Standardized Enforcement: Access to Justice vs Contractual Innovation [*]

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Abstract

We model the different ways in which precedents and contract standardization shape the development of markets and the law. In a setup where more resourceful parties can distort contract enforcement to their advantage, we find that the introduction of a standard contract reduces enforcement distortions relative to precedents, exerting two effects: i) it statically expands the volume of trade, but ii) it crowds out the use of innovative contracts, hindering contractual innovation. We shed light on the large scale commercial codification occurred in the 19th century in many countries (even Common Law ones) during a period of booming commerce and long distance trade.

0. Introduction

Recent work shows that Common Law promotes the development of financial, labor, and other markets, the use of innovative contracts, and greater adaptability (see La Porta et al. 2008 for a review). The interpretation of this evidence is controversial. Some view it as suggesting that "law matters," confirming the economic efficiency of Common Law (Hayek 1960, Posner 1973). Others remain skeptical. For instance, Rajan and Zingales (2003) argue that in the early 20th century financial markets were more developed in Civil Law systems than in Common Law ones. To them, this reversal casts doubts on the role of legal systems, which are time invariant, indicating that other factors such as politics played a key role. Similarly, Franks et al. (2008) and Franks and Sussman (2005) show that 19th and 20th century British courts took a long time to provide adequate protection to shareholders and creditors. Again, it seems that Common Law does not automatically guarantee strong investor protection. Finally, rapid legal convergence among developed countries (Coffee 2001), suggests that the link between legal systems and economic development may be misguided.

One striking feature of this debate is the absence of a model teasing out the predictions of the hypothesis that "law matters," thereby enabling researchers to test it against its alternatives. To interpret the data, we need a model in which legal systems affect contracting, and where questions concerning legal evolution can be addressed. This paper proposes a new simple model that sheds light on these issues.

We study a transaction between a buyer and a seller of a customized widget in which quality-contingent pay is needed to induce the seller's effort. The difficulty for courts to assess the quality of the widget creates enforcement risk. In the spirit of Gennaioli (2004, 2012), such risk is most severe for innovative and flexible contracts, which contain "open ended" terms that require judicial interpretation. In our model,

these interpretive ambiguities on average favor the party (buyer or seller) that is more powerful in litigation. Unequal litigation ability, due to parties' differential resources or information, distorts contract enforcement.[1]

We then consider two legal systems aimed at reducing these enforcement problems. The first regime, which we call *laissez faire*, relies on precedents. Much legal thinking views precedents as promoting judicial consistency and efficiency (Posner 1973). In our model, as judges gain experience with new contracts, a body of precedents develops that narrows down legal uncertainty and enforcement risk.

The second legal regime, which we call *standardization*, combines precedents with the codification of the enforcement of specific contracts. This creates a set of cheap-to-enforce standard contracts, whose provision is a main goal of contract law (e.g. Schwartz and Scott 2003). The standard contract is contingent on a few, preset pieces of evidence that judges are trained to interpret ex-ante. As far as innovative contracts are concerned, precedents still reduce enforcement risk. However, parties can now avoid enforcement risk also by using the standard contract.

We then ask: How do laissez faire and standardization shape the role of unequal litigation ability? How do they affect the evolution of law, contracts and welfare?

In our analysis, two principles stand out. First, under *laissez fair*e enforcement risk prevents unequal parties from writing contingent contracts, hindering gains from trade. This effect is strong at early stages, when there are few precedents. Precedent creation then increases courts' predictability, allowing parties to write more and more contingent contracts. Complete contracts are attained in the long run.

Second, introducing a *standard contract* reduces enforcement risk, exerting two effects: it boosts the volume of trade among very unequal parties (who would not

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[1] Section 4 shows that similar results hold when judicial errors are purely random. Our main focus, though, is on inequality because the latter arguably plays a key role in developing countries.

contract under laissez faire), but it crowds out the use of innovative contracts by moderately unequal parties. The standard reduces the private benefit for these parties of using flexible innovative contracts, as the latter are subject to enforcement risk.

Standardization thus creates a static vs. dynamic tradeoff. On the one hand, this regime statically improves welfare by boosting the volume and efficiency of trade among unequal parties. On the other hand, it stifles contractual innovation to such an extent that after some time welfare may be higher under laissez faire. If inequality is strong, the static benefit of standardization is large: to jump start markets society must give up some legal evolution. If inequality is low, the dynamic benefit of laissez faire in terms of greater adaptability is large.

As we discuss in Section 3, our model yields several testable predictions linking inequality, contractual innovation and standardization. We do not wish to resolve the Common vs. Civil Law debate here, but Section 3 argues that our model may help shed light on it. As a historical application, Section 5 discusses the standardization efforts undertaken in the 19th century to support growing commerce.

The paper is organized as follows. Section 2 builds a static model of laissez faire where open ended contracts allow strong parties to distort contracting, and studies the static role of standardization. Section 3 studies the dynamic properties of laissez faire and standardization. Section 4 discusses one extension. Section 5 reviews some real world standardization episodes in light of our model. Section 6 concludes. Section 7 (the Appendix) contains all proofs not presented in the other Sections.

We model litigation among unequal parties as an asymmetric contest, in line with early work by Tullock (1980) and Dixit (1987). Bernardo et al. (2000) use a context model to derive the optimal burden of proof, Daugherty and Reinganum (2000) study enforcement distortions arising from selective presentation of evidence.

Relative to these papers, we focus on contracting, standardization and the dynamics of different legal systems.[2] Our model is also related to the literature on boilerplate and standard contracts. Adieh (2006) views standardization as a way to foster coordination among contracting parties. Kahn and Klausner (1997) similarly view it as a way to exploit network effects and save on unspecified transaction costs. We endogenize these transactions costs as a function of enforcement risk and view standardization as a way to deal with unequal litigation ability.

Finally, we contribute to the work on legal evolution. Relative to early papers (Priest 1977, Rubin 1977), recent models of judge-made law focus on judicial behavior (Gennaioli and Shleifer 2007, Hernandez and Ponzetto 2008, Anderlini et al. 2008). Our approach is closest to the Gennaioli and Shleifer's (2007) model of distinguishing and to Hadfield's (2006) portrayal of precedents as a form of judicial training. The main novelty of our work is its focus on contracting and standardization. The above papers consider torts, with the exception of Anderlini et al. 2008, which however does not study, as we do, the choice between standard and novel contracts.

1 The model

Time is continuous. At each $t \geq 0$, a measure one of matches between a buyer (*B*) and a seller (*S*) forms at random (we later specify how). Each match involves the supply of a relationship-specific widget: the value of the widget is 0 for the market and $v \geq 0$ for the buyer, where v is a random variable uniformly distributed in $[0, \bar{v}]$ and $\bar{v} \leq 1$. See Bolton and Dewatripont (2005), ch. 12, for similar models.
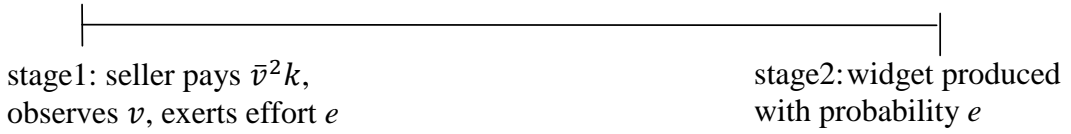
At instant t, production occurs in two stages, 1 and 2. In stage 1, *S* pays a fixed cost $\bar{v}^2 k > 0$ (e.g. to acquire specific human capital), privately observes the

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[2] Other papers studying the *static* effects of judicial error when the latter is due to judicial bias or corruption are Bond (2004), Glaeser and Shleifer (2003), Glaeser, Sheinkman and Shleifer (2003).

realization of v, and exerts unobservable effort $e \in [0,1]$. His cost of effort is $C(e)$, where $C(0) = C'(0) = 0$, $C'(e) \geq 0$, $C''(e) \geq 0$, and $C'''(e) \leq 0$. In stage 2, the widget is produced with probability e and B also learns its value v.

A higher value of $\bar{v}$ means that the widget is on average more valuable and thus effort is more important. In the remainder, we refer to $\bar{v}$ as the importance of the seller's investment. As we will see, when $\bar{v}$ is higher S should be afforded greater legal protection. $\bar{v}$ is distributed across sellers according to a p.d.f. $f(\bar{v})$ in $[0,1]$.

stage1: seller pays $\bar{v}^2 k$,   stage2: widget produced
observes v, exerts effort e with probability e

Figure 1: The two production stages

At a given v, first best effort $e_{fb}(v)$ solves $\max_e e \cdot v - C(e)$, which yields:

$$C'\left(e_{fb}(v)\right) = v.$$

Owing to convex costs, effort increases in v. We call "surplus" the quantity:

$$W(\bar{v}) = \int_0^{\bar{v}} \left[e_{fb}(v) \cdot v - C\left(e_{fb}(v)\right)\right] \frac{1}{\bar{v}} dv. \tag{1}$$

Social welfare at $\bar{v}$ is equal to surplus minus setup costs, $W(\bar{v}) - \bar{v}^2 k$. We prove:

Lemma 1 *The transaction is socially valuable, namely $W(\bar{v}) \geq \bar{v}^2 k$ for all $\bar{v}$, if:*

$$k \leq \frac{1}{6C''(0)}. \tag{2}$$

Equation (2) ensures gains from trade at any $\bar{v} \geq 0$. If marginal costs are not too steep (C'' is small), effort provision increases very fast with v. Thus, if paying the fixed cost k is profitable at low widget values ($\bar{v} \approx 0$), which is ensured by (2), it also profitable at any $\bar{v} > 0$ (owing to $C'''(e) \leq 0$). We henceforth assume that Equation (2) holds.

Consider how to implement $e_{fb}(v)$. First best effort cannot be achieved if the price of the widget is negotiated at stage 2. In this case, a hold-up problem arises: if B

has all the bargaining power (which we assume throughout), he obtains the widget for a zero price ex post. Thus, S has no incentives to exert effort. To provide S with proper incentives, the price of the widget must be fixed in stage 1. Ideally, contracts could commit B to pay a state contingent price $p(v) = v$, inducing S to internalizes the value of the widget and thus to exert $e_{fb}(v)$. The problem is that this contract requires verification of v in stage 2, and courts may not be apt at such task.[3] We now build a model of imperfect court verification and study its implications for contracts.

1.1 Signals, events, and precedents

State verification is complex because v results from many conflicting signals. For a given $\bar{v}$, the actual value of the widget depends on a measure $\bar{v}$ of binary signals $s_i \in \{0,1\}$. Each signal is identified by index $i \in [0, \bar{v}]$. The realized value v is the average realization of all signals: a measure v of signals takes value 1, the remaining $(\bar{v} - v)$ signals take value 0. Signals' realizations in $\{0,1\}$ are verifiable in court.

The indices $i \in [0, \bar{v}]$ capture different factors affecting gains from trade (e.g. B's demand, S's production costs…). Crucially, signals carrying a lower index i are more likely to take value 0 rather than 1: holding v fixed, signals having indices below the threshold $i(v) \equiv \bar{v} - v$ take a value of 0, those having indices above $i(v)$ take a value of 1. Below we plot the signal realizations for generic $\bar{v}$ and v.
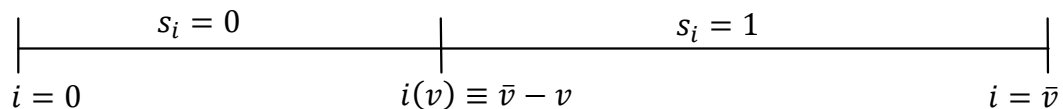
Figure 2*: The structure of signals

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[3] Owing to asymmetric information, parties cannot set the proper price in stage 1. Because in stage 2 parties are symmetrically informed, they could in principle use revelation games (Maskin and Tirole 1999) (e.g. specific performance contracts such as options, Noldeke and Schmidt 1995). In line with work in incomplete contracts (Grossman and Hart 1986), we assume that these mechanisms are not used. There is a large debate on the foundations of incomplete contracts, but solving this debate is outside the scope of our paper. See Hart and Moore (2008) for a new foundation of incompleteness.

We can then establish the following result:

Lemma 2 *Signals' realizations in* $\{0,1\}$ *allow the following inferences:*

a) *If* $s_i = 1$, *then* $v \geq \bar{v} - i$. *If* $s_i = 0$, *then* $v < \bar{v} - i$.

b) *Take two signals* $s_{i'}$ *and* s_i, *with* $i' > i$. *If* $s_{i'} = 0$, *then* $v < \bar{v} - i'$. *If* $s_i = 1$, *then* $v \geq \bar{v} - i$. *If* $s_i = 0$ *and* $s_{i'} = 1$, *then* $v \in [\bar{v} - i', \bar{v} - i]$.

