On the Evolution of Collective Enforcement Institutions: Communities and Courts

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ABSTRACT

Impersonal exchange has been a major driver of economic development. But transactors with no stake in maintaining an ongoing relationship have little incentive to honor deals. Therefore, all economies have developed institutions to support honest trade and realize the gains of impersonal exchange. We analyze the relative capacities of communities (or social networks) and courts to secure cooperation among heterogeneous, impersonal transactors. Our main finding is that communities and courts are complements: They support cooperation in different types of transactions. We apply our results to the rise and fall of a medieval enforcement institution, the Law Merchant, concluding that progressive reductions in the risks and costs of transportation over long distances, driven in part by improvements in shipbuilding methods, increased first the value and then the composition of long-distance trade in ways that initially favored and later undermined this institution.

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I. Introduction

The enormous improvements in wealth and wellbeing of the last millennium — as well as the more sporadic advances of earlier ages — could not have occurred without the existence of institutions and organizational arrangements supporting impersonal exchange: The progressive realization of scale economies and gains from specialization that underlay economic development requires both the expansion of trade beyond an individual's immediate circle of acquaintances and the flexibility to take advantage of newly discovered 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. Without institutions that can instill reasonable confidence in the security of bargains and property, the range of transactions that prospective traders will be willing to undertake will be reduced and the realization of scale and specialization economies correspondingly attenuated.

The role of governments in protecting property rights and enforcing contracts has long been recognized. 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 (roughly the 11th to 14th centuries (Lopez, 1971)) when long-distance trade blossomed in an environment of small and fragmented political units. A series of recent papers has sought to explain how a variety of non-governmental, self-enforcing institutions could have sustained the dramatic commercial

development of the period without state enforcement.[1] Among these were *merchant guilds*, which provided members mutual support and protection in their overseas dealings, and the *lex mercatoria*, or Law Merchant, commonly described as a spontaneously created system of customary rules governing trade among merchants that was administered by private judges chosen for their familiarity with commercial practices (Berman, 1983: 333-56).[2] Descriptions and analyses of the medieval Law Merchant ascribe 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: 654). Despite its many desirable qualities, however, "[t]he Law Merchant system of judges and reputations was eventually replaced by a system of state enforcement" (Milgrom, North, and Weingast, 1990: 20; Mitchell, 1904: 157).

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, 2003b: 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? Put another way, research on institutions stands to benefit, as did research on economic organization earlier, from "operationalization" of the theory through a program of (i) describing the critical features of the economy (including the attributes of transactors and transactions), (ii) identifying the distinguishing features and capabilities of alternative

[1] Prominent contributions to this literature include Milgrom, North, and Weingast (1990); Greif (1993, 2006); and Greif, Milgrom, and Weingast (1994).

[2] Merchant guilds are distinct from the later crafts or trade guilds (Volckart and Mangels, 1999: 437).

institutions, and (iii) relating the features of the economy to the differential capabilities of governance structures in a way that yields testable hypotheses (*cf.* Williamson, 1988: 66, 73; 2002: 441).

In this paper, we seek to advance this program by drawing on a framework introduced by Dixit (2003b, 2009) to analyze the relative capacities of communities (or social networks) and courts to secure cooperation among heterogeneous, impersonal transactors. Specifically, we adopt Dixit's device of a circle economy to capture differences in the knowledge and abilities (trading attributes) of transactors who (periodically) face opportunities to transact with new and unfamiliar trading partners. We then consider the range of potential trading partners for which collective enforcement by communities and courts can sustain cooperation and relate these to the value of trade, the degree of shared knowledge ("connectedness") of transactors, and the competence of courts to verify performance.[3]

Our main findings highlight the role of the value of trade in relation to the heterogeneity of transactors, who may differ in their knowledge, ability, resources, location, or any other economically relevant dimension. In contexts in which expected gains from trade increase with the dissimilarity or "distance" of transactors — Dixit's primary focus — we find, like Dixit, that communities or social networks can sustain cooperation only for transactions with relatively "nearby" trading partners. In contrast to Dixit's results, however, courts in our model tend to be complementary to communities in the sense that they function most effectively for relatively "distant," high-value transactions. In addition, we analyze explicitly contexts in which gains from trade are negatively related to distance, which Dixit dismisses as uninteresting because "trades will unambiguously best be carried out using automatic self-governance in small communities each of which has homogeneous membership" (2003b: 1297). We find,

[3] We use the term *collective or multilateral enforcement institutions* to describe institutions for the enforcement of agreements involving others than the just parties to the transaction themselves. These institutions encompass both Dixit's *external governance* (enforcement by courts or other organizations) and *self governance* (enforcement by communities or social networks). Greif uses the term *contract enforcement institutions* for both types of enforcement. Consistent with the legal definition of contract, we reserve the term *contract* only for agreements that would be legally binding in a public court of law.

however, that increases in the gains to reneging (defection) that accompany increases in the value of "local" trade may outweigh the greater likelihood that nearby transactors learn about previous defections, causing community enforcement to break down. Courts, on the other hand, are likely to be effective in sustaining cooperation in such settings.

Applying insights from the model, we then examine the conditions that may have contributed to the emergence of the Law Merchant in late Medieval Europe and to its subsequent supersession by state courts. Most accounts associate the Law Merchant's dominance and demise with the quality of state enforcement: emerging of necessity when governments were weak and withering as the state power and interests in commercial activity made community enforcement obsolete. Our analysis and review of the historical literature suggests an alternative explanation: Progressive reductions in the risks and costs of transportation over long distances, driven in part by improvements in shipbuilding methods, increased first the value and then the composition of long-distance trade in ways that initially favored and later undermined community enforcement institutions.

The next section provides an overview of the issues, including a brief description of the Law Merchant. Section 3 introduces the basic model and then characterizes behavior under, and compares the effectiveness of, community and court enforcement. Section 4 interprets the history of Law Merchant in light of our results. Section 5 offers conclusions and suggests additional applications.[4]

2. Courts, Communities, and Commitment

The obstacle to trade and cooperation posed by opportunistic behavior is a central theme of the literatures on both institutions and organization: Two (or more) parties stand to gain from transacting, but differences in the timing of actions and the accrual of benefits leave one or both exposed to the risk that

[4] Proofs, robustness checks, and extensions of the model appear in a pair of appendices.

the other will not uphold his end of the bargain.[5] Unless institutions or organizational arrangements capable of sustaining cooperation exist or can be devised, individuals may find it better not to transact at all. Despite this concurrence, analyses of institutions and organizations differ in important respects. First, the analysis of institutions involves a shift in orientation to reflect, among other things, the generally broader scope and greater durability of institutions compared to organizations. Whereas organizational arrangements are chosen by the parties themselves for the transaction at hand, institutions operate over an array of transactions comprising an economy (or possibly industry). As a result, 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 that exceed the duration of most transactions and must therefore account for the dissolution of old relationships and emergence of new trading opportunities.[6] At the same time, the operation and merits of institutions and of transaction-level organizational arrangements are interdependent. On the one hand, the institutional environment determines in part the organizational choices available to transactors. On the other, the quality and limitations of private governance affects the demand for, and possibly the performance of, political and legal institutions.[7]

Figure 1 portrays several sources of or supports for commitment and the properties that distinguish them. In the far left of the diagram, the category "internal value systems" allows for the possibility that some people may pass up opportunities to take advantage of a trading partner because of

[5] Examples of research examining political institutions as responses to commitment problems include North and Weingast (1989) and Weingast and Marshall (1988). For a discussion of the parallels between political and commercial commitment problems and additional citations, see Masten (2006).

[6] In Williamson's characterization of the levels of social analysis, level-3 (private) governance choices operate on a one-to-ten year horizon while level-2 institutional environment adjustments occur on a ten-to-one-hundred year horizon (Williamson, 2000: 596-9). Exceptions exist, of course: The duration of some contracts exceeds the endurance of many constitutions (see Elkins et al., 2009).

[7] For an analysis emphasizing the interactions of organization and political and legal institutions in the context of public utility procurement, see Levy and Spiller (1994).

altruism or morals. Someone who knows that he is dealing with such a person can undertake transactions with confidence in the other's cooperation. Such knowledge is particularly unlikely in impersonal exchange, however, and the existence of even a subset of opportunists in a population of potential trading partners dictates caution.[8] Cooperation may also be sustained between transactors who expect to be engaged in indefinitely repeated exchange with each other. Such repeated bilateral transactions occur in all economies and may dominate in small subsistence economies, but restricting trade to only those with whom one has such an ongoing relationship would require the sacrifice of many otherwise productive undertakings. As opportunities for advantageous trade beyond the clan or village to the region and beyond increase, and the capacity of bilateral interactions to sustain cooperation correspondingly decreases, the need for some form of multilateral enforcement mechanism rises.

Figure 1 distinguishes between two basic types of multilateral mechanisms, communities and courts. Our conception of a community is similar to Cooter's (1996: 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 (e.g., the jazz community (Phillips, 2009)) or formal (e.g., the New York Diamond Dealers Club (Bernstein, 1992)). The important defining characteristics of a community — (i) frequency of interactions[9] and (ii) shared knowledge or interests of members —

[8] Recognition that not all parties are prone to opportunism but that bounded rationality makes it difficult to distinguish the trustworthy from the unscrupulous is a feature of transaction cost analyses; see Williamson (1985: 48). Dixit (2003b) explicitly assumes two types of traders, Normal and Machiavellian, the latter, characterized as "especially skillful cheaters," assumed to represent only a small proportion of traders (1299).

[9] 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*.

introduce the possibility that opportunistic behavior by or toward one member will be learned of by others who may respond by refusing to transact with transgressors.[10] 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.[11] Second, public officials usually are 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.

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. By most accounts, the economic decline and stagnation precipitated by the fall of the Roman Empire was followed, beginning in the 11th 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

[10] The assumption that community sanctions are limited to expulsion or ostracism 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, in expected terms, is limited by the value of continued membership in the community.

[11] 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 right and protections, and extraordinary remissions of normal laws" (Kadens, 2004: 48). Marketplaces that failed to provide an attractive legal environment "perished, because no traders attended the market" (Bindseil and Feil, 1999: 745, quoting Feger, 1958:12). This parallel raises a general caveat about the relation between our stylized model and actual institutions: 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 4 below, in the period of the medieval Law Merchant. Implications of the model should thus be thought of as favoring more "court-like" or "community-like" enforcement, the distinguishing properties of real world institutions being matters of degree.

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: 17).

In response to these challenges, merchants developed an array of private institutions that served to secure agreements and facilitate trade, perhaps the most important of which was a system of mercantile courts known as the Law Merchant. Most standard accounts portray the operation of the Law Merchant in decidedly complimentary terms. Because merchants courts were typically administered by merchant judges chosen "on the basis of their commercial experience, their objectivity and their seniority with the community of merchants," rather than by professional jurists (Trakman, 1983: 15; Berman, 1983: 346), decisions were sensitive to the needs and understandings of the merchants.[12] Regardless of the forum, the "law" of the *lex mercatoria* reflected the customs of the merchants, rather than local, or later, centralized state law (*id.*). Most important, by most accounts, Law Merchant hearings were free of formalistic procedures. Most disputes were resolved within a day or two (Gross, 1906: 243-4; Sachs, 2006: 685) and appeals were often forbidden (Berman, 1983: 347; Gross, 1906; 236): "In all types of commercial courts the procedure was marked by speed and informality" (Berman: 347; see also Baker, 1979: 300-4).

