piece of "hard" evidence in addition to the "soft" evidence considered previously. Suppose that at $t = 2/3$ only a hard signal $s_v = r + \varepsilon$ is available, where ε is normally distributed with mean 0 and variance γ^2. s_v might be a pre-specified estimate by an accountant of the firm's prospective cash flow. Since s_v is hard, judges have no discretion in interpreting it and simply report its value. If $\eta = 1$ and γ is sufficiently small, it is easy to see that the parties write a contract where I-control is set for $s_v < (\overline{r} + \underline{r})/2$ while E-control is set otherwise. Under this contract, the probability of correctly allocating control is:

[19] 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. See also Bergman and Nikolaievski (2005) for evidence on the inability of undeveloped legal systems to enforce flexible financial contracts. Looking at venture capital deals in twenty developed economies, Kaplan et al. (2003) find a weaker association between Common Law tradition and contractual complexity. This is also consistent with my analysis, as rich countries are likely to have better court systems (e.g. more informed judges with lower θ), regrdless of the colonial origin of their legal system.

$$p = G\left(\frac{\overline{r} - \underline{r}}{2\gamma}\right), \tag{17}$$

which is identical to the probability (13) that the judge correctly enforces the contingent contract of Section 3.2 but evaluated at the point where $\sigma = 0$, i.e. when all judges are unbiased. By contracting on a hard signal, parties bear the signal's noise γ but avoid the cost of polarization σ.

Suppose now that judges can also use soft evidence to assess s_v. For example, one party may question the competence or integrity of the accountant who produced s_v by bringing additional, soft, evidence $s_u = \varepsilon + u$ on the accountant's error, where u is normally distributed with mean 0 and variance t^2. Then, it is easy to see that the use of s_u leads parties to a situation equivalent to the one they face if only a soft signal $\widehat{s}_v = r + z$ is available, where z is normally distributed with mean 0 and variance $\gamma^2 t^2/(\gamma^2 + t^2)$.[20] That is, the possibility to interpret hard evidence in light of soft evidence brings us back to the soft evidence case of Section 3 and 4! The use of s_u has two effects. First, it beneficially reduces the noisiness of information to $\gamma^2 t^2/(\gamma^2 + t^2) \leq \gamma^2$; second, it allows judges to sneak their biases into adjudication. This implies that under the previous contingent contract, control is efficiently allocated with probability:

$$p = G\left[\frac{\overline{r} - \underline{r}}{2\frac{\gamma t}{\sqrt{\gamma^2+t^2}}\sqrt{1 + \frac{\gamma^2 t^2}{\gamma^2+t^2}\frac{\sigma^2}{(\overline{r}-\underline{r})^2}}}\right], \tag{18}$$

In contrast to (17) where only the verifiable signal is used, in (18) state verification accuracy is adversely affected by σ. It is easy to see that the use of s_u increases the probability of a

[20] By solving a simple signal extraction problem it is possible to find that the judge's information upon observing s_u and s_v is summarized by $\widehat{s}_v = \rho_0 + \rho_1 s_v + \rho_2 s_u = r + z$. Signal $\widehat{s}_v$ thus represents the judges' estimate of the true value of s_v and it is unverifiable because the judge can always find an arbitrary value of s_u so as to find the value of $\widehat{s}_v$ inducing, through the parties' contract, his desired control allocation. This formulation implies that introducing one piece of soft evidence allows the judge to manipulate hard evidence in substantially (depending on t^2). One can introduce costs of manipulation in the model but the current setup shows the interplay of soft and hard evidence in the starkest manner.

control misallocation provided:

$$\sigma \geq \left(\frac{\overline{r}-\underline{r}}{t}\right)^2 \frac{\gamma^2+t^2}{t^2}. \tag{19}$$

If judicial dispersion σ is small or absent, Equation (19) is violated and it is always optimal - consistent with conventional wisdom - to let judges use s_u in addition to s_v. If instead σ is sufficiently strong relative to the informational gain of using soft evidence, the use of s_u *increases* enforcement risk and *reduces* welfare. In that case, it may be welfare enhancing to forbid judges from using s_u in contract enforcement. Note that if σ is large, the use of s_u may even induce the parties to switch to a non-contingent contract. Thus, the use of more evidence at trial may paradoxically reduce parties' willingness to write contingent contracts when such evidence is ambiguous and hard to verify. This also suggests that when a verifiable signal s_v is available, parties may prefer to contract on it rather then to write an open ended contract (e.g. one instructing judges to "set control efficiently"), for the latter allows judges to discretionally use also soft evidence in enforcement.[21]

6.2 Ex-Post Renegotiation

Parties may try to reduce the costs of enforcement risk by renegotiating away judicial mistakes ex-post. To study this possibility suppose that E, the informed party, has all the bargaining power in renegotiation and makes a take-it-or-leave-it offer to I before going to court.[22] The entrepreneur's offer consists of a new allocation of control and repayment replacing those in the original contract. If I accepts the offer, parties settle out of court. If I declines the offer, a judge enforces their ex-ante contract. For ex-post renegotiation to remove all inefficiencies in the allocation of control, it must be the case that the bargaining equilibrium is separating or, put differently, that E has the incentive to truthfully report r.

Consider the possibility for parties to write an ex-ante feasible contract such that in

[21] To tighten the link between this analysis and Proposition 2, note that the case where $\theta = 0$ is analogous to the case where γ is arbitrarily close to zero. In this case, the verifiable signal is almost perfect but writing an open ended contract allows judges to sneak their biases σ into adjudiciation, potentially generating massive enforcement risk.

[22] It is harder for renegotiation to avoid the ex-post inefficiencies created by judicial errors if I had all the bargaining power and tried to extract rents by screening E's information.

renegotiation E has the incentive to truthfully report r and the first best allocation of control is implemented. Before delving into this analysis, note that – foreseeing renegotiation – it may be optimal for I to lend an amount D greater then the setup cost k at $t = 0$. By doing so, the investor can improve the ability of E to renegotiate ex-post, triggering a more efficient outcome. The extra lending $D - k$ is akin to a $t = 1$ cash flow, so E can grab a fraction $(1 - \alpha)$ of it ex-post. This implies that ex-post repayments can also include the amount $\alpha(D - k)$ and, at the same time, that in renegotiation the entrepreneur can always make an upfront payment of $(D - k)$ to the investor if he wants to.

