On the Evolution of Collective Enforcement Institutions: Communities and Courts

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ABSTRACT

We analyze the capacities of communities (or social networks) and courts to secure cooperation among heterogeneous, impersonal transactors. We find that communities and courts are complementary in that they tend to support cooperation for different types of transactions but that the existence of courts weakens the effectiveness of community enforcement. Our findings are consistent with the emergence of the medieval law merchant and its subsequent supersession by state courts as changes in the costs and risks of long-distance trade, driven in part by improvement in shipbuilding methods, altered the characteristics of merchants' transactions over the course of the Commercial Revolution in Europe. We then contrast the European experience with the evolution of enforcement institutions in Asia over the same period.

1. INTRODUCTION

The realization of scale economies and gains from specialization that underlie economic development inevitably requires both the expansion of trade beyond an individual's immediate circle of acquaintances and

the flexibility to respond to new trading opportunities. But trade between individuals who have only a transitory association is hazardous: with no stake in maintaining an ongoing relationship, transactors have little incentive to honor deals or respect property rights. State-sponsored legal systems can provide the security necessary to support impersonal exchange. But significant opportunities for gainful trade sometimes lie outside the boundaries of effective governmental authority. Such was arguably the case during the late-medieval Commercial Revolution in Europe (roughly the 11th to 14th centuries [Lopez 1971]), when long-distance trade blossomed in an environment of small and fragmented political units.

The puzzle of how merchants and traders managed to govern their affairs without the benefit of state enforcement has led scholars to focus attention on the role of self-enforcing, nongovernmental institutions (prominent contributions to this literature include Milgrom, North, and Weingast [1990]; Greif [2006]; Greif, Milgrom, and Weingast [1994]). Among these was the *lex mercatoria,* or law merchant, commonly described as a spontaneously arising system of customary rules governing trade among merchants that was administered by private judges chosen for their familiarity with commercial practices (Berman 1983, pp. 333–56). Descriptions and analyses of the medieval law merchant have ascribed to it a host of positive attributes, including "its universal character, its flexibility and dynamic ability to grow, its informality and speed, and its reliance on commercial custom and practice" (Benson 1989, p. 654). Despite its many purported virtues, however, "[t]he Law Merchant system of judges and reputations was eventually replaced by a system of state enforcement" (Milgrom, North, and Weingast 1990, p. 20).

The supersession of the law merchant by state courts—a system notably deficient in most of the qualities attributed to the law merchant—highlights a shortcoming of much of the literature on institutions: its "system-specific" nature (Dixit 2003, p. 1294), that is, its tendency to offer explanations for the existence or emergence of a particular institutional outcome at a particular time and place, when what we (ultimately) want is a theory that can explain variations in institutional arrangements and the dynamics of institutional evolution. Why do particular institutions, out of the set of potential arrangements, appear (and

fade) when and where they do? Williamson (1991, p. 169) raises this criticism with specific reference to the law merchant: "The subset of products and organizations that satisfy the parameter values for the Law Merchant System . . . as a sequential equilibrium strategy is never described. . . . What were the characteristics of these transactions and what explains the breakdowns?"

We seek to address this criticism by analyzing factors affecting the relative capacities of communities (or social networks) and courts to secure cooperation among heterogeneous, impersonal transactors. To do so, we draw on a framework introduced by Dixit (2003) to capture differences in the knowledge and abilities (trading attributes) of transactors who (periodically) face opportunities to transact with new and unfamiliar trading partners.[1] The model allows us to consider ranges of potential trading partners for which collective enforcement by communities and courts can sustain cooperation and to identify characteristics of the economy such as the value of trade and the degree of shared knowledge (connectedness) of transactors that affect those ranges.[2]

Our main findings relate to transactor heterogeneity and, in particular, to how dissimilarity of transactors—in knowledge, ability, resources, location, or other economically relevant dimensions—affects the likelihood of meeting, the value of cooperating, and the dissemination of information about prior transactions. Among other things, we find that courts and communities are complementary in the sense that they tend to support cooperation for different types of transactions. We also find that the availability of community sanctions supplements court enforcement, which allows cooperation over a wider range of transactions than could be supported by court enforcement alone. The reverse, however, is not true: the existence of courts diminishes the effectiveness of community enforcement. Although the possibility that formal, legal en-

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1. See also Tabellini (2008) and Baron (2010), who exploit Dixit's (2003) circle-economy framework to analyze the capacity of guilt and altruism to sustain cooperation; Leeson (2008b), who endogenizes the transactors' location on the circle; and Prüfer (2012), who studies the impact of formal organizations (associations) on cooperation.

2. We use the term "collective" or "multilateral enforcement institutions" to describe institutions for the enforcement of agreements involving parties other than those to the transaction. These institutions encompass both the external governance (enforcement by courts or other organizations) and Dixit's (2003) categories of self-governance (enforcement by communities or social networks). Greif (2006) uses the term "contract enforcement institutions" for both types of enforcement. Consistent with the legal definition of a contract, we reserve the term "contract" for agreements that would be legally binding in a public court of law.

forcement may crowd out informal, reputational enforcement has been suggested before, the reason for such crowding differs in our analysis: the availability of courts reduces the reputational consequences of opportunism, and thus the effectiveness of community enforcement, by encouraging some transactors to trade who, in the absence of effective court enforcement, would have refused to deal with someone who had defected in a prior transaction.[3]

Applying insights from the model, we revisit the history of the medieval law merchant. Whereas prior accounts have associated the law merchant's dominance and demise with (exogenous) changes in the quality of state enforcement institutions—emerging of necessity when governments were weak and withering as state power and interests in commercial activity made community enforcement obsolete—our analysis suggests an explanation in which the law merchant's emergence and subsequent subordination to state courts could have arisen endogenously: progressive reductions in the risks and costs of transportation over long distances, driven in part by improvements in shipbuilding methods, stood to alter the value and composition of long-distance trade in ways that initially favored and later undermined community enforcement. We then contrast the European experience with the evolution of enforcement institutions in Asia, particularly the failure of state enforcement to displace community enforcement in China and India over the same period despite comparatively strong and unified governments.

Section 2 provides an overview of the issues, introduces the basic model, and characterizes behavior under, and compares the effectiveness of, community and court enforcement. Section 3 contains our analysis of the medieval European law merchant and comparison with Asian institutional development. Section 4 offers conclusions. Proofs appear in the Appendix and an online appendix.

3. Among those noting the potential for formal enforcement to crowd out informal arrangements, Macaulay (1963, p. 64) suggests that appeal to formal legal obligations stood to interfere with cooperation in business dealings by signaling a lack of trust. Signaling is also at the heart of Bénabou and Tirole's (2006) analysis showing how explicit incentives can undermine reputation by creating doubt about the extent to which good behavior was a response to incentives rather than reflective of personal moral character. Our analysis also differs from studies in which the introduction of formal enforcement alters preferences or intrinsic motivation (for example, Bohnet, Frey, and Huck 2001; Jackson 2011). Closest in spirit to our finding, Baker, Gibbons, and Murphy (1994) show that the availability of sufficiently effective explicit contracts can undermine what would otherwise be effective self-enforcing agreements by reducing the bilateral punishment for defection. For a more extensive overview and discussion of the literature on crowding out in the context of contracting, see Gilson, Sabel, and Scott (2010).

2. COURTS, COMMUNITIES, AND COMMITMENT

A central concern of the literatures on both organization and institutions is the obstacle to trade and cooperation posed by opportunistic behavior. But whereas analyses of organization, and of contracting in particular, emphasize efficient exchange between specific parties over a limited period, the analysis of institutions involves a shift in orientation to reflect, among other things, the generally broader scope and greater durability of institutions compared with organizations. Because institutions operate over an array of transactions composing an economy (or, possibly, industry), the distribution of heterogeneous skills, knowledge, and locations of transactors in an economy, and not just the attributes of a particular transaction, become relevant. The greater durability of institutions, in turn, means that analyses of institutions entail time frames—sometimes centuries or longer—that exceed the duration of most transactions and must therefore account for the dissolution of old relationships and emergence of new trading opportunities. As opportunities for advantageous trade beyond the clan or village to the region and further increase, and the capacity of bilateral interactions to sustain cooperation correspondingly decreases, the need for some form of multilateral enforcement mechanism rises.

Communities and courts represent two such mechanisms. Our conception of a community is similar to that of Cooter (1996, p. 1646): "A community of people is a social network whose members develop relationships with each other through repeated interactions. The modern economy creates many specialized business communities. These communities may form around a technology such as computer software, a body of knowledge such as accounting, or a particular product such as credit cards. Wherever there are communities, norms arise to coordinate the interaction of people." Communities may be informal (for example, the jazz community) or formal (for example, the New York Diamond Dealers Club [Bernstein 1992]). The important defining characteristics of a community—frequency of interactions[4] and shared knowledge or interests of members—introduce the possibility that opportunistic behavior by or toward one member will be learned of by others who may

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4. The relationships constituting membership in a community should be understood in terms of the frequency of interaction with any member of the community as distinct from relationships developed through repeated interactions with particular individuals.

respond by refusing to transact with transgressors.[5] To the extent this occurs, the existence of communities can deter defection from cooperation.

Courts or, more generally, governments differ from communities in two respects. First, whereas the severity of sanctions that a community can impose on defectors is constrained by the value of ongoing future cooperation, courts can invoke governmental powers to coerce behavior and therefore may be able to impose larger sanctions.[6] Second, public officials are usually not members of the communities of disputants, or at least cannot be members of every community, and are therefore at a disadvantage relative to community members in determining whether an infraction has occurred and the nature of the infraction.

2.1. The Model

To analyze the capacities of communities and courts to sustain cooperation, we draw on Dixit (2003), whose model compactly incorporates several dimensions of economies relevant to the performance of enforcement institutions: heterogeneity in the value of trade among transactors, stochastic opportunities for impersonal trade, conflicting incentives within transactions, and localized information. Transactor heterogeneity is represented by the location of transactors around a circle, distances along which can be interpreted as representing differences in relevant economic or social variables such as technological or resource endowments, knowledge or expertise, or kinship or other social or cultural affinities, as well as geographic location.

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5. The assumption that community sanctions are limited to expulsion, ostracism, or refusals to transact excludes well-known examples of organizations that use violence to enforce cooperation. Less drastically, associations may fine members for misbehavior. In voluntary communities at least, the size of such punishments is limited, in expected terms, by the value of continued membership in the community. For an analysis of such associations, see Prüfer (2012).

