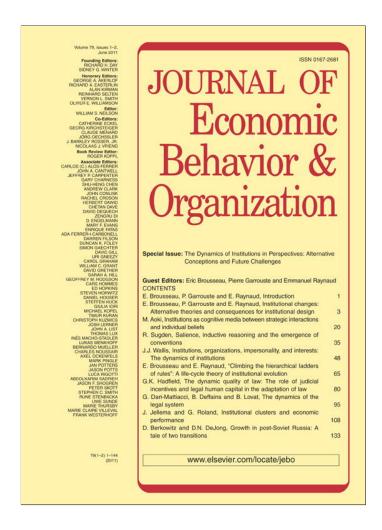2010

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The dynamic quality of law: The role of judicial incentives and legal human capital in the adaptation of law

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ABSTRACT

In this paper I show that the capacity for a legal regime to generate value-enhancing legal adaptation to local and changing conditions through adjudication depends on its capacity to generate and implement adequate expertise about the environment in which law is applied (*shared legal human capital*). I present a model in which welfare-promoting adaptation of legal rules depends on the incentives of both judges (to risk rule change) and litigants (to bear the cost associated with informing the court about novel features of the environment and alternative rules.) I demonstrate that a legal system will not adapt through adjudication if legal costs relative to damages are either too high or too low, if judicial incentives for change are inadequate or if judicial error rates are initially too high. Comparatively, I show that a legal regime is likely to do better with improved mechanisms for processing information system-wide to reduce judicial error and lower absolute legal costs, but that other apparently beneficial institutional features such as lower relative legal costs, judges who are more willing to adapt law or who make fewer initial errors may or may not lead to lower welfare overall.

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1. Introduction

Positive economic analysis of the evolution of law has, since Posner (1977), been organized around the claim that the value of the common law is its ability to work out, over time, efficient legal rules. Some authors have rested this claim on the premise that common law judges inherently seek efficiency; often this literature has framed the analysis as an investigation of the different incentives influencing parties interacting with courts and legislatures and as a debate about whether judges or legislators are more susceptible to rent-seeking (Posner, 1977; Rubin, 1982; Tullock, 1980). Gennaioli and Shleifer (2007) focus on the impact of judicial bias on the capacity of common law to evolve to efficiency. Other authors have rested predictions about the likelihood that the common law will evolve to efficiency on the incentives of litigants to continue challenging inefficient rules (Rubin, 1977; Priest, 1977; Goodman, 1978; Cooter et al., 1979). Despite differences, these models of the evolution of the common law all share a common recognition that courts do not start out with the right rules. Rather, they move towards them, if at all, only as a product of their interaction with litigants.

With few exceptions (Hadfield, 1992; Talley, 1999; Hylton, 2006), however, the literature on the evolution of common law has not analyzed the process of information acquisition and learning in courts. Similarly, the recent literature comparing the economic effects of common law and civil code regimes has emphasized differences in agency but not learning

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relationships (Glaeser and Shleifer, 2002; Mahoney, 2001). Where information acquisition has been emphasized, it has been in a static rather than dynamic setting. Early work comparing rules and standards (Diver, 1983; Rose, 1988; Kaplow, 1992) and more recent work comparing judicial discretion to rulemaking in legislatures (Shavell, 2007; Anderlini et al., 2008) compares efficiency when a rule is determined in light of ex ante versus ex post information. The strategic revelation literature (Milgrom and Roberts, 1986; Shin, 1994, 1998; Dewatripont and Tirole, 1999; Daughety and Reinganum, 2000) analyzes information acquisition by courts in the context of the efficient application of fixed rules in a static environment.

In this paper I develop a model to explore the dynamic relationship between the institutional attributes of a legal regime and the regime's capacity to learn about and adapt to welfare-relevant changes in the environment. I focus in particular on adaptation through adjudication on the premise that in any legal regime there is welfare-relevant information that is known initially only to those involved in a regulated activity and that rule enforcers (judges) need to know in order to adapt the interpretation and application of legal rules to a changed set of circumstances. The model thus does not evaluate the broader tradeoff between adaptation through a legislature versus adaptation through enforcement institutions such as courts, the question raised by the legal origins literature (La Porta et al., 1997, 1998, 2004; Mahoney, 2001; Djankov et al., 2002, 2003; Botero et al., 2004), which identifies an empirical relationship between economic variables and legal families broadly identified as those rooted in civil law (French, German, Scandinavian) and common law (English). Rather it presumes that some adaptation through courts is both necessary and unavoidable (in any legal regime, including civil code regimes, adaptation comes about not only through overt rule change but also through rule interpretation and judgments about how to apply rules in concrete circumstances) and evaluates the impact of institutional features on the likelihood that welfare-promoting adaptation occurs through this process.

The model focuses on the accumulation of *shared legal human capital* across judges in a legal regime. Shared legal human capital determines the likelihood that judges make mistakes in adapting an existing rule to novel conditions. I demonstrate that the capacity for a legal regime to adapt its legal rules in a welfare-improving direction over time is a function of the interaction of the incentives of judges and litigants.

In particular, I show that for any legal adaptation to occur there must be some judges who face sufficient rewards for rule adaptation to warrant the risk of making errors and litigants must be willing to invest in developing and presenting costly evidence and legal argument in light of the fact that judges make errors in the use of this information. If the risk of judicial error is too high initially, one or both of these conditions may not hold and the legal regime may remain mired at a sub-optimal legal rule with no error-reducing accumulation of legal human capital. More generally, the capacity for legal adaptation through adjudication is shown to depend on five parameters: exogenous legal human capital, system-wide information-processing (which translates individual case information into shared expertise for judges), the distribution of judicial rewards for rule adaptation, the costs of legal processes to judges and litigants and the level of damages. These parameters are determined by the institutional features of a legal regime such as the use of a formally trained career judiciary as opposed to a capstone judiciary, court specialization, publication practices such as the used of signed decisions and the extent and distribution of judicial opinions and the reliance on sequenced hearings as opposed to a single event trial (Hadfield, 2008).

I also compare legal regimes in terms of their capacity for legal adaptation, based on differences in these parameters. I show that lower absolute legal costs and improved information processing unambiguously improve the capacity for a legal regime to adapt its legal rules to changes in the environment through adjudication. Other differences that we might expect to improve legal adaptation – such as more widespread judicial incentives for change or higher initial legal human capital – however, turn out to have ambiguous effects. These apparently salutary attributes can reduce welfare if they cause excessive levels of experimentation with novel rules before enough legal human capital has accumulated to enable judges to implement novel rules (or existing rules in novel ways) with sufficient accuracy.