If in this setting the original contract promises repayments $d_E(r)$ and d_I, by going to court I obtains on average $\omega(r)d_E(r) + [1 - \omega(r)]\, d_I$ in state r, where $\omega(r)$ is again the probability that E-control is enforced in r by judges. Suppose that E reports r truthfully and pays I the latter's reservation value $\omega(r)d_E(r) + [1 - \omega(r)]\, d_I$, implementing a first best allocation of control. Then, it must always be the case that the average repayment $\omega(\underline{r})d_E(\underline{r}) + [1 - \omega(\underline{r})]\, d_I$ obtained by I in $\underline{r}$ is strictly larger than $\alpha\underline{r} + (D - k)$. Suppose that this is not the case. Then, given that when E-control is efficiently set in $\overline{r}$ the investor cannot expect to get more than $\alpha\overline{r} + (D - k)$, in an ex-post efficient separating equilibrium ex-ante break even would always be fulfilled provided:

$$\alpha E(r) + D - k \geq D \tag{20}$$

which is harder to fulfill that the break even condition (11) characterizing the truthful revelation contract. In this case, renegotiation cannot obviously help to attain the first best because if (20) is met, the truthful revelation contract is feasible and so state verification contracts are not used.

Suppose therefore that $\omega(\underline{r})d_E(\underline{r}) + [1 - \omega(\underline{r})]\, d_I > \alpha\underline{r} + (D - k)$ and consider ex-post renegotiation in $\underline{r}$. In this state, by truthfully reporting $\underline{r}$, setting I-control and repaying $\omega(\underline{r})d_E(\underline{r}) + [1 - \omega(\underline{r})]\, d_I$ to the investor, E obtains $\lambda + (D - k) - \omega(\underline{r})d_E(\underline{r}) - [1 - \omega(\underline{r})]\, d_I$. Since E obtains all renegotiation surplus, this payoff is certainly larger than what E obtains by going to court. The problem, though, is that E may want to misreport, claiming that the state is $\overline{r}$. Clearly, E is always able to misreport, if he wants to. This is because in every state r the entrepreneur has the same amount $D - k$ of resources to make an upfront payment to I before the cash flow is generated at $t = 1$. Crucially, if E falsely claims that the true state is $\overline{r}$, I adjusts his reservation value to $\omega(\overline{r})d_E(\overline{r}) + [1 - \omega(\overline{r})]\, d_I$. But then, since upon implementing E-control in $\underline{r}$ the entrepreneur is always able to keep at least the private benefits of control $(1 - \alpha)\underline{r}$, a sufficient condition for the entrepreneur to truthfully reports $\underline{r}$ and forsake this private benefit is thus:

$$\lambda - \omega(\underline{r})d_E(\underline{r}) - [1 - \omega(\underline{r})]\, d_I + (D - k) \geq (1 - \alpha)\underline{r}$$

which can be rewritten as:

$$\lambda - (1 - \alpha)\underline{r} + (D - k) \geq \omega(\underline{r})d_E(\underline{r}) + [1 - \omega(\underline{r})]\, d_I$$

The above condition implies that, in a separating equilibrium, the average repayment to the investor in state $\underline{r}$ (net of the pledgeable portion of the ex-ante cash infusion $D - k$) must be smaller than $\lambda - (1 - \alpha)\underline{r} + (D - k)$. Given that in state r the investor can obtain at most $\alpha\overline{r} + (D - k)$, renegotiation implements the first best and I breaks even only if:

$$\mu\,(\alpha\overline{r} + D - k) + (1 - \mu)\,[\lambda - (1 - \alpha)\underline{r} + (D - k)] \geq D. \tag{21}$$

Which is the exact same condition as (11), implying that ex-post renegotiation can only avoid the cost of judicial bias if the truthful revelation contract is feasible. Put differently, ex-post renegotiation cannot avoid the cost of judicial bias when state verification contracts are used. Intuitively, state verification contracts are used precisely when it is too costly from an ex-ante standpoint to induce E to truthfully reveal r. This implies that if α is so low that it is too costly for the parties to give E the incentive to report r in an ex-ante contract, it is also too costly to provide E with the same incentives through ex-post renegotiation. Hence, parties cannot renegotiate away all the ex-post misallocations of control created by judicial bias under state verification contracts.

7 Conclusions

I presented a model of private contracting where imperfectly informed and potentially biased judges play an important role in verifying complex contingencies. I showed that in this world judicial bias reduces the extent to which contracts are contingent, leading to welfare losses and possibly underinvestment. This suggests that the law can greatly affect the parties' ability to write sophisticated and flexible contracts by shaping the distribution of judicial bias and information. Of course, this is only a first step toward understanding how the law can affect the economy by shaping private contracting. My analysis can be extended in several ways. At one level, one could include more institutional detail into the analysis, comparing for example different litigation proceedings (e.g. adversarial vs. inquisitorial) or rules of judicial appointment (e.g. lay vs. professional judges). This way one could endogeneize the quality of information available to judges or the distribution of judicial biases.

Alternatively, one could study enforcement risk in a different transaction. One 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 allows to protect a party by giving her residual rights of control. My model, though, shows that non-contingent contracts may be precisely designed to protect the most vulnerable party effectively playing a role similar to that of asset ownership. This implies that there may be an intriguing substitutability between asset ownership and contracts, whereby a "protective" allocation of ownership rights may foster the ability of parties to write flexible contracts. In this sense, rather than unilaterally affecting ownership structures, the ability of parties to write flexible contracts may itself depend on the allocation of asset ownership. Studying this possibility may deepen our understanding of the relationship between firms and contracts and of how such a relationship depends on features of the law such as the extent of property rights protection and the quality of contract enforcement.

Finally, my model could be studied in general equilibrium to analyze the two-sided interaction between enforcement risk and economic development. On the one hand, enforcement risk may affect which investments are undertaken, as different activities are likely to be more or less vulnerable to judicial bias depending for example on their innovativeness or complexity. On the other hand, economic development may allow agents to diversify some enforcement risk away by investing in large, standardized, financial markets. Studying whether these effects imply a complementarity or a substitutability between legal and economic development is an interesting topic for future research.

