

# Development and the Interaction of Enforcement Institutions \*

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## Abstract

How do markets and institutions interact? How does development influence this interaction? In this paper we examine how formal and informal contract enforcing institutions interact in a competitive market where consumers do not observe quality before purchase. Firm level incentives for high quality can be achieved with an informal enforcement mechanism, *reputation*, the efficacy of which is enhanced by consumers investing in “connectedness,” or with a formal mechanism, *legal enforcement*, the effectiveness of which can be reduced by means of bribes. We provide a theory of the joint determination of the market prices and the formal-informal institutional mix which together guarantee high quality. We use our theory to predict how market prices and institutions evolve with development. Higher levels of development (proxied by the lower frequency of bad productivity shocks) are associated with a lower efficacy of informal enforcement, and – up to a certain threshold – better performance of formal institutions as well as lower incentive compatible market prices, and higher consumer welfare. In addition, the theory predicts that any market characteristic that causes prices to be lower is associated with better performing judicial institutions.

JEL: D02, D7, L14, O12.

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# 1 Introduction

It is well recognized that informational and contracting constraints increase the difficulty of “doing business” in developing countries (Mookherjee, 1999). At the same time, there is ample evidence of various informal resolutions to these problems. The consensus in the literature seems to be that informal enforcement mechanisms emerge when formal mechanisms work poorly, while when formal mechanisms work well, they crowd out the relatively inefficient informal institutions: hence, developing countries tend to have better performing informal institutions, while developed countries tend to have better formal ones. Recent examples from the literature can be found in Dixit (2004) which provides a nice overview.<sup>1</sup>

The problem is that in most countries these two types of institutions **co-exist**, and the “institutional mix” that we observe is not necessarily one extreme or the other. Indeed, as Dixit (2004) suggests, formal and informal modes of governance are two conceptually pure extremes that are unlikely to be seen in reality so that the study of the interface between them is an important and open question. Most of the literature moreover *assumes* that the interaction is one way – formal institutions affect the working of informal institutions (e.g. see Kali (1999) and Sobel(2006)) but not the other way round. In this paper we take a first step at filling this gap by developing a theory of institutional interaction where *both* formal and informal institutions co-exist and both are endogenous. The theory aims to predict an equilibrium institutional mix as a function of the level of development.

In India for example, most real estate transactions take place knowing that the legal system cannot help to redress grievances, but at the same time the dysfunctional legal system is important because recourse to the court by either party means effectively an embargo on the sale of the property. The use of informal methods of contract enforcement is pervasive in this environment: it takes the form of using brokers who build reputations and networks. The market for brokers is unregulated and very competitive at the entry point. However there are brokers who develop

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<sup>1</sup>McMillan and Woodruff (1999, 2000) find a strong substitution between formal and informal institutions in Vietnam and other transition economies; Kranton and Swamy (1999) give a historical example from Colonial India to show how setting up of civil courts lead to a breakdown of informal rural credit markets; and Greif (1993, 1994, 1997) and Greif *et al.* (1994) discuss informal contract enforcement in the Medieval Age. See also Ostrom (1990), Ellickson (1991), Kandori (1992), Besley *et al.* (1994), Ellison (1994), Battigalli and Maggi (2004), Allen, Qian and Qian (2005), and Pyle (2005). Finally, see Esfahani (1991) for a discussion on informal enforcement mechanisms in developing countries, and Greif (2004), and MacLeod (2006) for the discussions on different modes of governance.

larger market shares through reputation for being able to protect their clients from unscrupulous buyers/ sellers. It is no coincidence that judicial corruption in the real estate sector in India is notorious.<sup>2</sup> The essence of our paper is to show possible causality through the market price in this setting: the functioning of the informal enforcement method depends on how (badly) the judicial system functions through the increased incentives to build the informal mechanism and at the same time the functioning of the judicial system depends on how the informal mechanism works. If the informal mechanisms worked so well that conditional on going to court, the gains from bribing were sufficiently low then perhaps there is less scope for corruption as well.

The study of institutional interaction derives increased significance from the view, now pervasive in the literature, that “institutions” are key to the process of development.<sup>3</sup> As Acemoglu *et al.* (2005) observe, a fundamental issue that this literature must address is that of how institutions are determined. Our paper contributes to this second literature by exploring the reverse causation: how can the level of development of a country or sector – measured, as in Kremer (1993), by the frequency of bad productivity shocks in the production process – determine the level of incentive compatible market prices and the institutional mix for a fixed level of quality. In our example of the Indian real estate market -it is perhaps not surprising that the nature of the formal-informal interactions is different in the real estate market – where the scope for asymmetry of information is very high and there are no warranties as compared to other markets for durable goods. Other such markets might be for example health services: in developing countries the level of regulation on entry is quite low so that these markets happen to be quite competitive at the entry point and are characterized by volatility in the sense of firms entering and exiting the industry quite rapidly.