A further surprising result is that a regime does not necessarily do better if it is better at discouraging opportunistic litigants who seek to induce judges to change rules in welfare-reducing rather than welfare-enhancing directions. This depends on assumptions about the nature of information processing: if increased information across a diversity of cases contributes to the systemic capacity to distinguish when rules should adapt and when they should not, then legal regimes that initially allow in information from opportunistic litigants may reduce judicial error more effectively and benefit more from rule change over time.

The key results thus emphasize that long-run improvements in the capacity for a legal regime to respond to a changing environment require some but not too much experimentation with legal rules to promote judicial learning.

Section 2 lays out the model and then assesses litigants' incentives to invest in the costly effort to educate a court about the new or changed environment and judicial incentives to adapt the rule, given the risk that departing from an established rule will be costly for the judge. This section establishes conditions under which a system will adapt and conditions under which it will remain stuck at an established rule, despite the existence of a welfare-improving adaptation. Section 3 then evaluates the welfare implications of rule adaptation. I show that even if a welfare-improving rule exists, it may not be optimal for a regime to adapt in light of the costs of the proceedings necessary for judges to acquire information and the cost of errors incurred in the process. If sufficient learning benefits accrue, however, it can be optimal for a regime to adapt even when the initial impact of rule adaptation is welfare-reducing. Section 3 compares the level of welfare achieved in regimes that differ in initial legal human capital, legal costs, damages, potential learning benefits and judicial incentives. Section 4 summarizes the results, discusses limitations and extensions and relates this paper to the literatures on

legal origins, the evolution of law, the choice between rules and standards, and the strategic revelation of information in courts.

2. Model

The model investigates the conditions under which a legal regime will adapt an existing legal rule to new information about welfare-relevant changes in the environment. Adaptation is modeled as a switch to a new rule that produces higher social welfare if implemented without error but the model is easily interpreted to apply to adaptation in the interpretation or implementation of a rule the text of which does not change, as will occur in a regime where judges apply law based on statutes or codes.[1]

Consider a multi-period system in which in each period there are N actors each of whom engages in an activity $x \in X$ with value V. (In each period, the actors are one-shot players and exit the system at the end of the period.) Assume that as of the start of some period 1 an existing legal rule, R^e, a function that maps this action into a penalty D, has emerged:

$$R^e(x) = D \qquad \forall x \in X$$

I assume

$$V > D$$

such that no actor is deterred from acting by R^e. Concrete examples of such a rule include a strict liability rule for injuries caused by defective products and a rule that requires an actor to pay damages if choosing not to carry through on a contractual agreement.

Suppose that in period 1 there is a change in the environment that differentiates the actors into two types: a good type, representing a fraction p of all actors, and a bad type. This partitions the activity space X into two subsets, X_G and X_B. Given this change good types should be allowed to engage in activity X without penalty whereas bad types should incur the penalty. That is, per-period social welfare beginning in period 1 would be higher under a new rule R^n where

$$R^n(x) = \begin{cases} D & \forall x \in X_B \\ 0 & \forall x \in X_G \end{cases}$$

In terms of a rule imposing strict liability for defective products, for example, the new information may result from a change in technology such that the products sold by good types no longer are defective according to the appropriate legal definition of 'defective' while those sold by bad types are. If the rule concerns contract liability, the new information may be about the correct interpretation of the intent of good types not to incur a particular contractual obligation.[2]

I assume that x is observable to an enforcer (a prosecutor or a plaintiff) and that it is costless for an enforcer to sue an actor engaged in activity x. Thus all such actors (whom we can now call defendants) are sued in each period. There are N judges (or courts-I will use the terms interchangeably) and defendants are randomly assigned to a judge. There is no settlement and no appeal so in each case a judge reaches a final determination of liability, either holding a defendant liable for damages D or releasing the defendant from liability. The activity x is verifiable by the judge. Whether an action x makes an actor a good type ($x \in X_G$) or a bad type ($x \in X_B$) is known only to the actor *ex ante*.

In making the liability determination, the judge adopts and attempts to implement a rule, either R^e or R^n. Courts are passive in the sense that they can only make the decisions that they are asked to make by the parties before them. This implies that a judge will adopt and implement R^e unless asked by a defendant to consider adopting R^n. Once sued, a defendant chooses whether or not to ask the court to allow the defendant to present a defense, attempting to persuade the judge that it is a good type and therefore to switch to R^n. Proceedings to present a defense, if permitted, cost the defendant k and the court c. Without loss of generality, I am assuming that the plaintiff presents no evidence or argument other than the (costless) evidence that the defendant has engaged in activity x and would thus be liable under the existing rule.

If a court indicates it is willing to consider adopting R^n it hears evidence and argument about whether the defendant's activity should be classified as good and the defendant therefore released from liability. We can think of a judge's decision not to allow evidence and argument and to implement R^e based on the costlessly observable and verifiable information x as a decision to grant summary judgment. A judge that allows evidence and argument to be advanced to persuade the judge to deviate from R^e can be thought of as denying a motion for summary judgment and allowing the matter to proceed to more

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[1] Rule adaptation through interpretation and application occurs regularly even in civil law systems (see Lasser, 2004).
[2] Equivalently, we could model the case in which the existing 'rule' holds no defendants liable and welfare would be increased if a change in the rule were adopted to hold bad defendants liable. In this version of the model, plaintiffs are in the position of having to choose whether to invest in educating a court about the need for a new cause of action. "Bad" plaintiffs would then be those seeking to holding all defendants liable, not merely those for whom liability is welfare-improving.

extended hearings or trial.[3] I will say that R^n has been *adopted* by a judge if the judge finds a defendant not liable (dismissal), meaning that the outcome could only have been reached given the application of R^n.[4]

If a judge conducts more extended proceedings and attempts to determine whether the defendant's activity can be justified as good in a given case – leading to dismissal – he or she risks making either of two types of errors: holding a good type liable (*type 1 error*, α) or a bad type not liable (*type 2 error*, β). The error that a judge may make is not strictly speaking identifying a good defendant as bad or vice versa; it is interpreting the evidence and argument presented by the defendant as providing good reasons to depart from the existing legal treatment of the defendant's activity. A judge is called upon to articulate these reasons and judged on the basis of them. Thus a judge might know that the pool of defendants contains only 'good' types, for example, but may still make an error in reasoning, providing bad reasons for dismissing the case against the defendant or being unable to understand or articulate the good reasons for dismissal and so being unable to justify dismissal. This is what distinguishes the judicial requirement of reasoned decisionmaking from voting or pure discretion.

I assume that judges know the probability p that, based on information about x alone, a defendant is a good type and, given additional evidence and argument, the probabilities α and β that he or she will make a type 1 and type 2 error in interpreting the defendant's case. I assume defendants also know these true probabilities.