6. Mobility—of individuals generally and traders in particular—constrains the effective power of governments as well as of communities. The desire to attract merchants, for example, induced rulers in the Middle Ages to adopt laws and policies favorable to merchants, including "safe-conducts, trading rights and protections, and extraordinary remissions of normal laws" (Kadens 2004, p. 48). Marketplaces that failed to provide an attractive legal environment "perished, because no traders attended the market" (Bindseil and Pfeil 1999, p. 745, quoting Feger 1958, p. 12). Although our model draws a stark distinction between court and community enforcement, differences between the two are much blurrier in the commercial world, especially, as will become evident in Section 3, in the period of the medieval law merchant. Implications of the model should thus be thought of as favoring more courtlike or community-like enforcement, the distinguishing properties of real-world institutions being matters of degree.
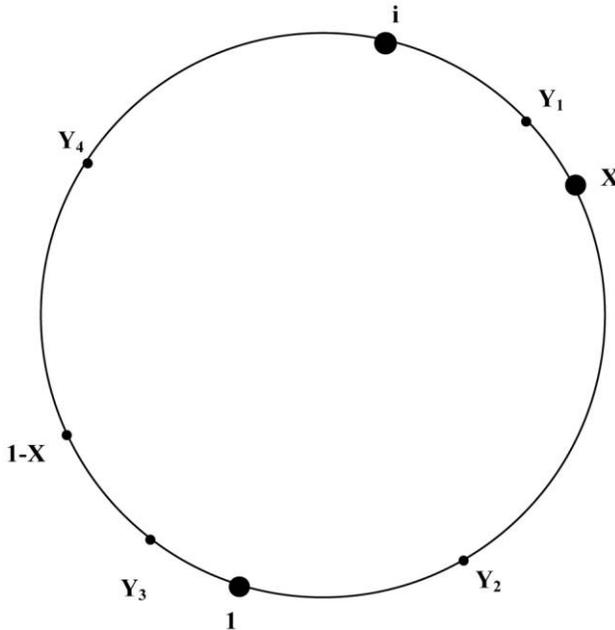
Figure 1. Locations of potential matches *y* for transactor *i* relative to current match *x*

Formally, the economy in our analysis consists of a continuum of transactors uniformly distributed on a circle with a circumference of 2, as depicted in Figure 1. The mass of transactors per unit arc length is normalized to 1, which implies a mass 2 population in the economy.[7] Distance between two transactors, X—measured by the shorter of the two arc lengths between them (hence, $X \leq 1$)—affects three considerations in the model: the probability of transactors meeting, the potential gains from trade between two transactors, and the probability of receiving information about the previous behavior of other transactors. We define the probability of meeting and potential gains here and the probability of receiving information about behavior in Section 2.2.

7. Dixit (2003, p. 1299) specifies a circumference of $2L$, but as he notes, his model has an extra degree of freedom such that an increase in the size of the world L is equivalent to a decrease in the unit in which distance is measured. Consistent with this, distance in our model should be understood as being relative to the size of the relevant trading space. Our model also differs from Dixit's in several other technical respects described in more detail below.

2.1.1. Matching. First, we assume that individuals are more likely to meet and discover an opportunity for gainful cooperation the closer they are in attribute space. Specifically, the probability that any two players i and x are matched in any given period is

$$\mu \equiv \frac{e^{-X}}{2(1 - e^{-1})}. \tag{1}$$

In other words, the probability of a match between two transactors decreases exponentially with their distance X.[8] In keeping with our focus on impersonal trade, matching is independent across periods.

2.1.2. Gains from Trade. A central feature of the model is that potential gains from trade are also related to distance. Specifically, the potential payoff to a given transactor i from trading with a transactor at distance X is $he^{\theta X}$. Gains from trade may thus be increasing or decreasing in distance depending on the sign of the parameter θ: for $\theta > 0$, potential gains from trade increase with distance, and for $\theta < 0$, trade is more valuable between closer transactors. Gains from trade might increase with distance (or dissimilarity) because of the benefits accruing to specialization, while gains decreasing with distance could result from high transportation costs or because dissimilarity in, say, language or knowledge impedes communication or the understanding necessary to recognize gainful opportunities (compare Dixit 2003, p. 1297).

2.1.3. Conflict in Exchange. As noted earlier, the existence of gains from trade does not guarantee their realization. We capture the possibility of opportunistic behavior with the assumption that, in each period, matched transactors play a noncooperative trade game as follows:

Stage 1. Transactors decide simultaneously whether to transact. If either chooses not to transact, their payoffs are zero, and the period ends for these transactors.

Stage 2. If the matched transactors agree to transact, each decides whether to cooperate (perform) or defect (renege). The payoff to each transactor is $ae^{\theta X}$, where a is determined for each transactor from the reduced-form (prisoner's dilemma) payoff matrix depicted in Table 1.

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8. In our notation, lowercase letters i, x, and y represent transactors, and uppercase letters X and Y indicate distances of transactors x and y from i. Our use of exponential functions in distance is for comparability with Dixit (2003). Prüfer (2012) shows that results using this framework are robust to the substitution of linear functions in distance.

Table 1. Noncooperative Trade Game

i/x	Cooperate	Defect
Cooperate	h, h	l, w
Defect	w, l	d, d

Note. In this matrix $w > h > 0 > d > l$ and $2h > w + l$.

Stage 3. Transactors proceed to the enforcement stage corresponding to the relevant institution as described in the following sections.[9]

Finally, we assume that time (between periods) proceeds in discrete intervals, $t \in \{0, 1, \ldots, \infty\}$, and that transactors are risk neutral, have infinite horizons, and have a uniform per-period discount factor $\delta \in (0, 1)$.

2.2. Community Enforcement

Consistent with our emphasis on impersonal exchange, the probability that any particular pair of transactors will actually encounter each other again is zero in our model.[10] Consequently, in the absence of courts (or other third-party enforcement institutions), the only punishment that a transactor can impose on a partner who defects is to report the partner's misbehavior with the aim of affecting the behavior of future transactors. Such reports can be effective, however, only to the extent that a future transactor matching with the offending transactor has learned of the partner's prior defection and responds in a way that punishes the defector for his earlier misbehavior.

We model the dissemination of information through a transactor's community as a function of the transactor's location. Specifically, we assume that, following each transaction, every transactor reports the identity of his partner and the partner's behavior chosen from the message space {cooperated, defected, did not trade} and that the probability that a transactor y hears another transactor x's announcement is

$$\eta_{x,y} \equiv \kappa e^{-|Y-X|}, \tag{2}$$

where $|Y - X|$ is the distance between transactors y and x and $\kappa \in [0,$

9. As described below, community enforcement technically takes place in stage 1 of the next period, when each transactor decides whether to transact with his new trading partner.
10. This feature of the model is a crucial difference from the literature on relational contracting (for example, Baker, Gibbons, and Murphy 1994).

1] is a parameter reflecting transactors' overall connectedness to other transactors on the circle.[11]

As is standard, in deciding whether to cooperate, transactors trade off the gains from defection in the current transaction against the present value of potential lost trading opportunities in the future. From the payoff matrix in Table 1, the current-period gain from defection is $(w - h)e^{\theta X}$. The future cost of today's defection, meanwhile, depends on the expected value of future trade, the probability that future transacting partners with whom a transactor is matched have learned of his previous defection, and the reactions of those transacting partners to that knowledge. If we let L_i represent this expected future cost of defection, the discounted value to transactor i of cooperating relative to defecting in the current period t can be represented as $V(w, h, \theta, X, \delta, \kappa) = L_i - (w - h)e^{\theta X}$. Defining the scope of cooperation as the range of distances between two players for which trade and cooperation constitute an equilibrium, and letting $X^* = \{X|V = 0\}$ denote the boundary of the scope of cooperation, we propose the following candidate equilibrium strategy:

Community Enforcement (CE) Strategy. For player i matched with partner x,

1) in $t = 1$, if $\theta > 0$ [$\theta < \theta^*$], transactor i transacts and cooperates with partner x if the distance between i and x is $X \leq X^*$ [$X \geq X^*$] and does not transact otherwise;

2) in every subsequent period, i transacts and cooperates with its match x unless the distance $X > X^*$ [$X < X^*$], or player i has received news that x defected in period $t - 1$, or player i himself defected in period $t - 1$ and his match x has learned about it, in any of which cases transactor i does not interact with x.[12]

In effect, the CE strategy calls for a transactor to transact with his current match if cooperation is individually profitable ($V(\cdot) \geq 0$) unless either has learned that the other defected in the previous period. In Appendix Section A.1, we characterize the relation between the value of cooperating, $V(\cdot)$, and the boundary of the scope of cooperation under

11. We assume the parameter κ to be the same for all transactors. Prüfer (2012) shows that, if transactors have different κ's, cooperation is dependent on the κ of the less well connected transactor (smaller κ_i), but results remain qualitatively unchanged. As is common in the literature (see, for example, Kandori 1992; Kali 1999; Dixit 2003), we also assume that reporting is truthful. A model in which detecting the veracity of reports is easier the closer the source of the report to the recipient would yield qualitatively similar results.

12. For purposes of the model, we assume that transactors who defected in the previous period know whether their new trading partners have learned of that defection.

community enforcement, X^*, and show that the CE strategy constitutes a Markov perfect equilibrium to the infinitely repeated game in which mutual cooperation occurs within the scope of cooperation and trade breaks down for transactions outside that range. Specifically, we establish the following proposition:

Proposition 1: The Scope of Cooperation under Community Enforcement. A Markov perfect equilibrium exists in which all players play the CE strategy and, in equilibrium, the scope of cooperation, in which players transact and cooperate with each other, is delimited by X^*. Outside the range $[\theta^*, 0]$, community cooperation occurs in equilibrium for nearby transactions $(X < X^*)$ for $\theta > 0$ and for distant transactions $(X > X^*)$ for $\theta < \theta^*$. Within the range $[\theta^*, 0]$, community enforcement may support cooperation for either nearby or distant transactions or both.

Proposition 1 implies that, for $\theta > 0$, there exists an upper bound X^* on the distance between partners up to which it is rational for i to cooperate. For larger distances, the expected future punishment is too small to overcome the short-term gain to defection. This occurs because future punishment depends on the transmission of information, captured by $\eta_{x,y}$, and the probability of being matched to a community member of x in the next period, captured by μ, both of which decrease in distance, and gains from defecting in a current transaction are a function of the potential gains from trade, which increase with distance when $\theta > 0$.