Appendix 1: State verification under a general contract $[x(\overline{r}), x(\underline{r})] \in [0,1]^2$

Consider contract $[x(\overline{r}), x(\underline{r})]$. After observing s, if the judge reports $\overline{r}$, he erroneously sets E-control with probability $x(\overline{r})\Pr(\underline{r}\,|s)$, if he reports $\underline{r}$, he erroneously sets I-control with probability $[1-x(\overline{r})]\Pr(\overline{r}\,|s)$. The judge's expected cost of reporting $\overline{r}$ is equal to $x(\overline{r})\beta_I(\lambda-\underline{r})\Pr(\underline{r}\,|s)+[1-x(\overline{r})]\,\beta_E(\overline{r}-\lambda)\Pr(\overline{r}\,|s)$, while his expected cost of reporting $\underline{r}$ is equal to $x(\underline{r})\beta_I(\lambda-\underline{r})\Pr(\underline{r}\,|s)+[1-x(\underline{r})]\,\beta_E(\overline{r}-\lambda)\Pr(\overline{r}\,|s)$. A judge having pro-enterpreneur bias $\beta \equiv \beta_E/\beta_I$ thus reports $\overline{r}$ if and only if:

$$[x(\overline{r})-x(\underline{r})]\,\beta(\overline{r}-\lambda)\Pr(\overline{r}\,|s) \geq [x(\overline{r})-x(\underline{r})]\,(\lambda-\underline{r})\Pr(\underline{r}\,|s). \tag{22}$$

If $x(\overline{r}) > x(\underline{r})$, the term $[x(\overline{r})-x(\underline{r})]$ drops from both sides and (22) is identical to Equation (1), which prevails under the fully contingent contract $[x(\overline{r})=1, x(\underline{r})=0]$. If instead $x(\overline{r}) < x(\underline{r})$, the adjudication rule is the opposite of (1), but this is just equivalent to considering contract $[x'(\overline{r}), x'(\underline{r})]$ where $x'(\overline{r}) = x(\underline{r})$, $x'(\underline{r}) = x(\overline{r})$.

Equation (22) can be derived from the judge's attempt to maximize his utility of control (rather than minimize his error costs). To see this, suppose that the judge views his payoff under E-control as being equal to $\widetilde{\beta}_E r$ and his payoff under I-control as being equal to $\widetilde{\beta}_I\lambda$, where $\widetilde{\beta}_E, \widetilde{\beta}_I \geq 0$ and $\widetilde{\beta}_E + \widetilde{\beta}_I = 1$. In this setting, a judge is pro-entrepreneur when $\widetilde{\beta}_E > 1/2$ and pro-investor when $\widetilde{\beta}_E < 1/2$. Upon observing s, the judge sets the probability $\psi(s)$ of reporting $\overline{r}$ by solving:

$$\begin{aligned}\max_{\psi(s)}\;& [x(\overline{r})-x(\underline{r})]\left[\left(\widetilde{\beta}_E\overline{r}-\widetilde{\beta}_I\lambda\right)\Pr(\overline{r}\,|s)-\left(\widetilde{\beta}_I\lambda-\widetilde{\beta}_E\underline{r}\right)\Pr(\underline{r}\,|s)\right]\psi(s)+ \\ &+\left[\widetilde{\beta}_E E(r\,|s)-\widetilde{\beta}_I\lambda\right]x(\underline{r})+\widetilde{\beta}_I\lambda.\end{aligned} \tag{23}$$

The verification rule obtained in this problem is identical to the one of Equation (22) once judicial bias is redefined as $\beta_E \equiv \left(\widetilde{\beta}_E\overline{r}-\widetilde{\beta}_I\lambda\right)/(\overline{r}-\lambda)$ and $\beta_I \equiv \left(\widetilde{\beta}_I\lambda-\widetilde{\beta}_E\underline{r}\right)/(\lambda-\underline{r})$. As evident from these expressions, the moderate judges who try to avoid both error types are those having $\lambda/\overline{r} \leq \widetilde{\beta}_E/\widetilde{\beta}_I \leq \lambda/\underline{r}$.

Appendix 2: Proofs

Proof of Proposition 2. E chooses $[x(r), d_E(r), d_I]$ so as to solve:

$$\max_{[x(r),d_E(r),d_I]} E\left\{\omega(r)\left[r-d_E(r)\right]+\left[1-\omega(r)\right](\lambda-d_I)\right\}+\vartheta E\left\{\omega(r)d_E(r)+\left[1-\omega(r)\right]d_I-k\right\},$$

where $\omega(r)$ is defined in (5c), (5d), ϑ is the multiplier of the break-even constraint. We can rewrite this problem as:

$$\max_{[x(r),d_E(r),d_I]} E\left\{\omega(r)r+\left[1-\omega(r)\right]\lambda\right\}+\nu E\left\{\omega(r)d_E(r)+\left[1-\omega(r)\right]d_I-k\right\},$$

where $\nu\equiv\vartheta-1$ is the relevant Lagrange multiplier. The derivatives of the lagrangian with respect to $x(\overline{r}), x(\underline{r}), d_E(r)$ and d_I are:

$$x(\overline{r}) \;:\; \mu p_{\overline{r}}(\overline{r}-\lambda)+(1-\mu)(1-p_{\underline{r}})(\underline{r}-\lambda)+\nu\left\{\begin{array}{c}\mu p_{\overline{r}}\left[d_E(\overline{r})-d_I\right]+\\ +(1-\mu)(1-p_{\underline{r}})\left[d_E(\underline{r})-d_I\right]\end{array}\right\} \tag{24}$$

$$x(\underline{r}) \;:\; \mu(1-p_{\overline{r}})(\overline{r}-\lambda)+(1-\mu)p_{\underline{r}}(\underline{r}-\lambda)+\nu\left\{\begin{array}{c}\mu(1-p_{\overline{r}})\left[d_E(\overline{r})-d_I\right]+\\ +(1-\mu)p_{\underline{r}}\left[d_E(\underline{r})-d_I\right]\end{array}\right\} \tag{25}$$

$$d_E(r) \;:\; \nu\frac{\partial}{\partial d_E(r)}E\left\{\omega(r)d_E(r)+\left[1-\omega(r)\right]d_I\right\} \qquad \forall r \tag{26}$$

$$d_I \;:\; \nu\frac{\partial}{\partial d_I}E\left\{\omega(r)d_E(r)+\left[1-\omega(r)\right]d_I\right\} \qquad \forall r \tag{27}$$

Expressions (26) and (27) imply that $\nu\geq 0$ (i.e. $\vartheta\geq 1$): intuitively, investor break even is always binding because E always sets the lowest payments ensuring break-event. When $\nu=0$ (i.e. $\vartheta=1$), there is social indifference as to the funds transferred to I (so that E always sets the minimal payments consistent with break even), when $\nu>0$ (i.e. $\vartheta>1$) transferring funds to I is socially valuable because it allows the project to be undertaken. This is the case of Proposition 2, so that the optimal contract is described by (8). The proof of Proposition 2 then works in three steps A, B and C.