Proof: By Figure 2, if $s_i = 1$ there are at most i of signals whose realization is 0. Thus, $v \geq \bar{v} - i$. If instead $s_i = 0$, there are at least i signals whose realization is zero. Thus, $v < \bar{v} - i$. The implication of observing $s_{i'}$ and s_i easily follows. QED

Our signal structure has two main features. First, the realization of one signal s_i allows to determine whether v is above or below threshold $\bar{v} - i$. This implies that the most informative signal, which best predicts v, is the middle one having index $i = \bar{v}/2$.[4] Signals with extreme indices are little informative: most of the time they take the same value of 0 or 1.

The second feature is that it is possible to verify v almost perfectly by just looking at two signals. By property b), after observing $s_{i+\epsilon} = 1$ and $s_{i-\epsilon} = 0$ (for very small $\epsilon > 0$) one can conclude that v is very close to $\bar{v} - i$. As long as one can sample the most informative signals, state verification is an easy task.

Judges adjudicate cases based on signal realizations. Ideally, when doing so they should draw the inferences of Lemma 2. We assume this is not possible for two reasons. First, judges have limited competence: they do not know the relevance (i.e. informativeness) of different pieces of data. Upon observing a realization in $\{0,1\}$, the judge has a uniform prior over the true index $i \in [0, \bar{v}]$ that generated it.

Second, the inference judges can draw from signals is constrained by precedents. To formalize this notion, we call "settled" the signals that judges used in

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[4]Formally $cov(s_i, v) = (i - i^2/\bar{v})$ is highest (so s_i is most predictive of v) for $i = \bar{v}/2$.

past litigations. In transaction $\bar{v}$, settled signals are a subset P_t of the set of signal indices $[0, \bar{v}]$. We call "usettled" all signals $i \notin P_t$ that were not used by judges in the past. We then formalize precedents as follows.

Definition 1 *Precedents are described by a function* $\hat{\imath} : P_t \longrightarrow [0, \bar{v}]$ *mapping a signal's true index* $i \in P_t$ *into a judicially attributed index* $\hat{\imath}(i)$.

Precedents constrain the adjudication of settled signals because, upon observing s_i for $i \in P_t$, the judge must call event $v \geq \bar{v} - \hat{\imath}(i)$ if $s_i = 1$ and $v < \bar{v} - \hat{\imath}(i)$ otherwise. Adjudication of precedents is mechanic. The mapping $\hat{\imath}(i)$ summarizes which event judges called in the past after ruling on the signals that were unsettled at the time.

Crucially then, judges can recognize $\hat{\imath}(i)$ and thus enforce precedents but they cannot recognize the indices of unsettled signals. This seeks to capture the notion that judges are trained to recognize precedents while they have no prior training on unsettled signals, and parties cannot provide them with such training by contract.[5]

At each t, precedents (and thus the set P_t) are updated with the unsettled signals used by judges in this period. We are thus adopting the same structure of Gennaioli and Shleifer (20007) where judges refine precedents by incorporating new empirical dimensions (here signals) into adjudication. In line with Gennaioli and Shleifer (2007), judges can use one and only one unsettled signal at the time (while they are free to use settled signals). Intuitively, it is costly for judges to justify the relevance of an unsettled signal and provide it with an interpretation constituting a

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[5] These assumptions are intuitive. The multitude of signals captures the multitude of proxies available for assessing the good's value. The impossibility to use contracts to train judges is equivalent to the incomplete contracts assumption that parties cannot directly contract on a precise signals (or contingency) because these signals are hard to describe in an ex-ante contract. Indeed, suppose for instance that B wants to buy a fast car. He could write a contract on speed, but the contract cannot specify whether the speed requirement applies or not to all weather conditions (the car may not sprint safely on a wet road). These ambiguities will be litigated in court and judges (who do not know the preferences of litigants) might interpret them in disagreement with the spirit of the original contract. However, after a judge renders a decision on how to interpret a certain contract provision (e.g. concerning speed), future judges will mechanically interpret the same provision in the same way.

precedent. This yields the appealing feature that precedents are updated incrementally. We study the evolution of the settled range P_t in Section 3.

1.2 Contracts

Courts can verify, and contracts can be contingent on, the following events: *i*) whether S delivers or not a widget to B, *ii*) the realization in $\{0,1\}$ of one unsettled signal, and *iii*) the indices $\hat{\imath}$ and the realizations of signals in the settled range P_t.

To see the implications of this, consider contracting at $t = 0$. We study the case $t > 0$ in Section 3. In the first period, there are no precedents ($P_0 = \phi$). Thus, contracts only specify a fixed payment $p > 0$ contingent on the delivery of the widget and a bonus $\Delta \geq 0$ enforced by the judge conditional on the realization of an unsettled signal. This contract is *open ended*, because judges cannot be given instructions on which specific unsettled signal to use (they cannot recognize it). For instance, parties may stipulate that the bonus should be paid if and only if the widget is "satisfactory." Just as for the open ended contracts used in the real world, judges determine the meaning of this clause ex post, based on one unsettled signal. We call "innovative" a contract whose payment is contingent on unsettled signals, namely $\Delta > 0$.

1.3 Inequality and the enforcement of open ended contracts

Litigation is a contest where B claims the quality of the widget to be low, so that the bonus should not be enforced, while S claims the opposite. To prove his claim, B presents in court n_0 unsettled signals taking value zero (which indeed signal low quality), while S presents n_1 signals taking value one (which signal high quality).

Parties differ in their signal collection ability: B can freely collect up to a share β of the available signals taking value zero, S up to a share $(1 - \beta)$ of the available

signals taking value 1. Parameter $\beta \in [0,1]$ captures B's collection advantage relative to S. If $\beta < 1/2$ the seller is a better signal collector than the buyer: he may be richer and thus able to hire better lawyers (S may be a large corporation, B a consumer), or more informed on where to find signals. If $\beta > 1/2$, the buyer is a better signal collector. If $\beta = 1/2$, parties are equal. Inequity varies in the population of buyer-seller pairs according to the following distribution:

A.1 β *has a p.d.f.* $h(\beta)$ *that is unimodal and symmetric around its mean* $E(\beta) = 1/2$.

On average B and S are equal. The variance of β captures social inequality.

The seller knows β when choosing effort. Section 4 discusses the case in which β is learned in court, reflecting pure noise. Crucially, judges do not observe β, which is thus unverifiable (and noncontractible). This is realistic, for powerful parties could send to court a straw man with low collection ability.

In line with models of litigation contests (e.g. Dixit 1987), we assume a function for aggregating the evidence (n_0, n_1) presented by parties. In particular, we postulate that the judge rules for S and enforces the bonus if and only if:

$$n_1 \geq n_0.$$

The party presenting more evidence wins. After choosing the winner, the judge renders his verdict by picking just one of the unsettled signals presented by that party.[6]

The above contest function is intuitive. If one views signals as arguments and counterarguments, the rule simply says that the party running out of arguments loses. As we prove in Lemma 3, this function describes the rule used by a Bayesian judge to guess, based on (n_0, n_1), the realization of the most informative signal $i = \bar{v}/2$.

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[6]If the judge rules for S, he picks a signal $s_i = 1$ and attributes index $\hat{\imath}(i) \leq \bar{v}/2$ to it, which becomes a precedent. The opposite is true if the judge rules for B. Similar results obtain when: i) parties choose how many signals to sample (at a certain cost), and ii) the judge enforces Δ with probability $n_1/(n_1 + n_0)$. Results are available upon request.

An important property of our contest function is that it does not correct for differences in litigants' collection ability. One justification is that β is neither directly observable nor verifiable by the judge. Most important, and this is the stance taken by law and economic models on trials (e.g. Daugherty and Reinganum 2000), real world rules of procedure often compel judges to treat evidence at face value. For example, courts cannot discard factual evidence simply because the party who produced it has a better lawyer. Accordingly, courts are often forbidden from making inferences based on a party's decision not to present evidence (i.e. the "self incrimination privilege").[7]

Of course, as long as there is flexibility in interpreting case facts, the judge will try to use his prior knowledge. However, the above rules of procedure limit his ability to do so. To capture these limits in the starkest way, we make the crude assumption that judges base their decision on (n_0, n_1), disregarding prior information.[8] If parties have the same collection ability, the constraint of treating evidence at face value does not distort justice, in the spirit of Milgrom and Roberts (1986). When instead one party is better at signal collection, this constraint is costly, and the legal system should devise strategies for avoiding distorted decisions. As we will see, standardization in our model is a natural way to accomplish this goal.

2. Optimal contracting under imperfect state verification

We study the model at $t = 0$. Section 2.1 studies how the bonus is enforced. Section 2.2 studies *laissez faire*, Section 2.3 studies *standardization*.

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[7] In similar spirit, if a plaintiff provides no evidence, then he loses regardless of his status (this is true a fortiori if the defendant offers exculpatory evidence). If the factual evidence in a case is insufficient to support a verdict of liability, the judge can reverse a jury finding of liability.

[8] One may wonder why the law should specify these rules of evidence in the first place rather than leaving judges freedom in judging the merits of cases. One possibility is that judges themselves may be biased in favor of a party (Gennaioli 2004, 2012). Indeed, the distortion of justice caused by such bias is very similar to the one caused by inequality. Standardization plays a similar role in these two cases.

The timing at $t = 0$ is as follows. A buyer-seller match $(\bar{v}, \beta)$ forms randomly, with density $f(\bar{v}) \cdot h(\beta)$ (variables $\bar{v}$ and β are independent). Next, parties choose whether to contract or not. If they contract, they set (p, Δ).[9] Then, S observes v and exerts effort. After the widget is produced, parties litigate over Δ. The judge observes the evidence (n_0, n_1), and chooses whether to enforce p or $p + \Delta$.

2.1 Judicial enforcement of the bonus

Let us backward solve the model, starting with the litigation of transaction $\bar{v}$. Consider signal collection. If the value of the widget is v, there are exactly $(\bar{v} - v)$ signals taking value zero and v signals taking value one. Given the assumed signal collection technology, B presents $n_0 \leq \beta(\bar{v} - v)$ signals taking value zero, while S presents $n_1 \leq (1 - \beta)v$ signals taking value one. We then prove:

Lemma 3 *In a transaction $(\bar{v}, \beta)$, the judge enforces the bonus Δ if and only if:*

$$v \geq \hat{v} \equiv \beta \cdot \bar{v}. \tag{3}$$

The judge does not enforce the bonus for $v < \hat{v}$.

The enforcement of the bonus depends on the widget's true value v and on the litigants' strength β. If v is high, there are many signals taking value 1. As a result, it is likely that S wins and the bonus is enforced. At the same time, for given v the bonus is not enforced provided β is sufficiently high. If B is much better than S at signal collection, he can win even if facts are quite unfavourable to him. If $\beta = 1/2$, adjudication is not distorted. The proof of Lemma 3 shows that if Equation (3) holds, a Bayesian judge infers that the most likely value of the informative signal is $s_{\bar{v}/2} =$

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1. As the judge does not observe β, he cannot tell if the imbalance in the evidence reflects litigation ability or the underlying facts. Thus he treats (n_0, n_1) at face value.

2.2 Optimal contracting under laissez faire

Consider how parties optimally set their contract (p, Δ) in transaction $(\bar{v}, \beta)$. After learning v, and based on his expectation on the enforcement of the bonus as described by Equation (3), S exerts optimal effort according to:

$$\begin{cases} C'(e_l) = p & if \quad v < \beta \cdot \bar{v} \\ C'(e_h) = p + \Delta & if \quad v \geq \beta \cdot \bar{v} \end{cases} \tag{4}$$

Where $e_l \leq e_h$. The optimal contract sets (p, Δ) to implement the surplus maximizing effort levels (e_l, e_h), which solve:

$$max_{e_l, e_h} \int_0^{\beta \cdot \bar{v}} [e_l \cdot v - C(e_l)] \frac{dv}{\bar{v}} + \int_{\beta \cdot \bar{v}}^{\bar{v}} [e_h \cdot v - C(e_h)] \frac{dv}{\bar{v}}. \tag{5}$$

The first order conditions of the problem are:

$$C'(e_l) = \beta \cdot \frac{\bar{v}}{2}, \qquad C'(e_h) = (1 + \beta) \cdot \frac{\bar{v}}{2}. \tag{6}$$

Together with Equation (4), these first order conditions yield the following result.

Lemma 4 *The optimal contract for transaction $(\bar{v}, \beta)$ is equal to*:

$$p = \beta \cdot \frac{\bar{v}}{2}, \qquad \Delta = \frac{\bar{v}}{2}. \tag{7}$$

Proof: by inspection of Equations (4) and (6).

The base price and the bonus increase in the importance of the seller's effort. At high $\bar{v}$, effort is valuable. Thus, incentives are high powered. Accordingly, the contract is innovative, $\Delta > 0$, because conditioning payments on unsettled signals allows effort to better track v. The optimal bonus Δ increases in the range $\bar{v}$ of possible values.