In the case of negative θ, X^* defines the lower boundary on rational cooperation for $\theta < \theta^*$ (where θ^* is a specific level of $\theta < 0$ defined in Section A.1). In other words, where larger distances between matched transactors sufficiently decrease the value of the transaction, the connectedness of a nearby x may not be enough to induce i to cooperate because the proximity of the partners causes the payoff from defecting (which increases with the value of a transaction) to exceed the expected punishment despite the higher incidence of matching and communication among nearby transactors. Between θ^* and 0, regions of cooperation may occur for either or both distant or nearby transactions, the cause of which is the conflicting effect of V on the three parameters $\eta_{x,y}$, μ, and θ that enter as coefficients on X, which makes V nonmonotonic in X (see Section A.1).

Figure 2 depicts the boundary of effective community enforcement X^* in (θ, X)-space using a numerical example. In the figure, community enforcement is effective—transactors have an incentive to cooperate with
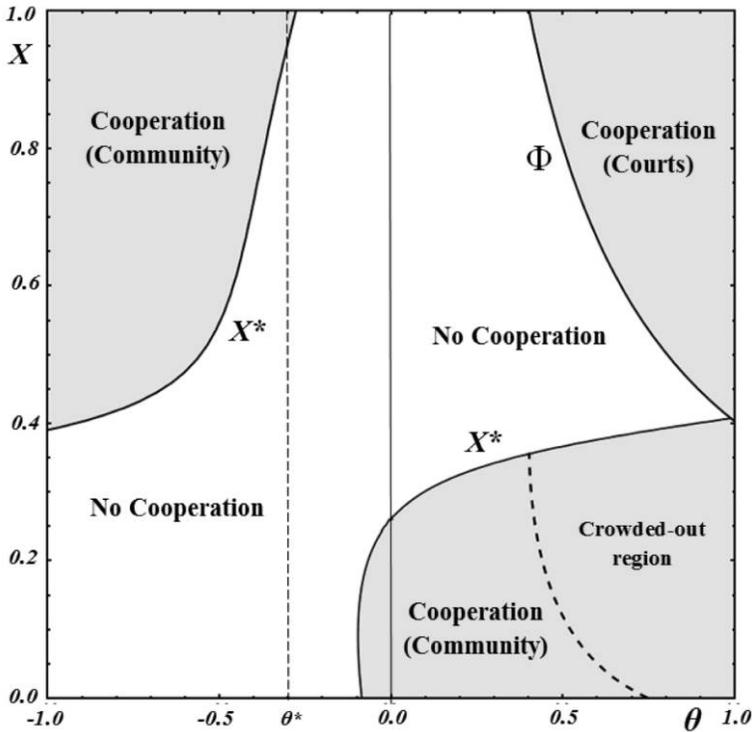
Figure 2. Cooperation under community and court enforcement (numerical example for $w = 1.4$, $h = \kappa = c = 1$, $l = -0.5$, $\delta = 0.6$, $\tau = 0.45$).

each other ($V > 0$)—in the shaded northwest and southeast corners of the graph but not in the other regions. In other words, community enforcement is able to sustain cooperation for transactions between nearby partners when the gains from trade increase with distance or dissimilarity (θ is positive) and for relatively low value transactions between distant or dissimilar partners when gains from trade increase (sufficiently) with proximity.[13]

2.3. Court Enforcement

Consistent with our earlier characterization, we model courts as having the ability to investigate claims of defection and the power to levy dam-

13. Figure 2 also illustrates the potential existence of regions of cooperation for both distant and nearby transactions for values of θ within $[\theta^*, 0]$.

ages on defecting parties. Moreover, because courts in our model are generalist—that is, they lack the local expertise and knowledge of transactors in the economy—they may not be able to determine fault as accurately as would members of a community.[14] More specifically, we assume that the capacity of courts to adjudicate disputes is related to the characteristics and complexity of transactions (relative to the court's inherent ability) but not to the location of the transactors: transactors' locations have no differential effects on the effectiveness of courts. We capture differences in the difficulty of adjudicating a dispute through a single parameter, $\tau \in [0, 1]$, which can be thought of as the probability that a plaintiff with a valid claim is able to satisfy the burden of proof necessary to win its case.[15]

If a court rules for the plaintiff, the court requires the defendant to pay the plaintiff damages D. If the plaintiff fails to prove its case, the court finds for the defendant, and no damages are awarded. In the event that both parties sue, the court evaluates each party's claim and assesses damages independently, so that each party's payoff is the sum of outcomes of each suit. Finally, both filing and defending suits are costly: plaintiffs incur costs c and defendants incur costs g.[16]

Given these assumptions, the expected payoff to a transactor from filing suit depends on both his behavior and that of his partner in the central transaction. Specifically, a transactor's expected payoffs from filing suit, as a function of his own and his trading partner's behavior in the central transaction, are as follows: A transactor who cooperated while his partner defected would expect $\tau D - c$ from filing suit and have a payoff of $-g$ if sued by his (defecting) partner. A transactor who defected while his partner cooperated would expect $-\tau D - g$ from being sued and have a payoff of $-c$ were he to sue his (cooperating) partner. If both transactors cooperate or both defect, the plaintiff gets $-c$ and

14. These assumptions distinguish court enforcement in our model from that of external enforcement in Dixit (2003), in which courts lack the power to coerce performance and are able only to detect (perfectly) and report incidents of cheating.

15. Because trade is always efficient in the model ($he^{\theta X} > 0$), only type II (false-negative) judicial errors can occur. We assume that courts are able to compel payment through, for example, the threat of imprisonment for failing to obey a court order and are impartial and nonstrategic: their decisions are rule based and not dependent on the identities of the parties or on inferences from the strategies of the litigants.

16. We assume that litigants bear their own costs regardless of who wins the case. Results would not be materially affected under the assumption that the loser pays the prevailing party's litigation costs.

the defendant get $-g$, and thus each would receive $-c - g$ if both filed suit.

On the basis of this payoff structure, we can show (see Section A.2) that court enforcement will sustain cooperation if and only if damages D satisfy

$$D \geq \max \left\{ \frac{c}{\tau}, \; \frac{(w-b)e^{\theta X} - g}{\tau} \right\}. \tag{3}$$

The main implication of this inequality is that, for cooperation to be sustained through court enforcement (as part of a subgame perfect equilibrium), two conditions must be satisfied. First, the damage payment a transactor expects to receive must be large enough to justify the cost of filing suit. Second, the damage payment a defector expects to have to pay has to be sufficiently large relative to the gain from defecting to deter defection. If either condition is violated, court enforcement will fail to support cooperation, and the unique Nash equilibrium at stage 1 is for the parties not to transact.

As is well known, with sufficiently large damages, courts could assure cooperation in every transaction. For both practical and doctrinal reasons, the damages that a party can expect to pay for breach of contract are typically limited. For purposes of our analysis, we assume, as is true in many contexts, that courts award expectation damages, which, given the payoff matrix in the central transaction above, are $D_{\text{Exp}} = (b - l)e^{\theta X}$ in our model.[17] The following proposition (proved in Section A.2)

17. Although English common-law courts came to favor monetary damages fairly early, relegating claims for equitable relief to the Chancery (see, for example, Plucknett 1956, pp. 687–89), the default remedy in civil law has traditionally been specific performance, with recourse to monetary damages where specific relief was not practical or possible, such as claims for late delivery. An artifact of our model is that, because performance is always efficient, the availability of specific performance does not materially alter our results. If remedial performance is not feasible, the existence of specific performance is obviously irrelevant. If, on the other hand, performance subsequent to a determination of liability is possible, a defendant who is found liable for expectation damages will always prefer performance to paying damages in the model, which thus yields the same outcome as under specific performance. Finally, because the expected payoff to a successful plaintiff under either remedy is the value of performance times the probability of prevailing, plaintiffs' incentives to sue are also the same under expectation damages and specific performance. Harsher sanctions, including corporal punishment, for contract violations were more prevalent in medieval times. But a greater severity of punishments was likely offset (and perhaps justified) by a lower probability of locating and returning a merchant engaged in long-distance trade. The severity of punishments would likely also have been constrained by state competition for traders; see note 6.

characterizes the range of transactions for which court enforcement will sustain cooperation.

Proposition 2: The Scope of Cooperation under Court Enforcement. In subgame perfect equilibrium with court enforcement, transactors cooperate if and only if the distance between them, X, satisfies the following conditions:

case $\theta > 0$:

$$X \geq \Phi \qquad \text{if } \tau \geq \frac{w - h}{h - l} - \frac{g}{(h - l)e^{\theta}} \tag{4}$$

and

$$X \in [\Phi, \Gamma] \qquad \text{if } \frac{w - h}{h - l} - \frac{g}{(h - l)e^{\theta}} > \tau \geq \frac{w - h - g}{h - l}; \tag{5}$$

case $\theta < 0$:

$$X \leq \Phi \qquad \text{if } \tau \geq \frac{w - h - g}{h - l} \tag{6}$$

and

$$X \in [\Gamma, \Phi] \qquad \text{if } \frac{w - h}{h - l} - \frac{g}{(h - l)e^{\theta}} \leq \tau < \frac{w - h - g}{h - l}; \tag{7}$$

where

$$\Phi \equiv \ln\left[\frac{c}{(h - l)\tau}\right]/\theta \quad \text{and} \quad \Gamma \equiv \ln\left[\frac{g}{(w - h) - \tau(h - l)}\right]/\theta. \tag{8}$$

The parameters Φ and Γ define the boundaries of the scope of cooperation under court enforcement. For relatively accurate courts, represented by high values of τ (as defined by equations [4] and [6]), the range of transactions for which court enforcement supports cooperation is limited only by the transactors' willingness to sue: for distances outside the relevant boundary, Φ, prospective damages are too low to justify the expense of filing suit. Specifically, for $\theta > 0$, Φ represents a lower bound on the distance at which the partner x may be located from player i for mutual cooperation to be rational. For distances X less than Φ, transactors defect at stage 2 knowing that litigation costs are too high relative to expected damages to justify their partners' filing suit, and, consequently, they do not transact at stage 1. For $\theta < 0$, the threshold for filing suit is satisfied for transactions with closer (and therefore more valuable) trading partners. In this case, Φ represents an upper bound on distance for cooperation instead.