Step A. Consider first condition $\eta\geq(1-p_{\underline{r}})/p_{\overline{r}}$, which implies that $x(\overline{r})=1$. By exploiting (3) and (4) and after changing the integration variable in $p_{\overline{r}}$ and in $p_{\underline{r}}$ one can rewrite it as:

$$H_1(z)\equiv e^z\int_{-\infty}^{z}e^{-(a+bt)^2/2}dt-\int_{-\infty}^{z}e^{-(bt-a)^2/2}dt\geq 0 \tag{28}$$

where $z \equiv \ln \eta$, $a \equiv (\overline{r} - \underline{r})/2\theta g$, $b \equiv \theta/(\overline{r} - \underline{r})g$ and $g \equiv \sqrt{1 + \theta^2\sigma^2/(\overline{r} - \underline{r})^2}$. Note that $g = 1$ if $\sigma = 0$ and $g > 1$ otherwise. Inequality (28) is always met for $z > 0$. To see what happens if $z \leq 0$, note that $\lim_{z \to -\infty} H_1(z) = 0$. Consider what happens as z increases from $-\infty$. The first derivative of $H_1(z)$ is:

$$H_1'(z) \equiv e^{-(bz-a)^2/2} \left[e^{z+(bz-a)^2/2} \int_{-\infty}^{z} e^{-(a+bt)^2/2} dt + e^{z(1-2ab)} - 1 \right] \tag{29}$$

If $\sigma = 0$, then $g = 1$ and $2ab = 1$. As a result, $H_1'(z) \geq 0$ for all $z \leq 0$. Since $\lim_{z \to -\infty} H_1(z) = 0$, then $H_1(z) \geq 0$ $\forall z$, which implies that if $\sigma = 0$ the optimal contract sets $x(\overline{r}) = 1$ for every z. As we shall see, this property implies that if $\sigma = 0$ a contingent contract is always chosen. When instead $\sigma > 0$ and $g > 1$. The square bracketed term in (29) shows that $H_1'(z) \geq 0$ whenever:

$$\int_{-\infty}^{z} e^{-(a+bt)^2/2} dt \geq e^{-z-(bz-a)^2/2} - e^{-(bz+a)^2/2} \tag{30}$$

At $z = 0$, the left hand side above is positive while the right hand side is zero, so (30) is satisfied and thus $H_1'(0) > 0$. In general, the left hand side of (30) increases in z, the right hand side decreases in z for $z \geq z^*$ and increases in z for $z < z^*$, where z^* is a negative threshold smaller than $(ab - 1)/b^2$. Thus, when $z < z^*$ both the left and the right hand side of (30) increase in z. As $z \to -\infty$, both sides tend to 0, but by inspecting the first derivatives of both sides one sees that there exists a $z^{**} < z^*$ such that the right hand side of (30) increases faster than the left hand side for $z < z^{**}$. Hence, in proximity of $-\infty$, (30) is violated and parties set $x(\overline{r}) = 0$ for all values $z < z^{**}$. For $z > z^{**}$, the left hand side of (30) starts growing faster than the left hand side (which eventually becomes even decreasing) and thus expression (30) may become positive. We already know that at some point it becomes positive because at $z = 0$ (30) is satisfied. But then, this implies that there exists a unique point $\widetilde{z}$ such that $H_1'(z) \geq 0$ for $z \geq \widetilde{z}$ and $H_1'(z) < 0$ otherwise.

Thus, if $\sigma > 0$ there is one and only one $z_1 < 0$ such that $H_1(z) \geq 0$ for $z \geq z_1$ and $H_1(z) < 0$ otherwise. Uniqueness of z_1 follows from the fact that $H_1'(z)$ changes sign only once. Crucially, since $(1-p_{\underline{r}})/p_{\overline{r}} \leq p_{\underline{r}}/(1-p_{\overline{r}})$, if $z < z_1$ parties use contract $x(\overline{r}) = x(\underline{r}) = 0$. Consider how z_1 varies with σ. By noting that $da/d\sigma = -ag'(\sigma)/g$, $db/d\sigma = -bg'(\sigma)/g$ and that $g'(\sigma) > 0$, from the implicit function theorem [and since $H_1'(z_1) > 0$], it follows that

$$sign(\frac{dz_1}{d\sigma}) = -sign\left[e^{z_1}\int_{-\infty}^{z_1} e^{-(a+bt)^2/2}\,(a+bt)^2\,dt - \int_{-\infty}^{z_1} e^{-(bt-a)^2/2}\,(bt-a)^2\,dt\right].$$

The formula inside the square brackets is nothing else than a transformation of $H_1(z_1)$ where the first integrand is multiplied by $(a+bt)^2$ while the second integrand is multiplied by $(bt-a)^2$. Since $z_1 < 0$, we know that $t < 0$. Thus, since we also know that $b \geq 0$ and $a \geq 0$, the expression in square brackets is smaller than what is obtained by setting $b = 0$ in the functions that multiply the exponentials inside the integrals. Since the latter expression is precisely $H_1(z_1) = 0$, then the expression in square brackets in negative, which implies that z_1 increases in σ. Also, since as $\sigma \to +\infty$, both a and b tend to 0, z_1 tends to 0 as well. Since $z_1 < 0$, we know that $t < 0$. As a result, since we also know that $b \geq 0$ and $a \geq 0$, the expression in square brackets is smaller than the one obtained by setting $b = 0$ in the functions that multiply the exponentials inside the integrals. But then, since the latter expression is precisely $H_1(z_1) = 0$, then the expression in square brackets in negative, which implies that z_1 increases in σ. Also, since as $\sigma \to +\infty$, both a and b tend to 0, z_1 tends to 0 as well.

Step B. Consider now condition $\eta \leq p_{\underline{r}}/(1-p_{\overline{r}})$. By exploiting (3) and (4) one can rewrite it as:

$$H_2(z) \equiv e^{-z}\int_{-\infty}^{-(bz-a)} e^{-u^2/2}du - \int_{-\infty}^{-(a+bz)} e^{-u^2/2}du \geq 0 \tag{31}$$

where z, a, b and g are defined as before. Notice that $H_2(z) = H_1(-z)$. Thus, H_2 is a symmetric transformation of H_1.This has three implications. First, (31) is surely satisfied for $z \leq 0$, just as (28) is surely met for $z \geq 0$. Second, when $\sigma = 0$, $H_2(z) \geq 0$ $\forall z$ and thus $x(\underline{r}) = 0$ for every z. Third, for $\sigma > 0$ there exists a $z_2 = -z_1 > 0$ such that (31) is satisfied if and only if $z \leq z_2$, just as (28) is only met for $z \geq z_1$. Also, z_2 decreases in σ and $\lim_{\sigma\to+\infty} z_2 = 0$. This implies that when $z \geq z_2$ the parties use contract $x(\overline{r}) = x(\underline{r}) = 1$.