The base price depends on the buyer's litigation strength β. Higher β increases the range over which the bonus is *not* enforced, reducing the seller's incentive to exert effort. To restore incentives, parties stipulate a higher base price p.

Consider the impact of inequality β on welfare. To do so, denote by $W(\bar{v}, \beta)$ the surplus from trade valued at the optimum, namely Equation (5). We prove:

Proposition 1 *If* $2C''(1) > C''(0)$ *then, for each $\bar{v}$, there is a value $\beta^* \in (0,1)$ such that $W(\bar{v}, \beta) < W(\bar{v}, \beta^*)$ for all $\beta \neq \beta^*$. If:*

a) $k \leq 1/8C''(0)$, *parties always contract (and pay the fixed cost $\bar{v}^2 k$)*

b) $k > 1/8C''(0)$, *for each $\bar{v}$ there are two thresholds $\overline{\beta}, \underline{\beta}$, where $\underline{\beta} \leq \beta^* \leq \overline{\beta}$, such that parties contract if and only if $\beta \in \left(\underline{\beta}, \overline{\beta} \right)$.*

Under mild assumptions, social surplus is inverse-U shaped in β and peaks at a litigation strength β^*. Any deviation from β^* is detrimental, so that strong inequality reduces welfare. When β is very high, the buyer is so strong that the judge almost never enforces the bonus. When β is very low, the seller is so strong that the judge enforces the bonus very often. In both cases, there is a welfare loss because incentive payments track very little the widget's true value v. In the extreme cases where β is either 0 or 1, the judge only enforces a flat delivery price. As a result, parties only contract if β is sufficiently close to β^*. Inequality hinders welfare by dissipating information in court, which lowers both the efficiency and the volume of trade.

The value of β^* captures the buyer's optimal legal protection in transaction $\bar{v}$. When contracts are open ended, their enforcement relies on resolving factual ambiguities (is the quality of the widget is satisfactory?), and β^* identifies the extent to which this resolution should optimally be pro-buyer. We prove:

Corollary 1 *The buyer's optimal protection β^* weakly decreases in the importance of the seller's effort $\bar{v}$. Denote by $(\tilde{e}_h, \tilde{e}_l)$ the optimal effort levels when $\beta = 1/2$. Then, the optimal legal protection is pro buyer, i.e. $\beta^* > 1/2$, when:*

$$\frac{C(\tilde{e}_h) - C(\tilde{e}_l)}{\tilde{e}_h - \tilde{e}_h} > \frac{\bar{v}}{2}, \tag{8}$$

while $\beta^* < 1/2$ when the inequality is reversed.

Optimal legal protection depends on the value and cost of the seller's effort. If – as in Equation (8) – the average marginal cost of effort is above the average value of the widget $\bar{v}/2$, parties should be protected against effort over-provision. Such protection is guaranteed by a pro-buyer legal standard $\beta^* > 1/2$. If, by contrast, the average value of effort is large relative to its marginal cost – namely when the inequality in (8) is reversed – parties should be protected against effort under-provision. This is accomplished by setting a pro-seller legal standard $\beta^* < 1/2$.

Grossman and Hart (1986) stress that – when contracts are incomplete – asset ownership protects, and allows parties to provide incentives to, the party making valuable investments. In our model, contractual incompleteness generates legal ambiguity. The party making valuable investments is then provided incentives by resolving this ambiguity in his favour. In principle, the law could require judges to use the optimal legal standard β^*. Unfortunately, though, this is infeasible because judges rule on evidence that is not only ambiguous, but also selected. Because judges cannot properly de-bias such evidence, they cannot apply the ideal standard β^* to it. As we will see, standardization provides a way to implement β^* by training judges to consider just a few, preset, signals.

We now provide a useful closed-form characterization of our model.

**Example (1)** *If $C(e) = e^2/2$, we have that $e_h = (1 + \beta)\bar{v}/2$, $e_l = \beta\bar{v}/2$, and:*

$$W(\bar{v}, \beta) - \bar{v}^2 k = \bar{v}^2 \left(\frac{1}{6} - \frac{1 - 3\beta + 3\beta^2}{24} - k \right). \tag{9}$$

In this case, optimal legal protection is fully balanced, namely $\beta^* = 1/2$ for all $\bar{v}$.

For all $\bar{v}$, the transaction is undertaken when $k \leq 1/8$, it is not undertaken when $k \geq 15/96$. When $k \in (1/8, 5/32)$, it is undertaken when $\beta \in \left(\underline{\beta}, \overline{\beta} \right)$ where:

$$\underline{\beta} = \frac{1 - \sqrt{5 - 32k}}{2}, \quad \overline{\beta} = 1 - \underline{\beta}. \tag{10}$$

When $C(e) = e^2/2$ welfare is proportional to $\bar{v}^2$ and quadratic in β. In this case, Equation (8) holds with equality so that welfare is maximized when parties are equal, $\beta^* = 1/2$. Another useful property, plotted in Figure 3, is that whether parties contract or not depends only on β and not on $\bar{v}$ (i.e., $\overline{\beta}$ and $\underline{\beta}$ do not depend on $\bar{v}$).
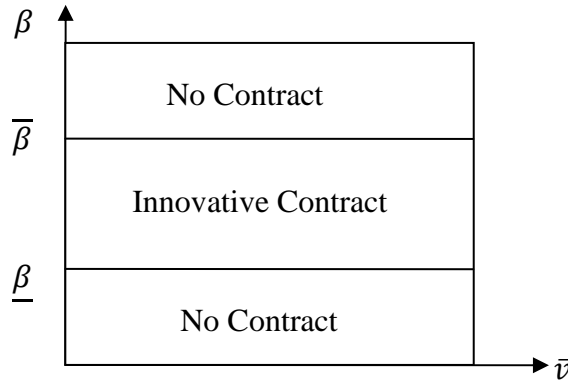
Figure 3: Contracting under laissez faire when $C(e) = e^2/2$

By summing welfare in Equation (9) across all buyer-seller pairs $(\bar{v}, \beta)$ willing to contract, we find that aggregate welfare in society is equal to:

$$\int_0^1 \int_{\underline{\beta}}^{\overline{\beta}} [W(\bar{v}, \beta) - \bar{v}^2 k] h(\beta) f(\bar{v}) d\beta d\bar{v}. \tag{11}$$

Because welfare in a given pair is concave in β, greater dispersion of buyer-seller matches (i.e. greater social inequality) reduces aggregate welfare.

2.3 Contract Standardization

Standardization can be undertaken by the public legal system via commercial codification, e.g. by specifying default investor rights (La Porta at al. 1998), or by a private trade association (Bernstein 2001). In either case, standardization essentially creates off the shelves contracts. Parties then choose whether to use these contracts or to "opt-out" of them by writing nonstandard terms. We model standardization by assuming that it makes available to parties a contract that: a) is contingent only on certain preset signals, and b) is predictably enforced because judges are trained how to interpret these signals. Features a) and b) naturally emerge in our model as a way to soften the costs caused by parties' unequal collection ability.[10]

In our model, restricting admissible evidence (condition a)) is necessary but not sufficient to improve fact finding. For instance, suppose that the law specifies that judges should only consider a share $(1 - \beta)$ of the signals presented by B and a share β of those presented by S. This rule would de-bias signal collection. However, it is infeasible because β is neither observable nor verifiable. Setting a plain limit n on the measure of admissible signals is also suboptimal, for it causes a waste of information (as parties have no incentive to present informative signals in our model). Thus, limiting the evidence parties can present (e.g. the parol evidence rule) is not enough. Judges should also be trained to recognize certain informative signals (condition b)).

In line with these ideas, we model standardization as the creation of a contract contingent on the realization of a pre-defined signal carrying index $i_S \in [0,1]$. Only one signal is standardized for all transactions $\bar{v} \in [0,1]$. After such signal is chosen, judges are trained to recognize it. Training is costly, which justifies why only few (i.e.

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[10] Atomistic parties cannot attain these goals by contract because: a) it is hard to contract on litigation procedures (Scott and Triantis 2005), and b) it is even harder for parties to train judges to recognize specific signals. Niblett (2005) shows that even in a developed legal system such as the U.S. one, the enforcement of private standardization (arbitration clauses) is highly uncertain, suggesting that effective standardization requires some cooperation by the public legal system.

just one) signals are standardized. In litigation, parties are then forbidden to present any other signal $i \neq i_S$ in court. The standard contract is mechanically enforced based on the realization s_{i_S}. This amounts to specifying the legal circumstances in which the widget's quality is "satisfactory" (i.e., when $s_{i_S} = 1$). Of course, a fixed standard cannot tailor the interpretation of "satisfactory" to each transaction $\bar{v}$. This one-size-fits-all feature creates a cost of using the standard for some parties.

Given Lemma 2, the standardization of i_S allows judges to correctly determine whether $v \geq v_S \equiv 1 - i_S$ or not. From now on, we identify the standard contract using only threshold v_S. In our analysis we take v_S as given, but we later show (see footnote 11), how v_S can be endogeneized.

At $t = 0$, parties to transaction $(\beta, \bar{v})$ choose between: i) the standard contract, ii) the innovative contract, and iii) no contract. If parties choose the standard, they set a base price and a bonus (p_S, Δ_S), where Δ_S is enforced if and only if $v \geq v_S$. Setting the optimal (p_S, Δ_S) is akin to setting the effort levels $(e_{S,l}, e_{S,h})$ that solve:

$$max_{e_{S,l}, e_{S,h}} \int_0^{v_S} [e_{S,l} \cdot v - C(e_{S,l})] \frac{dv}{\bar{v}} + \int_{v_S}^{\bar{v}} [e_{S,h} \cdot v - C(e_{S,h})] \frac{dv}{\bar{v}}. \qquad (12)$$

Comparison of Equations (5) and (12) reveals the following useful result.

Lemma 5 *The use of the standard contract in transaction $(\beta, \bar{v})$ is equivalent to replacing inequality β among parties with the standard-induced inequality*:

$$\beta_S \equiv min \left[\frac{v_S}{\bar{v}}, 1 \right]. \qquad (13)$$

The optimal terms (p_S, Δ_S) for transaction $(\beta, \bar{v})$ are then equal to:

$$p_S = \beta_S \cdot \frac{\bar{v}}{2}, \qquad \Delta = \frac{\bar{v}}{2}.$$

Proof: by inspection of Equations (12), (5) and (7).

The standard pins down the parties' litigation strength. A higher v_S reduces the likelihood that the bonus is paid, much as if B was stronger (i.e., β_S is higher). For a fixed v_S, the bonus is enforced more often if the widget is more valuable. Thus, the standard protects S more (β_S is lower) when $\bar{v}$ is higher. In line with this notion, the base price and bonus under standardization simply replace β with β_S in Equation (8).

The above result illuminates contract choice. We in fact have that:

**Proposition 2** *If $k > 1/8C''(0)$, then for a given $\bar{v}$ and a given standard v_S we have:*

i) *If $\beta_S \notin (\bar{\beta}, \underline{\beta})$, the standard is not used. If $\beta_S \in (\bar{\beta}, \underline{\beta})$, all parties to $\bar{v}$ contract.*

ii) *If $\beta_S \in (\bar{\beta}, \underline{\beta})$, there are two thresholds $\bar{\beta}_S, \underline{\beta}_S$ such that the innovative contract is used for $\beta \in \left(\underline{\beta}_S, \bar{\beta}_S\right)$, while the standard is used otherwise. Standardization reduces the use of the innovative contract, formally $\underline{\beta}_S \geq \underline{\beta}$ and $\bar{\beta}_S \leq \bar{\beta}$.*

By protecting parties against inequality, standardization has two effects. First, it increases the volume of trade among parties that are so unequal that they would not contract under laissez faire (property *i*)). For this to be the case, the standard must be sufficiently close to the parties' ideal legal protection, namely $\beta_S \in (\bar{\beta}, \underline{\beta})$.

Second, standardization crowds out innovative contracts (property *ii*)). Some parties who contract under laissez faire still suffer from significant inequality. Standardization helps them soften enforcement distortions. This occurs if the standard β_S is closer to optimal protection β^* than the parties' inequality β. The fixed standard is not used in all transactions $\bar{v}$, though, for it provides excessive protection to the seller when $\bar{v}$ is very large and insufficient protection to him when $\bar{v}$ is very low.