For less accurate (lower τ) courts, transactors' maximization behavior in the central transaction may also yield an additional bound on cooperation defined by Γ: if the distance X is too large (in the case of $\theta > 0$) or too small (for $\theta < 0$), the gains to defection will be too large relative to the expected damages, given the inaccuracy of the court, to sustain cooperation. In this event, cooperation fails, not because courts are too expensive relative to the stakes but because they are insufficiently effective in assessing liability to deter opportunism given the large payoff to defection.

Figure 2 depicts the boundary of effective court enforcement Φ in (θ, X)-space, again, using a numerical example.[18] For the parameter values used, court enforcement is able to sustain cooperation in the shaded northeast corner of the graph: courts become effective only when the value of trade with distant or dissimilar partners is sufficiently valuable, and their scope of effectiveness expands as the effect of distance on the value of trade gets larger (that is, as θ increases).

2.4. The Determinants and Interaction of Community and Court Enforcement

Our models of community and court enforcement contain several institution-specific parameters that influence the effectiveness of community and court enforcement in largely transparent ways: greater transactor connectedness (κ) and more accurate adjudication (τ), for example, increase the range of transactions for which community and court enforcement, respectively, sustain cooperation.[19] Our primary interest,

18. The upper bound on effective court enforcement, Γ, does not appear for the parameter values used in Figure 2. An artifact of Dixit's (2003) exponential gains-from-trade specification, which we also adopt, is that, holding other parameters constant, the gains from trade for $\theta \leq 0$ (the maximum of which occurs at $X = 0$) are always less than or equal to the gains from trade for $\theta \geq 0$ (the minimum of which also occurs at $X = 0$). Balancing potential gains from trade for positive and negative θ's (by, for example, varying h appropriately) would show court enforcement to be effective in sustaining cooperation for low-X transactions when $\theta < 0$ (for sufficiently high τ). The overall increase in expected gains from trade in the model as θ rises is broadly consistent with the expansion of wealth that accrues to decreasing costs of and barriers to trade associated with globalization.

19. An implication worth noting is that, because $L_i(\kappa = 0) = 0$, transactors will not transact with transactors who are not connected (that is, if $\kappa = 0$), which underscores the importance of communication in environments of impersonal exchange where, despite infinitely repeated exchange, the likelihood of any two transactors meeting again is too low (here, zero) for bilateral sanctions to sustain cooperation. Other immediate implications of the definitions of L_i and V (see equations [A1] and [A4]), include that the scope of community enforcement decreases with gains from defecting ($\partial V/\partial(w - h) < 0$) and increases with the discount factor (time horizon) ($\partial V/\partial \delta > 0$).

however, is in the effects of the underlying economic variables common to both models—in particular, dissimilarity or distance X and the relationship between distance and the value of cooperative trade captured by the parameter θ—with respect to which the preceding analysis yields a number of novel insights. First, contrary to speculation by Dixit (2003, p. 1297) that, for negative values of θ, "trades will unambiguously best be carried out using automatic self-governance in small communities each of which has homogeneous membership," we find that increases in the gains to reneging (defection) that accompany increases in the value of local (low-X) trade when $\theta < 0$ may outweigh the greater likelihood that nearby transactors learn about previous defections, which results in a breakdown of cooperation. This finding is illustrated in Figure 2, which shows community enforcement sustaining cooperation for negative θ only for the relatively low value (high-X) transactions in the northwest corner.

Second, in contrast to Dixit's model, in which external governance substitutes for self-governance (community enforcement) and expands the "scope of honest trade" (cooperation; Dixit 2003, p. 1297) only for large-enough economies, courts and communities in our model are complementary in the sense that they tend to support cooperation for different sets of transactions: community enforcement tends to work best for relatively low value transactions, and court enforcement tends to work best for relatively high value transactions.[20] This complementarity appears in Figure 2 for positive values of θ (the right-hand side of the figure), where community enforcement supports cooperation with relatively nearby (low-X) transactors in the southeast corner while court enforcement sustains cooperation between more distant (high-X) transactors in the northeast corner. As seen in Figure 2, an implication of the complementarity of communities and courts is the possibility that a range of distances exists for which neither communities nor courts alone can sustain cooperation. Also possible, but not illustrated in Figure 2 (except

20. As noted in Section 2.3, depending on the accuracy of courts, an upper limit may also exist on the value of transactions for which court enforcement is effective. The contrast with results from Dixit (2003, p. 1309) derives from his conception of external governance, which operates, in effect, as an intermediary providing complete information on traders' previous behavior. Whereas the effectiveness of self-governance (community enforcement) is limited by the size of the economy in his model, his external governance sustains cooperation universally for any size economy but at an administrative cost proportional to the size of the economy.

at a point on the X-axis for $\theta = 1$), is that the ranges covered by communities and courts overlap.

The analysis to this point has examined the range of transactions for which courts and communities are capable of sustaining cooperation individually, that is, without considering whether the existence of one enforcement institution affects the performance of the other. Typically, however, transactors will have access to both communities and courts, and defectors may be subject both to community sanctions L and to damages plus litigation costs, $\tau(h - l)e^{\theta X} + g$. The consequences of the simultaneous availability of both institutions for cooperation depend on the distance between transactors in their current match, X, and can be divided into three cases or regions corresponding to whether cooperation is supported by courts alone, not supported by either institution alone, or supported by communities alone.

Case 1. For transactions in the interval $X \in [\Phi, \Gamma]$ ($X \in [\Gamma, \Phi]$ for $\theta < 0$), for which courts sustain cooperation by themselves, the additional availability of community sanctions has no effect: under the conditions set out in proposition 2, filing suit is individually rational in this region, and the threat of court enforcement is sufficient to support cooperation without the addition of community enforcement. In other words, if courts are effective in supporting cooperation on their own, communities are irrelevant.

Case 2. Outside the interval over which courts are effective alone, the coexistence of communities and courts will support cooperation for some transactions that could not be sustained by either institution individually. Specifically, for distances $X > \Gamma > X^*$ ($X < \Gamma < X^*$ for $\theta < 0$), the expected punishment for defecting is the sum of L_i and $\tau(h - l)e^{\theta X} + g$: in this region, filing suit against a defecting trading partner is individually rational, but enforcement is insufficiently accurate (τ is too low) and, therefore, the expected court sanction is too small to deter cheating for these high-value transactions. For distances outside but close to Γ, however, the addition of community sanction L_i will be enough to make defection unprofitable.[21]

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21. Because an interior upper bound on effective court enforcement does not occur for the parameter values used in Figure 2 (that is, $\Gamma = 1$), this expansion of the range of court-supported cooperation with the introduction of communities is not illustrated. Note that, although combined court and community sanctions would also be large enough to deter defection for some transactions outside but close to Φ, filing suit is not rational in this area because expected damages are too low to justify litigation costs, and consequently only community sanctions are operative.

Case 3. Finally, whereas the existence of communities supplements court enforcement, the existence of courts diminishes the effectiveness of community enforcement.[22] Recall that L_i, the punishment to transactor i for defection in the current period under community enforcement, is the loss associated with the possibility that transactor i's next-period match will refuse to trade with i. With the existence of courts, the possibility arises that i's next-period match will find it profitable to trade with i even though he has learned of i's prior-period defection, because he knows that the threat of court enforcement will induce i to cooperate in the new $(t + 1)$ transaction. More precisely, a next-period match y will trade with i regardless of i's current behavior if y lies in the interval for which court enforcement is effective, $Y \in [\Phi, \Gamma]$ $(Y \in [\Gamma, \Phi]$ for $\theta < 0)$. As a result, the expected loss to i from defecting, L_i, will be reduced by an amount, L_Δ, equal to the expected value of trade with next-period transactors who lie within the scope of court enforcement. For the parameter values used to illustrate the results in Figure 2, this reduction in the expected community punishment (for $\theta > 0$) would be[23]

$$
L_\Delta \equiv \delta \left[\int_\Phi^\Gamma \frac{e^{-Y_2}}{2(1 - e^{-1})} \kappa e^{-(Y_2 - X)} h e^{\theta Y_2} dY_2 \right.
$$

$$
\left. + \int_\Phi^\Gamma \frac{e^{-Y_3}}{2(1 - e^{-1})} \kappa e^{-(2 - X - Y_3)} h e^{\theta Y_3} dY_3 \right].
$$

(9)

It is straightforward to see that the larger the scope of court enforcement $[\Phi, \Gamma]$, the larger is L_Δ, and, therefore, the smaller will be the community punishment for defection in the presence of court enforcement, $L_i - L_\Delta$. Accordingly, the range of transactions for which community enforcement can sustain cooperation when court enforcement is

22. We thank Robert Gibbons for originally drawing our attention to this crowding-out effect. Cooter and Landa (1984) offer a model in which increased effectiveness of court enforcement reduces membership in trading groups—their analog to community enforcement in our model—but, because the probability of member performance declines with the size of trading groups (by assumption), the resulting smaller group size enhances, rather than diminishes, the effectiveness of trading groups in their model.

23. The variables Y_2 and Y_3 represent distances of next-period matches that fall within ranges characterized in Section A.1 and illustrated in Figure 1. Although the exact form of L_Δ depends on specific parameter values in relation to conditions (4)–(7) and equation (8) of proposition 2, the result that L_Δ increases with the scope of court enforcement is general. A formal proof of the crowding-out result is available in the online appendix.

also available will be smaller than if courts did not exist. In Figure 2, the effect of the existence of effective court enforcement on the scope of community enforcement is depicted by the dashed curve extending from X^* at $\theta = .4$ to the horizontal axis; for the parameters in the figure, the region for which communities can sustain cooperation shrinks by the area below X^* and to the right of this dashed curve (labeled "crowded-out region") as the scope of court enforcement expands with increases in θ.

In sum, the result that communities and courts tend to be effective for different transactions implies that, in some environments, cooperation may be supported over a broader range of transactions when both institutions exist than with either alone. Moreover, when the accuracy of courts is poor (low τ), the availability of community sanctions can supplement weak court enforcement. But the existence of court enforcement also tends to undermine community sanctions, which reduces the scope of community enforcement as the range of transactions for which courts are effective increases. Finally, we wish to emphasize that changes in the effectiveness of enforcement institutions, both individually and in relation to each other, result in this analysis from changes in the relationship between distance and the value of trade (embodied in θ) and not because of changes in the inherent, system-specific qualities of the institutions themselves (such as τ or κ).