As portrayed in these accounts, the medieval Law Merchant represented a community-based enforcement institution that permitted the expansion of intraregional trade during a period of fragmented

[12] These tribunals took various forms, including courts operated at markets and fairs, borough courts in market towns, maritime courts in seaports, and courts of Merchant Guilds (Berman, 1983: 346-7; and Trakman, 1983: 16-17). In what Baker (1979) describes as the "orthodox story," the law merchant in England "was confined to its own special courts, the borough and piepowder courts and the Court of Admiralty" until the sixteenth century (296). Piepowder courts were "the humble court of the market or fair in which the disputes of wayfaring merchants, the dusty-footed men, were settled" (Gross, 1906: 231), although some such courts came to operate without a fair or market (*id*., 237).

and often weak states. According to Trakman, the Law Merchant "offered the medieval merchant an ideal solution" to the many challenges posed by international commerce (1983: 11). Founded on commercial customs and operated by the merchant community itself, the Law Merchant closely mirrored merchant needs. "Justice and fairness, speed and informality, low cost and amicability all prevailed as interdependent variables, reflective of the commercial environment under investigation. These attributes together emphasized that the primary source of the Law Merchant lay in mercantile values and practices as incorporated into law" (*id*.: 13).[13]

Even if the Law Merchant did not operate as adroitly as its most ardent proponents 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 taken over by public courts.[14] Although state courts initially sought to retain the Law Merchant's most desirable properties, particularly its speed, informality, and reliance on commercial customs, over time the rigid procedures and strict adherence to uniform substantive doctrines associated with modern courts came to dominate.[15] The challenge posed by the history of the Law Merchant is to identify what conditions may have contributed, first, to the emergence of the Law Merchant and, later, to its absorption and supersession by state courts.

[13] Some descriptions of the Law Merchant border on utopian. See, for example, Benson (2002: 127-131).

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

[15] In England, 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: 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 (*id.*: 661-2). 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 (*id*.: 663-4).

3. The Model

Our analysis of the capacities of communities and courts to sustain cooperation draws on Dixit (2003b), which introduces a model of enforcement institutions that compactly incorporates several dimensions of economies relevant to the performance of institutions: heterogeneity in the value of trade among transactors, stochastic opportunities for impersonal trade, conflicting incentives within transactions, and localized information. Specifically, transactor heterogeneity is represented by the location of transactors distributed around a circle, distances along which can be interpreted as representing differences in any 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. Distance between any given pair of transactors, in turn, enters the analysis in three ways: (i) the probability that that pair of transactors will discover an opportunity for mutually beneficial trade (matching), (ii) the potential value of trade between those transactors, and (iii) the probability that the transactors will learn about each other's behavior in previous transactions.

Like Dixit, we also limit our focus to two types of enforcement institutions: community enforcement, the equivalent of self-governance in Dixit's terminology, and court enforcement, our analog to Dixit's external enforcement. In our characterization, courts have the ability to investigate claims of defection but, rather than merely reporting incidents of cheating as in Dixit's model, we ascribe to courts the power to impose damages on defecting parties. Finally, because courts in our model are "generalist," that is, they lack the "local" expertise and knowledge of transactors in the economy, courts may not always be able to determine fault as accurately as would members of a community, especially for complex transactions.[16]

[16] Our model also differs from Dixt's in several technical respects described in more detail below.

3.1. Trade and Communication in a Circle Economy

As in Dixit (2003b), we posit an economy consisting of a continuum of transactors uniformly distributed around a circle. The circle has a circumference of 2, with the mass of transactors per unit arc length normalized to one, implying a mass 2 population in the economy.[17] Distance between two transactors, X, is measured by the shorter of the two arc lengths between them; hence, $X \leq 1$.

As discussed above, "distance" affects three considerations in our model: (i) the probability of meeting a given transactor, (ii) the potential gains from trade, and (iii) the probability of receiving information about the previous behavior of other transactors. We define (i) and (ii) here, and define (iii) in section 3.2.

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 words, the probability of any two players matching decreases exponentially with their distance X.[18] Consistent with our emphasis on impersonal trade, matching is independent across periods.[19]

[17] Dixit specifies a circumference of 2L, but as he notes, the 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 (2003b: 1299). In other words, our distance measure is relative to the size of the relevant trading space.

[18] The denominator normalizes the aggregate matching probability of a player with all other players over both arcs to 1, that is, $\int_0^1 \mu dX = 1/2$.

[19] We discuss the assumption of exogenous matching in Appendix A.1.

Gains from trade. Again, like Dixit, we assume that distance also affects the potential gains from trade, where the potential payoff to a given transactor i from trading with a transactor at distance X is $he^{\theta X}$. In contrast to Dixit, however, we consider the possibility that gains from trade may increase or decrease with distance. Specifically, we allow the parameter θ to take negative as well as positive values: For $\theta > 0$, potential gains from trade increase with distance, and for $\theta < 0$, trade is more valuable between closer transactors. Gains from trade increasing with distance might occur 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 makes communication or understanding necessary to recognize gainful opportunities more difficult (see Dixit, 2003b: 1297).

Given the preceding definitions, an individual transactor's expected gain from mutual cooperation, before the identity of his partner is known, is

$$G \equiv 2\int_0^1 \frac{e^{-X}}{2(1-e^{-1})} he^{\theta X} dX = \frac{(e^{\theta}-e)h}{(e-1)(\theta-1)}. \tag{2}$$

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 or not 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 following reduced-form payoff matrix: [20]

[20] The most natural value for h is 1, which would make $2e^{\theta X}$ the total gains from trade, and $e^{\theta X}$ each individual's share of the gains, if both parties cooperate. We retain h as a variable to maintain comparability with Dixit (2003b).

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

and

$$w > h > 0 > d > l \text{ and } 2h > w + l. \tag{3}$$

Stage 3: Transactors proceed to the enforcement stage corresponding to the relevant institution as described in the following sections.[21]

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

3.2. Community Enforcement

Consistent with our emphasis on impersonal exchange, the probability that a given pair of transactors will encounter each other again is zero in our model.[22] Consequently, in the absence of courts (or other third-party enforcement institutions), the only punishment that a transactor can impose on a partner who defected 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 misbehavior and responds in a way that "punishes" the defector for his prior bad behavior.

[21] As described below, community enforcement technically takes place in stage 1 of the next period when each transactor decides whether or not to transact with his new trading partner.

[22] This feature of the model is a crucial difference with the literature on relational contracting (e.g., Baker et al., 2002).

We model the dissemination of information through an individual 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 interact}.[23] The probability that transactor x's announcement is "heard" by transactor y is

$$\eta_{x,y} \equiv \kappa e^{-|Y-X|} \tag{4}$$

where $|Y-X|$ is the distance between transactors y and $x$and $\kappa \in [0,1]$ is a parameter reflecting transactors' overall "connectedness" to other transactors on the circle.[24]

After being matched with a new partner, each transactor may receive news, according to equation (4), about this new partner's behavior in the previous period. For clarity, we define $s_{y,t}$ to be player y's state variable before he chooses 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 $s_{y,t} = 1$ otherwise. The central transaction then takes place for every pair of players. Finally, every player reports the outcome of his current transaction as described above.

We proceed next to identify a strategy set for all transactors that constitutes a perfect Markov equilibrium.

Community Enforcement (CE) Strategy. Let $V(w,h,\theta,X,\delta,\kappa)$ represent the present discounted value to transactor i of cooperating in period t relative to defecting in period t (defined more explicitly below). Define the following Markov strategy for player i matched with partner x:[25]

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[23] As is common in the literature (see, e.g., Kandori, 1992; Kali, 1999; and Dixit, 2003b), we assume that reporting is truthful. We discuss the effects of strategic/untruthful reporting on equilibrium in Appendix A.3.

[24] Our specification of the communication probability differs from Dixit's (2003) by the inclusion the parameter κ. In the basic model, κ is the same for all transactors. We discuss the implications of individualizing κ in Appendix A.4, where at each location on the circle player x would be endowed with a κ_x drawn from an arbitrary distribution over [0,1].

- In period t = 1, player i transacts and cooperates with partner x if $V(w,h,\theta,X,\delta,\kappa) \geq 0$, and does not transact otherwise.

- In every subsequent period, player i transacts and cooperates with partner x if $V(w,h,\theta,X,\delta,\kappa) \geq 0$ and $s_{i,t} = 1$, and does not transact otherwise.

In effect, the CE strategy calls for a transactor to transact with his current match if cooperation is profitable ($V(\cdot) \geq 0$) unless he has received a report that his current partner deviated from the CE strategy in the preceding period or he defected himself. The CE strategy has several 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 on the previous behavior of his partner x, and i has not defected himself in the previous period, 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 $V(\cdot) < 0$. 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 incentive compatible for i because the CE strategy requires the defector x 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 partners, independent of i's action. Hence, adhering to the CE strategy is a (weak) equilibrium action for i.[26]

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[25]Of course, as in any infinitely repeated game, other equilibria also exist. Our aim is to show that a simple strategy exists in our model that supports cooperative exchange under community enforcement.

[26] In order to make sure that a player who receives information that his current partner defected last period actually punishes that partner by not interacting, the CE strategy requires that the defector participate in his own punishment by not interacting either. Then, as shown above, the player who is supposed to punish has no incentive to deviate from punishment. This is a common structure in repeated games of collective enforcement institutions; see Greif (2006, Appendix C) for more details. It can be interpreted in a way such that there is a slight probability in the background of the model by which not participating in one's own punishment could be detected by other players. Those players would then be entitled to punish the uncooperative defector by not interacting until eternity.

It remains to show that there exists a perfect Markov equilibrium in which all players play the CE strategy. Recall that an individual transactor's expected gain from mutual cooperation, before the identity of his partner is known, is *G*, defined in equation (2). Now consider player *i*'s tradeoff at stage 2 if he is matched to *x*. Transactor *i* knows that if he defects, his next period match *y* will learn about it with a certain probability, η. If *y* plays the CE strategy and learns about *i*'s defection, he will 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 player *i* does yet not know in period *t* the type of his next match in period *t* + 1, we have to consider four subcases, which are illustrated in Figure 2. Specifically, the expected loss to player *i* from not transacting in period *t* + 1 is the forgone value of transacting weighted by (i) the probability that *i* is matched to *y* in *t* + 1 and (ii) the probability that *y* received news from *x* that *i* defected in *t,* or

$$\begin{aligned} L \equiv \delta[&\int_0^X \frac{e^{-Y_1}}{2(1-e^{-1})}\kappa e^{-(X-Y_1)} h e^{\theta Y_1} dY_1 + \int_X^1 \frac{e^{-Y_2}}{2(1-e^{-1})}\kappa e^{-(Y_2-X)} h e^{\theta Y_2} dY_2 \\ &+\int_{1-X}^1 \frac{e^{-Y_3}}{2(1-e^{-1})}\kappa e^{-(2-X-Y_3)} h e^{\theta Y_3} dY_3 + \int_0^{1-X} \frac{e^{-Y_4}}{2(1-e^{-1})}\kappa e^{-(X+Y_1)} h e^{\theta Y_4} dY_4]. \end{aligned} \tag{5}$$

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

$$he^{\theta X} + \delta G + \frac{\delta^2}{1-\delta} G \geq we^{\theta X} + (\delta G - L) + \frac{\delta^2}{1-\delta} G \tag{6}$$

$$\Leftrightarrow L \geq (w-h)e^{\theta X}. \tag{7}$$

The left and right sides of (6) are *i*'s net present value from cooperating and defecting in period *t,* respectively. The first term on each side of (6) 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. And the third term is equal for both sides because, under the concept of Markov strategies, actions in one period have an impact only on one subsequent period.[27] After manipulation, we get equation (7), which states that *i* will only cooperate if the next period loss that he incurs if he defects now, *L*, is larger than the immediate additional gain from defection, $(w-h)e^{\theta X}$. We can now define more explicitly the present value of cooperation relative to defection, $V(w,h,\theta,X,\delta,\kappa)$, as

$$V\left(w,h,\theta,X,\delta,\kappa\right) \equiv L-(w-h)e^{\theta X}. \tag{8}$$

Interpretation. We note first that, given that $L(\kappa=0) = 0$ and $(w-h)e^{\theta X} > 0$, no transactors are willing to transact with another transactor who is not "connected" (has $\kappa = 0$). This result underscores the importance of communities or networks in environments of impersonal exchange where, despite infinitely repeated exchange, the likelihood of any two transactors meeting again is too low (in our case, zero) for bilateral sanctions to sustain cooperation.