The probability that the judge makes an error in interpreting the defendant's case is a function of the *shared legal human capital*, K_t, available to the judge in each period. In particular,

$$\alpha_t = f^1(K_t)$$
$$\beta_t = f^2(K_t)$$

with

$$\frac{df^i}{dK_t} < 0.$$

K_t represents the accumulated knowledge within the legal system about the relationship between rules, the environment and social welfare. Thus higher shared legal human capital increases the competence of every judge, allowing him or her to do a better job of interpreting a defendant's case and deciding whether social welfare would be increased or decreased by a determination that the defendant's activity is of the good type. I abstract from individual differences in judicial competence in order to focus on systemic effects.

The available legal human capital in period 1, K_1, is exogenous. K_2, legal human capital in period 2, can be augmented by the investments in evidence and legal argument made by defendants in period 1. Let T be the set of defendants who ask and are permitted to present evidence and argument in a proceeding in an effort to persuade the judge to change rules and dismiss the case against the defendant. Let

$$\Delta = \sum_{i \in T} k$$

Then let

$$K_2 = K_1 + i(\Delta)$$

where i is an information processing function that captures the extent to which information in particular cases is shared among judges and other commentators and converted into legal human capital. I will assume that i is strictly informative: $i' > 0$.[5]

2.1. Defendants' incentives to seek rule change

Suppose a defendant has asked the court to hold proceedings to consider the adoption of R^n and the court has announced that it will. The defendant must then decide whether to present evidence and argument seeking to persuade the court that the defendant's activity should be properly classified as an element of X_G, making the defendant a good type. If the defendant chooses not to present a defense its expected loss L equals D: in the absence of evidence relevant to R^n the court reverts to implementing R^e.

Both types seek to minimize their loss. For good types, presenting a defense results in an expected loss

$$L_G = \alpha_t D + k$$

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[3] In civil law countries where there is no single-event trial and a judge (or panel of first-instance judges) conducts a series of hearings on factual and legal matters, the decision to foreclose a line of evidence and argument would simply be one of several sequential decisions shaping the case.

[4] This accords with the practice in common law reasoning of extracting a rule from a decision only if the outcome requires the rule. If judges express an opinion about the desirability of a change in a rule, but reach a decision that can be fully explained in terms of the existing rule, the judicial opinion is dicta and is not treated as authoritative in the sense of establishing a precedent – a new rule.

[5] Information collected at trial could be disinformative if errors made in individual cases become systemic, rather than being corrected by aggregation and wider analysis. I leave the analysis of this possibility for future work.

and good types will be willing to invest in presenting a defense if and only if

$$k/d \leq (1 - \alpha_t).$$

For bad types, the expected loss is

$$L_B = (1 - \beta_t)D + k$$

and bad types will be willing to invest in presenting a defense if and only if

$$k/d \leq \beta_t.$$

Notice that good types are discouraged from investing by the risk of type 1 errors; bad types are encouraged by the risk of type 2 errors. I assume defendants' true type has some impact on the information content of what they present as evidence and argument and in particular that good types are more likely than bad types to be identified as good types, and bad types are more likely than good types to be identified as bad types. Formally, $(1 - \alpha) > \beta_t$. Given this, no defendants seek rule change in period t if

$$k/d > (1 - \alpha_t).$$

Only good defendants seek rule change if

$$\beta_t \leq k/d < (1 - \alpha_t).$$

Both good and bad defendants seek rule change if

$$k/d \leq \beta_t.$$

Note that it is never the case that only bad defendants seek rule change.

We can now state our first result with respect to the capacity for a legal regime to adapt to changes in the environment and switch from R^e to R^n:

Proposition 1. *If $k/D > (1 - \alpha_1)$, R^e is adopted and implemented by all judges in both periods 1 and 2. That is, the system does not adapt.*

Because the legal system is passive, meaning courts cannot adapt the law if they are never asked to do so, if defendants in period 1 are unwilling to provide the court with the costly evidence and argument they would need to justify a change in the rule there can be adaptation in period 1. This is true regardless of judicial willingness to entertain the case for rule change. With no willingness to provide information in period 1, there is no accumulation of shared legal human capital and the state of the system is the same in period 2 as in period 1: the system never adapts.

If at least some defendants are willing to invest in seeking rule change, the system's capacity to adapt will depend on judicial willingness to entertain the case for rule change. The next section considers judicial incentives.

2.2. Judicial incentives and rule change

Judges who are asked by defendants to entertain a defense must decide whether to be rule-followers (granting summary judgment, refusing to conduct further proceedings and continuing to implement R^e) or potential rule changers (denying summary judgment, allowing extended proceedings and in so doing opening up the potential that they will adopt a new rule R^n). This depends on judicial assessement of the rewards for rule-following and rule-changing. Depending on the nature of the judiciary in a given regime and how it evaluates judges, the source of these rewards might be promotion within the ranks to a superior position or transfer to a more desirable court or city, re-election, the prestige or perks derived from being well-thought of by professional peers and/or the public, appointment to a higher court and/or personal satisfaction. (See Hadfield, 2008 for a discussion of the factors that influence judicial rewards in different types of legal systems.)

Let γ be the per-period reward judges enjoy when they follow the existing rule R^e. The judge receives this reward if he or she grants summary judgment or, after conducting proceedings, nonetheless finds the defendant liable. Conducting the trial, however, costs the judge $c > 0$, resulting in a net reward of $(\gamma - c)$ if after proceedings the judge reaches the same result (holding the defendant liable) that could have been reached on summary judgment. For simplicity I assume the reward for rule-following is the same for all judges. In addition I assume that even if R^n is adopted by some judges in period 1, judges in period 2 still perceive R^e to be the existing rule with reward γ. Thus in this time scale there is no capacity for judicial assessment that R^n has become the new rule they should follow to obtain payoff γ.

Let φ_j be the reward judge j expects to receive if he or she independently and *correctly* adapts or changes a rule, that is, if he or she correctly identifies and articulates good reasons for dismissing the case against a good defendant. Again, conducting the proceedings costs c and the net reward is $\varphi_j - c$. φ_j is distributed with positive density everywhere on the interval $[0, \bar{\varphi}]$ according to the cumulative distribution function G. This assumes that the reward enjoyed by a judge who changes the rule

varies among judges and depends on whether those who determine judicial rewards (the judge's audience–superiors in a civil service bureaucracy, the public and politicans in a common law judiciary, for example) agree that the reasons provided for allowing this change in the rule are good and the judge is found to have correctly concluded that social welfare is higher with this change in the rule. I assume this audience correctly identifies the correct outcome for a case. This assumption – that the audience is ultimately perfectly informed – is grounded on two ideas: first, that the audience reaches this assessment at some future point when all cases have been decided and can be evaluated together and second, that the audience consists of a large number of observers. Time and scale thus overcome the individual errors judges make in a given time period and case. I normalize the return judges obtain if they are found to have made an error and incorrectly changed the rule – by appealing to bad reasons (which may happen even if the defendant is in fact good, and always happens if the defendant is in fact bad) – to be zero.