3. COMMUNITIES, COURTS, AND THE COMMERCIAL REVOLUTION

The period of commercial development as Europe emerged from the Dark Ages (roughly 5th to 9th centuries) illustrates the problems of sustaining cooperation among impersonal transactors needed to realize the benefits of expanding trade. The economic decline and stagnation precipitated by the fall of the Roman Empire was followed, beginning in the 10th century, by a period of increasing agricultural productivity, urbanization, and, eventually, intercity and overseas trade. Merchants wishing to engage in such trade faced numerous obstacles, however: "[T]he merchants of Medieval Europe . . . were separated from one another by geographic barriers, by cultural diversities and by dissimilar profit goals. . . . [T]he sanctions applied by local communities in subsistence economies no longer represented a realistic control over transregional trade. . . . Medieval merchants could avoid their creditors by transacting within new markets, by moving their wares to distant fairs and impersonal guilds. The risk of 'evil men . . . entering the realm of

the trusted' evolved as a realistic threat to inter-community trade in medieval society" (Trakman 1983, p. 17).

Although aspects of its nature and operation remain in dispute, scholars generally agree that the system of mercantile courts known as the law merchant offered at least a partial solution to the challenges confronting medieval traders. Chief among its attractive features were its speed, informality, and reliance on merchants' commercial customs. Law merchant hearings were expeditious and free of formalistic procedures (see, for example, Berman 1983, p. 347; Baker 1979, pp. 300–304). Most disputes were resolved within a day or two (Gross 1906, pp. 243–44; Sachs 2006, p. 685), and appeals were generally forbidden (Berman 1983, p. 347; Gross 1906, p. 236). Because merchant courts were administered by merchant judges chosen "on the basis of their commercial experience, their objectivity and their seniority within the community of merchants," rather than by professional jurists (Trakman 1983, p. 15; see also Berman 1983, p. 346), decisions of merchant courts were sensitive to the needs and understandings of the merchants. Finally, if more controversial, the law merchant addressed the problem of weak and ineffective state enforcement: merchants who failed to comply with merchant court decisions risked ostracism from the merchant community (Benson 1989, p. 649; Trakman 1983, p. 10; Milgrom, North, and Weingast 1990, p. 5).[24]

Even if the law merchant did not operate as adroitly as its most ardent admirers suggest, the system seems to have operated well enough for interregional trade to prosper for much of the 11th and 12th centuries. Gradually, however, the functions of the merchant courts began to be

24. Some descriptions of the law merchant border on utopian (see, for example, Benson 2002, pp. 127–31). Whether the law merchant was in fact self-enforcing, as many scholars have claimed, has been the subject of debate (see, for example, Kadens 2004, p. 51). Our review of the literature reveals surprisingly thin documentary support for the claim that the threat of ostracism sustained merchant court decisions. Such weak documentary evidence could simply reflect the success of the law merchant in securing merchants' compliance: ostracism could have been rarely observed because it was so effective; no merchant would risk the loss of business by ignoring merchant court rulings. Merchants' reputations undoubtedly mattered in other ways as well. The willingness of fellow merchants to testify on behalf of a litigant, and the credibility of that testimony, would likely have depended on the litigants' and witnesses' reputations and standing in the merchant community, for example. Even if merchant courts did not rely exclusively on merchants' reputations, their limited jurisdiction would likely have left them more dependent, relative to centralized state courts, on community enforcement for their successful operation. Sufficient for our purposes is that, on the continuum of formal and informal enforcement institutions that exist in most economies, the law merchant was more community-like in character (compare note 6).

taken over by public courts.[25] Although state courts initially sought to retain the law merchant's most desirable properties, over time the rigid procedures and strict adherence to uniform substantive doctrines associated with modern courts came to dominate.[26]

Prevailing explanations for this history tend to emphasize the emergence of the law merchant as a response to the absence of effective state enforcement rather than the inherent superiority of private courts.[27] Richman (2004, pp. 2335–36), for example, includes the medieval law merchant among the set of "commercial networks [that] resort to self-enforcement because state contractual enforcement is not a reliable option." Similarly, Milgrom, North, and Weingast (1990, p. 4) characterize the law merchant as a means of securing merchant bargains "prior to the rise of large-scale third-party enforcement of legal codes by the nation-state" (compare Benson 1989, p. 647). If the absence of effective state enforcement occasioned the rise of the law merchant, it then stands to reason that the growth and extension of state authority would lead to its decline.[28] Over time, it is argued, states acquired both an interest in shaping commercial law and the coercive power to enforce state court

25. Despite its "ideal" nature, "the Medieval Law Merchant failed to prevail entirely in its original form" (Trakman 1983, p. 17). "Toward the end of the medieval period the local mercantile courts suffered a decline" (Baker 1979, p. 306).

26. In England, for example, local maritime courts were superseded by centralized courts of admiralty appointed by the Crown, the first references to which occurred in the mid-14th century (Plucknett 1956, p. 661). The procedure of these courts, which dealt with both commercial and maritime matters, "was of the slower civilian type" and were subject to criticism (Plucknett 1956, pp. 661–62). During the 16th century local admiralty courts largely succumbed to the central admiralty, which, in turn, increasingly surrendered jurisdiction over commercial matters to the common-law courts (Plucknett 1956, pp. 663–64; see also Trakman 1983, pp. 276–81; Zywicki 2003, p. 1607).

27. For examples of the alternative, preferability-of-private-law explanation, see Zywicki (2003, pp. 1596–97): "[T]here was no demand by merchants for the common law to innovate because merchants were satisfied with the rules produced by the *lex mercatoria*"; Stringham and Zywicki (2011, p. 512): "The common law . . . did not deal with disputes between merchants, in large part because of the incompetence of the common law courts to deal with commercial disputes."

28. See, for example, Cooter (1996, p. 1648): "[A]s the English legal system became stronger and more unified, English judges increasingly assumed jurisdiction over disputes among merchants"; Stringham and Zywicki (2011, p. 512): "[T]he law merchant courts appear to have been victims of the creeping power of the common law courts, which imposed their own bureaucratic practices on law merchant courts and asserted the right to hear appeals from them."

judgments.[29] Such coercive power gave state courts an advantage over community enforcement: "Rather than depend for punishment upon the decentralized behavior of merchants, state enforcement could seize the property of individuals who resisted paying judgments, or put them into jail. If judgments could be enforced this way, then, in principle, the costs of keeping the merchants well informed about one another's past behavior could be saved" (Milgrom, North, and Weingast 1990, pp. 20–21).[30] At the same time, states were showing an increasing interest in commercial trade, and by the 16th century, "great and powerful kingdoms with definite commercial policies of their own, began freely to declare and to modify the law" (Mitchell 1904, p. 157).

European states undoubtedly gained power and expanded their reach over the course of the second millennium. Far less clear, however, is whether state courts became significantly more effective or less costly over time or what interest states had in using contract enforcement as a vehicle for regulating commercial transactions. Indeed, instead of imposing state authority over contract disputes on resistant merchants, states appear to have taken on the function of contract enforcement reluctantly. Twelfth-century royal courts in England, for example, exercised jurisdiction over property, tort, and criminal matters but deliberately eschewed enforcement of contracts: "[I]t is not the custom of the court of the lord king to protect private agreements, nor does it even concern itself with such contracts as can be considered like private agreements" (*Tractatus de Legibus et Consuetudinibus Regni Angliae* [circa 1188], quoted in Simpson 1987, p. 4; see also Baker 1979, pp. 296–97). Before the 15th century, "[t]he King's court was not very fond of contract" (Plucknett 1956, p. 637). States clearly had the capacity to enforce merchant contracts long before they assumed that role.

29. As this statement suggests, the state-ascension hypothesis has two versions. One holds that states' wresting of control of courts from merchants was hegemonic: although merchant courts were more efficient, states were intent on centralizing authority (for example, Benson 1989, pp. 651–63; Mitchell 1904, p. 157). The other, more benign, version is that, as state court administration and enforcement capacity improved, merchants gravitated from merchant courts to the now-superior state courts. This second explanation would correspond to an improvement in τ (and possibly an increase in the size of damages D) in our model.

30. Despite emphasizing the absence of effective state enforcement in the rise of the law merchant, Milgrom, North, and Weingast (1990, p. 21) ultimately attribute its demise to increasing information costs of running the system as the volume of trade increased. Their results differ from ours in that, among other things, theirs depend on the volume of trade whereas ours turn on the composition of trade.

3.1. The Evolution of Trade and Enforcement Institutions in Medieval Europe

In contrast to the prevailing treatment, our analysis suggests an explanation for both the emergence of the law merchant and its subsequent supersession by state courts that does not depend on exogenous changes in the competence, power, or interests of states. The central result of our model, illustrated in Figure 2, is that the effectiveness of enforcement institutions varies with the value of trading with distant transactors. In settings where the most valuable trade is local (corresponding to $\theta < 0$ in the model), community enforcement is effective for a range of relatively low value transactions, but voluntary trade either cannot be sustained or, for the highest-value projects, requires enforcement by a third party with coercive power. When, by contrast, the relationship between the profitability of trading opportunities and the distance (or dissimilarity) of transactors turns positive ($\theta > 0$) and increases, community enforcement initially suffices for transactors with sufficiently similar attributes and shared knowledge but is eventually undermined as the range of transactions for which court enforcement is effective expands.

Economic conditions in Europe in the Middle Ages largely conformed to this progression. By all accounts, the period preceding the Commercial Revolution in Europe, roughly the 5th–9th centuries, was one of general economic contraction, leaving Europe with "little room for investment over and above the preservation of life" (Lopez 1971, p. 59). The collapse of the Roman Empire, barbarian invasions, and coastal piracy combined to make travel and transportation, already hazardous, even more dangerous. With the Muslim conquest of the northern coast of Africa, shipping between the southern and northern Mediterranean effectively ended (McCormick 2001, pp. 110, 118–19); in the rest of the Mediterranean, trade was "absolutely marginal" (McCormick 2001, p. 574).