Step C. The previous analysis shows that if $\sigma = 0$ contract $x(\overline{r}) = 1$, $x(\underline{r}) = 0$ is always chosen. To see what happens when $\sigma > 0$, define $\kappa(\sigma) \equiv e^{-z_1(\sigma)}$. Then, the above analysis implies that if $\eta < 1/\kappa(\sigma)$ parties use $x(\overline{r}) = x(\underline{r}) = 0$, for $1/\kappa(\sigma) \leq \eta \leq \kappa(\sigma)$ they use $x(\overline{r}) = 1$ and $x(\underline{r}) = 0$, for $\eta > \kappa(\sigma)$ they use $x(\overline{r}) = x(\underline{r}) = 1$. Finally, since $z_1(\sigma)$ increases in σ then $\kappa(\sigma)$ falls in σ over the same range. This proves Proposition 2.

Proof of Proposition 3. After imposing on condition (11) the restriction $(1-\mu)/\mu = (\overline{r}-\lambda)/(\lambda-\underline{r})$ implied by assumption A.3 (i.e.$\eta = 1$), one finds that the truthful revelation contract is feasible provided:

$$\frac{\lambda-\underline{r}}{\overline{r}-\underline{r}} \cdot \left\{ \alpha\overline{r} + \frac{\overline{r}-\lambda}{\lambda-\underline{r}} \left[\lambda - (1-\alpha)\underline{r}\right] \right\} \geq k, \tag{32}$$

which can be rewritten as:

$$-\lambda^2 + \lambda \left[\overline{r} + \underline{r} + \alpha\left(\overline{r}-\underline{r}\right)\right] - \left[\overline{r}\underline{r} + k\left(\overline{r}-\underline{r}\right)\right] \geq 0. \tag{33}$$

The left hand side is inversely-U shaped in λ, and we now study the behavior of the expression for $\lambda \in (\underline{r}, \overline{r})$. The left hand side reaches its maximum at $\lambda = \left[\overline{r} + \underline{r} + \alpha\left(\overline{r}-\underline{r}\right)\right]/2 < \overline{r}$, implying that the left hand side is increasing in the domain of interest $\lambda \in (\underline{r}, \overline{r})$. At $\lambda = \underline{r}$, Equation (33) boils down to $(\alpha\underline{r} - k)\left(\overline{r}-\underline{r}\right) \geq 0$, which is fulfilled if and only if $\alpha\underline{r} \geq k$. As a result, if $\alpha\underline{r} \geq k$, the truthful revelation contract is always feasible, namely for $\lambda \geq \underline{r}$.

If instead $\alpha\underline{r} < k$, Equation (33) is not met at $\lambda = \underline{r}$. Can it be met at any other $\lambda < \overline{r}$? A sufficient condition for the answer to be "yes" is that Equation (33) be satisfied at $\lambda = \overline{r}$. By substituting this value in the left hand side expression, I find that Equation (33) becomes $(\alpha\overline{r} - k)\left(\overline{r}-\underline{r}\right) \geq 0$. One can see that, given assumption A.3, this condition is always verified due to A.2 (evaluated at $\mu = 1$). As a result, there exists a threshold $\lambda_i^* \in (\underline{r}, \overline{r})$ such that the truthful revelation contract is feasible for $\lambda \geq \lambda_i^*$.

Overall, there exists a threshold $\lambda^* \in [\underline{r}, \overline{r})$, where $\lambda^* = \underline{r} \cdot \mathbf{I}\left(\alpha\underline{r} \geq k\right) + \lambda_i^* \cdot \left[1 - \mathbf{I}\left(\alpha\underline{r} \geq k\right)\right]$ and $\mathbf{I}\left(\cdot\right)$ is the indicator function, whereby the truthful revelation contract is feasible if and only if $\lambda > \lambda^*$. It is immediate to see that threshold λ^* decreases in α, as better pledgeability of cash flows improves the feasibility of truthful revelation.

When $\lambda < \lambda^*$ the truthful revelation contract is infeasible and a state verification contract is used. With respect to the latter contract, the proof Proposition 2 showed that $\eta = 1$, if $\nu = 0$ the optimal contract is $x(\overline{r}) = 1$, $x(\overline{r}) = 0$. Clearly, $\nu = 0$ as long as under such contract I's break-even is not binding namely if:

$$p\left[\mu(\alpha\overline{r}-\lambda)+(1-\mu)(\lambda-\alpha\underline{r})\right]\equiv pA\geq B\equiv k-\left[\mu\lambda+(1-\mu)\alpha\underline{r}\right] \tag{34}$$

By A2 we know that $A > B$. Since $p \in [1/2, 1]$, then (34) is always met provided $B < 0$. Consider now the behavior of B as a function of λ. It is easy to see that given assumption A.2 the function B always decreases in λ. Moreover, when $\alpha\underline{r} < k$, which is necessary for $\lambda < \lambda^*$, we also have $B > 0$ that at $\lambda = \underline{r}$. At $\lambda = \overline{r}$, instead, due to the fact that $\overline{r} > k$, we have that $B < 0$. As a result, there is a threshold $\lambda_1 > 0$ such that $B > 0$ for $\lambda < \lambda_1$ and $B \leq 0$ otherwise. This establishes that for $\lambda \geq \lambda_1$ (34) is met and thus $x(\overline{r}) = 1$, $x(\overline{r}) = 0$ is used for every σ. Note that threshold λ_1 decreases in α, implying that higher pledgeability of cash flows fosters the use of the fully contingent contract for $\lambda < \lambda^*$.

Suppose now that $\lambda < \lambda_1$. Then, given $A > B > 0$, condition (34) is met provided $p \geq B/A$. Since $p \geq 1/2$, condition (34) is always satisfied if $B/A < 1/2$. This is the case provided $2k < \lambda + \alpha E(r)$ which by using A3 becomes $\lambda > 2k/(1+\alpha)$. For $\lambda > 2k/(1+\alpha)$,the contingent contract is always feasible even if $\lambda < \lambda_1$. As a result, defined $\widetilde{\lambda} \equiv \min\left[2k/(1+\alpha), \lambda_1\right]$ the contingent contract can only be infeasible provided $\lambda < \widetilde{\lambda}$; for $\lambda \geq \widetilde{\lambda}$ such contract is certainly feasible regardless of σ. Note that the threshold $\widetilde{\lambda}$ falls in α. It is also immediate to find that for $\alpha = 1$ then, provided $k > \underline{r}$ (otherwise there is no financing problem), we have $\widetilde{\lambda} = k$.