In sum, our model yields a trade-off between the inflexibility of the standard and its ability to avoid enforcement distortions. If parties do not need protection against

inequality (β is close to β^*) and/or the standard is unsuitable for their transaction (β_S is relatively far from β^*), they prefer the flexibility of the innovative contract. If instead parties are very unequal (β is far from β^*) and/or the standard is relatively close to optimal legal protection (β_S is close to β^*), they avoid enforcement distortions by using the latter. In all other cases, they do not contract. Figure 4 below represents the choice between the standard and the innovative contract.
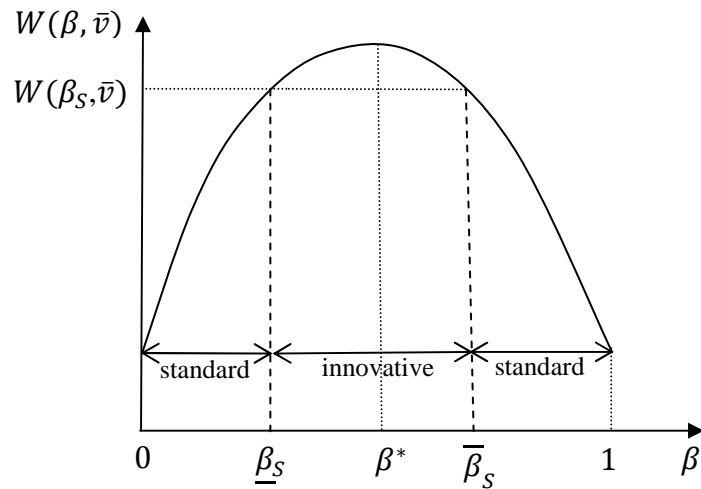
Figure 4: contract choice when $\beta_S \in (\overline{\beta}, \underline{\beta})$

Effects *i*) and *ii*) of Proposition 2 imply that standardization improves welfare at $t = 0$ by expanding the parties' contract space.[11] In particular, we have:

Corollary 2 *Standardization improves welfare at $t = 0$, the more so the more the distribution $h(\beta)$ is concentrated on levels of β close to 0 and 1.*

Standardization reduces the enforcement distortions caused by inequality among litigants. Its benefit is thus larger in societies where inequality is more severe. To visualize these effects, consider the quadratic-cost model of Example (1).

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[11] The choice of the common standard v_S can be endogeneized by specifying the objective function of the public (or private) body setting it. For instance, v_S could be set by majority voting among buyer-seller pairs at $t = 0$ (e.g. because the latter are members of a trade association). Since parties' preferences over the standard are single peaked, the standard is set by the median transaction. In the model of Corollary 2, the optimal threshold for $\bar{v}$ is $v_S = \bar{v}/2$. As a result, majority voting would set the median $\bar{v}$, namely $v_S = \bar{v}^m/2$ where $f(\bar{v}^m) = 1/2$.

Example (2) *When $C(e) = e^2/2$, the standard contract is used in transaction $(\beta, \bar{v})$ when β_S is sufficiently close to $1/2$ and β is sufficiently far from $1/2$.*

With quadratic cost, $\beta^* = 1/2$ for all transactions $\bar{v}$. The inflexibility of the standard is thus costliest when β_S is far from $1/2$. In this case, parties either use an innovative contract or do not contract at all. Figure 5 plots contracting under standardization.
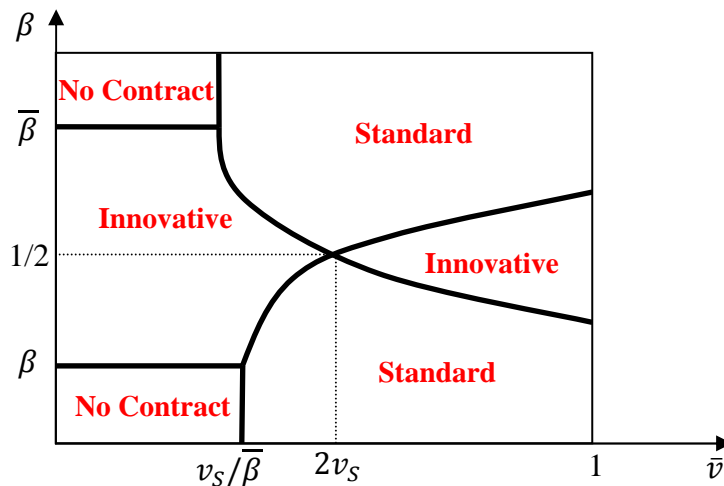
Figure 5: contracting when $C(e) = e^2/2$ and $\underline{\beta} < v_S < 1/2$

To see the role of the standard, superimpose Figure 5 to contracting under laissez faire (Figure 3). This yields Figure 6 below.
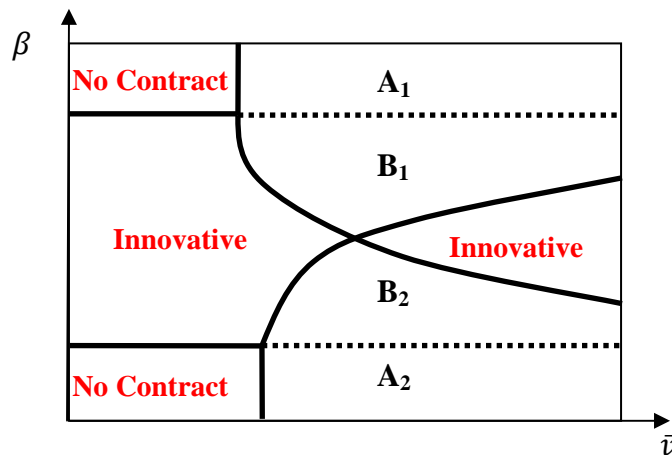
Figure 6: static effects of standardization

Standardization boosts the volume of trade in regions A_1 and A_2, while it crowds out innovative contracts in regions B_1 and B_2. We now move to the dynamic analysis.

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3. The Evolution of Precedents and Contracts

Law evolves through the litigation of innovative contracts. Thus, precedent creation depends on the unsettled signals presented by parties in court. We find:
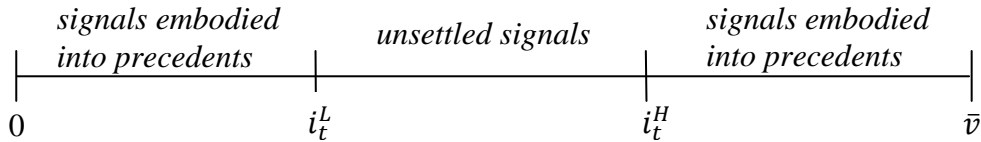
Lemma 6 *When litigating transaction $\bar{v}$, it is (weakly) optimal for B to collect unsettled signals carrying the lowest indices i and for S to collect the unsettled signals with the highest indices i. Thus, at any t there are two thresholds i_t^L and i_t^H, where $i_t^H \geq i_t^L$, such that the settled range for $\bar{v}$ is equal to $P_t \equiv [0, i_t^L] \cup [i_t^H, \bar{v}]$.*

Consider the contracting round at $t = 0$. In each litigation episode, the buyer presents low indexed signals. This is because the latter are more likely to take value zero, so they increase B's probability to win. The seller, by contrast, presents high indexed signals, as the latter are more likely to take value one.[12] Since in all disputes parties present the most extreme signals, the stock of precedents created at $t = 0$ across all litigations is populated by signals with high and low indices. As this process is iterated, the stock of precedents at $t > 0$ takes the form below.

| signals embodied into precedents | unsettled signals | signals embodied into precedents |

$0 \qquad\qquad i_t^L \qquad\qquad i_t^H \qquad\qquad \bar{v}$

Figure 7: Precedents at *t*

This structure of legal evolution captures the idea that, being a by product of litigation, precedents reflect more partisan than informative evidence.[13] We denote the measure $g_t = i_t^H - i_t^L$ of unsettled signals as the "incompleteness of the law" at t.

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[12] Collecting extreme signals is *strictly* optimal for parties if they do not (fully) knowing the realized v before choosing which signals to sample. In this case, collecting extreme signals minimizes the probability that some of them must be discarded because they are unfavorable.

[13] Since parties are short lived, they do not internalize the future benefit of presenting informative evidence in court. Even with long lived parties, though, this effect is very weak because judges pick signals at random, so they are unlikely to pick the most informative ones. More generally, all we need for our results is that litigants under-provide informative signals relative to the social optimum.

By Definition 1, precedents map the true index i of signals in $[0, i_t^L] \cup [i_t^H, \bar{v}]$ into a judicially attributed index $\hat{\imath}(i)$. Of course, since precedents are themselves set by uninformed judges, the mapping $\hat{\imath}(i)$ is most likely to be incorrect (i.e., $\hat{\imath}(i) \neq i$).

3.1 Contracting and Legal Evolution under Laissez Faire

At any $t > 0$, parties can write a delivery price contingent on the realization as well as on the indices $\hat{\imath}(i)$ of precedents. These indices are contractible because judges mechanically verify them. Parties can also contract on the realization of one unsettled signal (recall that judges cannot use more than one such signal at the time).

Denote by $\boldsymbol{s}^t \equiv \left(s_{\hat{\imath}(i)}\right)_{\hat{\imath}}$ the array of realizations of settled signals at t. A non-innovative contract for $\bar{v}$ specifies a delivery price $p(\boldsymbol{s}^t | \bar{v})$. Such contract is perfectly enforced because judges are trained to recognize the index $\hat{\imath}(i)$ of precedents. By contrast, an innovative contract specifies also a bonus $\Delta_t > 0$ contingent on the realization of an unsettled signal. This is again an open ended clause that depends on judicial assessments of the widget's quality. This distinction thus embodies a precise notion of what it means to "opt out" of the law: it means to contract on a contingency that is not yet embodied into precedents.

In principle, judges' ability to predictably enforce precedents can greatly improve contracts. Indeed, suppose that precedents reflect the true informational content of signals, namely $\hat{\imath}(i) = i$. Parties can then specify that if $s_{\hat{\imath}+\epsilon} = 1$ and $s_{\hat{\imath}-\epsilon} = 0$ (for ϵ close to zero) the judge should enforce $p(\boldsymbol{s}^t | \bar{v}) = \bar{v} - \hat{\imath}$. Since in this case, by Lemma 2, the true value of the widget is close to $\bar{v} - \hat{\imath}$, the first best is approximated arbitrarily well around $\bar{v} - \hat{\imath}$.

By repeating this logic for all signals in $P_t \equiv [0, i_t^L] \cup [i_t^H, \bar{v}]$, the contract effectively induces judges to enforce the first best price $p(v) = v$ for all $v \in [0, \underline{v}_t] \cup$

$[\overline{v}_t, \overline{v}]$. Here note that the set $[0, \underline{v}_t] \cup [\overline{v}_t, \overline{v}]$ is the settled range expressed in terms of widget values (rather than signals), where $\underline{v}_t \equiv \overline{v} - i_t^H$ and $\overline{v}_t \equiv \overline{v} - i_t^L$ are precedent-dependent thresholds. In the unsettled range $v \in (\underline{v}_t, \overline{v}_t)$, distortions in the enforcement of the bonus resurface.

Of course, the problem with the previous argument is that precedents do not reflect the true informational content of signals. As a result, the above contract cannot induce the first best in the settled range. Indeed, when $\hat{\imath}(i) \neq i$ the event $s_{\hat{\imath}+\epsilon} = 1$ and $s_{\hat{\imath}-\epsilon} = 0$ does *not* imply that the value of the widget is close to $\overline{v} - \hat{\imath}$. The inaccuracy of judicial rulings potentially prevents parties from benefitting from precedents. Consider now optimal contracting for any mapping $\hat{\imath}(i)$. We prove that:

Lemma 7 *Given* $P_t \equiv [0, i_t^L] \cup [i_t^H, \overline{v}]$, *and any precedent mapping* $\hat{\imath} : P_t \rightarrow [0, \overline{v}]$, *the optimal contract* $(p(\mathbf{s}^t | \overline{v}), \Delta_t)$ *for* $(\beta, \overline{v})$ *induces judges to enforce*:

i)   *The "first best" price* $p(v) = v$ *in* $v \in [0, \underline{v}_t] \cup [\overline{v}_t, \overline{v}]$.

ii)   *A base price* p_t *and a bonus* Δ_t *for* $v \in (\underline{v}_t, \overline{v}_t)$, *where the bonus is enforced if and only if* $v \geq \hat{v}_t \equiv \beta \overline{v}_t + (1 - \beta) \underline{v}_t$, *and where*:

$$p_t = \underline{v}_t + \beta \cdot \frac{\overline{v}_t - \underline{v}_t}{2}, \ \Delta_t = \frac{\overline{v}_t - \underline{v}_t}{2}. \qquad (14)$$

The optimal contract $(p(\mathbf{s}^t | \overline{v}), \Delta_t)$ is fully specified in the Appendix. As judges enforce it, they set a price schedule featuring two properties. First, it coincides with the first best price in the settled range $v \in [0, \underline{v}_t] \cup [\overline{v}_t, \overline{v}]$. Crucially, this is true even if precedents are incorrect. Because parties know the true event verified by each signal $\hat{\imath}(i)$, they associate an optimal price to it. In words, the optimal contract endogenously leads judges to correctly interpret precedents.[14] The intuition here is

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[14]Formally, the contract says that if parties present $s_{\hat{\imath}(i+\epsilon)} = 1$ and $s_{\hat{\imath}(i-\epsilon)} = 0$ (for ϵ close to zero) the judge should enforce a price of $\overline{v} - i$ rather than what is mechanically implied by precedents. Indices

that in contractual areas of law precedents are valuable even if incorrect. By creating predictable adjudication, they provide a reliable basis for contracting.