The factors that contributed to the reinvigoration of European trade are numerous (and disputed), but among them were increased agricultural productivity and associated population growth and the attenuation of the barbarian threat and strengthening of states, which improved security for both persons and possessions. Gradually, trade routes began to reopen, and opportunities for profitable long-distance trade reemerged. The limitations of ships and general risks of sea travel limited the volume and range of goods suitable for interregional trade, however. To be profitable to transport, goods had to be valuable enough to justify

the cost of transportation (high value to weight) but not so valuable that their loss would be ruinous.[31] In the Mediterranean, goods meeting these criteria included incense, spices, and silk from the Near East and furs, swords, and slaves from Europe (McCormick 2001, pp. 662, 729–35; Williamson 2010, p. 11); in northern Europe, interregional trade before the 13th century consisted primarily of such high-value-to-transport-cost products as wax, furs, wine, and cloth (Hybel 2002, p. xviii; Campbell 2002, p. 6).[32]

The growth in long-distance trade accelerated further with a series of innovations in shipbuilding technology beginning in the late 12th century that significantly lowered transportation costs and expanded the types and volumes of goods that could be economically traded. Historical and archeological studies estimate that the largest early medieval commercial ships had maximum capacities under 75 tons (Bill 2002, pp. 102–3; McCormick 2001, pp. 95–96, 415–16). Around 1180–1200, however, shipbuilders began to adopt a new method of construction involving the insertion of horizontal beams that protruded through the planking of the ship's sides (Bill 2002, p. 105). Such through-beam construction and other improvements, followed by a second wave of major innovations in the 15th century, allowed shipbuilders to construct cargo ships that were not only significantly larger but sturdier, safer, and cheaper than their predecessors (Bill 2002, pp. 105–12; Unger 1980, pp. 216–21). Maximum cargo capacities, which had been essentially static before 1150, roughly doubled at the end of the 12th century and continued to rise throughout the late Middle Ages and beyond, reaching capacities of at least 500 tons in the north and more than 1,000 tons in the Mediterranean by 1600 (Bill 2002, pp. 102, 112; Unger 1980, p. 221).

The reduction in transportation costs that accompanied larger and safer ships increased the volume but also changed the nature of commerce. First, no longer limited to products of high value relative to transport costs, later trade also included heavier and lower-value cargoes, with commerce in bulk commodities such as stone, pottery, timber, and grain "develop[ing] from an incidental activity to regular trade during the two and half centuries from 1150 to 1400" (Hybel 2002, p. xvii).

31. McCormick (2001, p. 407) notes that, under Rhodian sea law, "[m]erchants who freighted heavy or expensive cargoes aboard old ships were not entitled to indemnification."
32. Verlinden (1965, p. 127) lists products regularly traded at fairs in Flanders and Champagne in the early 12th century as including cloth, silk, leather, fur, linens, spices, wax, sugar, alum, lacquer, and dyewoods.

Tariff lists and other records attest that "the supply of goods in the period 1200–1350 became quite differentiated" (Poulsen 2002, p. 35). Second, as the volume and variety of traded goods grew, so did the number of markets serving that trade.[33] Initially, a few prominent cities and ports and a relatively small number of organized fairs served as the principal venues for long-distance trade. The expansion of trading opportunities for merchants, however, created profit opportunities for rulers and landlords, who stood to gain from the collection of rental fees, customs, and tolls as well as from increased business for their tenants (Britnell 1981, p. 221; Kadens 2004, p. 49). In England, for example, the Crown granted over 300 licenses for new markets between 1200 and 1349 in 21 counties alone (Britnell 1981, pp. 209–10).[34] Although most of these new markets were inland and not directly related to long-distance trade (Britnell 1981, p. 215), coastal and riparian markets also proliferated: "The growth of long-distance trade . . . accounts for the exceptionally rapid growth of markets on advantageous sites," especially along rivers and the sea coast, which became "colonized as never before with markets" (Britnell 1981, pp. 213–14).

The decline in transportation costs and expansion of long-distance trade opportunities during the Commercial Revolution and thereafter correspond to an increase in θ in our model, from negative during the early Middle Ages, when limited opportunities and high risks depreciated the value of trade over long distances, to progressively more positive values as shipping technology and the safety and security of merchants and their cargoes improved. In the earliest period, "agriculture was paramount, commerce and industry were adequate but marginal, security and stability rather than growth were the supreme ideal of the ruling classes" (Lopez 1971, p. 57). What trade did take place was necessarily local and of modest value, for which community enforcement was likely to have been sufficient, with the most valuable investments—fortifications, water mills, and churches, for example—undertaken under the direction

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33. Berman (1983, p. 335) cites estimates that the number of merchants in western Europe also increased dramatically, from the thousands in 1050 to the hundreds of thousands by 1200.

34. These 21 counties represented 55 percent of the land area of England (Britnell 1981, p. 209). Two-thirds (219 of 329) of the markets licensed in this period survived into the 16th century (Britnell 1981, pp. 210, 219). On the increase in medieval market towns in Normandy, see Hilton (1985), and on the increase in Germany, see Bindseil and Pfeil (1999). On the proliferation of fairs in the late Middle Ages, see Epstein (1994).

and control of the local lord.[35] The volume and geographic distances of trade increased through the first 2 centuries of the new millennium as lower transportation costs and risks permitted greater realization of gains from trade associated with regional dissimilarities in climate, technology, knowledge, and resources (low positive θ), but because the range of traded products and the number of markets remained limited, transactions during this middle period tended to occur within relatively stable communities of merchants, whose proximity (low X) in terms of knowledge, experience, and acquaintances were conducive to community enforcement. Gradually, the proliferation of ports and products and the larger capacities of ships that accompanied continued improvements in shipping technology and navigation after 1200 (increasing θ) raised the value to merchants of trading outside of (that is, at greater informational distances from) their traditional markets, transactions for which community enforcement would have been less effective but for which court enforcement was relatively well suited.[36]

3.2. Institutional Evolution in Asia

Roughly contemporaneous with Europe's Commercial Revolution, Asia also experienced a period of protracted growth in long-distance trade. Beginning in the 10th century, "[t]he volume of sea trade in Southeast Asian waters grew dramatically . . . and continued at a high level until the mid-thirteenth century" (Christie 1998, p. 344; Roy 2012, p. 43). And as in Europe, this was followed by a second great expansion, beginning in Asia around 1400 AD and continuing into the 17th century (Reid 1993, pp. 10–18). Like their European counterparts, Asian merchants initially relied on informal institutions to govern their transac-

35. On the conditions of pre–Commercial Revolution Europe generally, see Volckart and Mangels (1999, pp. 435–36).

36. We do not mean to suggest that this progression was uniform or monotonic; wars and plagues, among other factors, interrupted and not infrequently reversed the general trends. But the long-term direction was toward expanding opportunities for long-distance trade. Compare Lopez's (1987, p. 375) distinction between inner and outer areas of trade in the 14th century: "The 'outer' area was a field of large risks and large profits, a frontier where good luck was almost as important as good management. . . . In the 'inner' area of long-distance trade, however, commerce had now ceased to be an adventure. It was a highly competitive market, where success depended mainly on efficiency, quickness and almost meticulous weighing of transport charges, tolls and marketing conditions. Investments were comparatively safe and profits were usually moderate, even if judged according to modern standards. Distance was not always the dominant factor in drawing the border between 'outer' and 'inner' areas, since war could at any moment render trade extremely dangerous even at the gates of a commercial metropolis."

tions. With the expansion of trade beyond localities, Chinese merchants developed networks based first on kinship and later on "native place," industry, and occupational identities (Wong 2001, pp. 396–97). A variety of self-governing institutions similarly supported trade in medieval India, including merchant assemblies that administered marketplaces and fairs and "merchant fraternities" of long-distance traders, forerunners of India's later mercantile castes (Hall 1980, pp. 104–5, 141; Roy 2012, p. 59).

Unlike in Europe, however, state courts in Asia tended not to displace informal enforcement in commerce. Indian trade continued to be "organized around informal associations and families" throughout the precolonial period (Roy 2012, p. 120). Wong (2001, pp. 396–97), discussing enforcement institutions in Qing China (1644–1911 AD), observes, "What is striking about the general range of mechanisms employed by Chinese merchants to reduce risks in commercial transactions is the absence of state adjudication and enforcement. This is quite distinct from saying Chinese did not use contracts. . . . What we do not see is frequent court litigation using these contracts directly arising from expanding trade. . . . A combination of occupational guilds, native place associations, and contracts with middleman guarantors made an increasing number of transactions possible without frequent recourse to courts."

As with attempts to explain institutional evolution in Europe, explanations for the persistence of informal institutions in Asia generally emphasize either the unavailability of reliable state enforcement, which necessitated reliance on private enforcement, or the efficacy of the private (community) alternatives, which made state enforcement institutions unnecessary. Attributing the prevalence of community enforcement in Asia relative to Europe to deficiencies in state enforcement is difficult to reconcile with the fact that large, unified empires dominated substantial portions of both China and the Indian peninsula for extended periods at a time when European governments were still relatively weak and fragmented (Rosenthal and Wong 2011, ch. 1; Roy 2012, chs. 2–3). As a result, the preferred explanation has tended to be that state courts did not supersede communities in Asia because informal arrangements worked so well. Greif and Tabelini (2010, p. 137), for example, attribute the relative absence of state enforcement in imperial China to the effectiveness of kinship organizations that "reduced the need for formal enforcement institutions." Explanations for why informal arrangements were more effective in Asia than in Europe—where, after all, informal institutions such as the law merchant were alleged to have been so ef-

ficacious prior to government intrusion—often cite, in turn, cultural and demographic factors such as religion and relative population homogeneity (for example, Landa 1981; Greif and Tabelini 2012; Deng 2000, p. 10).

Our analysis suggests an alternative or, more modestly, an additional explanation for the divergent institutional development in Europe and Asia: both the persistence of community enforcement and delayed emergence of court enforcement in Asia relate to the underlying rate of development and composition of trade. As in Europe, early Asian trade consisted predominantly of high-value-to-weight products such as spices, dyes, and textiles (Roy 2012, pp. 42–43). Two factors, however, retarded the steep decrease in transportation costs in Asia that had greatly expanded the diversity and value of trade in Europe. First, the relatively large inland areas of China and India meant that much more trade had to move over land in Asia than in Europe. The much higher cost associated with overland transportation imposed a greater constraint on the distance and range of products that could be profitably traded in Asia relative to Europe.[37]

Second, owing partly to these geographic factors, Asia did not experience the dramatic improvement in shipbuilding and navigation that occurred in Europe. At the end of the 16th century, when European cargo ships reached capacities up to 1,000 tons, typical Chinese vessels ranged between 20 and 200 tons, with "only the biggest junks, those taking rice from Java to cities in Sumatra and the Malayan Peninsula, exceed[ing] 200 tonnes" (Reid 1993, pp. 39–40).[38] The available evidence indicates that ship design and construction in South Asia "changed little from the early historic times to the seventeenth century" (Roy 2012, p. 48). Roy (2012, pp. 10–11) explicitly ascribes the smaller capacities and capabilities of Indian ships to climate, local resources, and geog-

37. Trade also moved by rivers and waterways in both India and China. River trade had limitations compared to ocean transport, however. Roy (2012, p. 10) notes, for example, that "the spatial reach of rivers was limited in peninsular India. Even the largest rivers were not navigable beyond a hundred odd miles, and some of the smaller ones were not navigable beyond a few miles." In addition, natural events and processes such as floods and silting could devastate commerce in riparian ports (Elvin 1977, pp. 441–44; Roy 2012, p. 10).