For $\kappa > 0$, the definition of *V* yields the following proposition.

Proposition 1 (Cooperation under social network enforcement) If all other actors $-i$ use the CE strategy, there exists a perfect Markov equilibrium, in which player *i* also plays the CE strategy if and only if the relative gains from cooperation are non-negative, that is, if $V \geq 0$.

It is straightforward to show, given the definitions of *V* and *L* in equations (8) and (5), that $\partial V/\partial(w-h) < 0$, $\partial V/\partial\delta > 0$, and $\partial V/\partial\kappa > 0$. In words, the relative value of cooperation decreases in the gains from defecting and increases with the discount factor (time horizon) and transactors' "connectedness."

[27] At a cost of some loss of realism, use of Markov strategies substantially simplifies statement of the tradeoff that each player faces.

Holding $(w-h)$, δ, and κ constant, we would like to know how "distance" affects the incentives to cooperate and, thus, the range of transactions for which one's community can be expected to sustain cooperation. To analyze this question, we need to examine the effects of X and θ on V in more detail, which involves several cases. We first consider two unambiguous cases, $\theta > 0$ and $\theta < \theta^* < 0$, where θ^* is defined below.

We begin by refining the Markov strategy of player i at stage 2 in period t and call it the CEX strategy:

- In $t = 1$, if $\theta > 0$ [$\theta < \theta^*$], transactor i transacts and cooperates with partner x if the distance between i and x, $X \leq X^*$ [$X \geq X^*$], and does not transact otherwise.
- In every subsequent period t, if transactor i is matched to player x and either the distance $X > X^*$ [$X < X^*$] or $s_{i,t} = 0$, then transactor i does not interact with x. Otherwise, i transacts and cooperates with x.

This refinement has no effect on V (as defined in (8)). The definition of the state variable also remains unchanged, that is, $s_{i,t} = 1$ unless transactor i has received news that his current match x defected in period $t-1$ or i defected in period $t-1$ himself, in which case $s_{i,t} = 0$. The refinement allows us, however, to state the following proposition, which we prove in Appendix B, as a refined version of Proposition 1.

Proposition 2 (The scope of cooperation under community enforcement) If all other actors $-i$ use the CEX strategy, there exists a perfect Markov equilibrium, in which player i also plays the CEX strategy if and only if $X \leq X^*$, for $\theta > 0$, and if and only if $X \geq X^*$ for $\theta < \theta^*$.

Proposition 2 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 short-term gain from defection is too large and the expected punishment in the future is too small. This result is due to the localization of information transmission, captured by η, and the probability of being matched to a community member of x in the next period, which is decreasing in distance X and captured by μ.

For $\theta < \theta^* < 0$, that is, if increasing the distance between matches sufficiently decreases the value of the transaction, there is a lower bound X^* above which it is rational for the players to cooperate. This

implies that, despite the localization of matches and information transmission, the connectedness of x may not be able to induce i to cooperate if the partners are located sufficiently close to each other. This result can be understood by referring to the base value of a transaction, proxied by θX, which drives the payoff of defecting. Independent of the sign of θ, i only has an incentive to cooperate if the base value of the transaction is sufficiently low.

Figure 3 illustrates this result using a numerical example. It shows that in the southwest and northeast corners of the graph — but not in the other regions — players have an incentive to cooperate with each other ($V \geq 0$). It is visible that, in the southwestern region, cooperation has an upper bound in X-space whereas, in the northeastern region, it has a lower bound. Moreover, Figure 3 illustrates the ambiguous region, where $\theta \in [\theta^*, 0]$. Depending on the parameter values chosen, transactions in this region either have an upper or a lower bound on cooperation. The qualitative direction of this result may differ for alternative parameter values, however. The economic reason for these qualitative changes lies in the conflicting effects of η, μ, and θX, which make V nonmonotonic in X.

An implication of the preceding and Proposition 1 is the following corollary.

Corollary 1 (Cooperation and transaction value in the presence of community enforcement) Communities can sustain cooperation in transactions with sufficiently low value but for not high value transactions.

3.3. Court Enforcement

The capacity of courts to adjudicate disputes is related to the characteristics/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

justiciability of 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.[28]

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 rewarded.[29] 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 *g*.

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 and his trading partner's behavior in the central transaction are as follows:

Case A.1. Both transactors cooperate:

$$-c \tag{9}$$

Case A.2. Transactor cooperates; partner defects:

$$\tau D - c \tag{10}$$

Case B.1. Transactor defects; partner cooperates:

$$-\tau D - c \tag{11}$$

Case B.2. Transactor defects; partner defects:

$$\tau D + \tau(-D) - c = -c \tag{12}$$

[28] Our model allows only for "type-2" (false negative) judicial errors. We assume that courts are able to compel payment through, for example, the threat of imprisonment for failing to obey a court order. We also assume that courts are impartial and nonstrategic: Their decisions are not dependent on the identities of the parties and are rule-based and not the outcomes inferences from the strategies of the litigants. See Appendix A.5 for a discussion of corrupt and biased judges.

[29] We assume that litigants bear their own costs regardless of who wins the case, the so-called "American rule." Results would not be materially affected under the requirement that the loser pay the prevailing party's litigation costs — sometimes referred to as the "English rule" — which is common outside of the United States

Based on the above, we first establish the following lemma.

Lemma 1: Minimum effective damage payment. *The existence of courts sustains cooperation if and only if damages D satisfy:*

$$D \geq \max\left\{\frac{c}{\tau}, \frac{(w-h)e^{\theta X} - g}{\tau}\right\}. \tag{13}$$

Proof. It is evident from cases A.1, B.1, and B.2 that filing a suit is not profitable if both transactors cooperated or if a transactor had defected himself.[30] For a transactor who cooperated and whose partner defected, filing suit is profitable only if

$$D \geq \frac{c}{\tau}. \tag{14}$$

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 (where the defendant's cost g is substituted for plaintiff's cost c in (11)). It is therefore rational for i to cooperate if

$$he^{\theta X} \geq we^{\theta X} - (\tau D + g). \tag{15}$$

Solving (14) and (15) for D proves Lemma 1. ■

[30]The unprofitability of filing suit when both partners have defected is peculiar to the symmetry in our model. If harms from breach are asymmetric or the difficulty of proving breach differs between transactors, suits would be profitable if expected net damages exceeded litigation costs.

Note that a court that acted "strategically" and sought to infer liability from the filing decisions of transactors — by, for example, always finding for the plaintiff on the grounds that only plaintiffs with valid claims would find it profitable to sue — would alter transactors' incentives so that the profitability of suing was no longer dependent on behavior in the central transaction, thereby undermining the value of the signal previously contained in the act of filing suit. This feature of the model is consistent with legal procedure prescribing that judgments be based solely on facts relevant to the substance of the case as presented at evidence at trial.

The main implication of this lemma 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 defection to deter defection. If either condition is violated, court enforcement will fail to support cooperation in the central transaction, and the unique Nash equilibrium at stage 1 is for the parties not to transact.

It is straightforward to show that, holding distance (X) constant, cooperation is more likely to be sustained by court enforcement the lower plaintiff costs, c; the higher defendant costs, g; the more verifiable the transaction (or more effective the courts), τ; and the lower the gain from defection, $(w-h)e^{\theta X}$.

Special case: Expectation damages. In most settings, the standard remedy for contract breach is expectation damages.[31] Under an expectation damage rule, a transactor found liable for breach must compensate the other party for its loss relative to what it would have earned had the contract been performed. In our model, these damages would equal

$$D = (h - l)e^{\theta X}. \tag{16}$$

[31] In the model, cooperation increases with the size of damages, D, implying that courts could guarantee cooperation simply by setting very large damages or, equivalently, requiring specific performance of contractual obligations backed by imprisonment for failure to perform. In practice, courts infrequently employ such punitive damages or specific performance and, in many jurisdictions, courts prohibit transactors from agreeing to "penalties," that is, liquidated damages that exceed the other party's reasonable expectations. A large literature exists on contract damages. For an overview of the law and economics literature on contract enforcement, see Hermalin et al. (2007, 99-126). The size of damages would also be constrained by state competition for traders; see note 11 above.

Substituting (16) into (14) and (15) and solving for the values of X for which (14) and (15) hold with equality yields

$$\Phi \equiv \frac{\ln\left[\frac{c}{(h-l)\tau}\right]}{\theta}, \quad \text{and} \quad \Gamma \equiv \frac{\ln\left[\frac{g}{(w-h)-\tau(h-l)}\right]}{\theta}, \tag{17}$$

which we use in the following proposition (proved in Appendix B).

Proposition 3 (The scope of cooperation under court enforcement) *It is part of a subgame perfect equilibrium for transactors to cooperate if and only if the distance between them, X, satisfies the following conditions:*

Case $\theta > 0$:

$$X \geq \Phi \text{ if } \tau \geq \frac{w-h}{h-l} - \frac{g}{(h-l)e^{\theta}}, \tag{18}$$

$$X \in [\Phi, \Gamma] \text{ if } \Gamma \geq \Phi \ \wedge \ \frac{w-h}{h-l} - \frac{g}{(h-l)e^{\theta}} > \tau \geq \frac{w-h-g}{h-l}. \tag{19}$$

Case $\theta < 0$:

$$X \leq \Phi \text{ if } \tau \geq \frac{w-h-g}{h-l}, \tag{20}$$

$$X \in [\Gamma, \Phi] \text{ if } \Gamma \leq \Phi \ \wedge \ \frac{w-h}{h-l} - \frac{g}{(h-l)e^{\theta}} \leq \tau < \frac{w-h-g}{h-l}. \tag{21}$$

Figures 4 and 5 illustrate the relationships characterized by Proposition 1. First, figure 4 depicts (for high values of τ) how the sign of θ affects the range of transactions for which court enforcement supports cooperation. If $\theta > 0$ (top panel in figure 4), 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 lower than Φ, transactors defect knowing that prospective damages are too low to justify the expense of filing

suit. When $\theta < 0$, the threshold for filing suit is satisfied for transactions with closer (and therefore more valuable) trading partners. In this case (illustrated in the bottom panel of figure 4), Φ represents an *upper* bound on distance for cooperation instead.

As long as transactions are sufficiently verifiable (τ is sufficiently large), Φ is the only interior bound on cooperation. For lower levels of enforceability, however, an additional bound on cooperation, Γ, arises associated with the transactors' maximization behavior in the central transaction: If the distance X is too high (in the case of $\theta > 0$) or too low (for $\theta < 0$), the gains to defection will be too large relative to the expected damages to sustain cooperation. In this event, cooperation fails, not because courts are too expensive, but because they are insufficiently effective in assessing liability to deter defection. Whereas Φ represents the boundary of distances for which the stakes are too small to justify use of court enforcement, Γ characterizes the boundary on distances for which the stakes outstrip the capacity of courts to detect and deter opportunism. (See figure 5.) For low enough values of τ, Φ and Γ may "cross" (the corresponding condition (19) or (21) does not hold) and cooperation cannot be sustained for transactors at any distance. The unique stage 1 Nash equilibrium in that event is that no trade takes place.