The second feature of the optimal contract is that it is innovative: in the range $v \in \left(\underline{v}_t, \overline{v}_t\right)$, it induces judges to enforce a base price p_t and a bonus $\Delta_t > 0$. The bonus is enforced provided S collects more unsettled signals than B. Just like at $t = 0$, the optimal base price p_t increases in B's litigation strength β while the optimal bonus Δ_t tracks the variation of the widget's value. When there are no precedents ($\underline{v}_t = 0, \overline{v}_t = \overline{v}$) Equation (14) boils down into the optimal contract at $t = 0$.

Regarding effort provision, in the settled range $v \in \left[0, \underline{v}_t\right] \cup \left[\overline{v}_t, \overline{v}\right]$ parties implement the first best, which is characterized by $C'(e) = v$. In the unsettled range $v \in \left(\underline{v}_t, \overline{v}_t\right)$, they implement two optimally chosen effort levels $(e_{l,t}, e_{h,t},)$.
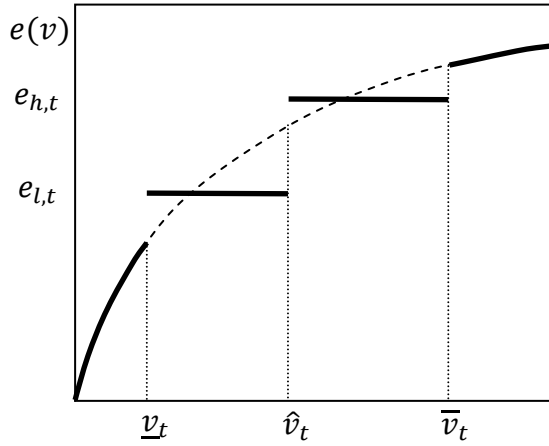
Figure 8: Effort provision under the optimal contract at t

In Figure 8, the dashed line identifies first best effort, the bold line effort under the optimal contract. The bonus is enforced less often when β and thus $\hat{v}_t$ is higher.

Denote social surplus at t by $W_t(\beta, \overline{v}, g_t)$. We then prove that:

Proposition 3 *If* $2C''(1) > C''(0)$, *for each $\overline{v}$ we have that, at any time t:*

î$(i + \epsilon)$ and î$(i - \epsilon)$ may be far from the truth, but the contract specifies a correct price upon their joint realization. If we view precedents as pinning down a "language" used by judges to call signals, the optimal contract translates the first best policy in the language of precedents.

i)   *There is an optimal value $\beta_t^* \in (0,1)$ of the buyer's relative strength at which surplus $W_t(\beta, \bar{v}, g_t)$ is maximized.*

ii)   *If $k > 1/8C''(0)$, there are two values $\overline{\beta}_t, \underline{\beta}_t$ such that parties contract if and only if $\beta \in \left(\underline{\beta}_t, \overline{\beta}_t\right)$.*

iii)   *As the law becomes complete, namely $g_t \to 0$, all parties contract – namely $\underline{\beta}_t \to 0$, $\overline{\beta}_t \to 1$ – and the first best is attained.*

Notwithstanding legal evolution, properties *i)* and *ii)* illustrate that strong inequality continues to reduce the welfare of contracting parties. Crucially, property *iii)* shows that legal evolution reduces the cost of inequality: as the law becomes complete, there are no distortions, all parties contract, and the first best is attained. The intuition is that under laissez faire legal evolution works as an endogenous standardization mechanism. This is shown by Figure 8, where the range over which effort differs from its first best level (i.e., where the dashed and solid lines differ) shrinks as g_t falls.

The case with quadratic cost allows for a nice closed form characterization:

Example (3) *When $C(e) = e^2/2$, we have that $e_h = (1/4)(2\bar{v} + (3 + \beta)g_t)$, $e_l = (1/2)(\bar{v} - (1 - \beta)g_t)$, and social welfare $W_t(\bar{v}, \beta, g_t) - \bar{v}^2 k$ is equal to:*

$$\bar{v}^2 \left[\frac{1}{6} - \frac{1 - 3\left(\frac{1}{2} + \frac{2\beta - 1}{2\bar{v}}g_t\right) + 3\left(\frac{1}{2} + \frac{2\beta - 1}{2\bar{v}}g_t\right)^2}{24} g_t^3 - k \right]. \qquad (15)$$

Optimal legal protection is perfectly balanced for all t, namely $\beta_t^* = 1/2$ for all $\bar{v}$ and t. In this case, $\underline{\beta}_t$ (resp. $\overline{\beta}_t$) monotonically falls (resp. increases) as g_t drops.

A useful property of quadratic costs is that optimal legal protection β_t^* is fixed at 1/2 for all t. This implies that the welfare of all contracting parties monotonically

increases with legal evolution (i.e., as g_t falls).[15] This renders the analytics of the quadratic cost case very tractable because it implies that the range over which parties write innovative contracts monotonically expands as precedents accumulate.

In particular, legal evolution increases welfare by exerting two effects. First, it reduces the size of the unsettled range, over which effort is distorted. This is captured by the term g_t^3 in square brackets. Second, in the unsettled range, lower g_t reduces the cost of inequality β. The fewer the unsettled signals, the smaller is the litigation advantage of strong parties. This is captured by the term g_t in round brackets.

To study the dynamics of contracts and welfare, we must derive the law of motion for precedent creation. We find:

Proposition 4 *For a given $\bar{v}$, the law's incompleteness evolves according to equation:*

$$\dot{g}_t = -(g_t/\bar{v}) \cdot \left[H(\bar{\beta}_t) - H\left(\underline{\beta}_t\right) \right], \qquad g_0 = \bar{v}. \qquad (16)$$

In Equation (16), $H(\cdot)$ is the c.d.f. of β. The creation of new precedents increases in: a) the total volume of innovative contracts signed $\left[H(\bar{\beta}_t) - H(\underline{\beta}_t) \right]$, and b) in the incompleteness g_t of the law. A higher volume of innovative contracts increases the use of unsettled signals, fostering their litigation and precedent creation. Accordingly, if a larger share $g_t/\bar{v}$ of signals are unsettled, the litigation of innovative contracts is more likely, which also boosts legal evolution.[16]

Propositions 3 and 4 highlight the possibility of a virtuous interaction between legal evolution and contracting. According to Proposition 3, legal evolution (i.e. lower g_t) induces more parties to write innovative contracts, fostering economic activity.

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[15] For a general $C(e)$, marginal reductions in g_t may not benefit *all* parties. Now an increase in $\underline{v}_t$ (or a drop in $\bar{v}_t$) may distort $\hat{v}_t$ away from optimal legal protection. This cost could more than offset the benefit of implementing the first best over a marginally wider range. It is still true, though, that large reductions in g_t will improve everybody's welfare, as the extreme case *iii)* of Proposition 3 shows.
[16] We are assuming that all litigants go to court. This is just a simplifying assumption. Our main results only require that in each period a fraction of the cases in (16) goes to court.

According to Proposition 4, on the other hand, contracting enhances legal evolution. This lowers legal uncertainty, rendering contracts more complete until the benchmark of complete contracts is reached in the long run. If at $t = 0$ some parties contract (i.e. $\left[H(\overline{\beta}_0) - H(\underline{\beta}_0)\right] > 0$), the unique steady state of Equation (16) is $g_\infty = 0$.

Besides improving effort provision, legal evolution reduces the welfare impact of inequality in litigation strength. To show this, Figure 10 reports social welfare in Equation (15) for different levels of β (we are sticking to the quadratic cost here).
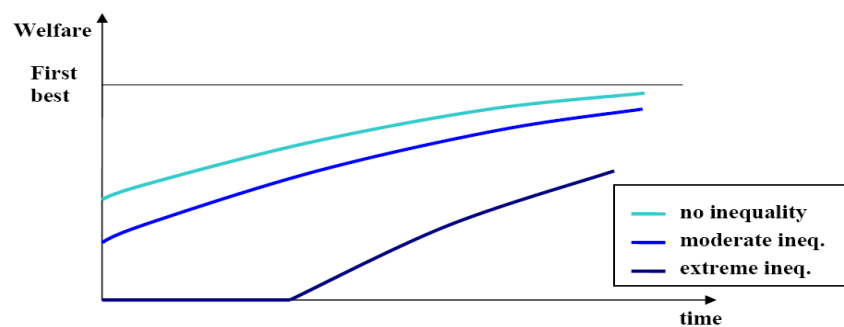
Figure 10: inequality and legal evolution for $C(e) = e^2/2$

Initially, very unequal parties do not contract, as shown by the dark blue line. As a result, they do not benefit from early stages of legal evolution. After some legal evolution has occurred, though, highly unequal parties start to contract. Eventually, everybody attains the first best, regardless of β.[17] This convergence may be slow, especially if inequality is large, for in this case only few parties are willing to contract.

3.2 Contracting and Legal Evolution under Standardization

Under standardization, parties can still use innovative contracts, whose litigation leads to precedent creation. Now, however, parties can also choose to use a standard contract. We consider two distinct forms of standardization:

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[17] Complete contracting is not attained in the long run if the transaction changes over time or precedents depreciate. If the rate of change/depreciation is not too high, there is a steady state legal uncertainty level. It is then still true that legal evolution progressively renders contracts more complete and allows parties to get closer to the first best. This analysis is available upon request.

a) The standard contract v_S is set at $t = 0$ and is not updated over time.

b) The standard contract v_S is set at $t = 0$ and is updated by including into it the new precedents created in every period.

In case b), standardization absorbs a main benefit of laissez faire: the progressive refinement of contracts (so that also the standard contract allows parties to attain the first best in the settled range). Proposition 5 holds under *both* cases a) and b).

The only simplifying restriction in the following analysis is that v_S is such that the standard is preferred to no contract at $t = 0$. We then prove:

Proposition 5 *If at $t = 0$ the standard v_S is introduced, then in transaction $\bar{v}$ at each $t \geq 0$ there are two thresholds $\overline{\beta}_{S,t}$ and $\underline{\beta}_{S,t}$, such that the innovative contract is used if and only if $\beta \in \left(\underline{\beta}_{S,t}, \overline{\beta}_{S,t} \right)$ and the standard is used otherwise. We then have:*

i) *Standardization hinders the use of the innovative contract, namely $\underline{\beta}_{S,t} \geq \underline{\beta}_t$ and $\overline{\beta}_{S,t} \leq \overline{\beta}_t$, at any t. This crowd out effect is particularly strong if the standard is updated over time (i.e., case b) above).*

ii) *At g_t, standardization slows down legal evolution, which fulfils:*

$$\dot{g}_t = -(g_t/\bar{v}) \cdot \left[H\left(\overline{\beta}_{S,t} \right) - H\left(\underline{\beta}_{S,t} \right) \right], \qquad g_0 = \bar{v}. \qquad (17)$$

Point i) confirms, for any given incompleteness g_t, that standardization boosts the volume of trade but crowds out contractual innovation. If the standard is time-invariant (case a)), it is especially used if the law is undeveloped. In fact, as precedents develop, innovative contracts become more and more refined relative to the fixed standard, so that parties switch to them. If instead the standard is updated with precedents (case b)), its use does not fall over time, and so the crowd out effect is equally strong at all levels of g_t.

This leads to the dynamic effect of point ii): by crowding out innovative contracts, standardization stifles precedent creation and legal evolution. Thus, there is a trade-off between the static and dynamic efficiency of standardization. Setting a statically efficient standard boosts crowding-out, hindering contractual innovation.

We study this possibility in detail for the case of quadratic effort cost, $C(e) = e^2/2$, which allows us to characterize the role of inequality. We find that:[18]

Proposition 6 *Suppose that the standard contract is introduced at time $t = 0$ and is updated over time. Then, there is a threshold $t^* \in R_+ \cup \{+\infty\}$ increasing in the variance of β such that social welfare at time t is higher under standardization than under laissez faire if and only if $t < t^*$. There is a value $v_S^* \in (\underline{\beta}, \bar{v}/2)$ such that for $v_S > v_S^*$ we have $0 < t^* < +\infty$.*

This result conveys two ideas. First, the benefit of standardization in terms of boosting the volume and efficiency of trade persists for some time. Under laissez faire, precedents result from the slow accumulation of narrow, little informative, signals. As a result, precedent creation does not effectively reduce enforcement risk in the short run. Standardization by contract is a more effective strategy because it coordinates judicial learning on a broader signal that is more informative than the evidence presented in court by litigants (at least provided v_S does not take very extreme values).

Second, under laissez faire legal evolution is faster than under standardization. This effect arises because the former regime fosters the use of innovative contracts. As a result, the benefit of standardization becomes smaller and smaller over time.

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[18] Similar effects, but also more complex algebra, arise if the standard contract is not updated.