In line with this view of the markets we are interested in, our setting is a competitive economy where firms produce a good of variable quality, and consumers can observe quality only after they have bought the good. Bad quality occurs either be-

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<sup>2</sup>There is a famous case of a Chief Justice of the Supreme Court of India (Y.K Sabharwal) who took over cases relating to demolition of commercial properties in residential areas. The Municipal Corporation of Delhi (another governmental body known to be corrupt) started the “sealing” drive whereby many small shops in residential areas were demolished. After several Public Interest Litigations the case was taken over by Mr Sabharwal. Later on it emerged that his two sons were involved in a real estate firm that profited enormously from the demolition through increasing the demand for malls.

<sup>3</sup>See Acemoglu *et al.* (2005) for a review of the relationship between institutions and growth, and the discussions on contract enforcing institutions in Mookherjee (1999).

cause of an exogenous, unobservable bad productivity shock,<sup>4</sup> or because firms did not put in the effort required to produce high quality, so that a one-sided asymmetric information problem arises. Thus, effort is unobserved and unverifiable while quality is unobserved at the time of purchase and is verifiable. In such an environment, building upon the reputation model of Allen (1984),<sup>5</sup> and more recently, Hörner (2002), we study two institutions that enforce contracts: a “formal” enforcement mechanism, *legal enforcement*, and an “informal” mechanism, based on *reputation*. While the formal mechanism is centralized and can administer high penalties to cheating firms, it can be corrupted by firms bribing officers in the judicial system to avoid compensating consumers. On the other hand, corruption is less of a problem in the informal mechanism, as it relies on networks of uninterested consumers connecting with one another to provide truthful information about cheating firms. However, punishment is also less effective because the highest imposable penalty consists of not buying from cheating firms. In this setting we study how the performance of the institutions affect one another, and the market price and how productivity shocks affect the interaction between these two institutions. We provide a theory of the joint determination of alternative contract enforcing institutions together with the incentive compatible market price required to sustain high quality in equilibrium.

A novel feature of our approach is the co-existence of the two institutions in a market environment with large numbers of firms and consumers. Unlike bilateral exchange models studied in the literature on “relational” vs. “formal” contracts<sup>6</sup>, it is the (collective) actions of price taking agents at the micro level that determine how these institutions function and interact. Also, we do not assume that the use of the informal mechanism necessarily implies that agents are “outside” the market: hence, the institutional interaction does not depend on scale effects on the formal institution arising from the participation of agents in the informal one.<sup>7</sup> Institutional

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<sup>4</sup>Shocks can be of different types, such as physical (e.g. electricity shortages, transportation difficulties, unskilled labor), socio-political (e.g. crime and corruption), or stemming from policy uncertainty. In fact, a growing body of literature documents how policy uncertainty is a serious concern for businesses in developing countries. See, for instance, Hallward-Driemeier and Stewart (2004), World Bank (2005), and The Economist Intelligence Unit (2005).

<sup>5</sup>See also Klein and Leffler (1981), Shapiro (1983) and Kranton (2003).

<sup>6</sup>For example, Sobel (2006).

<sup>7</sup>This feature is in contrast to Kranton (1996) or Kali (1999), which assume that the use of one institution precludes the use of the other. Both papers are based on scale effects, and show how the numbers of people using reciprocal exchange or the monetary market exchange can affect the functioning of each institution. Similarly, Li (1999) shows how self governance (reputation based informal mechanism) is a diminishing returns system optimal on a small scale compared to the formal legal system, which is an increasing returns system.

interaction happens instead through the competitively set *equilibrium price of goods*, as both consumers' connectedness decisions, and firms' bribing decisions influence and are influenced by equilibrium prices.