From the preceding, we can also make the following observation.

Corollary 2 (Cooperation and transaction value in the presence of courts) If the courts are sufficiently effective, court enforcement can sustain transactions of sufficiently high value; court enforcement cannot sustain cooperation in low value transactions.

The key to understanding this proposition is that court enforcement has no interior upper bound in value because the court's ability to compel performance can enforce virtually any judgment of the court provided that courts are sufficiently able to determine liability. Court enforcement does have a lower interior bound, however, because the cost to plaintiffs of filing suit may exceed the damage payment income expected from a court case if the value of the underlying transaction is too low.[32]

[32] In this equilibrium, court suits are never filed because the existence of courts just serves as a threat to support cooperation. Appendix A.2 offers a model extension that accommodates suits on the equilibrium path.

3.4. Comparison of Community and Court Enforcement

Although several institution-specific variables affect relative performance — the variables κ and δ for community enforcement; and c, g, and τ for court enforcement — the primary variables of interest in our analysis are θ and X. In particular, we found that, in the case of $\theta > 0$ (the value trade increases with distance), for high enough τ (judicial accuracy) the existence of courts sustains cooperation between sufficiently distant (dissimilar) transactors whereas community enforcement is most effective for transactors located sufficiently close to each other. For $\theta < \theta^*$, the results are reversed: Community enforcement supports cooperation in sufficiently distant transactions and the existence of courts in sufficiently close ones.

The key to understanding these findings is contained in Corollaries 1 and 2. Regardless of the sign of θ, community enforcement is effective (provided $\kappa, \delta > 0$) in deterring defection only for low-value transactions. The intuition is that, if the value gets too high, the short-term gains from defection are too tempting to pass up. By contrast, courts support cooperation only if trade is sufficiently valuable that transactors are willing to incur the cost of litigation. In contexts where liability is particularly difficult to prove, however, the expected gain to defection may be large enough in high value transactions that court enforcement may no longer effectively deter opportunism.

Bringing these findings together to consider a situation where both courts and communities exist in an economy yields several insights. Consider first a case where $\theta > 0$ and τ is high. In this case, if $\Phi > X^*$, community enforcement sustains cooperation in short-distance transactions while court enforcement sustains cooperation in long-distance relationships. For transactions at intermediate distances characterized by $X \in (\Phi, X^*)$, however, there is no cooperation in equilibrium. This occurs because either the level of connectedness is too low for community enforcement or the cost of filing a suit is too high for court enforcement. In the opposite case, where $\Phi < X^*$, by contrast, both courts and communities effectively support cooperation at intermediate distances, $X \in [\Phi, X^*]$. For transactions supported by both institutions, courts and communities would be redundant and, because both enforcement institutions

effectively deter defections in equilibrium (hence, litigation costs would not be incurred), neither institution would have a "transaction cost" advantage over the other in the context of the model. To the extent, however, that the ranges of supported transactions do not perfectly overlap, investments that enhance the effectiveness of one or the other institution might still be justified. [33]

This result contrasts with Dixit's (2003b) finding that worlds of intermediate size fare worst because they are too large for self governance but too small to make "external governance" cost-effective, where "external governance" in his model is an institution that can perfectly detect defection ex post but comes at a cost proportional to the size of the circle economy. In our model, a larger economy is equivalent to an increase in relative distance (see footnote 17) or, equivalently, a lower degree of connectedness, κ, which reduces the scope of cooperation. By contrast, the value of "external governance" by public courts in our characterization depends only on the parameters of the legal system, which are independent of the size of the economy.

Our model yields at least two other departures from Dixit's results. First, in Dixit's model, where $\theta > 0$, the addition of external enforcement expands the scope of cooperation under self governance (community enforcement), but this scope remains an upper bound. By contrast, in our model, the scope of cooperation under court enforcement is a lower bound, implying that courts and community enforcement are complements in the sense that they support cooperation for different sets of transactions. Second, contrary to Dixit's speculation that "trades will unambiguously best be carried out using automatic self-governance in small communities each of which has homogeneous membership" (2003b: 1297), we find that increases in the gains to reneging (defection) that accompany increases in the value of "local" trade may outweigh the greater likelihood that nearby transactors learn about previous defections,

[33] Appendix A.6 considers an extension of the model in which community and court enforcement exist simultaneously.

resulting in the breakdown of cooperation. Courts are likely to be effective in sustaining cooperation in such settings, however.

4. Discussion

As previously noted, the challenge posed by the history of the Law Merchant is to understand the circumstances and forces that contributed first to its emergence and later to its absorption and supersession by state courts. Broadly, as Richman (2004: 2335) notes, private enforcement systems may arise for either of two reasons: "because reliable state-sponsored contract enforcement is unavailable" or because "public courts are available but … private law is preferable." Conversely, existing private enforcement systems may wither either because state institutions strengthen or because the private system becomes less effective. Richman assigns the emergence of the medieval Law Merchant to the former category: the set of "commercial networks [that] resort to self-enforcement because state contractual enforcement is not a reliable option" (*id.*: 2335-6). Similarly, Milgrom, North, and Weingast view the Law Merchant as having arisen to solve the problem of securing merchant bargains "prior to the rise of large-scale third-party enforcement of legal codes by the nation state" (1990: 4).

If the absence of effective state enforcement occasioned the rise of the Law Merchant, its decline would naturally follow from the growth and extension of state authority. Over time, it is argued, states acquired both an interest in shaping commercial law and the coercive power to enforce state court judgments:[34] 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: 157). At the same time, "[e]nforcement of the private codes by the state added a new dimension to enforcement, especially in later periods when nationstates exercised extensive geographic control. Rather than depend for punishment

[34] See, for example, Cooter (1996: 1643): "as the English legal system became stronger and more unified, English judges increasingly assumed jurisdiction over disputes among merchants."

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 et al., 1990: 20-1).[35]

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. First, merchant courts relied on the enforcement tools of the state to a much greater degree than often portrayed in the literature. Kadens, for example, characterizes as "largely inaccurate" the assumption that the enforcement mechanisms of merchant courts "were so weak that the merchants had to rely heavily on reputation networks to convince each other to live up to contracts" (2004: 51). Far from arising spontaneously, setting up a marketplace was a privilege granted by a king or lord and accompanied by the right to raise taxes and mint coins as well as to create market law and enforcement institutions independent of the regular courts: "An element of practically all market documents of the 9th to 11th centuries is the removal of the competence of normal courts for the market place and the assignment of the right to establish a court (which practically included the right to specify the law) to the owner of the market" (Bindseil and Pfeil, 1999: 741). With those grants, merchant courts acquired the same powers as other courts to fine, seize property, and impose other types of punishments (e.g., pillorying) to enforce their rulings (Sachs, 2006: 685). A merchant who cheated another merchant

[35] The state accession hypothesis has two versions. One holds that states' wresting of the control of courts from merchants was hegemonic (e.g., Benson 1989; Mitchell, 1904; Berman, 1983): Although merchant courts were more efficient, states were intent of centralizing authority. 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 corresponds to an improvement in τ (and possibly an increase in the size of damages, D) in our model.

"'stood in peril of death' at the hands of a foreign tribunal."[36] Even at the Champagne Fairs — Milgrom, et al.'s primary illustration — "the lord appointed wardens to act upon administrative and judicial matters in his name and serjeants, essentially policemen, to enforce the orders of the court, guard the merchandise at night, keep the peace, and deliver summonses" (Kadens, 2004: 53). If a merchant was outside the town's jurisdiction, enforcement might be achieved through group reprisals: boycotting or the seizing of the merchandise of the defaulting merchant's compatriots.[37]

Second, rather than 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 exercised jurisdiction over property, tort, and criminal matters but deliberately eschewed enforcement of contracts: "it 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."[38] States evidently had the capacity to enforce merchant contracts long before they assumed that role.[39]

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[36] Kadens (2004: 60), quoting Hubert Hall, *2 Select Cases concerning the Law Merchant, A.D. 1239- 1633* (1930). See also Williamson (2010: 6), quoting Brătianu, (1927: 32): "In some Italian jurisdictions, for example, notaries could have faced the prospect of being burned at the stake for falsifying documents."

[37] Our review of the literature reveals surprisingly thin documentary support for the claim that threats of ostracism by merchants sustained merchant court decisions. Milgrom, North, and Weingast (1990) cite Benson (1989); De Roover (1965); and Trakman (1983). Benson (1989), in turn, also cites Trakman (1983: 10), which alludes only that "Reciprocity and the threat of business sanctions compelled performance," for which Trakman provides no references. De Roover contains only a passing reference to the law merchant (1965: 100) and no discussion of ostracism or similar punishments of individual merchants. (Boycotts of specific ports or countries are, however, mentioned.) Berman (2002) adds a reference to Wooldridge (1970), a book primarily concerned with U.S. monopoly provision of public goods and services. Greif, Milgrom and Weingast (1994) do provide an example of an agreement among a group of Flemish merchants not to trade with any merchant "anywhere in England who deals with sales of wool [who] deals falsely with any merchant in this alliance" (1994: 756). But other examples of multilateral actions they provide involve embargoes and boycotts against entire (usually) cities, or expulsions from the merchant guild of members who violated an embargo, rather than sanctions against individual merchants for ignoring merchant court rulings. Weak documentary evidence of ostracism supporting Law Merchant decisions could simply reflect the success of the Law Merchant in securing merchant compliance: Ostracism could have been rarely observed because few merchants would risk the loss of business by ignoring merchant court rulings. Undoubtedly, reputation played an important role during this period, as it continues to do in modern-day commercial dealings (Macaulay, 1963), but ostracism was evidently not the exclusive remedy available to medieval merchants.

[38] *Tractatus de Legibus et Consuetudinibus Regni Angliae* (circa 1188), as quoted in Simpson (1987: 4). Before the 15th century, "[t]he Kings court was not very fond of contract," leaving adjudication of private commercial

(continued on next page)

The alternative to state accession is that the gradual withering of the Law Merchant had more to do with its own limitations and failures than with the accretion of state power and institutions.[40] Important to understanding the erosion of Law Merchant is a revised understanding of what the Law Merchant was and was not. Two features are particularly important. First, merchant courts differed from state courts in adopting expeditious procedures and in the use of good faith in resolving disputes (Baker, 1979: 300). "Most importantly, merchant procedure was equitable procedure. It relied not on the rigor of the law but on judging '*ex aequo et bono*,' according to that which is fair and best for the parties and doing so in the simplest possible fashion. By this standard, the particular needs of the parties governed a

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agreements to local mercantile courts (Pluknett, 1956: 636-7). See also, Baker (1979: 296-97). Although the Law Merchant also covered such aspects of commercial exchange as transportation, insurance, and financing, the most common source of disputes involved the sale of goods (Berman, 1983: 334; Sachs, 2006: 781).

[39] Several authors have noted that judges in medieval England received part of their compensation from litigants and suggest that this led to competition among courts and tribunals for cases (e.g., Landes and Posner, 1979: 257-58; Benson, 1989; and Zywicki, 2003: 1582-1589). Whether or not such competition actually took place (for a contrary view, see Simpson, 1975), several points are worth noting. First, fees from litigants constituted only part of a judge's compensation (Landes and Posner: 256), implying that running a court system was costly to the state. Second, judges were, in effect, agents of the state, and the state's choice of a compensation scheme that encouraged judges to compete for cases presumably reflected a policy choice; states could have chosen instead to pay judges out of general tax revenue or a duty specifically on merchants but not tied to cases. Finally, compensating judges through fees paid by litigants may have made the use of state courts more appealing to judges but would have made them more expensive and therefore less appealing to litigants (relative to a system of free access to courts). Overall, these factors suggest that the state, or the merchants themselves, must have perceived some advantage of state courts over merchant tribunals. As Berman suggests, competition between medieval courts might be better thought of as analogous to modern disputes over jurisdictional boundaries between U.S. federal and state courts (1983: 268-9).