Critically, the effect may be so strong that after some time welfare may be larger under laissez faire than standardization.[19] This is graphically represented below.
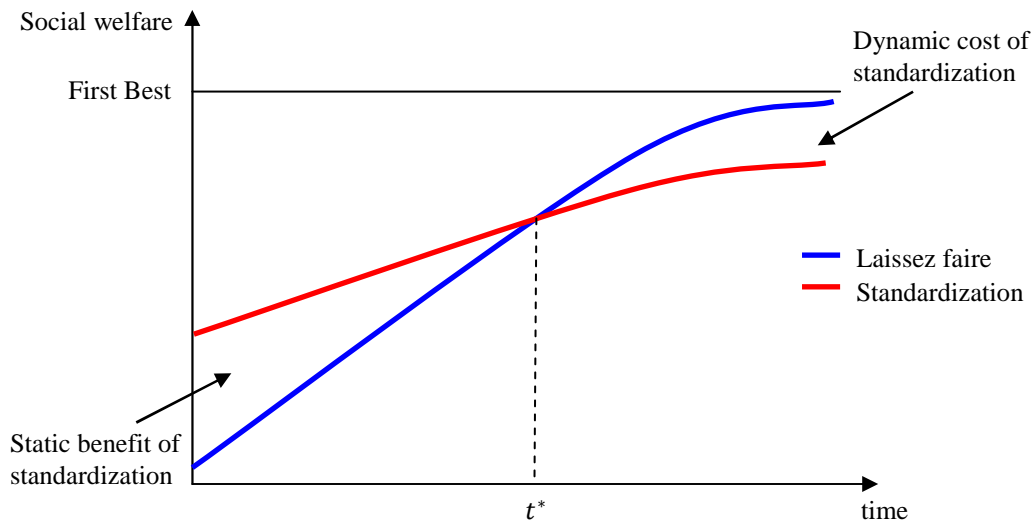
Figure 12: evolution of laissez faire and standardization

As a result, our model can generate a reversal in the performance of different legal regimes. Initially, welfare is lower under laissez faire. By boosting legal evolution, laissez faire eventually catches up, and it may even overtake standardization. In more unequal societies, standardization remains beneficial for a longer time (i.e., threshold t^* increases in the variance of β). There are two reasons for this. First, when inequality is higher there are fewer buyer-seller matches willing to use innovative contracts. The static benefit of introducing the standard is thus higher. Second, by reducing the volume of contracting under laissez faire, inequality also slows down precedent creation. This effect contributes to reduce the dynamic cost of standardization.

Interestingly, note that the cost of standardization does not rely on the assumption that the standard is time invariant. Somewhat paradoxically, when the standard is updated with precedents, it is even less profitable for parties to use

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[19] Thus standardization solves free riding among litigants ex-post (who do not want to bear the cost of showing informative signals) while laissez faire solves free riding among contracting pairs ex-ante.

innovative contracts, so that the crowding out effect is particularly strong. This result does not imply that standardization is welfare decreasing. Indeed, one can show that it is possible to find a standard v_S that improves discounted social welfare relative to laissez faire. The normative message of Proposition 6 is that, in setting a standard, one should strike a delicate balance between its static benefit and its dynamic cost. For example, setting in transaction $\bar{v}$ the statically efficient standard $v_S = \beta^* \bar{v}$ eliminates all contractual innovation, causing a large long run cost.

3.3. Discussion

Our model provides a tractable framework for analyzing how the volume and efficiency of contracts evolve via the mutual interaction of the legal and economic systems. This interaction is absent from existing models of legal evolution, which abstract from contracting (Gennaioli and Shleifer 2007, Ponzetto and Hernandez 2009) or do not consider the choice between standard and novel contracts (Anderlini et al. 2008). The model makes several predictions that could be tested empirically.

A broad prediction of our model is that the enforcement quality should be especially important for countries/regions plagued by inequality. Galeser et al. (2003) provide correlations consistent with this fact. Additionally, in these countries/regions legal standardization should be relatively more efficient. A first pass here would be to test if the relative performance of Common Law systems varies with social inequality. Although standardization has occurred in Common and Civil Law systems alike (see Section 5), Common Law systems are closer to the "ideal-type standardized" regime owing to their greater reliance on codes (see La Porta et al. 2008).[20]

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[20]Commercial statutes are also used in Common Law systems, but comparative legal scholars stress the greater scope of codification in Civil Law systems, due – among other things – to their greater reliance on precise bright line rules as opposed to standards. See Schlesinger et al. (1988).

Crucially, these broad predictions can also be scrutinized by using finer micro data. In the first place, our model implies that more unequal parties are ceteris paribus less likely to: i) contract with each other and, ii) use innovative contracts. This could be tested by looking at a specific market (e.g. venture capital), and the take up of new, *non standardized*, contracts (e.g. new financing arrangements) by parties depending on their wealth or education (see Lerner and Schoar 2005). This prediction could also be tested by looking at the diffusion of certain contract forms across countries characterized by different levels of inequality, enforcement quality and legal evolution. Kaplan et al. (2007) provides a useful starting point on this issue.

A second micro-prediction is that standardization of laws/contracts enhances the volume of contracting by facilitating trade among unequal parties. This could be tested by looking at episodes where certain contracts (e.g. housing mortgages) are standardized and by studying how their use depends on factors such as the parties' wealth and education. Another interesting testing ground is international transactions. In this domain, contracts among firms occur in the presence of substantial inequality, which reflects superior knowledge of local laws. And contract standardization has been progressively undertaken by international commercial arbitration tribunals.

The dynamic implications of the model can also be tested, particularly because several scholars are starting to construct measures of legal evolution and enforcement risk (Niblett et al. 2010, and Niblett 2009). Our model predicts that greater litigation should foster the creation of precedents and the use of more sophisticated contracts. Although there is scant systematic evidence, this prediction is consistent with Tufano (2003), who argues that the decisions of U.S. judges in the 19th century to reorganize failed railroad in spite of creditors' foreclosure rights was a key stimulus for the creation of new contracts such as contingent charge securities and voting trusts. As

stressed by Franks and Sussman (2005), litigation also played an important role in the development of floating charge financing, which is a widely used for of debt financing in many Common Law countries (Gennaioli and Rossi 2012).

The possibilities of reversals in the performance of standardized and laissez faire legal systems can also provide a useful perspective on the law and finance literature (La Porta et al. 2008). Our model suggests that a reversal from a superiority of Civil Law to that of Common Law (Rajan and Zingales, 2003) may be due to the relatively greater commercial codification of the former regimes. Codification may have jump started financial markets in the early 20th century but may have also stifled subsequent contractual experimentation, hindering financial development. This is confirmed by the greater documented use of innovative financial contracts involving a contingent allocation of control in Common Law systems (Lerner and Schoar 2005). At the same time, the slow reduction of enforcement uncertainty in Common Law and thus the cost of the latter regime is consistent with recent evidence on torts and contracts by Niblett et al. (2010) and Niblett (2009). An attempt to measure the role of adaptability and innovation in different legal systems has recently been made by Beck and Levine (2005).

Crucially, our model predicts that we should see a convergence in the performance of different legal systems, in light with Coffee's (2001) remark that there has been convergence in the U.S., French and Japanese legal systems. Thus, the law should be not so important in mature economies. Our model further suggests that the law should also play a small role in very poor economies, where markets are thin for the lack of highly profitable investment opportunities (i.e. $\bar{v}$ is low). The law will instead matter at intermediate levels of development, when skills and technologies are

available but their employment requires the presence of an infrastructure for predictably enforcing contracts and trade. These predictions await empirical scrutiny.

4 Extension: random litigation strength

We now show that our main results do not change when the litigation strength of B and S is realized in court at stage 2, after the contract is signed. As parties now do not know the direction of enforcement bias, it may be hard for parties to reduce distortions by way of an optimal ex ante contract.

To see this, suppose that the unsettled range is $(\underline{v}_t, \overline{v}_t)$, so that the bonus is enforced if $v \geq \hat{v}_t \equiv \beta \overline{v}_t + (1 - \beta)\underline{v}_t$. This implies that, if the widget's value is v, the seller expects the bonus to be enforced provided $\beta \leq \mu(v) \equiv (v - \underline{v}_t)/(\overline{v}_t - \underline{v}_t)$. Knowing that β is distributed with density $h(\beta)$, in state v the seller expects the bonus to be enforced with probability $H(\mu(v)) = \int_0^{\mu(v)} h(\beta)\, d\beta$. As a result, at time t, in state v, and under contract (p_t, Δ_t), the seller expects to receive the payment:

$$p_t + \Delta_t \cdot H(\mu(v)). \tag{18}$$

In contrast to Equation (4), the payment smoothly increases in v. If $h(\beta)$ is uniform, the function $H(\mu(v))$ is linear in v. In this special case, parties can set (p_t, Δ_t) such that $p_t + \Delta_t \cdot H(\mu(v)) = v$ for every v: the first best is attained despite imperfect enforcement. When however $H(\mu(v))$ is not linear in v, Equation (18) will be necessarily different from v, at least sometimes. In line with our previous analysis then, distorted enforcement creates welfare losses. In particular, since by A.1 the function $H(\mu(v))$ is increasing, convex for $\beta < 1/2$ and concave for $\beta \geq 1/2$, there are at most three points in $(\underline{v}_t, \overline{v}_t)$ where Equation (18) is equal to the true value v.

Characterizing the optimal (p_t, Δ_t) and welfare in this new model is beyond the scope of this paper. Some useful properties can however be gauged from Equation (18). If there is no bias in signal collection – formally $h(\beta)$ is concentrated on $\beta = 1/2$ – judges enforce the bonus if and only if $v \geq \bar{v}/2$, just as in Equation (4). When in contrast enforcement risk is so extreme that $h(\beta)$ is concentrated on $\beta = 0$ and $\beta = 1$, then judges always enforce a price of $p_t + \Delta_t/2$. In this case, the only enforceable price is fully non-contingent. The level of effort and welfare implemented in equilibrium is then identical to that of Section 2 when litigation strength is extreme.

In sum, a party's litigation advantage is shaped by random factors that realize in court ex-post (e.g. access to persuasive evidence, views of the judge) as in Gennaioli (2012), the results do not seem to substantially change from our previous analysis. When enforcement risk is strong, contingent contracts cannot be properly enforced. This creates effort under and over provision that destroys gains from trade. Also in this setup, legal evolution reduces the cost of enforcement risk by shrinking the unsettled interval $(\underline{v}_t, \overline{v}_t)$. The main difference with the previous setup is that, insofar as enforcement risk is the same for all parties, the model does not feature heterogeneity in enforcement distortions across different buyer-seller pairs.

5. Some Real World Episodes of Contract Standardization

This section presents some historical evidence corroborating our key idea that standard contracts and commercial codes can be viewed as ways to reduce legal uncertainty and thus to foster the creation of new markets. We mainly focus on standardization efforts undertaken in Common Law legal systems because these regimes are traditionally less codified than their Civil Law counterparts, permitting a better identification of the drivers of codification.

We are mainly interested in what is perhaps the largest movement toward commercial codification in modern history, the so called "golden age of commercial codification" (Gutteridge 1935), which occurred in the 19th century in the leading world economies and in some of their colonies. Many of these standardization episodes occurred in common law countries, involving mother countries such as Britain, British colonies such as India and later spreading to the U.S, which enacted uniform commercial legislations culminating in Llewellyn's Uniform Commercial Code. A similar U.S. reform undertaken for analogous reasons was the Sales of Goods Act of 1893 (Hilbert, 1920). The leading view of legal thinkers and legal historians in interpreting those events is precisely that codification of commercial law created a reliable basis for contracting and market development by harmonizing and standardizing sources and by facilitating an understanding of the law to both judges and the public (Diamond, 1968). Crucially, in historically more unequal societies codification was seen as providing the fundamental tool to eliminate en mass privileges and servitudes reflecting the traditional power of landowners, and encumbered the active use and transfer of assets necessary for trade and industry (e.g. Horwitz 1977). In this sense, the efficiency considerations highlighted by our model may have played some role in triggering these reforms as the 19th century was precisely a period of booming industry and long distance trade, where creating a reliable contractual infrastructure was crucial to foster the development of new markets. We now review two specific episodes of contract codification to see in detail the main drivers and instruments of standardization.

5.1 The Indian Codification of Contract Law

The English admirers of the French Code Civil, including Bentham and Lord Macaulay, believed that – by producing fairer and more reliable enforcement – standardization would encourage trade across the diverse peoples and nations of British colonies. Under their influence, the British Empire strictly codified criminal and contract law in India in the 19th century to overhaul a chaotic juridical situation. Under the original Law Charters of India, English, Muslim and Hindu residents were to be governed by their own laws in matters of contract. Soon there was broad dissatisfaction with this principle. Traditional laws differed across religions and casts, and had minimal tradition of supporting formal contracting, while common law had a residual role. Contractual litigation was seen as producing arbitrary resolutions, and made contracting very difficult. After a Penal Code based on a draft by Macaulay was enacted, its success led impulse to codify contract law.