If proceedings are conducted, the outcome is determined by the judge's interpretation of the evidence and argument and thus the probability of type 1 (seeing no good reasons to dismiss even when the defendant is good) and type 2 (seeing good reasons to dismiss when the defendant is bad). The outcome after proceedings is thus not a choice variable – the court is bound to reach the decision that is justified by his or her ability to articulate reasons based on the evidence and argument. The judge's choice variable, therefore, is whether to allow further proceedings (deny summary judgment) or not.

The judge's decision to allow proceedings or not depends on the judge's belief about the risk of errors and thus on the mix of defendants seeking to present a defense. As discussed above, we know that the pool of defendants that will ask a judge to entertain a defense consists either of all defendants, good and bad, or only good defendants. Let $\hat{p}$ be the probability that a defendant asking to present a defense is a good defendant and assume that the judge knows this probability. Then

$$\hat{p} = \begin{cases} p & \text{if } k/d \leq \beta_t \\ 1 & \text{if } k/d > \beta_t \end{cases}.$$

The probability of dismissing after hearing evidence and argument in period t is then given by

$$pr(\text{dismissal}) = \left[(1-\alpha_t)\hat{p} + \beta_t(1-\hat{p}) \right].$$

Applying Bayes' rule, the probability that a dismissal will be judged to be based on good reasons and hence produce the reward φ_j is then given by

$$pr(\text{good reasons}|\text{dismissal}) = \frac{(1-\alpha_t)\hat{p}}{(1-\alpha_t)\hat{p} + \beta_t(1-\hat{p})}.$$

The expected payoff of further proceedings for judge j is therefore

$$(1-\alpha_t)\hat{p}\varphi_j + \left[1 - (1-\alpha_t)\hat{p} - \beta_t(1-\hat{p}) \right] \gamma - c.$$

This implies that a judge will allow further proceedings to consider the defendant's evidence and argument for a new rule R^n if

$$\begin{aligned} \varphi_{,j} &\geq \left[1 + \frac{\beta_t(1-\hat{p})}{(1-\alpha)\hat{p}} \right] \gamma + c \\ &= \varphi_t^*. \end{aligned}$$

Note that if relative legal costs are sufficiently high (the probability of type 2 errors sufficiency low) such that $k/D > \beta_t$ and the pool of defendants seeking rule change consists exclusively of good types, then the minimal reward for rule change φ need only be sufficiently above the reward for rule-following to justify the cost of conducting the proceedings to hear evidence and argument:

$$\varphi^* = \gamma + c.$$

The proportion of judges who are willing to allow proceedings in period t is $(1 - G(\varphi_t^*))$. Because judges only conduct these proceedings if they are asked to do so by a defendant, however, the proportion of cases in which evidence and argument are heard is

$$(1 - (\hat{p} - p))(1 - G(\varphi_t^*)).$$

This proportion is equal to $(1 - G(\varphi_t^*))$ if relative legal costs are low enough to give bad defendants an incentive to invest in presenting a defense and $(1 - G(\varphi_t^*))$ if only good defendants find the investment in proceedings worth it.

We can now state a basic proposition about the conditions necessary for legal rule change to occur in period 1.

Proposition 2. *A proportion of judges equal to*

$$(1 - (\hat{p} - p))(1 - G(\varphi_1^*)) \left[(1-\alpha_1)\hat{p} + \beta_1(1-\hat{p}) \right] > 0$$

will effect a switch from R^e to R^n in period 1 if and only if

$$k/d \leq (1-\alpha_1)$$

and

$$\varphi_1^* < \bar{\varphi}.$$

Proposition 2 demonstrates a key insight: in order for rule change to occur, it is necessary for *both* defendants *and* at least some judges to face incentives to incur the costs associated with rule change. These are the costs of legal evidence and argument in the case of defendants and the costs associated with hearing evidence and argument and risking a mistaken decision for judges. Thus a legal regime can be stuck at R^e, despite the existence of a welfare-enhancing legal improvement R^n. This could occur because the costs to defendants of persuading courts to change the rule are too high ($k/D > (1-\alpha)$) or because no judges perceive an adequate reward to risking rule change ($\varphi^* > \bar{\varphi}$).

Both judicial and defendant decisions depend on judicial error: if error is too high, judges are unwilling to risk changing the rule and/or (good) defendants will not find it worth investing in the effort to change the rule given the high likelihood they will not benefit from the change. This connection to judicial error, however, also reveals a more subtle result. Legal costs that are *too low* might also stymie legal change. Low legal costs encourage bad defendants to join good defendants in the effort to persuade judges to adopt R^n; bad defendants are exploiting type 2 errors. This increases the threshold reward for rule change φ^* necessary to encourage judges to risk extended proceedings to consider a novel defense. If the risk introduced by bad defendants is sufficiently high (p is low and/or β is high) then this threshold may exceed the upper bound on the distribution of rewards perceived by judges. That is, if legal costs are too low, there may be no judges willing to risk hearing the defendant's case because of the presence of bad defendants in the pool of those seeking to present a defense.

As a corollary of Proposition 2 note that if the conditions for rule change are not met for at least some judges and defendants in period 1, then no rule change will occur in period 2 in the absence of external shocks to the parameters of the system. This expands our understanding of how a legal regime can stay mired at an existing rule despite the availability of a revised rule that, if accurately implemented, would eliminate a persistent welfare-reducing error in the existing rule. This can occur if legal costs are too high or too low, judicial rewards for rule change are too low or if legal human capital is too low (errors are too high.)

The interaction between judicial error and the willingness of both judges and defendants to invest in rule change thus produces the dynamics in the model. If a share of judges in period 1 do adopt R^n, then defendants' total period 1 investments in presenting evidence and argument (Δ) can accumulate as shared legal human capital, available to all judges in period 2. Given that information processing is strictly informative ($i' > 0$), this implies that

$$\alpha_2 < \alpha_1$$
$$\beta_2 < \beta_1$$
$$\varphi_2^* \leq \varphi_1^*.$$

We can therefore state the following with respect to rule change in period 2:

Proposition 3. *If there is no rule change in period 1 there is no rule change in period 2. If there is rule change in at least some cases in period 1, then*

(1) *the proportion of cases involving good defendants resulting in rule change is greater in period 2 than in period 1:*

$$(1 - G(\varphi_2^*))(1 - \alpha_2) > (1 - G(\varphi_1^*))(1 - \alpha_1);$$

(2) *there are no proceedings to consider rule change in cases involving bad defendants in period 2; if*

$$\beta_2 < k/d \leq \beta_1$$

and

(3) *the proportion of cases involving bad defendants resulting in rule change in lower in period 2 than in period 1; if*

$$k/d \leq \beta_2 < \beta_1$$

and iff

$$\frac{(1 - G(\varphi_2^*))}{(1 - G(\varphi_1^*))} < \frac{\beta_1}{\beta_2}.$$

3. Welfare analysis: comparing legal regimes

Proposition 3 introduces the idea that reducing legal errors through the accumulation of legal human capital may have undesirable consequences. Lower error rates encourage more judges to allow defendants to present evidence and legal argument but, unless the probability of a type 2 error has fallen sufficiently to cause bad defendants to drop out of the pool of defendants seeking to present a defense, this increases the potential for a type 2 error. Whether this results in more or fewer wrongful dismissals for bad defendants then depends on whether the increased number of proceedings for bad defendants is outweighed by the reduced risk of a type 2 error in a given proceeding.