[40] Despite emphasizing the absence of effective state enforcement in the rise of the Law Merchant, Milgrom et al. attribute its demise to an increase in information costs of running the system as the volume of trade increased (1990: 21):

> To the extent that the costs of running state adjudication and enforcement were roughly similar to the costs of running the private system and to the extent that taxes can be efficiently collected, a comprehensive state-run system would have the advantage that it eliminates the need for each individual to pay [the cost of using the centralized information system] each period. As the volume of trade increased in the late middle ages, the cost saving from that source would have been substantial. Thus our approach suggests that the importance of the role of the state enforcement of contracts was not that it provided a means of enforcing contracts where one previously did not exist. Rather, it was to reduce the transaction costs of policing exchange.

Their argument differs from ours in that theirs emphasizes the volume of trade whereas ours turns on the composition of trade.

given dispute rather than strict adherence to established law or precedent" (Kadens, 2004: 57)[41] Determining what constitutes good faith requires deep knowledge of the particulars of the transaction and understandings of the transactors, knowledge that other, similarly situated merchants, but not generalist adjudicators, were likely to have possessed. The crucial advantages of specialized merchant courts resided ultimately in their speed (and, thus, lower cost) and in their familiarity with merchant practices and customs, qualities that non-specialized state courts were unable to replicate.

Second, contrary to many characterizations (e.g., Benson, 1982: 1; 1989; Trakman, 1983:11), the Law Merchant was not a "universal law of trade" (Trakman: 11) based on customs uniformly applicable to all merchants throughout Europe. Rather, merchant customs "were local and trade-specific" (Kadens, 2004: 62; Ibbetson, 2007: 159-60). Deviations in merchant practices and trade usages were not significant obstacles in the early period of trade revival (roughly the 11th and early 12th centuries) because the number of both products traded and market centers were few.[42] Subsequent developments in shipbuilding technology, however, significantly lowered transportation costs and expanded the types and volumes of goods that could be economically traded. Specifically, around 1180-1200 shipbuilders began to adopt "through-beam" construction involving the insertion of horizontal beams that protruded through the planking of the ship's sides (Bill, 2002: 105). This and other contemporaneous innovations allowed shipbuilders to construct cargo ships that were larger, sturdier, safer, and cheaper than their predecessors, resulting in a significant decrease in transportation costs (*id.*: 105-112). Archeological and historical

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[41] *Ex aequo et bono* "means what is just and fair or according to equity and good conscience. Something to be decided *ex aequo et bono* is something that is to be decided by principles of what is fair and just. A decision-maker who is authorized to decide *ex aequo et bono* is not bound by legal rules but may take account of what is just and fair. Most legal cases are decided on the strict rule of law. For example, a contract will be enforced by the legal system no matter how unfair it may prove to be. But a case to be decided *ex aequo et bono*, overrides the strict rule of law and requires instead a decision based on what is fair and just under the given circumstances" (http://definitions.uslegal.com/e/ex-aequo-et-bono/).

[42] *Cf.* Williamson (2010: 11), who notes that, at the end of the 12th century, Venetian merchants traded principally with Egypt and principally for pepper.

records show cargo ship capacities, which had been essentially static before 1150, rising steeply thereafter (*id.*: 102).

Concurrent with these changes, the nature of trade began to shift. Whereas early intercity and interregional trade before 1200 focused on relatively high-value, easy-to-transport products, reflecting the relatively high risk and limited capacities of early ships, later trade also included heavier and lower value bulk cargoes. In Northern Europe, for example, transnational trade before the 13th century consisted primarily of such high-value-to-transport-costs products as wax, furs, wine, and cloth (Hybel, 2002: *xviii*; Campbell, 2002: 6). With the increase in ship capacity, the variety of products traded as well as the amount of trade increased, adding such bulk commodities as stone, pottery, timber, and grain, which "developed from an incidental activity to regular trade during the two and half centuries from 1150 to 1400" (Hybel, 2002: *xvii*).[43] At the same time, the number of markets and ports serving long-distance trade multiplied. Between 1200 and 1349, over 300 licenses for new markets were granted in twenty-one English counties alone (Britnell, 1981: 209-10).[44] Although a majority of these new markets were inland and not directly related to long-distance trade (*id.*: 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…." (*id.*: 213-14).

In terms of our model, developments in transportation costs and trade opportunities leading up to, during, and following the Commercial Revolution can be interpreted as θ increasing from negative (the value of trade decreasing in distance) to progressively more positive values (increasing values of trading beyond one's community). In the Dark Ages between the fall of the Roman Empire and the 11th century,

[43] *Cf.* Poulsen (2002: 35), who concludes, on the basis of tariff lists and other documents, that in Denmark "the supply of goods in the period 1200-1350 became quite differentiated."

[44] These 21 counties represented 55% the land area of England (Britnell: 209). Two-thirds (219 of 329) of the markets licensed in this period survived into the 16th century (Britnell: 210, 219).

"Europe had little room for investment over and above the preservation of life" (Lopez, 1971: 59). Given the high costs and risks of travel of any type, what trade did take place was marginal and occurred only on the periphery (high X), for which community enforcement was sufficient, while the most valuable (low X) investments — fortifications, water mills, and churches, for example — were undertaken under the direction and control of the local lord.[45]

As the threat from barbarian invasion subsided and trade routes began again to reopen, the value of long-distance trade increased (θ turned positive). But although trade took place over increasing geographic distances, the number of markets was small and the range of traded products limited. As a result, trade occurred mainly within relatively stable communities of merchants, and community enforcement worked well for merchants who were "close" (low X) in terms of knowledge and experiences. Finally, in the last stage, the proliferation of markets and products accompanying the continued decline in transportation costs (still higher θ) after 1200 greatly expanded the opportunities for trade but, in doing so, increased the heterogeneity of merchants and undermined the capacity of merchant courts to reach decisions based on shared knowledge about merchant practices while reducing the consequences of ignoring merchant court rulings.[46] The result was that, when states began to codify

[45] Shipping of grains, oil, and other products certainly occurred prior to the fall of Rome, but procurement was frequently by conquest and confiscation (vertical integration, if you will) rather than voluntary trade. Even then, in the ancient world, "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: 57).

[46] Dean Williamson (2010) describes a parallel process that occurred in financial and agency relationships during the same period. When trade involved repeated transactions in 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, which were susceptible to agent cheating, nevertheless to operate satisfactorily. Where trade was more episodic, 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 be found in Ellickson's (1989) description of operation and demise of whaling communities, and in Bernstein's (1999) discussion of trade association efforts to codify customs and practices of their members, which varied by region within the same trade.

merchant law, they often did so at the urging of merchants and with the aim of harmonizing disparate customs that confounded simple resolution of merchant disputes (Kadens, 2010: 23-5, 32-3).

5. Conclusion

The preceding analysis suggests a number of factors affecting the capacity of communities and courts to support cooperation among impersonal traders. Over long periods of time, societies that provide a mix of institutions appropriate for the prevailing types of commercial activity should tend to be more successful, and those institutions should spread as other states seek to imitate that success. In the period between the fall of the Roman Empire and the end of the 10th century, very little trade took place outside of the local communities in Europe. Various scholars have associated the revival of trade with the emergence of a set of mercantile institutions that promoted cooperation among merchants as trade expanded to distant ports and markets at the beginning of the Commercial Revolution in 11th and 12th centuries. Although by most accounts those institutions served merchants well, all agree that throughout Europe state courts gradually displaced the system of private mercantile courts known as the Law Merchant even as the trade that system fostered continued to grow.[47]

The Law Merchant did not entirely disappear. A modern version, for example, continues to govern international transactions (see, e.g., Trakman, 1983: chapters 2 and 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 New York Convention on the Recognition and Enforcement of Foreign Arbitral Awards (see Leeson, 2008). Signed by six countries in the first year, the Convention has gradually been adopted by 142 of the 192 UN Member States in the ensuing four decades. A better understanding of the considerations that make state

[47] The progression to modern times was hardly monotonic. Trade and much else, for example, were interrupted by the onset of the Black Death in the mid-14th century, after which Europe entered a period of uneven growth through the mid-16th century (Lopez, 1971: 85).

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.

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Appendix A: Model Robustness and Extensions

A.1 Endogenous Matching

We have assumed that matching of partners is due to the algorithm specified by (1). Given the impact of X on the base value of a certain transaction, one could ask whether it is rational for actors to accept exogenous matching or whether they would not insist on being rematched if their first draw was unfortunate. In other words, shouldn't we endogenize matching?

Let us state first that Dixit (2003b) assumes a similar matching rule to capture that local matches occur with a higher probability than farther matches. Moreover, this rule becomes more intuitive if we assume that, before the game is played, transactors have already determined the potential location of their partners. Thus, they have set the boundaries in X-space between which they would accept matches because they come at a sufficient trade value and the very idea of impersonal exchange prohibits that these boundaries are too restrictive. Then, nature would determine the exact distance between partners within the boundaries. For our results to hold, the only important assumption is that there is some degree of exogeneity in matching.

A.2 Suits Filed in Equilibrium

In our model, the existence of courts serves as a punishment device for victims that deters defection in certain relationships. However, in equilibrium no court suits are ever filed, which is obviously different in practice. The following model extension accommodates court suits on the equilibrium path.

Without loss of generality, we only consider the case where $\theta > 0$ in this extension. Assume, for simplicity, that only two types of courts exist: competent courts, for which $\tau = \overline{\tau} = 1$, and incompetent courts, for which $\tau = \underline{\tau} = 0$. Let the probability for each court type be .5. Hence, the prior expected court competence level is $.5$. Assume that each player, after being matched to his partner but before the central transaction in period t, gets a private signal about the quality of the specific court j that would deal

with the case in t, given he or his partner filed a suit. Player i's private signal is $\hat{\tau}_i \in \{0,1\}$ and player x's signal is $\hat{\tau}_x$. Moreover, let signals be i.i.d. and the probability that *i*'s signal is correct about court *j*'s level of competence be φ. Applying Bayes' rule yields that the probability that the court's competence level is high given that i received a high signal is φ, whereas the probability that the court's competence level is high given that i received a low signal is $(1-\varphi)$. Technically, $P(\tau = 1 \mid \hat{\tau}_i = 1) = \varphi$, $P(\tau = 0 \mid \hat{\tau}_i = 1) = (1-\varphi)$, $P(\tau = 1 \mid \hat{\tau}_i = 0) = (1-\varphi)$, and $P(\tau = 0 \mid \hat{\tau}_i = 0) = \varphi$. It follows that i's posterior belief about the quality of court j, which we denote τ_i, is $\tau_i(\hat{\tau}_i = 1) = \varphi$ and $\tau_i(\hat{\tau}_i = 0) = (1-\varphi)$.

To observe court suits on the equilibrium path, the following strategy combination must be a subgame-perfect equilibrium in period t.

Stage 1: Both players, i and x, choose to interact.

Stage 2: One player, i, defects; the other player, x, cooperates.[48]

Stage 3: x files a suit; i does not file a suit.

We solve the game by backward induction. Assume, for simplicity, that the realizations of the players' signals about court quality are $\hat{\tau}_i = 0$ and $\hat{\tau}_x = 1$. Consequently, $\tau_i = (1-\varphi)$ and $\tau_x = \varphi$.