38. The Chinese navy, like that of ancient Rome, was undoubtedly capable of building larger ships, as suggested by the massive ships allegedly deployed on Zheng He's expeditions of 1405–35. Such large ships—if they even existed (see Church 2005)—would have had no practical significance for normal merchant trade, however.

raphy:[39] "The limits on volume imposed by dependence on rivers meant that only simple ships and rudimentary harbors were needed. A study of the design and size of ships that plied Indian coasts suggests that shipwrights concentrated on building vessels that relied on monsoon winds rather than ocean currents. This preoccupation with adapting to local geographical constraints made Indian shipping less attentive to long-distance voyages and the challenges that such voyages entailed. . . . Ships built in India were, with some exceptions, much smaller than those being built in Europe after 1400 C.E."

The result was that, whereas the scale and diversity of European trade grew dramatically, the composition and patterns of trade in Asia were relatively static: "Through almost two thousand years, ships brought gold and horses into India and took away textiles and spices. . . . Through it all, the principal highways of traffic, the core merchandise, even the basic structure of ships, changed relatively little until the European era. . . . The scale of trade may well have increased but not reached a volume that would have induced merchants to sponsor larger ships and riskier trips" (Roy 2012, pp. 27–28, 48).

In sum, Asia, like Europe, experienced an increase in the value of long-distance trade at the beginning of the second millennium, corresponding to a shift from a negative to a positive value of θ in our model. As long as the number of ports and range of products traded remained limited, community enforcement institutions proved adequate to sustain cooperation among traders in both regions. But whereas continuing improvements in shipbuilding progressively lowered the transport costs and expanded the diversity of ports and products in Europe (which led to larger θ), Asia remained in the relatively low-θ region for which community enforcement was still most effective. Only much later as Asian trade became heavily influenced by Europe did the shift to court enforcement begin, first in India and later (and interrupted) in China. Even before the introduction of the British legal system in colonial India, the English East India Company established Bombay, Madras, and Calcutta

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39. Roy (2013, p. 87) notes that European merchants had advantages in navigational ability as well as shipbuilding: "[E]ven the biggest of these Indian merchants fell behind the European ones on account of unequal standards of knowledge of navigation as well as markets. The Europeans had developed a global understanding of the oceans long before the other ocean-bound cultures. In the 1700s they had knowledge of long-distance navigation spanning all of the world's major oceans. Their understanding of charts, maps, ocean currents, instruments, routes and their technique of making sturdier and larger ships carrying guns on board was superior to that of the Indian seafaring merchants."

as trading stations where trade was governed by long-term contracts subject to English law, in contrast to the spot markets or emporia typical of other Indian ports (Roy 2012, pp. 15, 121). The more systematic introduction of English-style courts and procedure to India beginning at the end of the 19th century quickly undermined traditional dispute resolution forums: "The availability of these courts, with their power to compel the attendance of parties and witnesses, and, above all, with their compulsory execution of decrees, opened the way for 'the contagion . . . of the English system of law'" (Galanter 1968, p. 70). Subsequent efforts to reinvigorate indigenous tribunals proved ineffective. "In commercial law, the rule of moral codes upheld by caste elders was incompatible with the demands of impersonal exchange in a globalizing economy" (Roy 2011, p. 132).

In China, informal institutions, particularly kinship relations and connections (*guanxi*), continued to play a dominant role even longer than in India. But with increasing trade, especially with the West, in the 19th century even China began to institute a new legal system on the European model late in the Qing Dynasty, a process cut short by the Communist Revolution (Rosenthal and Wong 2011, pp. 93–94). Looking forward, our analysis predicts that modern-day China should face increasing pressure to develop more effective contract enforcement institutions and, in turn, see an attenuation of the role of *guanxi* in business dealings.

4. CONCLUSION

Recent research has illuminated the ways in which a variety of informal institutions can support cooperation among impersonal transactors but has been criticized for failing to explore more systematically the conditions under which particular institutions arise and fade. In this paper, we have sought to address that criticism by relating the effectiveness of two collective enforcement institutions—communities (social networks) and courts—to characteristics of economies. Drawing on a framework introduced by Dixit (2003), we model the ability of communities and courts to sustain cooperation among transactors for whom differences in location, knowledge, or other economically relevant attributes affect the likelihood and value of trading and their ability to communicate. Despite its highly stylized representation of court and community enforcement institutions, the model provides a number of new insights into the factors influencing the relative effectiveness of these institutions that do not depend on exogenous changes in their strengths or properties.

In addition to showing that courts and communities tend to be effective for different types of transactions and that the existence of effective court enforcement undermines community enforcement, our analysis predicts an initial expansion in the range of transactions for which community enforcement can sustain cooperation followed by gradual displacement of communities by court enforcement as the value of trade between distant or dissimilar transactors increases, a pattern that parallels the historical emergence and erosion of the medieval law merchant as improvements in the security of travel and innovations in shipbuilding progressively reduced the cost and risks of transporting goods over long distances.

Although we emphasize a particular setting, we believe that the model has broader application. Williamson (2010), for example, describes an analogous shift in the structure of the contracts used to finance long-distance trade contemporaneous with our analysis. When trade involved repeated transactions in a limited number of widely traded products at a regular location (though not necessarily with the same merchants), as was the case with Venetian trade with Egypt in the 13th century, merchants were likely to have access to enough information to allow *commenda* (sharing) contracts to operate satisfactorily despite their susceptibility to agent cheating. Where trade was more episodic and diverse, as with the Turkish emirates and with Egypt after 1291, the absence of significant regular trade made reliance on *commenda* too hazardous, and merchants shifted to debt contracts that were relatively easy to enforce in court and thus less reliant on informal, reputational sanctions. Parallels can also be found in Ellickson's (1989) description of the operation and demise of 19th-century whaling communities. The analysis also has potential policy implications for the introduction or strengthening of commercial court systems in developing economies.

Our formal analysis considers just two of the variety of institutions potentially available to support impersonal trade. Other institutions with origins in the Middle Ages include merchant guilds (Greif, Milgrom, and Weingast 1994) and the community responsibility system (Greif 2006), both of which, among other things, helped to secure property-right protections beyond local jurisdictions. Our focus on institutions supporting voluntary exchange also led us to ignore institutions and organizations sustaining authority relationships. We know, for instance, that Rome shipped large volumes of grains, oil, and other products from Egypt and other Mediterranean ports. But such transfers were mainly the product

of conquest and confiscation—vertical integration, if you will—rather than voluntary trade.[40]

Finally, in both our formal analysis and our discussion of medieval trade and institutions, we have abstracted away from much important detail to focus on general forces and trends. The patterns we discuss were neither uniform nor universal throughout Europe, proceeding at different rates, and sometimes directions, at different locations and times. General agreement exists, however, that mercantile courts facilitated trade during the early Commercial Revolution and that over time much of the adjudication of merchants' disputes shifted to conventional state courts. The law merchant did not entirely disappear, however. A modern version, for example, continues to govern many international transactions (see, for example, Trakman 1983, chs. 2–3). Like its predecessor, however, efforts have been made to bring enforcement of international law merchant arbitration decisions under the domain of national courts through treaties such as the 1958 United Nations (UN) New York Convention on the Recognition and Enforcement of Foreign Arbitral Awards (see Leeson 2008a). Signed by six countries in the first year, the convention has gradually been adopted by 149 of the 193 UN member states in the ensuing 4 decades. A better understanding of the considerations that make state versus community enforcement more or less attractive may shed light on such questions as why and when countries choose to ratify such agreements. This paper takes a step in that direction by analyzing, albeit in a highly stylized model, some of the factors likely to affect the relative effectiveness of community and court enforcement.

APPENDIX

A.1. Proof of Proposition 1

The proof of proposition 1 involves three parts: establishing the expected payoffs from following and deviating from the community enforcement (CE) strategy; characterizing the relationship between $V(w, h, \theta, X, \delta, \kappa)$ and X; and identifying the conditions under which $V \geq 0$.

Part 1. Define $s_{y,t}$ to be transactor y's state variable before he chooses

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40. Compare McCormick (2001, pp. 83, 85): "Recent studies have emphasized that, in volume, the greatest shipments [in late antiquity] were non-commercial transports of state supplies. . . . [T]he importance of state-imposed fiscal transports means that we must speak sometimes of exchange rather than commerce." See generally Richman (2004) on the need to consider vertical integration, in addition to courts and private ordering, when analyzing alternative enforcement mechanisms.

an action in stage 1 of period t, where $s_{y,t} = 0$ if player y has received news that his current match i defected in period $t-1$ or if player y himself defected in period $t-1$ and his match i learned about it. Otherwise, $s_{y,t} = 1$. Under the CE strategy, a player thus transacts and cooperates for every $t \geq 1$ if and only if $V(\cdot) \geq 0$ and $s_{y,t} = 1$.