More generally, even though R^n is the 'correct' rule, in the sense that it treats good and bad defendants appropriately, whether a legal regime achieves a higher level of welfare when (some) judges switch to R^n depends on the costs of the new rule. This includes both the costs of presenting evidence and argument and conducting proceedings, and the costs of error – the wasted expenditure if the court is unable to identify the reasons that justify dismissing the claim against a good defendant and the welfare loss that results from dismissing claims against bad defendants.

3.1. Welfare effects of rule change

Let W^* be the level of social welfare enjoyed in a given case when either type of defendant is treated correctly: a good defendant is released from liability or a bad defendant is held liable. Normalize the level of social welfare when either a type 1 or a type 2 error is made to zero. To focus on the impact of the dynamics of judicial error and legal human capital on welfare, I will assume that if a court was able to restrict the availability of proceedings to good defendants, the welfare gains available from correctly dismissing the claim against a good defendant would justify the costs of those proceedings. Assuming that the judicially perceived cost of hearing evidence and argument c is also the social cost, the assumption is that

$$W^* > c + k.$$

Expected per-case social welfare in period t can then be written as

$$W_t = \begin{cases} (1-p)W^* & \text{if } k/d > (1-\alpha_t) \\ (1-p)W^* + (1 - G(\varphi_t^*)) \left[p(1-\alpha_t)W^* - (1-\hat{p})\beta_t W^* - k - c \right] & \text{if } k/d \leq (1-\alpha_t) \end{cases}$$

Let $W^e = (1-p)W^*$. $W_t = W^e$ if there is no rule change, that is either of the conditions in Proposition 2 are not met: no judges allow and/or no defendants seek proceedings to present evidence and argument to support a rule change.

First observe that proceedings to consider the adoption of R^n increase social welfare in period $t (W_t > W^e)$ if and only if

$$\left[\hat{p}(1-\alpha_t) - (1-\hat{p})\beta_t \right] W^* > k + c.$$

Then we can show the following:

Proposition 4. *Social welfare increases from period 1 to period 2 $(W_2 > W_1)$ if $W_1 > W^e$.*

Proof. See Appendix A. □

Proposition 4 is an important result because it demonstrates that so long as some rule change is justified in period 1, then the system is on a path to higher social welfare. This is true even if the greater proportion of judges, facing lower type 1 and type 2 errors, willing in period 2 to consider a possible rule change leads to more bad proceedings and thus a greater risk of a type 2 error. The intuition behind this proposition is that given that the benefit of potentially discovering that the defendant seeking to present a defense is a good defendant outweighs the risk that the effort may lead to a type 2 error in period 1, this is also true for the incremental proceedings to consider rule change in period 2.

Even if period 1 welfare is reduced by any rule change, it may still be the case that some rule change in period 1 is justified. This will be the case if the accumulation of social legal human capital in period 1 generates sufficient reductions in type 1 and/or type 2 errors. We can easily see that such cases exist. Suppose, for example, that the probability of type 2 errors is sufficiently low that only good defendants seek rule change in both periods. This implies that the only costs of first period rule change are legal costs (k and c). Then for p and W^* sufficiently large, rule change in period 1, even though not justified by welfare returns in period 1, generates sufficient benefits in period 2 to outweigh first period losses.

The fact that the accumulation of legal human capital at cost in period 1 can potentially generate sufficient reductions in errors in period 2 also leads to a somewhat surprising observation about the value of having bad defendants in the pool of defendants seeking rule change.

Proposition 5. *Consider two legal regimes A and B that are identical with the exception that*

$$\beta_1^A > \left(k/D \right)^A$$
$$\beta_1^B < \left(k/D \right)^B$$

implying that in regime A both good and bad defendants seek rule change in period 1 but only good defendants seek rule change in regime B. Regime A will accumulate more legal human capital in period 1 if

$$\frac{(1 - G(\varphi^{A*}))}{(1 - G(\varphi^{B*}))} > p.$$

Then there exist parameters such that $W_1^A + W_2^A > W_1^B + W_2^B$.

Proof. See Appendix A. □

3.2. Comparing legal regimes

I turn now to comparisons across legal regimes to determine the welfare impact of different attributes: the quality of judicial information processing, the distribution of judicial rewards, the initial levels of legal human capital, damages and the cost to both the court and defendants of proceedings to present legal evidence and argument. Some of these attributes are policy variables. The case in which rule change is never justified in either period 1 or period 2 is one in which the policy implications are clear, namely that a legal regime should structure judicial incentives that do not reward rule change. The more interesting cases from a policy perspective involve circumstances in which some rule change is warranted. I look first at the case in which rule change is justified even at initial levels of judicial error ($W_1 > W^e$) and then at the case in which rule change in period 1 is justified only by gains in period 2 ($W_1 < W^e$).

3.3. Welfare gains from rule change period 1

Consider two legal regimes, A and B, both of which would benefit from rule change in period 1: $W_1^A > W^e$ and $W_1^B > W^e$. Proposition 4 establishes that if initial levels of judicial error are sufficiently low to justify period 1 rule change without regard to gains in period 2, the level of social welfare achieved in a legal regime depends on how widespread rule change becomes and what further reductions in judicial error might be enjoyed in period 2.

3.3.1. Information processing
Suppose first that A and B are identical in all respects except that they have different information processing functions, with $i^A(\Delta) > i^B(\Delta)$. Regime A is thus more effective at extracting valuable error-reducing information out of the accumulated evidence and legal argument presented to courts; it may be characterized by greater publication of judicial opinions, more effective feedback from experts, or higher levels of judicial specialization or training. Regimes A and B will experience the same degree of rule change in period 1. Assuming this involves some positive accumulation of evidence and argument ($\Delta > 0$), regime A will experience lower rates of both type 1 and type 2 errors in period 2. This implies that judges in A are more willing to change rules than judges in B. Proposition 4 establishes that given our assumption that expected welfare from proceedings to consider a change to R^n is an improvement on welfare under the existing rule period 1 ($W_1 > W^e$), it is also the case that expected welfare from period 2 proceedings to consider rule change generates value above the level of the existing rule ($W_2 > W^e$). Higher period 2 social welfare in A then results both from greater judicial willingness to consider evidence and argument directed to rule change and lower judicial errors in the event of such proceedings.