At stage 3, given that i defected and x cooperated, *x* files a suit iff (30) holds for τ_x (see the proof of Proposition 3), i.e. if:

$$\tau_x \geq \frac{c}{(h-l)e^{\theta X}}. \tag{22}$$

[48] Considering the case where x defects and i cooperates would be analogous.

Given that i defected, i expects negative payoff from a court suit – see (11) and (12) - and thus does not file a suit in equilibrium himself, independent of τ_i.

At stage 2, i defects iff (31) does not hold for τ_i and x cooperates iff (31) holds for τ_x, i.e. if:

$$\tau_x \geq \frac{(w-h)e^{\theta X} - g}{(h-l)e^{\theta X}} > \tau_i . \tag{23}$$

At stage 1, both players choose to transact with each other if they believe that the court can effectively protect them from their partner's opportunism. This condition is satisfied if they would both file a suit at stage 3 if their partner defected at stage 2. This is given if (22) also holds for τ_i.

Summarizing, if τ_i and τ_x both satisfy (22) and (23), the strategy combination described above is a subgame-perfect equilibrium. This holds, for instance, for $(h-l)e^{\theta X} = 1$, $(w-h)e^{\theta X} - g = 0.5$, $c = 0.1$, $\varphi = 2/3$. With these parameter values, a suit will be filed in equilibrium whenever i and x get different signals, i.e. if $\hat{\tau}_i = 0$ and $\hat{\tau}_x = 1$, or vice versa.

A.3 Strategic or Untruthful Reporting via Communities

As mentioned above, the assumption that players report truthfully about actions taken in the central transaction to their community is common in the literature. Consider the following variant of our model.

After the central transaction each player i can choose the content of the message that he sends to his network from the message space, {cooperated, defected, did not interact}. As truthful self-reporting of a defector leads to an expected payoff loss in the subsequent period, given everybody plays the CE strategy, we assume that this message is accompanied by a claim that i himself cooperated. If player y receives conflicting messages from the period t partners i and x, assume that he will trust the sender

located closer to him on the circle. This assumption can be justified by observations that show that, when individuals are socially closer, both trust and trustworthiness rise.[49] The assumption becomes more intuitive by resorting to our interpretation of social distance on the circle as the degree of shared knowledge. By assumption, players located close to each other have a high overlap of knowledge sets. Thus, they could check their neighbors' statements more easily because they understand them better and can detect logical loopholes more easily than the statements of players with very different knowledge sets. Think about communication problems across academic fields or even disciplines. In this model variant, the CE strategy of player i has to be extended by the action of (endogenously) truthful reporting about i's partner's behavior.

As an effect of the model variant, the expected loss from defection, L, is reduced as compared to (5). This is due to the assumption on trustworthiness among closer players, which leads to the fact that all potential recipients of x's message who reside on the half of the circle closer to i, would never believe x, even if they received his message. The reduction of L quantitatively effects all subsequent results of the community model (making cooperation harder to achieve in equilibrium) but all results hold qualitatively.

A.4 Individual Levels of Connectedness

Communities are often individualized and the degree by which a player can send messages to others differs frequently. Assume that κ_i is the level of connectedness of player i, which may differ from other players' connectedness. How would this assumption affect our results?

First, assume that player i is matched with player x and that $\kappa_i > \kappa_x$, without loss of generality. Then, equation (8) differs for both players because player i's relative gains from cooperation depend on

[49] See, for instance, Glaeser et al. (2000) and further literature cited therein.

κ_x, whereas x's relative gains from cooperation depend on κ_i. In this case, (8) implies that $V_i(\kappa_x,\cdot) < V_x(\kappa_i,\cdot)$. Player i is better connected than x, which means that i's potential to punish x in case of defection by telling his friends about x's misdeed is higher than vice versa. Thus, κ_i can be interpreted as i's "big stick" to encourage x to cooperate. However, because x's connectedness is low in this example, the incentives for i to cooperate are also limited. Thus, if $V_i(\kappa_x,\cdot) < 0 \leq V_x(\kappa_i,\cdot)$, x does have an incentive to cooperate but i does not. However, if x understands i's incentive to defect, x will not interact with i.

Consequently, if κ_i and κ_x differ, the smaller of the two κ-values determines the binding relative gains of cooperation that decide whether the CE strategy leads to cooperation in equilibrium: $V = min\{V_i^*(\kappa_x,\cdot), V_x^*(\kappa_i,\cdot)\}$. Along the same lines, in equilibrium the scope of cooperation is the smaller one of the individual scopes:

$$X^* = \min\{X_i^*(\kappa_x,\cdot), X_x^*(\kappa_i,\cdot)\} \text{ for } \theta > 0, \tag{24}$$

$$X^* = \max\{X_i^*(\kappa_x,\cdot), X_x^*(\kappa_i,\cdot)\} \text{ for } \theta < \theta^*. \tag{25}$$

This extension produces an additional hypothesis, compared to the uniform κ case: In economies or industries where the distribution of connectedness (κ) at a given location has a high variance, we expect to find *less* cooperation. This is due to the statistical fact that in distributions with high (low) variance the probability that one of two draws is small is relatively high (low).

A.5 Corrupt and Biased Judges

In our model of courts we have used a shortcut and assumed that courts are neutral in the sense that they decide cases just based on the evidence and their competence, that is, τ. In practice, however, courts may be corrupt or biased in favor of one of the litigants. Here we suggest two simple variants to illustrate this in our model.

First, consider an exogenous bias of courts. In this case, the court also has a location on the circle, at distance J from player i and at distance $|J-X|$ from his partner, x. This reflects a political economy approach, namely that, even if a judge is not corrupt, he is a social actor himself and knows some people, e.g. from the same geographical region or with a similar professional background, better than others. In this model variant assume that, if the judge decides a case, on top of his insights based on the objective evidence and his competence (τ), it is possible that he receives one or two messages from the litigants, according to (4). This receipt can be interpreted as rumors about what truly happened in the central transaction of i and x. Assume that a judge puts a weight, $\alpha \in [0,1]$, on the message of rumors and a weight $(1-\alpha)$ on his own professional insights. It is straightforward to show that in such a model the litigant located closer to the judge can expect a more favorable decision from the court. This has an impact on the individual scopes of cooperation of the players.

Interestingly, for $\theta > 0$ and $J \lhd |J-X|$, if compared to (18) and (19), $\Phi_i < \Phi$ and $\Gamma_i < \Gamma$. This means that a player i who is better connected to a judge than his partner x will more easily file a suit if he cooperated and his partner defected because the expected damage payment he gets as a victim is higher than in the case of neutral judges. This fact deters x from defecting. However, it also reduces the expected damage payment that i has to pay if he defected himself. Thus, i is more likely to defect. For x, these effects are reversed.

The net effect of these changes depends on the assumptions on information. If the partners know J and $|J-X|$ when they are matched, they can foresee these effects. As a consequence, the less connected partner x would not interact with i unless the conditions in (18) and (19) hold for both partners. This would reduce cooperation in total. If, however, the precise location of the judge in the circle economy is not known, the results depend on the beliefs the players have. We leave a detailed analysis of this case for future research.

Second, consider an endogenous bias of ex ante neutral courts, that is players can bribe the judge to decide a case in their favor. In such a bribing game it is crucial whether the players can bribe the judge before the central transaction and whether they can credibly communicate the bribe to their partner or whether bribing occurs after the central transaction but before a suit is filed, or even after the legal costs c and g have been committed. In any specification, one plausible model of the bribing stage is a Tullock contest, in which a partner's success probability depends on the ratio of his bribe over all bribes paid. Again, we leave this issue for future research.

A.6 A Combined Model of Communities and Courts

In the main text of this paper, we have distinguished between the enforcement mechanisms offered by communities and by courts. However, it is straightforward to combine both models and to analyze the scope of cooperation if both enforcement institutions coexist. In such an extension, the order of play in period t is as follows:

Stage 1: Players choose to interact, or not.

Stage 2: Players choose to cooperate or to defect.

Stage 3: Players send messages around the circle about their partner's behavior and decide whether to file a suit, or not. If they file a suit, the court decides as before.

For the sake of brevity, we analyze this game for $\theta > 0$ only. The case for $\theta < 0$ is analogous. Given that court decisions are unaffected by communities, at stage 3, a player would only file a suit if he cooperated at stage 2 but his partner defected and $X \geq \Phi$ (see Proposition 3). If this condition does not hold, the existence of courts does not influence the community model's results. Instead, if $X \geq \Phi$, the stage 2 incentive constraint to cooperate and not to defect extends to:

$$L + \tau(h-l)e^{\theta X} + g \geq (w-h)e^{\theta X}. \tag{26}$$

The RHS of equation (26) is similar to the RHSs of (7) and (31), the single-institution incentive constraints, because the payoff from defection is unchanged. Its LHS, however, adds the LHSs of (7) and

(31) because, in the combined model, each player has two punishment devices instead of one but no extra cost. Given that L in (7) and $\tau(h-l)e^{\theta X}+g$ in (31) lead to the upper bounds on cooperation - X^* in the community model and Γ in the court model - $L+\tau(h-l)e^{\theta X}+g$ in the combined model adds both upper bounds. It follows that the joint availability of communities and courts increases the scope of cooperation. Since the two enforcement institutions are not exclusive, a cheated player can both inform his community about his partner's misbehavior, which costs the cheater business opportunities in the next period, and can exact a damage payment from the cheater by filing a court suit (and provoke that the cheater has to pay legal cost of g to defend himself). Similar to the court model, the effectiveness of courts in the combined model increases in τ.

Appendix B: Proofs

B.1 Proof of Proposition 1

To prove Proposition 1 we have to show two characteristics of V, (i) monotonicity in X, and (ii) the conditions under which $V \geq 0$.

On (i): Differentiating V with respect to X shows that $\frac{\partial V}{\partial X} =$

$$\frac{((e-1)e^{1+X+2X\theta}(w-h)(2-\theta)\theta^2 + (e^{\theta X}-1)(e^{2X+\theta}-e^{2+X\theta})(\theta-1)\delta\kappa h)}{e^{1+X+\theta X}(e-1)(\theta-2)\theta}. \tag{27}$$

Define $\hat{\theta}(X) \equiv \{\theta \mid \frac{\partial V}{\partial X} = 0\}$. By checking (27), we get $\frac{\partial V}{\partial X} > 0, \forall \theta < \hat{\theta}(X)$, and $\frac{\partial V}{\partial X} < 0, \forall \theta > \hat{\theta}(X)$. By substituting $X = 0$ and $X = 1$ into $\hat{\theta}(X)$ and evaluating, we get $\hat{\theta}(X = 0) = \hat{\theta}(X = 1) = 0$. However, $\hat{\theta}(X \in (0,1)) < 0$; see Figure 6.

Define $\theta^* \equiv argmin\{\hat{\theta}(X)\}$. It follows that, $\forall \theta > 0, \frac{\partial V}{\partial X} < 0$, that is, V is monotonically decreasing in X for positive θ. It also follows that, $\forall \theta < \theta^*, \frac{\partial V}{\partial X} > 0$, that is, V is monotonically increasing in X for sufficiently negative θ. For $\theta \in [\theta^*, 0]$, however, V is non-monotonic in X. This area is illustrated in Figure 6 by the region between the bold vertical lines at $\theta = 0$ and $\theta = \theta^*$. Henceforth, we focus on the two monotonic cases, $\theta > 0$ and $\theta < \theta^*$.