Summarizing, so far I found that for $\lambda \geq \lambda^*$ parties attain the first best by choosing truthful revelation, while for $\lambda \geq \widetilde{\lambda}$ the fully contingent contract is feasible (and optimal in the class of state verification contracts) regardless of σ. Defining a new threshold $\widehat{\lambda} = \min\left[\widetilde{\lambda}, \lambda^*\right]$, we know that for $\lambda \geq \lambda^*$ truthful revelation is used, while for $\lambda \in \left[\widehat{\lambda}, \lambda^*\right)$ the fully contingent contract is used for any σ, where the latter region is non empty only when $\widehat{\lambda} = \widetilde{\lambda}$. Because thresholds λ^* and $\widetilde{\lambda}$ fall in α, we have that $\widehat{\lambda}$ also falls in α, implying that pledgeability of cash flows fosters the use of the fully contingent contract. Since for $\alpha = 1$ we have seen that $\widetilde{\lambda} = k$, then – given assumption A.1 – we know that only the fully contingent contract is used for $\lambda < \lambda^*$.

Suppose now that $\lambda < \widehat{\lambda}$. In this range, the truthful revelation contract is infeasible and whether the fully contingent is used or not depends on judicial dispersion σ. To see how this works, consider the expression for p obtained by plugging $\eta = 1$ into (3), and substitute it in condition (34). Then, the latter condition identifies a threshold $\widehat{\sigma} \geq 0$, with $\widehat{\sigma}$ increasing in θ and $\lim_{\theta \to 0} \widehat{\sigma}(\theta) = +\infty$, such that parties set $x(\overline{r}) = 1$, $x(\overline{r}) = 0$ but only provided $\sigma < \widehat{\sigma}(\theta)$. Note that if θ is sufficiently large, there may exist no value of σ for which the fully contingent contract is feasible, in which case we set $\widehat{\sigma} = 0$. When this is the case, a condition on σ alone cannot ensure the use of the fully contingent contract for $\lambda < \widehat{\lambda}$. Once again, it is easy to see that $\widehat{\sigma}(\theta)$ increases in α, implying that better pledgeability improves the use of contingent contracts.

Finally, suppose that $\lambda < \widehat{\lambda}$ and $\sigma > \widehat{\sigma}$. Now, the investor break even constraint is binding, namely $\nu > 0$. Thus, (26) and (27) imply that payments are set at their maximum possible level $d_E(r) = \alpha r$ and $d_I = \lambda$. Because of $p > 1/2$, derivative (24) is strictly larger than (25), implying $x(\overline{r}) \geq x(\underline{r})$. Thus, (25) is negative and $x(\underline{r}) = 0$. If $x(\underline{r})$ were equal to 1, $x(\overline{r})$ would also be equal to 1, implying an average repayment to I of $\alpha E(r)$, which does not yield ex-ante break even. Given $x(\underline{r}) = 0$, to ensure break even it must be that:

$$x(\overline{r}) = \frac{\lambda - k}{(1-\mu)(1-p)(\lambda - \alpha \underline{r}) + \mu p(\lambda - \alpha \overline{r})} \tag{35}$$

When $\lambda \geq k$ the numerator of the right hand side is positive and for $\alpha < 1$ the denominator is positive as well. Expression (35) defines a function $x(\overline{r}\,|\sigma)$ decreasing in σ (and in θ). For $\lambda = k$ the optimal contract immediately jumps at $x(\overline{r}) = 0$ for $\sigma > \widehat{\sigma}$. For $\lambda > k$, if $\sigma \to +\infty$ then $p \to 1/2$ and the informational benefit of a contingent contract is zero. In particular, as $p \to 1/2$ the fully non-contingent contract $x(\underline{r}) = x(\overline{r}) = 0$ and $d_I = k$ is just as good for parties as the limit contract in (35). Thus, as polarization becomes extreme there is no benefit of writing state dependent contracts.

Appendix 3: Robustness to alternative contracts

I consider three contract types that in the interest of exposition I did not consider in the main body of the paper: i) contracts mixing truthful revelation and state verification, and ii) contracts inducing judges to truthfully report s (also by stipulating side payments to them), and iii) very open ended contracts allowing judges to “do what they want.”

i) Mixture of truthful revelation and state verification. We consider three sub-cases.

i.a) Contracts where the judge enforces a truthful revelation contract with probability $t \in (0,1)$ and sets I-control with probability $1-t$ (so far we only considered the extremes where $t \in \{0,1\}$). Under this contract, the investor obtains:

$$t\left[\mu(\alpha\overline{r}-\lambda)-(1-\mu)(1-\alpha)\underline{r}\right]+\lambda,$$

which yields break even provided

$$t \leq t^* \equiv (\lambda-k)\,/\,\left[(1-\mu)(1-\alpha)\underline{r}-\mu(\alpha\overline{r}-\lambda)\right]. \tag{36}$$

With probability t^* this contract beneficially exploits E's information, but to ensures break-even it must set I-control with probability $1-t^*$, even if it is ex-post inefficient to do so. By using Equation (14), one can see that the standard state verification contract studied in Section 4 is preferred to this mixture provided $x(\overline{r})(2p-1) \geq 1-t^*$, namely when σ is sufficiently small. This condition is satisfied for many parameter values, in particular when $\sigma \leq \sigma^*$ where σ^* is the value of polarization at which $x(\overline{r})(2p-1) = 1-t^*$, where t^* is the threshold identified by Equation (36). For $\sigma \leq \sigma^*$, the comparative statics of Proposition 3 continue to hold; by contrast, as $\sigma > \sigma^*$ the state verification contract is no longer used because it is dominated by the above mixture.

i.b) A contract setting E-control in state $\overline{r}$ with probability less than 1. It is easy to see that this contract is dominated by the one considered in 1.a).

i.c) A contract exploiting both judicial reports $\widehat{r}_j$ and the entrepreneur's report $\widehat{r}_E$. According to this contract, the report by the court is issues to enforce a state contingent repayment $d_I(\widehat{r}_j)$ while the report issued by the entrepreneur is used to enforce the control allocation $x(\widehat{r}_E)$. Even if judges perfectly verify, namely $\widehat{r}_j = r$, in order for E to set I-control in state $\underline{r}$ is must be that $d_I(\underline{r}) = l-(1-\alpha)\underline{r}$. As a result, this contract cannot improve upon the truthful revelation contract considered in Section 2.