3.3.2. Judicial incentives
Now consider two regimes that differ only in the distribution of judicial incentives. Suppose that in regime A there are more judges with higher judicial rewards for accurate rule adaptation than in regime B and in particular $G^A(\varphi_1^*) < G^B(\varphi_1^*)$. This implies that in period 1, for a given level of judicial error, more judges in A are willing to consider a proffered defense than is the case in B and rule change results in a larger set of case with good defendants in A. The assumption that $W^1 > W^e$ ensures that the gains from more extensive period 1 rule change in cases with good defendants outweighs losses from increased rule change in cases with bad defendants. Regime A also begins period 2 with a higher level of shared legal human capital and lower type 1 and type 2 errors. Higher judicial rewards then magnify the results we obtained with respect to improved judicial processing in period 2: positive expected value proceedings are more widespread in A than B, both because of lower error and because more judges at a given level of error are willing to risk rule change. Taken together, social welfare in A is higher in both periods and the gains come both directly from increased willingness to risk welfare-improving rule change and indirectly from the reductions in legal error and the further expansion of rule-changing that initial rule-change produces.

3.3.3. Initial judicial error
What if regime A begins period 1 with a higher level of legal human capital and lower errors than regime B? The effect here is analogous to what happens with higher judicial rewards. Suppose that it is either the case that the probability of a type 2 error is sufficiently high to lead bad defendants in both regimes to seek rule change or sufficiently low to exclude bad defendants in both regimes from the pool of those seeking rule change. Then lower errors in A imply that judges in A are more willing to entertain rule change in period 1. Proposition 4 then implies that more positive expected welfare proceedings are

conducted in A, resulting in even higher gains in A in period 2, through a widening gap between the levels of judicial error in the two regimes.

It is possible, however, that regime B with higher initial legal error could in the long run do better than regime A. As Proposition 5 establishes, if the higher probability of type 2 error encourages bad defendants to seek period 1 rule change in regime B but not in regime A, then more legal human capital may accumulate in B than in A. This could lead to error reductions in period 2 that outweigh the costs of those first period proceedings for bad defendants in B.

3.3.4. Legal costs

Consider two regimes with different legal costs and specifically $c^A + k^A < c^B + k^B$, but no other differences and in particular no difference in relative legal costs (k/D). A experiences under these assumptions a lower cost of achieving rule change and reductions in judicial error and judges that are more willing to conduct positive expected value proceedings to consider rule change in period 1. For both reasons, welfare is higher in regime A.

Now consider regimes that differ in relative legal costs (k/D), either because of a difference in absolute legal costs, damages or both. Relative legal costs affect defendants' decisions about whether or not to invest in proposing rule-change. As relative legal costs increase, there are fewer circumstances in which bad defendants are willing to invest; if relative legal costs get high enough, even good defendants are unwilling to invest. If relative legal costs in the two regimes lead the same mix of defendants to invest (all good in both or all good and bad in both), then the legal regimes will see no difference in social welfare coming from differences in the extent of rule change or judicial error; a social welfare differential will arise only through differences in absolute legal costs. If relative legal costs in A are low enough to encourage good defendants to invest, while those in B are too high, the relatively low-cost regime A will clearly be better off given the assumption that $W_1^A > W^e$ and the observation that because no defendants are willing to seek rule change in regime B welfare in that regime is just W^e.

The ambiguous case comes if relative legal costs in A are sufficiently low to cause bad defendants to seek rule change, which they are unwilling to do in the higher cost regime B. Then A experiences fewer proceedings with good defendants (because judges are less willing to risk hearing a defense given the presence of bad defendants in the pool of those seeking rule change) and also endures proceedings with bad defendants. These two effects reduce social welfare in A relative to B. There are two potential offsetting effects, however. First, if lower relative legal costs in A are due to significantly lower absolute legal costs k, each proceeding is less costly. Moreover, and probably more importantly, as shown in Proposition 5, more legal human capital may accumulate in period 1 in A than B. This higher level of human capital accumulation would produce lower errors in period 2 in A and this period 2 benefit could be sufficient to lead to overall higher welfare in A.

Proposition 6 summarizes the above results.

Proposition 6. *Consider two regimes, A and B, both of which would benefit from rule change in period 1: $W_1 > W^e$. Ceteris paribus, regime A will enjoy a weakly higher level of social welfare under any of the following conditions:*

    a. $i^A(\Delta) > i^B(\Delta)$
    b. $G^A(\varphi_1^*) < G^B(\varphi_1^*)$
    c. $K_1^A > K_1^B$ and not $\beta_1^A < k/d < \beta_1^B$
    d. $k^A < k^B$
    e. $c^A < c^B$
    f. $\left(k/D\right)^A < (1 - \alpha_1) < \left(k/D\right)^B$

Regime A may experience higher or lower welfare than regime B under the following conditions:

    g. $K_1^A > K_1^B$ and $\beta_1^A < k/d < \beta_1^B$
    h. $\left(k/D\right)^A < \beta_1 < \left(k/D\right)^B < (1 - \alpha_1)$.

3.4. Welfare gains only from rule change in period 2

The more interesting case in which to examine the comparative benefits of different regime attributes is the case in which initial levels of judicial error are sufficiently high that rule change is not warranted on the basis of outcomes in period 1 alone. There exist circumstances in which proceedings to consider potential rule change in period 1 will nonetheless generate sufficient welfare gains in period 2, as a result of the accumulation of legal human capital and the reduction in error in period 2.

Consider two regimes A and B in both of which $W_1 < W^e$. We can continue to reach unambiguous policy conclusions for some potential differences between two regimes. Clearly if A has more effective information processing ($i^A(\Delta) > i^B(\Delta)$) period 1 rule change will be justified (achieving $W_1 + W_2 > 2w^e$) in a wider range of circumstances than will be the case in regime B. Moreover, even if rule change is also justified in B, A will experience higher social welfare in period 2. It is also clear that if defendants' absolute (but not relative) costs of a proceeding (k) are lower in A than in B, period 1 rule change in A will be justified in a wider range of circumstances and higher social welfare achieved from period 1 rule change. Again, differences in relative legal costs alone will not affect social welfare if they do not lead to a divergence in the mix of defendants seeking rule change in the two regimes. If, however, higher relative legal costs in B mean that good defendants are unwilling to seek

rule change in *B* but are willing in *A*, then again we can unambiguously conclude that *A* will experience valuable rule change and higher social welfare in a wider range of circumstances: *B* is stuck at the existing rule.