On (ii): Substituting values in (8) shows that $V \geq 0$ if:

$$\frac{h}{w-h}\delta\kappa_x \geq \frac{(e-1)e(\theta-2)}{e^{\theta}-e^2} \quad \text{for} \quad X = 0, \tag{28}$$

$$\frac{h}{w-h}\delta\kappa_x \geq \frac{(e-1)e^{\theta}(e-1)}{e^{\theta}-1} \quad \text{for} \quad X = 1. \tag{29}$$

Define $X^* \equiv \{X \mid V = 0\}$ and consider $\theta > 0$. Because there $\frac{\partial V}{\partial X} < 0$, X^* characterizes an upper bound on cooperation in X-space. We have to distinguish among three subcases. First, if (28) does not hold, $V < 0$ for all X. Hence, the players have no incentive to cooperate; $X^* = 0$. Second, if (28) and (29) hold, $V \geq 0$ for all X. Hence, the players have an incentive to always cooperate; $X^* = 1$. Third, if (28) holds but (29) does not hold, there is a unique $X^* \in [0,1)$, 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 $X > X^*$.

Now consider $\theta < \theta^*$. Because there $\frac{\partial V}{\partial X} > 0$, X^* is a lower bound on cooperation in X-space. Again, we have to distinguish among three subcases. First, if (29) does not hold, $V < 0$ for all X. Hence, the players have no incentive to cooperate; $X^* = 1$. Second, if (28) and (29) hold, $V \geq 0$ for all X. Hence, the players have an incentive to always cooperate and $X^* = 0$. Third, if (29) holds but (28) 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 has an incentive to cooperate for $X \geq X^*$ but not for $X < X^*$. ■

B.2 Proof of Proposition 3

Assuming that player i's partner, x, cooperates, it is individually rational for i to cooperate, too, if (14) and (15) hold. Substituting (16) into these equations, it follows:

$$(h-l)e^{\theta X} \geq \frac{c}{\tau} \tag{30}$$

$$(h-l)e^{\theta X} \geq \frac{(w-h)e^{\theta X} - g}{\tau}. \tag{31}$$

Solving (30) for X shows that, given i defected, it is rational for x to file a suit at stage 3 if $X \geq \Phi$ for $\theta > 0$ and if $X \leq \Phi$ for $\theta < 0$.

At stage 2, consider $\theta > 0$ first. (31) holds if:

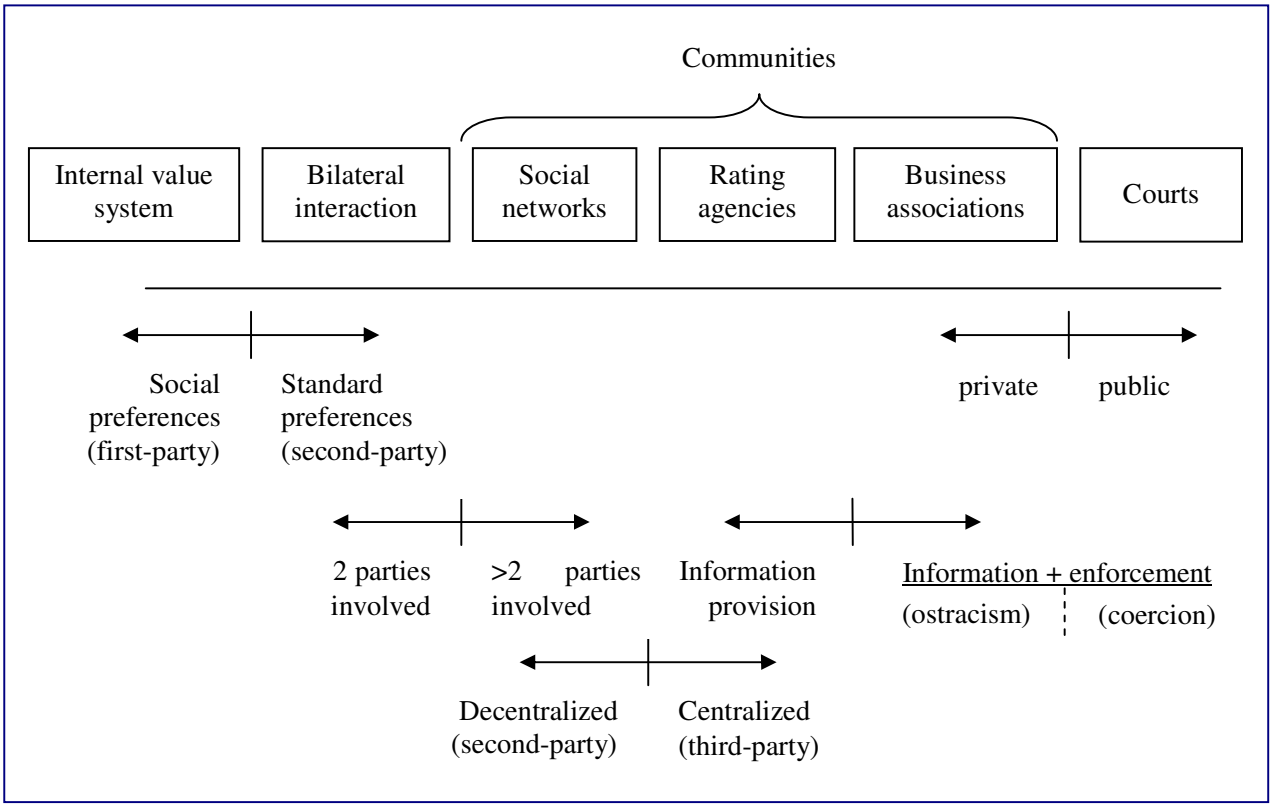
$$\tau \geq \frac{w-h-g}{h-l} \quad \text{at} \quad X = 0, \tag{32}$$

$$\tau \geq \frac{w-h}{h-l} - \frac{g}{(h-l)e^{\theta}} \quad \text{at} \quad X = 1. \tag{33}$$

Both sides of (31) are monotonic in X. Thus, if both (32) and (33) hold, it is rational to cooperate at stage 2 $\forall X \geq \Phi$. Note that the RHS of (33) is larger than the RHS of (32). Hence, (33) is the binding constraint, which proves (18) . If (33) does not hold but (32) holds, there is an interior solution in X -space, Γ, which is found by solving (31) with an equation sign for X. This proves (19).

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 RHS of (33) is smaller than the RHS of (32). Hence, (32) is the binding constraint, which proves (20). Third, if (33) does hold but (32) does not, there is an interior solution, Γ, which is a lower bound, not an upper bound, in X -space. This proves (21). ■

Figure 1. Six Commitment Mechanisms



Legend:

Bilateral (repeated relationship): No external parties involved; can enforce cooperative behavior via repetition of trade if cooperation occurs, trading stops in case of defection. Advantage: Observability of partner's behavior is sufficient (no verifiability needed)

Social networks: Related to bilateral repeated relationship, but other parties, who are known by one or both trading partners, are involved. If one partner defects, he loses future trade with partner but also with all potential trading partners in social network.

Rating agencies: Formal organization with centralized management (rules, some formal authority), membership may require a fee. Collects reports of members about the behavior of their trading partners and distributes them among the other members.

Business associations: Formal organization with centralized management (rules, some formal authority), membership may require a fee. Can enforce contracts either via *direct punishment* (if members have assigned power to management first) or via *ordering* the members not to trade with defecting party.

Courts: Encompasses all legal powers of the state (judiciary, executive) to enforce contracts. Verifiability of claims necessary by definition.

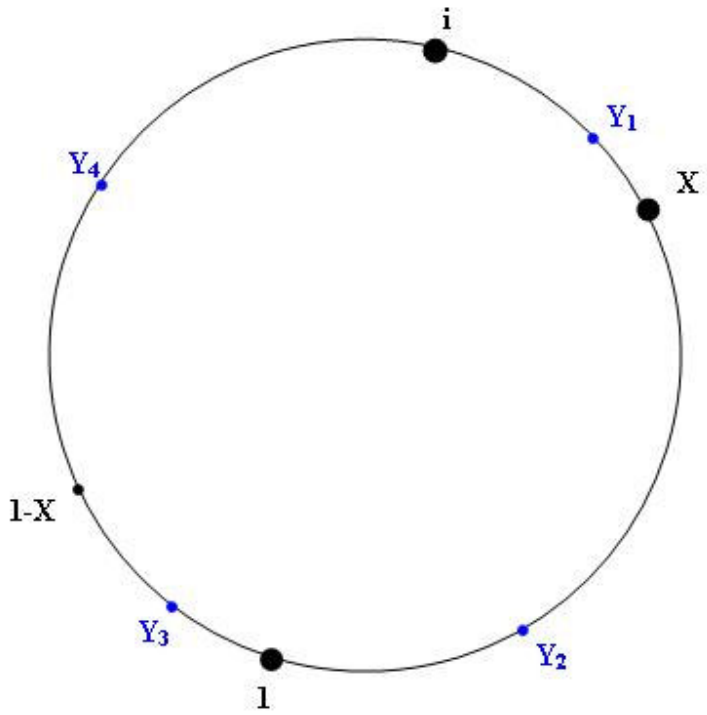


Figure 2. Possible locations of *y*, player *i*'s next period match, relative to x, *i*'s current match.

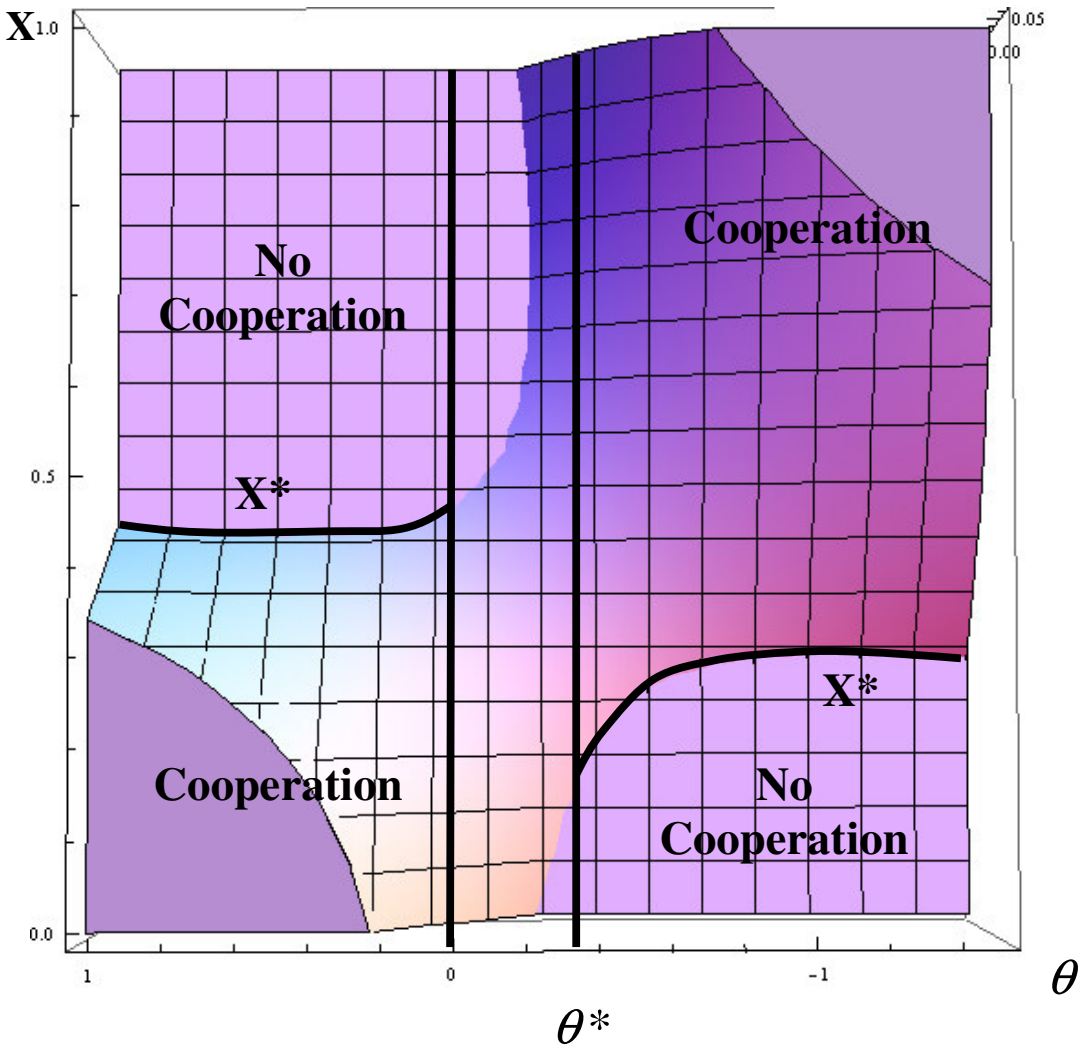


Figure 3. Cooperation under Community Enforcement.