The Indian Contract Act and the Evidence Act of 1872 imposed on Indian judges a strict statutory interpretation of contracts which took precedence on other sources of case law, including common, Hindu and Moslem law as well as local traditions. It stipulated general principles to define and resolve contractual conflicts, set explicit rules on supplying evidence to court, and provided templates in the form of "illustrations" to highlight how judicial decisions should be guided. The authors of the India Law Commission admitted that 'we have deemed it expedient to depart…. from English law in several particulars.' A main example was to encourage trade by eliminating excessive litigation arising from diverse sources of law. The Act simplified interpretation on specific issues relative to the more nuanced common law practice, such as in the area of contractual damages for non performance. In England, judges had discretion on determining whether contractual provisions represented

damages or penalties, which were enforced differently depending on circumstances. This required more extensive evidence gathering and legal argument.

The Indian Contract Act significantly simplified the enforcement of property transfers when a buyer in good faith acquired an asset from someone in possession who was not the legitimate owner (a form of *market ouvert*). Even if its adoption was not voluntary, the codification of Anglo-Hindu law was warmly received in India as a more rational system of law (Derret, 1968). Codes drawn from the Indian Contract Act were subsequently introduced in East Africa and other colonies.

Consistent with our model, contract standardization in India can be seen as an attempt to reduce legal uncertainty arising from conflicting laws and insufficient jurisprudence. Interestingly, the Indian Negotiable Instruments Act preceded the equivalent British Bills of Exchange Act (Encyclopedia Britannica, 1911). One possible explanation for this timing is that the greater inequality as well as lower judicial expertise prevailing in India made standardization more urgent there.

5.2 The Bills of Exchange Act of 1882

The Bills of Exchange Act of 1882, "codifies the greater portion of the common law relating to Bills of Exchange, Cheques, and Promissory Notes". Before this code, English law relative to bills of exchange, promissory notes and cheques was to be found in 17 statutes dealing with specific issues, and about 2600 cases scattered over some 300 volumes of reports. This codification remarkably simplified the law and reduced its ambiguity, and was certainly supportive of the diffusion of financial contracting (Diamond, 1968). The code also created template contracts which could be voluntarily chosen over general contracting under common law.

The extensive commentary to the Act allows some insight in identifying its effect on the common law contracting rules. In the British version the authors went at excruciating pain to restate the supremacy of the common law: *The rules of the common law, including the law merchant,* **save in so far as they are inconsistent with the express provisions of this Act**, *shall continue to apply..* Yet they also clearly indicated that *where a rule is laid out in express terms (in the Act)... the general (i.e. common law) rule ought not to be applied in ..limiting its effect...*

A clear case of innovation relative to common law practice is mentioned in the commentary to the Act and refers to §29(2), the case when under common law "a signature to a bill obtained by force and fear is valueless even in the hand of an innocent third part". In contrast, the Act established that any promissory note conform to the Act held by an acquirer in good faith is always valid independently from any irregularity in intermediate endorsements of the bill. Basically, this ensured entitlement by any holder, independently from the legitimacy of all previous transfers. Another innovation of the Act is that it establishes the default rule that each bill of exchange is negotiable unless explicitly excluded by the text, while before negotiability had to be explicitly included in the text. The spirit of the Bill of Exchange Act is thus also consistent with the notion that contract standardization ensured access to justice and more reliable enforcement by reducing the uncertainties involved in contract litigation.

6. Conclusions

We study the causes and consequences of commercial codification. We have shown that a strict codification of the enforcement of specific contracts may contribute to a legal orientation which becomes rigid and formalistic, and suppresses

contractual innovation (Beck and Levine, 2005). Contrasts between local law and a rigidly codified doctrine may hinder the development and enforcement of contract law and practice. However, some degree of standardization preserving a general freedom of contract is beneficial in terms of expansion in the scale of transacting, as the global move toward codification that occurred in the 19th century seems to suggest.

To ensure analytical tractability, we offered a stylized representation of the law; a richer characterization of legal aspects is thus a natural direction for future work. One interesting application of our setup concerns the optimal pace of standardization. Our analysis suggests that two principles may be part of an optimal legal standardization strategy. First, standardization should not only simplify and formalize local arrangements but also coordinate private sector players toward novel and mutually beneficial contract terms. Second, in order not to stifle contractual innovation prematurely, standardization might occur after market experimentation has already created a reliable set of contracts. Thus, one key role of standardization is also to extend the use of local, contractual innovations to a broader merchant community. This latter idea can help explain why the response of codification to economic changes tends to come with a lag relative to private arrangements.

More generally, we believe that the broad message of our model as well as of the experience of the "golden age of commercial codification" holds some relevance for the effort of many developing countries to strengthen their capacity for contract enforcement in light of endemic inequality and legal uncertainty. It may justify an approach to create standardized templates with narrowly defined enforcement to enhance trade opportunities and encourage contracting among strangers. This is a necessary mechanism for the emergence of an advanced division of labor and product specialization, and for the diffusion of tradable securities.

7. Appendix

Proof of Lemma 1 At $\bar{v}$, the transaction is socially valuable provided $W(\bar{v}) \geq \bar{v}^2 k$. By multiplying the two sides of the inequality by $\bar{v}$, this condition can be written as:

$$\int_0^{\bar{v}} \left[e_{fb}(v) \cdot v - C\left(e_{fb}(v)\right) \right] dv \geq \bar{v}^3 k.$$

At $\bar{v} = 0$, the condition holds with equality. The left hand side increases in $\bar{v}$. Its first derivative is equal to $e_{fb}(\bar{v}) \cdot \bar{v} - C\left(e_{fb}(\bar{v})\right)$, its second derivative is equal to $e_{fb}(\bar{v})$, and its third derivative is equal to $e'_{fb}(\bar{v}) = 1/C''(e_{fb}(\bar{v}))$ (by Equation (1)). The first, second, and third derivatives of the right hand side are equal to $3\bar{v}^2 k$, $6\bar{v}k$ and $6k$, respectively. The first and second derivatives of the left and right hand sides are equal to zero at $\bar{v} = 0$. Thus, a sufficient condition for the left hand side to always be above the right hand side is that the third derivative of the former be above that of the latter. In light of our assumption $C'''(e) \leq 0$, this requires $k < 1/6C''(0)$.

Proof of Lemma 3 Given the assumed contest success function, the seller presents all the signals he can collect taking value one, namely $n_1 = (1 - \beta) \cdot v$, while the buyer presents all the signals he can collect taking value zero, namely $n_0 = \beta(\bar{v} - v)$. As a result, $n_1 \geq n_0$ if and only if $v \geq \beta\bar{v}$. Suppose now that the judge is Bayesian and tries to de-bias signal collection. Then, he assesses – by taking the distribution of β into account – the probability that objective facts side more with S than B, namely that $v \geq \bar{v}/2$. Absent inequality, this is the case when $n_1 \geq n_0$. This is equivalent to the judge guessing the realization of the most informative signal $i = \bar{v}/2$. Because the judge knows that parties have the incentive to present all available signals, he infers that $n_1/n_0 = (1 - \beta) \cdot v/\beta(\bar{v} - v)$. The judge then infers that v satisfies:

$$v = \bar{v} \cdot n_1 \cdot \beta/[n_0(1 - \beta) + n_1\beta].$$

In the above equation, $v \geq \bar{v}/2$ if and only if $n_1 \cdot \beta \geq n_0(1 - \beta)$, so that:

$$Pr[v \geq \bar{v}/2] = Pr[\beta \geq n_0/(n_0 + n_1)] = \int_{n_0/(n_0+n_1)}^{1} \beta h(\beta) d\beta \, .$$

As the judge minimizes the probability of error, he rules for S if and only if $Pr[v \geq \bar{v}/2] > 1/2$. Given the symmetry of $h(\beta)$, this is the case when:

$$n_1 \geq n_0,$$

Namely he awards the case to the party presenting more evidence, as in Equation (4).

Proof of Proposition 1 Social surplus is proportional to:

$$W(\bar{v}, \beta) \propto \beta \left[e_l \cdot \beta \frac{\bar{v}}{2} - C(e_l) \right] + (1 - \beta) \left[e_h \cdot (1 + \beta) \frac{\bar{v}}{2} - C(e_h) \right].$$

Exploiting Equation (7), one can find that:

$$\frac{dW(\bar{v}, \beta)}{d\beta} = [C(e_h) - C(e_l)] - \beta \cdot \bar{v}(e_h - e_l).$$

The above derivative is positive at $\beta = 0$. It is also negative at $\beta = 1$, because $C(e_h) - C(e_l) = \int_{e_l}^{e_h} C'(x)dx < C'(e_h)(e_h - e_l)$, and because at $\beta = 1$ we have that $C'(e_h)(e_h - e_l) = \bar{v}(e_h - e_l)$. As a result, there is a unique β^* maximizing $W(\bar{v}, \beta)$ provided the above equation decreases in β (i.e. surplus is concave). This requires:

$$\frac{d^2 W(\bar{v}, \beta)}{d\beta^2} \propto \frac{de_h}{d\beta} - \beta \left[\frac{de_h}{d\beta} - \frac{de_l}{d\beta} \right] - 2(e_h - e_l) \leq 0.$$

Given that $C'''(e) \leq 0$, the term in square bracket is positive. A sufficient condition for concavity is then that the algebraic sum of the first and last term is negative. Given that $\frac{de_h}{d\beta} = \frac{\bar{v}}{2C''(e_h)} > 0$, a sufficient condition for this is:

$$4C''(e_h)(e_h - e_l) > \bar{v}.$$

If $2C''(e_h) > C''(e_l)$, which is satisfied if $2C''(1) > C''(0)$, the left hand side is larger than $2[C'(e_h) - C'(e_l)] = \bar{v}$. As a result, $2C''(1) > C''(0)$ ensures concavity.

Concavity then guarantees the existence of a maximum $\beta^* \in (0,1)$ fulfilling:

$$\frac{dW(\bar{v}, \beta^*)}{d\beta} = 0.$$

It is easy to check that $\frac{dW(\bar{v}, \beta^*)}{d\beta d\bar{v}} < 0$, which implies that β^* decreases in $\bar{v}$.

Consider parties' decision of whether to contract or not. Parties choose to contract whenever $W(\bar{v}, \beta) - \bar{v}^2 k \geq 0$. Given the previous analysis, a sufficient condition for parties to always contract is $W(\bar{v}, 0) - \bar{v}^2 k \geq 0$. Both the first and second term of this latter inequality are increasing and convex functions of $\bar{v}$, and their levels as well as first derivatives are equal to zero at $\bar{v} = 0$. Their second derivatives are respectively equal to $d^2 W(\bar{v}, 0)/d\bar{v}^2 = 1/4C''(e(\bar{v}))$ and $2k$. The second derivative of $W(\bar{v}, 0)$ is everywhere above that of $\bar{v}^2 k$ precisely when $k \leq 1/8C''(0)$, which therefore suffices to ensure that parties will always contract.

When instead $k > 1/8C''(0)$ then, for at least low levels of $\bar{v}$ parties do not contract for $\beta = 0,1$. For $k > 1/8C''(1)$ parties never contract (i.e. for any $\bar{v}$) at extreme values of β. In all of these cases, the concavity of $W(\bar{v}, \beta)$ implies the existence of the two thresholds $(\underline{\beta}, \overline{\beta})$, where we set $\underline{\beta} = \overline{\beta}$ when $W(\bar{v}, \beta^*) - \bar{v}^2 k < 0$.

Proof of Corollary 1. See proof of Proposition 1. Note that $\beta^* < 1/2$ simply requires that $\frac{dW(\bar{v}, 1/2)}{d\beta} < 0$, which is the inequality in the text of Corollary 1.

Proof of Example (1). Straightforward algebra.

Proof of Proposition 2 If $\beta_S \notin (\underline{\beta}, \overline{\beta})$, the standard is more biased that the maximum tolerable inequality, so parties to transaction $\bar{v}$ do not use it. Here the standard is irrelevant for transaction $\bar{v}$. If instead $\beta_S \in (\underline{\beta}, \overline{\beta})$, the standard is used in a buyer-seller pair $(\bar{v}, \beta)$ provided $W(\bar{v}, \beta_S) \geq W(\bar{v}, \beta)$. The condition $W(\bar{v}, \beta_S) - \bar{v}^2 k \geq 0$ is guaranteed by $\beta_S \in (\underline{\beta}, \overline{\beta})$. Thus, when $\beta_S \in (\underline{\beta}, \overline{\beta})$, all parties to transaction $\bar{v}$ will contract, regardless of their inequality. If instead $W(\bar{v}, \beta_S) < W(\bar{v}, \beta)$ parties use the innovative contract. By the same arguments made in the proof of Proposition 1, the condition for using the innovative contract becomes stricter than the one prevailing in the absence of the standard, as detailed in point ii) of Proposition 2.