Parameter differences that produce more extensive proceedings in period 1, however, will have ambiguous welfare effects, even assuming that the least well off regime still produces positive welfare gains relative to the existing rule in period 2. This is because increasing the extent of potential rule change in period 1 increases total legal human capital and period 2 error reductions but also increases the costs of achieving these effects. Total social welfare will then depend on balancing the costs incurred in period 1 with benefits generated in period 2. Thus a regime with higher initial legal human capital, lower trial costs or higher judicial rewards may do better, but it may also overinvest in period 1 rule change.

The potential for overinvestment in period 1 also leads to the possibility that a regime may even do worse overall with better information processing and lower relative legal costs. This possibility arises when, even in the better regime, period 2 welfare is still below the level achieved with the existing rule ($W_2 < W^e$). Then any proceedings have negative expected value and the fewer the better. Under these conditions, only if defendants' absolute legal costs, k, (but not relative legal costs) are lower in regime *A* can we unambiguously conclude that *A* will be better off.

Propositions 7 and 8 summarize these results.

Proposition 7. *Consider two legal regimes, A and B in both of which $W_1 < W^e$ and confine consideration to cases in which $W_2 > W^e$ in at least one of the regimes. Ceteris paribus, proceedings to conside rule change produce welfare gains in a wider range of circumstances and lead to higher total social welfare in A under any of the following conditions:*

$a.\ i^A(\Delta) > i^B(\Delta)$
$b.\ k^A < k^B$
$c.\ \left(k/D\right)^A < (1-\alpha_1) < \left(k/D\right)^B$

Rule change may or may not be justified in a wider range of circumstances and lead to higher total social welfare in A under any of the following conditions:

$d.\ c^A < c^B$
$e.\ G^A(\varphi_1^*) < G^B(\varphi_1^*)$
$f.\ K_1^A > K_1^B$

Proposition 8. *Consider two legal regimes A and B and assume that $W_1 \leq W_2 < W^e$ in at least one of the regimes. Then A unambiguously achieves higher social welfare than B only if*

$k^A < k^B.$

4. Conclusion

The model in this paper is a first step to connect the analysis of information processes in different types of legal institutions to the dynamic process of legal adaptation. The model identifies five parameters that influence the capacity of a legal regime to adapt law to local and changing conditions through adjudication so as to promote social welfare: (1) the distribution of judicial rewards for rule-adaptation; (2) the cost of producing evidence and legal argument for presentation to a court; (3) the level of damages; (4) the initial or exogenous level of judicial error and (5) the extent to which the legal regime transforms individual case information into informative – error-reducing – shared legal human capital. I demonstrate that in order for a legal regime to adapt law through adjudication it is not enough for judges to face incentives to adapt law. They must also anticipate that the errors they will make in adapting law to novel circumstances will not be too high. Moreover, they depend on the incentives of litigants to bear the cost of educating them about the environment. These incentives also depend on judicial errors: if judges make too many errors, good litigants for whom legal change is welfare-promoting will be discouraged from investing in these costs. A regime may thus be stuck at an existing rule despite the existence of a welfare-improving adapted rule because the mistakes judges are likely to make in a novel environment discourage judges, litigants or both from investing in the development of the shared legal human capital necessary to reduce error.

Assuming a legal regime does not remain stuck at an existing sub-optimal rule, the model presents some surprising results about how variation in the parameters that affect the process of legal human capital accumulation through adjudication can impact the dynamic quality of the law. Legal regimes will achieve higher welfare over time through rule adaptation if they have lower absolute legal costs or a more effective process for translating case-specific information into system-wide error reducing legal human capital. Because the process of legal human capital accumulation requires a balancing of costs and benefits over time, however, attributes that might appear to promote or defeat welfare can have surprising effects. If more judges face higher payoffs for rule adaptation there may be excessive adaptation in early stages when judicial errors are relatively high. Lower initial levels of judicial error (higher exogenous legal human capital) may also lead to an initial overinvestment in rule adaptation. Even lower legal costs, relative to the damages at stake, do not unambiguously improve the dynamic quality of the legal regime: if relative legal costs are low, "bad" litigants who seek to exploit the likelihood that judges will mistakenly adapt rules in welfare-reducing ways may flood the system and, anticipating this, judges will

be less willing to allow any litigants to proffer the evidence and legal argument necessary for them to learn and reduce the likelihood of error.

As I explore in more detail in a companion paper (Hadfield, 2008), each of the parameters in the model is linked in important ways to the institutional environment that defines a legal regime. Judicial rewards for rule-adaptation, for example, are a function of the organization of the judiciary and the nature of the information available to those who make up a judge's audience. Information processing is a function of how much factual detail and legal argument is included in judicial decisions and how widely those decisions are distributed. These and other features that affect the parameters I analyze differ systematically across legal systems.

The model in this paper thus contributes to but certainly does not resolve the issue posed by the legal origins literature and implicit in the literature on the efficiency of the common law about the relative economic value of different legal institutional settings. An important limitation of the paper is the focus exclusively on legal adaptation through litigation. Any legal system will experience some adaptation through this mechanism: legal rules do not only change when the text changes (which is what legislatures can do) but also when the interpretation and implementation of text changes (which is what only those who enforce rules can do). But learning through adjudication is clearly not the only mechanism for infusing legal rules with information. The contribution of this model is to emphasize the need to focus on the process by which information available to those with presumably the lowest costs of learning the information (those involved in the regulated activity) is transmitted into the system of regulation. I have shown how this process in courts depends in subtle ways on the interaction of the incentives of judges and litigants. Further work would more explicitly address the comparable issue of how different institutional settings affect the capacity of legislatures to learn and adapt law, particularly in light of the inevitable process of adjudication, interpretation and implementation in courts.

Further extensions of the model could also integrate this work with the strategic revelation literature. I have modeled the information process in courts in reduced form and suppressed any decisionmaking by plaintiffs. Provided the equilibrium is not fully revealing (Milgrom and Roberts, 1986), this reduced form approach is without loss of generality: whatever type 1 and type 2 errors result following the defendant's presentation of its case can be interpreted as the outcome of a strategic game between defendant and plaintiff. It remains to be seen, however, whether further insight into the dynamic accumulation of legal human capital can be generated by embedding the error process more explicitly in a game theoretic model.

Game theoretic modeling of the information process in courts could be particularly important to address another important limitation of the model presented here. I have assumed that presentations of evidence and argument from both good and bad defendants can be equally informative when processed by the system over time. Indeed, information from bad defendants, even if it distorts outcomes in particular cases, may be valuable in the long run because those who sift and synthesize information across cases may be better able to extract error-reducing legal human capital from a diversity of cases rather than those of a single type. (By the same token, variation in a sample improves the capacity to identify significant relationships in empirical work.) Nonetheless, it is likely the case that if a system attracts too much information from bad defendants that the system as a whole experiences increases rather than decreases in error rates. The strategic interaction between defendants and plaintiffs is likely to play a role in determining the balance of information that accumulates.