Numerical example for w = 1.38, h = κ = 1, δ = 0.6.

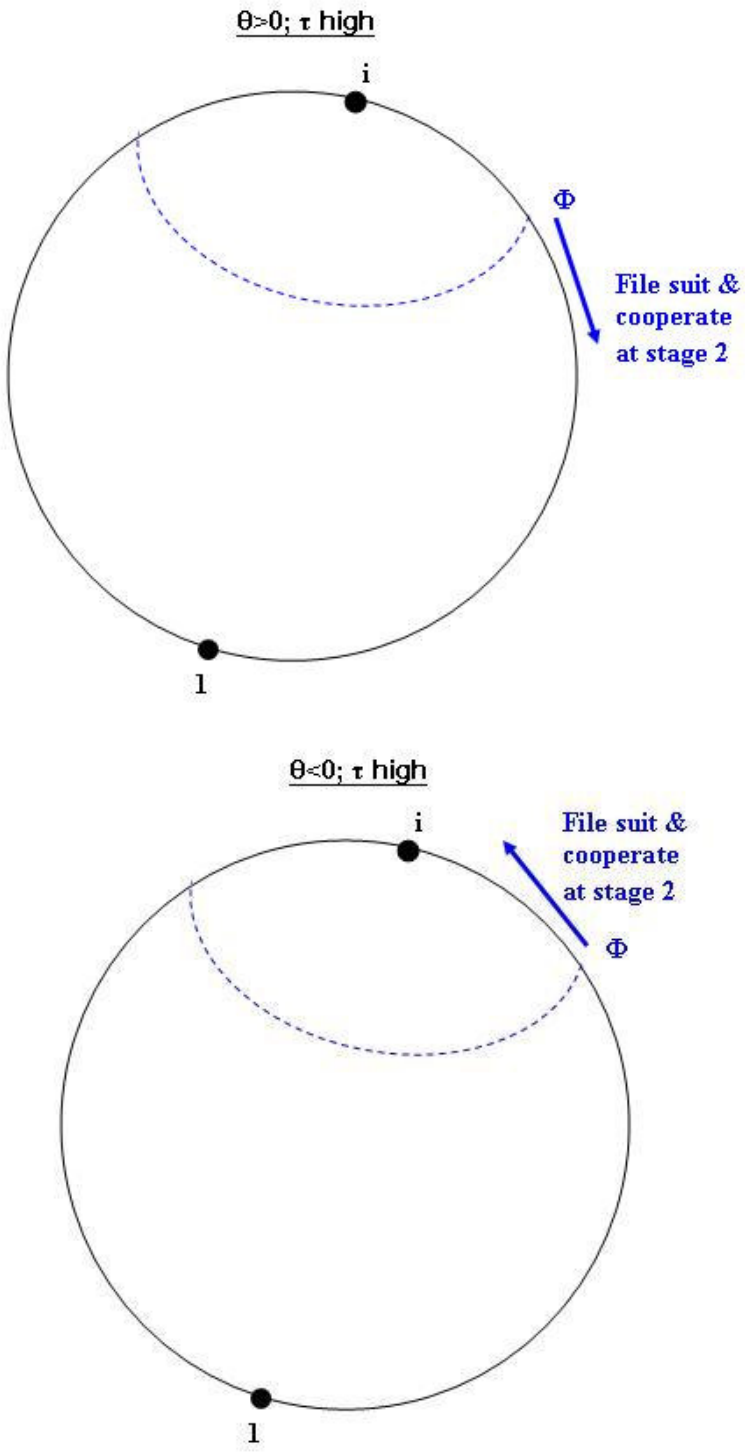


Figure 4. The scope of cooperation under effective court enforcement (τ high).

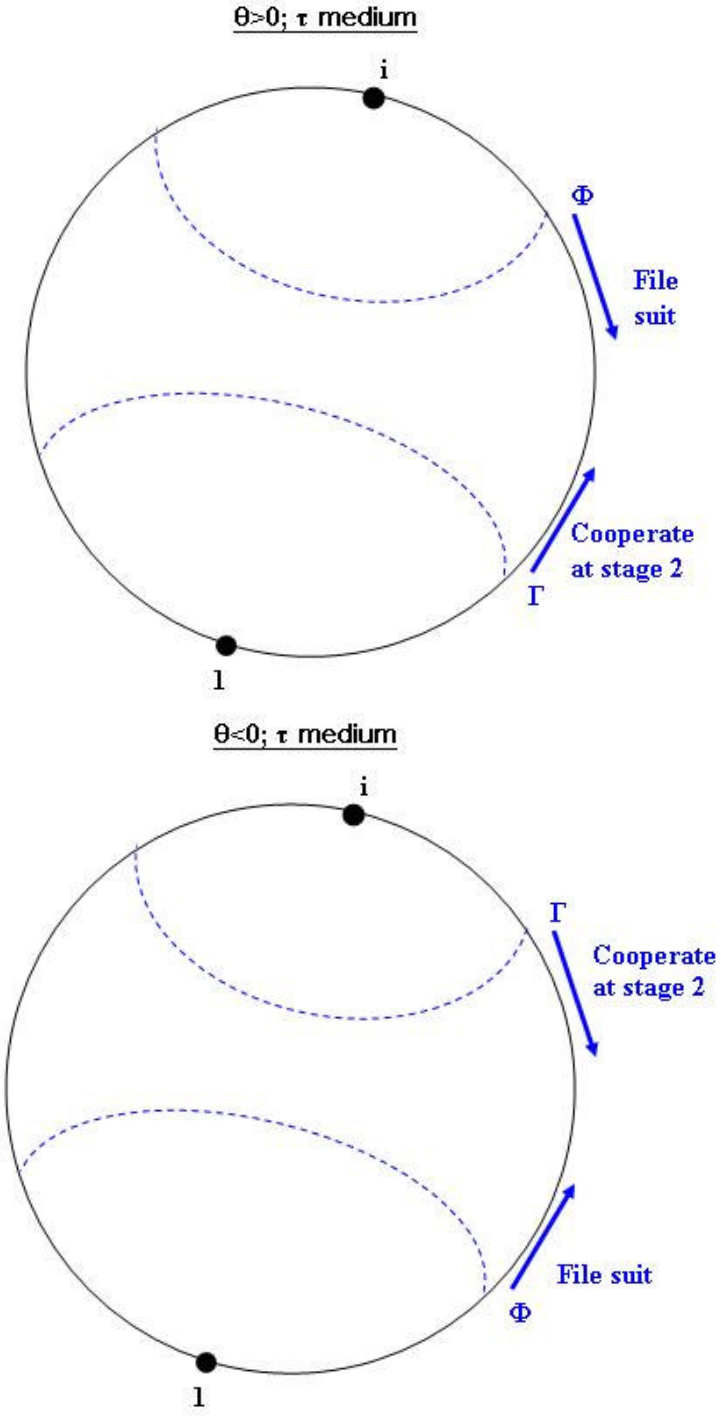


Figure 5. The scope of cooperation under court enforcement: Inferior enforcement (moderate τ)

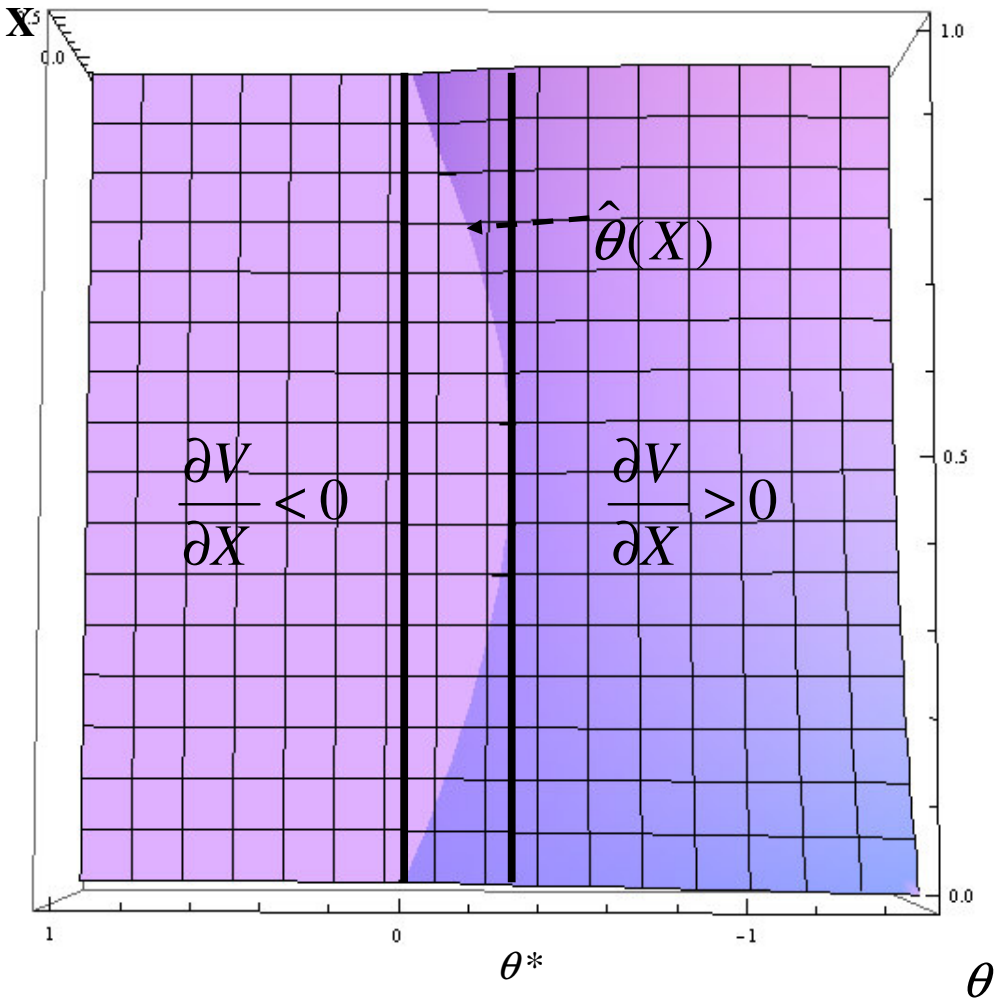


Figure 6. (for Proof of Proposition 1): Numerical example for $w = 1.38, h = \kappa = 1, \delta = 0.6$. In the bright [dark] region on the left [right], $\frac{\partial V}{\partial X} < 0$ [$\frac{\partial V}{\partial X} > 0$]. $\hat{\theta}(X)$ separates these regions. For $\theta \notin [\theta^*, 0]$, V is monotonic in X.