Proof of Corollary 2 When $\beta_S \notin (\underline{\beta}, \overline{\beta})$, the standard is never used in transaction $\bar{v}$ and there is no welfare gain associated with standardization. When instead $\beta_S \in (\underline{\beta}, \overline{\beta})$, the standard is used in transaction $\bar{v}$ by at least some parties and the gain relative to laissez faire is equal to:

$$\int_{\beta \in [0, \underline{\beta}) \cup (\overline{\beta}, 1]} [W(\bar{v}, \beta_S) - \bar{v}^2 k] h(\beta) d\beta +$$

$$\int_{\beta \in [\underline{\beta}, \beta_S) \cup (\overline{\beta}_S, \overline{\beta}]} [W(\bar{v}, \beta_S) - W(\bar{v}, \beta)] h(\beta) d\beta,$$

The first integral captures the benefit of allowing very unequal parties to contract with each other, while the second integral captures the benefit of allowing moderately

unequal parties to use a better contract. Because the integrand of the second integral is bounded above by $W(\bar{v}, \beta_S) - \bar{v}^2 k$ (this is by the definition of the two thresholds $\underline{\beta}$ and $\overline{\beta}$), increasing the probability density $h(\beta)$ attached to the first integral unambiguously increases the benefit of standardization. Intuitively, standardization benefits unequal parties, and mostly so when inequality is so large that parties would not contract at all under laissez faire. This logic holds for all possible values of $\bar{v}$.

Proof of Example (2). We sketch the working of this example and show how Figure 5 is built. By applying Proposition 2 to this quadratic cost case, one can find that if $\beta \geq v_S / \bar{v}$ the standard is preferred to the novel contract if it is also the case that $\beta \geq 1 - v_S / \bar{v}$. If instead $\beta < v_S / \bar{v}$, the standard is preferred to the novel contract if it is also the case that $\beta < 1 - v_S / \bar{v}$. The standard contract is preferred to no contract at all for $\bar{v} \in \left[v_S / \underline{\beta}, v_S / \overline{\beta} \right]$. It is then easy to construct Figure 5 under the maintained assumption that $\underline{\beta} < v_S < 1/2$.

Proof of Lemma 6. For convenience, we prove this in the Proof of Proposition 4.

Proof of Lemma 7. Given $\underline{v}_t, \overline{v}_t$, and the precedent mapping $\hat{\imath}(i)$, the parties specify the following contract terms for the settled and unsettled range.

For all $i \in P_t$, and for arbitrarily small $\epsilon > 0$, set $p(s^t) = \bar{v} - i$ if and only if $s_{\hat{\imath}(i+\epsilon)} = 1$ and $s_{\hat{\imath}(i-\epsilon)} = 0$. If we have that $s_{\hat{\imath}(i_t^H)} = 1$ and $s_{\hat{\imath}(i_t^L)} = 0$, then we are in the unsettled range. In this case, the price schedule can include an open ended term that effectively makes the contract contingent on one unsettled signals, which we denote by u. The judge can thus enforce a base price $p(s^t, B) = p_t$ if he rules for the buyer or a base price plus a bonus $p(s^t, S) = p_t + \Delta_t$ if he rules for the seller.

In analogy with our previous analysis at $t = 0$, when litigating in the unsettled range $v \in (\underline{v}_t, \overline{v}_t)$ at a widget value of v, the seller presents $n_1 = (1 - \beta)(v - \underline{v}_t)$ signals taking value one. The buyer presents $n_0 = \beta(\overline{v}_t - v)$ signals taking value zero. As a result, the bonus Δ_t is enforced if and only if $v \geq \hat{v}_t \equiv \beta \overline{v}_t + (1 - \beta)\underline{v}_t$. By applying the same logic of Equation (5) to the settled range and to the threshold $\hat{v}_t$, one finds that the optimal base price and bonus at t are those in Equation (14).

Proof of Proposition 3 Social surplus at time t is equal to:

$$W(\bar{v}, \beta, g_t) = \int_{v \in [0, \underline{v}_t) \cup (\overline{v}_t, \bar{v}]} \left[e_{fb}(v) v - C(e_{fb}(v)) \right] \frac{dv}{\bar{v}} + (\hat{v}_t$$
$$- \underline{v}_t) \left[e_l \cdot \frac{\underline{v}_t + \hat{v}_t}{2} - C(e_l) \right] + (\overline{v}_t - \hat{v}_t) \left[e_h \cdot \frac{\overline{v}_t + \hat{v}_t}{2} - C(e_h) \right].$$

By deriving the above equation with respect to $\underline{v}_t$ and $\overline{v}_t$ one can see that legal evolution (an increase in $\underline{v}_t$ or a decrease in $\overline{v}_t$) increases welfare by increasing the first integral but may decrease welfare by changing the location of $\hat{v}_t$. When legal evolution leaves $\hat{v}_t$ unaffected (formally when $\underline{v}_t$ increases by $d\underline{v}_t$ and $\overline{v}_t$ decreases by $d\overline{v}_t = -d\underline{v}_t(1 - \beta)/\beta$), then welfare unambiguously goes up.

Social welfare $W(\bar{v}, \beta, g_t)$ varies with β according to the formula:

$$\frac{dW(\bar{v}, \beta, g_t)}{d\beta} \propto [C(e_h) - C(e_l)] - \hat{v}_t(e_h - e_l).$$

As in the proof of Proposition 1, the above equation is positive at $\beta = 0$ and negative at $\beta = 1$. As a result, there is a unique β_t^* maximizing $W(\bar{v}, \beta)$, provided the above equation decreases in β (i.e., surplus is concave). Recall that concavity requires:

$$\frac{d^2 W(\bar{v}, \beta)}{d\beta^2} \propto \frac{de_h}{d\beta} - \beta \left[\frac{de_h}{d\beta} - \frac{de_l}{d\beta} \right] - 2(e_h - e_l) \leq 0.$$

Given that $C'''(e) \leq 0$, the term in square bracket is positive. As a result, a sufficient condition for concavity is that the algebraic sum of the first and last term are negative. Given that $\frac{de_h}{d\beta} = \frac{\bar{v}_t - \underline{v}_t}{2C''(e_h)} > 0$, a sufficient condition for this is:

$$4C''(e_h)(e_h - e_l) > (\bar{v}_t - \underline{v}_t).$$

If $2C''(e_h) > C''(e_l)$, which is in necessarily satisfied if $2C''(1) > C''(0)$, the left hand side above is larger than $2[C'(e_h) - C'(e_l)] = (\bar{v}_t - \underline{v}_t)$. If $2C''(1) > C''(0)$, concavity is satisfied. Given concavity, it is immediate to prove the existence of the thresholds of point ii). Concerning point iii), note that as the law becomes complete, the second and third integrals in $W(\bar{v}, \beta, g_t)$ and welfare converges to the first best.

Proof of Example (3). Finding the analytic formulas only requires some straightforward algebra. There are two additional things to note. First, the proof uses the fact that, as we will see when proving Proposition 4, we have $\underline{v}_t = \bar{v} - \bar{v}_t$. As a result, we can write $\hat{v}_t = \bar{v}/2 + (\beta - 1/2)g_t$. Second, the range of contracting monotonically expands as g_t falls because in this quadratic cost example greater legal completeness monotonically reduces $W_t(\bar{v}, \beta, g_t)$.

Proof of Proposition 4 and Lemma 7. Each litigation episodes involves the creation of one new precedent using one unsettled signal collected by parties. As a result, for a given $\bar{v}$ the maximal potential accumulation of signals by winning buyers is equal to the number of disputes where the true v is below $\hat{v}_t$, averaged across all the value of β in the population of contracting parties. Denoting by B_t the number of precedents potentially created by winning buyers at t, we thus have that:

$$B_t = \int_{\underline{\beta}_t}^{\bar{\beta}_t} \int_{\underline{v}_t}^{\hat{v}_t} h(\beta) \frac{dv}{v} d\beta \,.$$

Accordingly, the measure S_t of new precedents potentially created by winning sellers is equal to:

$$S_t = \int_{\underline{\beta}_t}^{\bar{\beta}_t} \int_{\hat{v}_t}^{\bar{v}_t} h(\beta) \frac{dv}{v} d\beta$$

In an instant of time dt, we assume that not all transactions have time to be litigated (or to lead to precedent creation), so that buyers create only dtB_t precedents while sellers create only dtS_t precedents. As buyers pick unsettled signals with low index, we have that at each t, $di_t^L = -d\bar{v}_t = dtB_t$. As sellers pick unsettled signals with high index, we have that at each time t, $di_t^H = d\underline{v}_t = dtB_t$. This process gives rise to Figure 7. The total measure of precedent created in instant dt, is then equal to:

$$dg_t = -(d\underline{v}_t - d\bar{v}_t) = -(B_t + S_t)dt$$

Because:

$$B_t + S_t = \int_{\underline{\beta}_t}^{\bar{\beta}_t} \int_{\underline{v}_t}^{\bar{v}_t} h(\beta) \frac{dv}{v} d\beta = \left[H(\bar{\beta}_t) - H(\underline{\beta}_t) \right] \frac{(\bar{v}_t - \underline{v}_t)}{v}$$

which yields the law of motion in the text.

Proof of Proposition 5 Straightforward in light of Propositions 1, 2 and 3. The only slight complication is to consider cases a) and b). When the standard is updated, with precedent, at any t social welfare under the standard is identical to $W(\bar{v}, \beta, g_t)$

evaluated at $\beta = \beta_S$. When the standard is not updated, social welfare under the standard is time invariant and equal to $W(\bar{v}, \beta_S)$.

Proof of Proposition 6. Since welfare is multiplicative in $\bar{v}$, we carry out our analysis only for the case $\bar{v} = 1$, but the analysis is valid for any given transaction $\bar{v}$. Suppose that at time $s > 0$ legal evolution under laissez faire has reached level $g^* \equiv (4 - 24k)^{1/3}$. This is the level at which all parties write an innovative contract regardless of their inequality β. From now on, legal evolution under laissez faire follows $dg_t/dt = -g_t$. Thus, expression (16) implies that at any $t > s$ aggregate social welfare under laissez faire is equal to:

$$W_t^{LF} = \frac{1}{6} - k - g^* \frac{e^{-3(t-s)}}{24} \int_0^1 (1 - 3\beta + 3\beta^2) dH(\beta)$$

Under standardization, legal evolution is $dg_t/dt = -g_t[F(1-v_S) - F(v_S)]$. Thus, since the non-standard contract is used by a measure $\varphi \equiv F(1-v_S) - F(v_S)$ of parties we find that:

$$W_t^S \leq \frac{1}{6} - k - g^* \frac{e^{-3\varphi(t-s)}}{24} \left[(1-\varphi)(1 - 3v_S + 3v_S^2) + \int_{v_S}^{1-v_S} (1 - 3\beta + 3\beta^2) dH(\beta) \right]$$

The inequality is due to the fact that legal evolution under standardization is slower than under laissez faire, so in the former regime $g_s < g^*$. Using the two expressions above, it is easy to find that at time t>s social welfare is higher under laissez faire if:

$$3(1-\varphi)(t-s) \geq \ln \frac{\int_0^1 (1 - 3\beta + 3\beta^2) dH(\beta)}{(1-\varphi)(1 - 3v_S + 3v_S^2) + \int_{v_S}^{1-v_S} (1 - 3\beta + 3\beta^2) dH(\beta)} \equiv h(v_S)$$

The above condition is only valid for t $< -$ (1/2φ)ln(1-2v_S): beyond this time social welfare under standardization grows at the same rate as under laissez faire. By using these conditions we obtain that laissez faire dominates standardization if:

$$3(1-\varphi) \left[-\frac{1}{2\varphi} \ln(1 - 2v_S) - s \right] \geq \ln \frac{\int_0^1 (1 - 3\beta + 3\beta^2) dH(\beta)}{(1-\varphi)(1 - 3v_S + 3v_S^2) + \int_{v_S}^{1-v_S} (1 - 3\beta + 3\beta^2) dH(\beta)} \equiv h(v_S)$$

Using the definition of φ (i.e. its dependence on v_S), one finds that that the left hand side increases from 0 to $+\infty$ as v_S goes from 0 to 1/2. By contrast, the right hand side decreases from 1 to less than 1 as v_S goes from 0 to ½ (to $\bar{v}/2$ for $\bar{v} \neq 1$). Thus, there is a $v_S^* < 1/2$ ($v_S^* < \bar{v}/2$ for $\bar{v} \neq 1$) such that, for $v_S > v_S^*$ the above inequality holds. This implies the existence of threshold $t^* > 0$ as stated in the proposition. It is immediate to see that greater social inequality [i.e. greater Var(β)] increases the value of t^* by increasing the value of the right hand side above.

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