If players follow the CE strategy, the cost to player i of deviating in period t will be the expected loss from not transacting in period $t+1$. A transactor i, who is matched to transactor x in period t, knows that if he defects, his next-period match y will learn about it with probability $\eta_{x,y}$ and that if y does learn about i's defection, the CE strategy requires that y not interact with i. This gives i a payoff of zero in period $t+1$, which means that he loses $he^{\theta Y}$ compared to mutual cooperation. Given that transactor i does not know in period t the type of his match in period $t+1$, his future forgone payoffs depend on the distance of his new match Y, which may lie in one of four ranges defined relative to the distance of his current match X (depicted in Figure 1). Specifically, the expected loss to player i of defecting in period t is

$$
L_i \equiv \delta \Bigg[\int_0^X \frac{e^{-Y_1}}{2(1-e^{-1})} \kappa e^{-(X-Y_1)} h e^{\theta Y_1} dY_1
$$

$$
+ \int_X^1 \frac{e^{-Y_2}}{2(1-e^{-1})} \kappa e^{-(Y_2-X)} h e^{\theta Y_2} dY_2
$$

$$
+ \int_{1-X}^1 \frac{e^{-Y_3}}{2(1-e^{-1})} \kappa e^{-(2-X-Y_3)} h e^{\theta Y_3} dY_3
$$

$$
+ \int_0^{1-X} \frac{e^{-Y_4}}{2(1-e^{-1})} \kappa e^{-(X+Y_4)} h e^{\theta Y_4} dY_4 \Bigg]. \tag{A1}
$$

By the one-stage-deviation principle, if player i assumes that player y plays the CE strategy, i will cooperate in the central transaction in period t if and only if the following incentive constraint holds:

$$
he^{\theta X} + \delta G + \frac{\delta^2}{1-\delta} G \geq we^{\theta X} + (\delta G - L_i) + \frac{\delta^2}{1-\delta} G, \tag{A2}
$$

which can be rewritten as

$$L_i \geq (w - h)e^{\theta X}, \tag{A3}$$

where G denotes an individual transactor's expected gain from mutual cooperation, before the identity of his partner is known. The left and right sides of expression (A2) are i's expected net present value of current and future trade from cooperating and from defecting in period t, respectively. The first term on each side is the present-period payoff, which is larger for defection than cooperation. The second term is the payoff in the next period $(t + 1)$, which is smaller for defection because i's next match might not interact with a defector. The third term, the expected present value of trade from $t + 2$ forward, is equal for both sides because, under the concept of Markov strategies, actions in one period have an impact on only one subsequent period. Rearranging expression (A3), we obtain the present discounted value to transactor i of cooperating in period t relative to defecting in period t:

$$V(w, h, \theta, X, \delta, \kappa) \equiv L_i - (w - h)e^{\theta X}. \tag{A4}$$

The CE strategy has the following features. First, it implies that the function $V(\cdot)$ must be nonnegative to generate cooperative behavior in the current period regardless of behavior in previous periods. If in period t player i does not receive news about the previous behavior of his partner x, and if i himself did not defect in the previous period, or he defected but his partner did not learn about it, then $s_{i,t} = 1$, and i's behavior under the CE strategy is to cooperate if $V(\cdot) \geq 0$ and not interact if $V(\cdot) < 0$.[41] However, if i does receive news from player y on the behavior of x in $t - 1$, then the CE strategy further conditions i's behavior on previous-period behavior: if i learns that x defected last period, he should punish the defector by not interacting with him. Moreover, not interacting is (weakly) incentive compatible for i because the CE strategy requires a defector who knows that his partner knows about his defection to participate in his own punishment by not interacting as well; if i deviated from the CE strategy by agreeing to transact with x (and either cooperating or defecting), i would not gain from this deviation because x's choice not to interact leads to a period payoff of zero for both

41. By making the trading decisions (stage 1) of previous defectors dependent on whether their new partners learned about their prior defections, we harmonize the partners' state variables: either both players' state variables take the value of one, or they both take the value of zero. This assures that deviation from the community enforcement (CE) strategy is not incentive compatible and, at the same time, makes the expected loss from defection depend on the community's information transmission technology κ.

partners, independent of i's action. Hence, adhering to the CE strategy is a (weak) equilibrium action for i.[42]

Part 2. Differentiating V with respect to X yields

$$\frac{\partial V}{\partial X} = \frac{(e-1)e^{1+X+2X\theta}(w-h)(2-\theta)\theta^2 + (e^{\theta X}-1)(e^{2X+\theta}-e^{2+X\theta})(\theta-1)\delta\kappa h}{e^{1+X+\theta X}(e-1)(\theta-2)\theta}.$$

(A5)

Define $\hat{\theta}(X) \equiv \{\theta|\partial V/\partial X = 0\}$. Evaluating equation (A5), we get $\partial V/\partial X > 0$ for all $\theta < \hat{\theta}(X)$ and $\partial V/\partial X < 0$ for all $\theta > \hat{\theta}(X)$. Substituting into $\hat{\theta}(X)$ yields $\hat{\theta}(X=0) = \hat{\theta}(X=1) = 0$ and $\hat{\theta}[X \in (0, 1)] < 0$. Defining $\theta^* \equiv \arg\min\{\hat{\theta}(X)\}$, it follows that, for all $\theta > 0$, $\partial V/\partial X < 0$; that is, V is monotonically decreasing in X for positive θ. It also follows that, for all $\theta < \theta^*$, $\partial V/\partial X > 0$; that is, V is monotonically increasing in X for sufficiently negative θ. For $\theta \in [\theta^*, 0]$, however, V is nonmonotonic in X. This area is illustrated in Figure 2 by the region between the dashed vertical line at $\theta = \theta^*$ and $\theta = 0$. Henceforth, we focus on the two monotonic cases, $\theta > 0$ and $\theta < \theta^*$.

Part 3. Substituting values in equation (A4) shows that $V \geq 0$ if

$$\frac{h}{w-h}\delta\kappa \geq \frac{(e-1)e(\theta-2)}{e^\theta - e^2} \qquad \text{for } X = 0 \qquad (A6)$$

and

$$\frac{h}{w-h}\delta\kappa \geq \frac{(e-1)e^\theta\theta}{e^\theta - 1} \qquad \text{for } X = 1. \qquad (A7)$$

Define $X^* = \{X|V = 0\}$. For $\theta > 0$, $\partial V/\partial X < 0$, and X^* therefore characterizes an upper bound on cooperation in X-space. Three subcases must be distinguished. First, if expression (A6) does not hold, $V < 0$ for all X, and the players have no incentive to cooperate, which implies that $X^* = 0$. Second, if expressions (A6) and (A7) hold, $V \geq 0$ for all X, and

---

42. Our assumption that a player who is supposed to punish another player has no incentive to deviate from punishment is a common structure in repeated games of collective enforcement institutions (for details, see Greif 2006, app. C). It can be rationalized by supposing that a slight probability ε exists that not participating in one's own punishment will be detected by other players, who would then be entitled to punish the uncooperative defector by not interacting until eternity. Alternatively, if the CE strategy allowed a player who received information about his partner's defection in period $t - 1$ not to punish that partner in period t, both players would know that the same would hold for their respective matches in $t + 1$. Consequently, they would not fear losing future trading opportunities by defecting in the current period, and mutual defection would become the unique Nash equilibrium in stage 2 of period t. In order to avoid the losses associated with this outcome ($d < 0$ in the central transaction), the unique subgame perfect action in stage 1 of period t would be not to transact. Hence, all trade would break down.

the players have an incentive always to cooperate, which implies that $X^* = 1$.

Finally, if expression (A6) holds but expression (A7) does not, a unique $X^* \in (0, 1]$ exists such that $V(X \leq X^*; \cdot) \geq 0 > V(X > X^*; \cdot)$. Hence, the players have an incentive to cooperate for $X \leq X^*$ but not for $X > X^*$.

By contrast, for $\theta < \theta^*$, $\partial V/\partial X > 0$, and X^* is a lower bound on cooperation in X-space. Again, we have three subcases. First, if expression (A7) does not hold, $V < 0$ for all X, and the players have no incentive to cooperate, which implies that $X^* = 1$. Second, if expressions (A6) and (A7) hold, $V \geq 0$ for all X, and the players have an incentive always to cooperate, which implies that $X^* = 0$. Finally, if expression (A7) holds but (A6) does not hold, there is a unique $X^* \in (0, 1]$ such that $V(X < X^*; \cdot) < 0 \leq V(X \geq X^*; \cdot)$. Hence, i's incentive is to cooperate for $X \geq X^*$ but not for $X < X^*$.

A.2. Proof of Proposition 2

We show that behavior described in proposition 2 constitutes a subgame perfect equilibrium. We begin by deriving expression (3). It is evident from the expected payoffs specified that filing a suit is not profitable if both transactors cooperated or for a transactor who had himself defected. For a transactor who cooperated and whose partner defected, filing suit is profitable only if

$$D \geq \frac{c}{\tau}. \tag{A8}$$

In the central transaction (stage 2), assume that player i's partner x cooperates. If i cooperates, his payoff is $he^{\theta X}$. If i defects and is sued by x, i's expected period payoff is $we^{\theta X}$ from defecting and $-(\tau D + g)$ from the suit. It is therefore rational for i to cooperate if and only if

$$he^{\theta X} \geq we^{\theta X} - (\tau D + g). \tag{A9}$$

Solving expressions (A8) and (A9) for D yields expression (3).

Next, assuming that player i's partner x cooperates, it is also individually rational for i to cooperate if expressions (A8) and (A9) hold. Substituting $D_{\mathrm{Exp}} = (h - l)e^{\theta X}$ into these expressions, it follows that

$$(h - l)e^{\theta X} \geq \frac{c}{\tau} \tag{A10}$$

and

$$(h - l)e^{\theta X} \geq \frac{(w - h)e^{\theta X} - g}{\tau}. \tag{A11}$$

Solving expression (A10) for X shows that, given that i defected, it is rational for x to file suit at stage 3 if $X > \Phi$ for $\theta > 0$ and if $X \leq \Phi$ for $\theta < 0$, where Φ is defined in proposition 2. At stage 2, consider first $\theta > 0$. Condition (A11) holds if

$$\tau \geq \frac{w - h - g}{h - l} \qquad \text{at } X = 0 \tag{A12}$$

and

$$\tau \geq \frac{w - h}{h - l} - \frac{g}{(h - l)e^{\theta}} \qquad \text{at } X = 1. \tag{A13}$$

Both sides of expression (A11) are monotonic in X. Thus, if both expression (A12) and expression (A13) hold, it is rational to cooperate at stage 2 for all $X > \Phi$. Note that the right-hand side of expression (A13) is larger than the right-hand side of expression (A12). Hence, expression (A13) is the binding constraint, which proves that expression (6) is valid. If expression (A13) does not hold but expression (A12) holds, there is an interior solution in X-space, Γ, which is found by solving expression (A11) with equality for X. This proves that expression (5) is valid.

The proof for $\theta < 0$ is identical to the proof for $\theta > 0$ with three exceptions. First, Φ defines an upper bound, not a lower bound, in X-space. Second, the right-hand side of expression (A13) is smaller than the right-hand side of expression (A12). Hence, expression (A13) is the binding constraint, which proves that expression (6) is valid. Finally, if expression (A13) does hold but expression (A12) does not, there is an interior solution Γ, which is a lower bound, not an upper bound, in X-space. This proves that equation (7) is valid.

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