In sum, the result that the use of the contingent contract falls in σ is robust to including exotic mixtures among state verification and truthful revelation contracts.

ii) Contracts that try to induce judges to truthfully reveal signal s. By rendering s

directly contractible, these contracts might avoid the costs of bias. Consider the formulation of judicial preferences introduced at the end of Appendix 1, where judicial preferences are encoded in the social welfare weights $\widetilde{\beta}_E, \widetilde{\beta}_I = 1 - \widetilde{\beta}_E$. The question is whether parties can write a signal and bias contingent contract $x(s, \widetilde{\beta}_E)$ in such a way that judges are induced to truthfully report s and $\widetilde{\beta}_E$, where judicial bias is naturally assumed to be unobservable to E and I. The contract may also provide the judge with monetary incentives for truthful reporting. I first consider the case where parties do not pay judges a bribe. This is probably the most realistic case, for contracts bribing judges for finding specific facts are illegal in most countries [see Bond (2004) for a study of court bribery]. I later consider also the role of such bribes.

ii.a) The case without bribes. Given $x(s, \widetilde{\beta}_E)$, a judge reporting $\left(\widehat{s}, \widehat{\widetilde{\beta}}_E\right)$ when the truth is $\left(s, \widetilde{\beta}_E\right)$ obtains utility:

$$\begin{aligned} U(\widehat{s}, \widehat{\widetilde{\beta}}_E \left| s, \widetilde{\beta}_E \right.) &= x\left(\widehat{s}, \widehat{\widetilde{\beta}}_E\right) \cdot \widetilde{\beta}_E E(r\,|s) + \left[1 - x\left(\widehat{s}, \widehat{\widetilde{\beta}}_E\right)\right]\left(1 - \widetilde{\beta}_E\right) \cdot \lambda = \\ & x\left(\widehat{s}, \widehat{\widetilde{\beta}}_E\right) \cdot \left\{\widetilde{\beta}_E \left[E(r\,|s) + \lambda\right] - \lambda\right\} + \left(1 - \widetilde{\beta}_E\right) \cdot \lambda. \end{aligned}$$

Thus, judges with $\widetilde{\beta}_E > \lambda / \left[E(r\,|s) + \lambda\right]$ report $\left(s^*, \widetilde{\beta}_E^*\right) = \arg\max_{\widehat{s}, \widehat{\widetilde{\beta}}_E} x\left(\widehat{s}, \widehat{\widetilde{\beta}}_E\right)$ while judges with $\widetilde{\beta}_E < \lambda / \left[E(r\,|s) + \lambda\right]$ report $\left(s_*, \widetilde{\beta}_{E,*}\right) = \arg\min_{\widehat{s}, \widehat{\widetilde{\beta}}_E} x\left(\widehat{s}, \widehat{\widetilde{\beta}}_E\right)$. This boils down to reducing the contract space to two numbers $x(\overline{r})$ and $x(\underline{r})$. Hence, judges cannot be induced to reveal $\left(\widehat{s}, \widehat{\widetilde{\beta}}_E\right)$ when bribes are not used.

ii.a) The case with bribes. Now, besides specifying allocation $x\left(\widehat{s}, \widehat{\widetilde{\beta}}_E\right)$, the contract also pays the judge $b(\widehat{s}, \widehat{\widetilde{\beta}}_E) \geq 0$ (due to limited liability, judges cannot be forced to pay money). My aim here is not to derive the optimal contract, but to show that the effectiveness of bribes is limited (which perhaps helps explain why they are not used in reality). In particular, I show that bribes cannot induce judges to implement the adjudication policy of an unbiased judge who optimally uses s. To see this, note that the unbiased judge's optimal policy is equal to:

$$x^{optimal}\left(s,\widetilde{\beta}_E\right)=\begin{cases}1 & for \quad \widetilde{\beta}_E\in[0,1] \text{ and } s>s_t\\ 0 & for \quad \widetilde{\beta}_E\in[0,1] \text{ and } s<s_t\end{cases}. \tag{37}$$

Here s_t is implicitly defined by $E(r\,|s_t)=\lambda$, which implies that when $s>s_t$ we have $E(r\,|s_t)>\lambda$, while when $s<s_t$ we have $E(r\,|s_t)<\lambda$. Suppose that a judge chooses to report $\widetilde{\beta}_E$ and $s>s_t$. Then, conditional on setting allocation $x^{optimal}\left(s,\widetilde{\beta}_E\right)=1$, he reports the vector $\left(\widehat{s},\widehat{\widetilde{\beta}}_E\right)\in(s_t,+\infty)\times[0,1]$ that maximizes his bribe $b(\widehat{s},\widehat{\widetilde{\beta}}_E)$. Truthful reporting then requires that $b(\widehat{s},\widehat{\widetilde{\beta}}_E)=b_1=$ constant for all $\left(\widehat{s},\widehat{\widetilde{\beta}}_E\right)\in(s_t,+\infty)\times[0,1]$. By the same token, if a judge reports $\widetilde{\beta}_E$ and $s<s_t$ then, conditional on setting $x^{optimal}\left(s,\widetilde{\beta}_E\right)=0$, he reports the vector$\left(\widehat{s},\widehat{\widetilde{\beta}}_E\right)\in(-\infty,s_t)\times[0,1]$ that maximizes the bribe $b(\widehat{s},\widehat{\widetilde{\beta}}_E)$. Truthful reporting then requires that $b(\widehat{s},\widehat{\widetilde{\beta}}_E)=b_0=$ constant for all $\left(\widehat{s},\widehat{\widetilde{\beta}}_E\right)\in(-\infty,s_t)\times[0,1]$.