Finally, a fuller analysis must also take into account the impact on information acquisition and legal human capital accumulation of several features suppressed here such as activity choices, settlement, norms of deference to the decisions of other judges (precedent and jurisprudence constante) and appeal. Hadfield (1992), for example, points to ways in which information acquisition by courts can be biased by the activity choices of agents along the evolutionary path under particular institutional assumptions regarding the impact of precedent and case or controversy requirements.[6] Talley (1999) considers the potential for information cascades in courts in a framework that can be easily interpreted to have relevance to the comparison between different institutional settings. Hylton (2006) examines the impact of settlement on the mix of cases that go to trial and thus form the basis for rule evolution.

Ultimately, the impact of different legal institutional structures will also require integration of the analysis of the information processes in courts and legislatures and the agency considerations (corruption, judicial preferences, etc.) that have dominated the legal origins literature to date. With further theoretical work we can then hope to unpack more of the empirical results and policy implications surrounding the design of legal systems to support economic activity.

Acknowledgements

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[6] A case or controversy requirement, characteristic of the U.S. system for example, limits courts to making decisions on the basis of information generated in actual disputes.

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Appendix A.

A.1. Proof of Proposition 4

Proof. We need to show $W_2 > W_1$.

$$
\begin{aligned}
W_2 - W_1 \quad &= (1 - G(\varphi_2^*)) \left[p(1-\alpha_2)W^* - (1-\hat{p}_2)\beta_2 W^* - k - c \right] - (1 - G(\varphi_1^*)) \left[p(1-\alpha_1)W^* - (1-\hat{p}_1)\beta_1 W^* - k - c \right] \\
&= (1 - G(\varphi_1^*)) \left[p\left[(1-\alpha_2)-(1-\alpha_1)\right]W^* + \left[(1-\hat{p}_1)\beta_1 - (1-\hat{p}_2)\beta_2\right]W^* \right] + \left[G(\varphi_1^*) - G(\varphi_2^*) \right] \left[p(1-\alpha_2)W^* - (1-p)\beta_2 W^* - k - c. \right]
\end{aligned}
$$

Then, assuming $i' > 0$ we have that

$$
\begin{aligned}
\alpha_2 &\leq \alpha_1 \\
\beta_2 &\leq \beta_1 \\
\varphi_1^* &\leq \varphi_1^*.
\end{aligned}
$$

which implies, among other things, that $\hat{p}_2 \leq \hat{p}_1$. Then $W_2 > W_1$ iff

$$
\left[G(\varphi_1^*) - G(\varphi_2^*) \right] \left[p(1-\alpha_2)W^* - (1-\hat{p}_2)\beta_2 W^* - k - c \right] > 0.
$$

This condition holds because

$$
\left[p(1-\alpha_2)W^* - (1-\hat{p}_2)\beta_2 W^* - k - c \right] \geq \left[p(1-\alpha_1)W^* - (1-\hat{p}_1)\beta_1 W^* - k - c. \right]
$$

The assumption that $W_1 > W^e$ then implies that the RHS of the above expression is positive $\quad\square$.

A.2. Proof of Proposition 5

Proof. We need to show that there exist parameters such that

$$
W_1^A + W_2^A > W_1^B + W_2^B
$$

even if

$$
\begin{aligned}
\beta_1^A &> \left(k/D\right)^A \\
\beta_1^B &< \left(k/D\right)^B.
\end{aligned}
$$

First set

$$
\begin{aligned}
\alpha_1^A &= \alpha_1^B = \alpha_1 \\
\beta_1^A &= \beta_1^B = \beta_1 \\
B_1 &= (1-\alpha_1) + \varepsilon
\end{aligned}
$$

Observe that

$$
\begin{aligned}
\varphi_1^{A*} \quad &= \left[1 + \frac{\beta_1(1-p)}{(1-\alpha_1)p} \right] \gamma + c \\
&= \left[1 + \frac{\beta_1(1-p)}{(\beta_1 + \varepsilon)p} \right] \gamma + c \\
&> \varphi_1^{B*} \\
&= \gamma + c.
\end{aligned}
$$

Then choose $G(\varphi) \ni$

$$
\frac{(1 - G(\varphi_1^{A*}))}{(1 - G(\varphi_1^{B*}))} > p.
$$

(This can be done by choosing G with weight on $[\varphi_1^{A*} - \varphi_1^{B*}]$ sufficiently small.)
Then

$$
\Delta^A > \Delta^B.
$$

$i' > 0$ and $(\mathrm{d}f^i)/(\mathrm{d}K_t) < 0$ implies that

$$\alpha_2^A < \alpha_2^B < \alpha_1$$
$$\beta_2^A < \beta_2^B < \beta_1.$$

Note that we can choose i and f such that

$$\alpha_2^B \approx \alpha_1$$
$$\alpha_2^A \approx 0.$$

(That is, there is almost no benefit from Δ^B but very large benefit from the increment of Δ^A above Δ^B.) Assume that

$$\beta_2^A < \left(k/D\right)^A$$

implying that in both regimes only good defendants seek rule change in period 2 and

$$\varphi_2^A = \varphi_2^A = \gamma + c.$$

I will show that there exists $\alpha_1, p, \alpha_1, \alpha_2^A$ and α_2^B such that

$$\begin{aligned}
\delta_2 &= W_2^A - W_2^B \\
&> W_1^B - W_1^A \\
&= \delta_1.
\end{aligned}$$

Now

$$\delta_2 = (1 - G(\gamma + c))pW^*(\alpha_2^B - \alpha_2^A)$$

and

$$\delta_1 = p(1 - G(\gamma + c))[(1 - \alpha_1)W^* - k - c] + (1 - G(\varphi_1^{*A}))(1 - p)W^* - (1 - G(\varphi_1^{*A}))[p(1 - \alpha_1)W^* - \beta_1(1 - p)W^* - k - c.]$$

Then taking successive limits,

$$\lim_{\substack{p \to 1 \\ \alpha_1 \to 1 \\ \alpha_2^B \to \alpha_1 \\ \alpha_2^A \to 0}} \delta_2 = (1 - G(\gamma + c))W^*$$

and

$$\lim_{\substack{p \to 1 \\ \alpha_1 \to 1 \\ \alpha_2^B \to \alpha_1 \\ \alpha_2^A \to 0}} \delta_1 = (1 - G(\gamma + c))(k + c).$$

By assumption,

$$W^* > k + c$$

and so we can select parameters $\alpha_1, p, \alpha_1, \alpha_2^A$ and α_2^B such that

$$\delta_2 > \delta_1.$$

$\square$

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