As a result, to implement the optimal policy of Equation (37) under truthful reporting, the contract can only specify two bribes b_1 and b_0 which are paid to the judge if $x^{optimal}\left(s,\widetilde{\beta}_E\right)=1$ and $x^{optimal}\left(s,\widetilde{\beta}_E\right)=0$ are set, respectively. A judge with pro-entrepreneur bias $\widetilde{\beta}_E$ observing s, reports $s>s_t$ instead of $s<s_t$ if and only if:

$$\widetilde{\beta}_E\geq\frac{\lambda+b_0-b_1}{\lambda+E(r\,|s)}. \tag{38}$$

Equation (38) shows that it is impossible to set a fixed b_0-b_1 such that the allocation is $x^{optimal}\left(s,\widetilde{\beta}_E\right)$ for every $\left(s,\widetilde{\beta}_E\right)$. If for instance $b_0-b_1\in(\lambda,-\lambda)$, in a neighborhood of s_t judges with relatively high $\widetilde{\beta}_E$ set $x=1$ even if parties prefer $x=0$. By contrast, judges with relatively low $\widetilde{\beta}_E$ set $x=0$ even if parties prefer $x=1$. That is, pro-entrepreneur judges set E-control too often, pro-investor judges set I-control too often, just as when bribes are not used at all. Figure 3 below graphically shows this point by plotting Equation (38) for a value $b_0 - b_1 \in (0, \lambda)$ as a function of $\widetilde{\beta}_E$ and s:

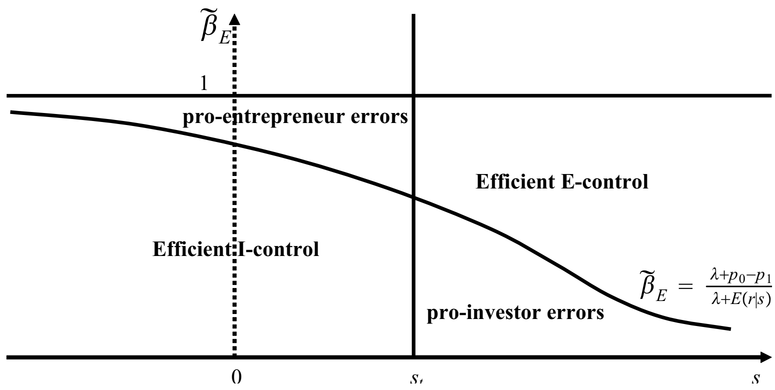

Figure 3

Thus, this cursory analysis shows that the very presence of judicial bias hinders the possibility of using judicial incentives to implement the optimal allocation of control. Even if bribes are used, judicial biases will introduce randomness in the allocation of control. Additionally, bribes are by their nature costly to the parties, and might even undermine investor break even. In this respect, non-contingent contracts have the advantage of: v) avoiding randomness (and thus costly errors) altogether, and vv) avoiding monetary costs for the parties, fostering break even.[23]

[23] This cost of bribes is best seen if judicial bias is observable. In this case, payments b_1 and b_0 can vary continuously as a function of $\widetilde{\beta}_E$.As a result, Equation (38) implies that by setting $b_0 - b_1 = \left(2\widetilde{\beta}_E - 1\right)\lambda$ parties can induce *all* judges to enforce the optimal policy of Equation (**??**). In the case of pro-entrepreneur judges (i.e. $\widetilde{\beta}_E > 1/2$), this requires to set $b_0 = \left(2\widetilde{\beta}_E - 1\right)\lambda$, $b_1 = 0$. In the case of pro-investor judges (i.e. $\widetilde{\beta}_E < 1/2$) this requires to set $b_0 = 0$, $b_1 = \left(1 - 2\widetilde{\beta}_E\right)\lambda$. The resulting ex-ante total cost for the parties of incentivizing judges is equal to:

$$\int_0^1 \lambda \cdot \left|2\widetilde{\beta}_E - 1\right| dF(\widetilde{\beta}_E) = 2\lambda \cdot \widetilde{\sigma},$$

where $F(\widetilde{\beta}_E)$ is the c.d.f. of bias and $\widetilde{\sigma} = \int_0^1 \left|\widetilde{\beta}_E - 1/2\right| dF(\widetilde{\beta}_E)$ is a measure of dispersion of judicial biases around the unbiased judge having $\widetilde{\beta}_E = 1/2$. Evidently, as judicial biases become more severe (i.e. as $\widetilde{\sigma}$ goes up), the cost of implementing the optimal policy increase as well, potentially undermining break even. If for instance judicial biases are symmetrically polarized at $\widetilde{\beta}_E = 0, 1$, then $\widetilde{\sigma} = 1/2$ and the cost of incentives becomes equal to λ, so that an amount of resoruces equal to the return under I-control must be pledged to judges. It is evident that, from the parties' standpoint, a non-contingent contract can be superior to this arrangment. The intuition here is that even if judicial bribes are allowed, state contingent allocations are very costly when dispersion of biases is high because the required bribes are very large in this case, in line

iii) Consider finally a drastically open ended contract allowing the judge to "do what he wants." This contract boils down to allowing the judge to maximize objective (23) not only with respect to $\psi(s)$ but also with respect to the control allocation $x(\overline{r}), x(\underline{r})$. It is then evident that this contract makes it impossible for the parties to set any state contingent allocation where $|x(\overline{r}) - x(\underline{r})| < 1$, namely even an allocation that is even slightly less contingent than the fully contingent one. This is because under a "let the judge do what he wants" contract the judge optimally sets $x(\overline{r}) = 1$ when his optimal policy is to find $\overline{r}$ [i.e. $\psi(s) = 1$] and $x(\underline{r}) = 0$ otherwise, thereby replicating the fully contingent contract. Crucially, then, the open ended contract does not allow parties to attain break even when contract $[x(\overline{r}) < 1, x(\underline{r}) = 0]$ is needed, such as in the cases highlighted by Proposition 3.

It is worthwhile concluding this discussion with an additional observation. In the current, simple setting, the open ended contract is equivalent to the fully contingent contract $x(\overline{r}) = 1, x(\underline{r}) = 0$. This equivalence, however, intuitively breaks down by slightly changing the model. Consider for example the realistic scenario in which judges must pay a (small) personal cost to observe s. This can be thought as the cost of considering and elaborating upon the parties' arguments as well as their assessments of r. Then, a contract allowing the judge to "do what he wants" allows him to disregard signal s and thus to save the personal cost, for the judge has discretion to set whatever allocation he wants regardless of s. this implies that many judges will enforce a control allocation solely based on their prior information, especially if they are biased [it is evident that biased judges are those who gain least from information acquisition]. Obviously, in this setting the fully contingent contract $x(\overline{r}) = 1, x(\underline{r}) = 0$ (e.g. a contract saying "the judge should set the allocation of control maximizing the project's ex-post return") is better than the open ended contract. This is because the contingent contract allows parties to make it explicit what is that judges must assess (i.e. the firm's ex-post return), forcing courts to perform some evidentiary search beyond what they would do if they were left completely unrestrained. For simplicity I do not consider this possibility here, but this notion is explicitly formalized in Gennaioli (2003).

with the conclusions reached by analyses of court corruption (Bond 2004). As a result, a non-contingent contract may be optimal.

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