Our results only partly confirm the common belief that formal and informal institutions substitute each other in this competitive market setting. On the one hand, consistent with the view that informal enforcement arrangements arise when formal institutions work poorly, we find that *poorly functioning legal institutions, by increasing the price of goods, provide consumers higher incentives to build informal enforcement networks*. On the other hand, however, we find that *well-performing informal enforcement networks, by lowering the price of goods, improve legal efficiency, as firms have less incentives to bribe*. This last result, although less intuitive, is consistent with the analyses of Putnam *et al.* (1993) and Knack and Keefer (1997), who find a positive relationship between social capital (interpreted, however, as *trust*), institutional quality, and economic performance. Consistently with the literature showing how product specialization is affected by the lack of well functioning legal systems (for example Levchenko (2004), Nunn (2007) )<sup>8</sup> – we generate an analogous result where market price is higher conditional on the same product quality when legal systems do not function well.

To conclude, we study how the equilibrium institutional mix is affected by the reliability of the production system, measured by the frequency of bad productivity shocks. In the model, shocks prevent firms from delivering a high quality good, and, *ceteris paribus* (that is, by holding the effectiveness of the alternative institution constant), when the frequency of bad productivity shocks decreases (i.e., the production process becomes more reliable) firms bribe less, and consumers connect less with one another. Nonetheless, when we let institutions interact through prices, firms' bribing may *a priori* not decrease anymore under more reliable production processes, as bribing relates positively to the price of goods, which has an ambiguous behavior. In accordance with common wisdom, however, we demonstrate that up to a certain threshold the strong effect of improved reliability on production costs lowers equilibrium prices. Therefore – up to a certain reliability threshold – improvements in the reliability of the production processes are associated with a decrease in the use of informal enforcement, lower prices, less bribing and higher consumer welfare.

Overall, our analysis demonstrates the relevance of fundamental market charac-

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<sup>8</sup>Tabellini (2007) uses another parameter *trust and respect* (which substitutes for legal enforcement) as the independent variable to explain specialization in contract intensive sectors.

teristics (captured in our model as the price) as potential channels of institutional interaction. One striking implication of our model is that *ceteris paribus* more concentrated markets are associated with worse functioning legal institutions and better informal institutions (via higher market prices). It also suggests a *physical* explanation (i.e., unreliable production processes coupled with high levels of asymmetric information) for why developing countries often fail to have well-performing judicial institutions. The analysis also extends to specific sectors of the economy where verifiability is an issue, and explains the differential performance of formal and informal contract enforcement across sectors.

The paper is organized as follows. Section 2 presents the basic model assuming *exogenous* institutions. Section 3 endogenizes connectedness and legal efficiency, and Section 4 concludes.

## 2 Contract Enforcement under Imperfect Institutions

The model is closely related to Allen (1984) and Hörner (2002) when institutions are exogenous. Our model captures the situation in a market where purchases are rare: e.g. surgery or buying a house. The economy consists of overlapping generations of consumers, each of measure one, and of firms producing a homogenous good of variable quality. Consumers live for two periods. In the first period (young consumers) they choose whether to buy the good in the market or not. In the second period the only role of old consumers is to provide information to young consumers. In what follows we focus only on young consumers. At each period firms can choose to provide high or low effort. If they choose low effort they produce a low quality good which is costless, while if they put in high effort they produce a high quality good with marginal costs  $c$ . Firms are also subject to an exogenous “bad” productivity shock that happens with probability  $1 - \vartheta$ , in which case the good becomes of low quality. Our uncertainty variable  $1 - \vartheta$  captures in a simple way the difficulty in using quality as a signal of effort. It represents production uncertainty faced by firms, such as problems related to infrastructure, regulation uncertainty, or the prevalence of an unreliable labor force, and as in Kremer (1993) we say that countries (sectors) with a higher “reliability parameter”  $\vartheta$  are more developed.

Quality is unobservable to consumers until after they have bought the good, and consumers cannot observe if low quality is due to a bad productivity shock, or

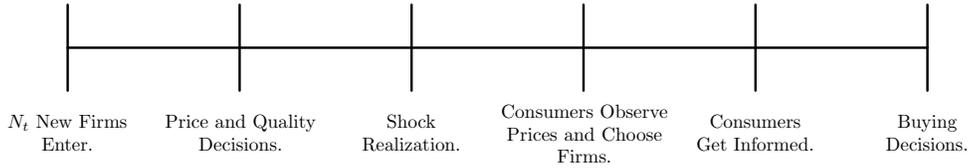


Figure 1: Timing of the stage game.

due to the firm’s decision to produce low quality. Shocks are persistent<sup>9</sup>, and when a firm has faced a bad productivity shock it stops producing high quality forever: hence, consumers face both moral hazard and adverse selection problems. To avoid repetitions, we will call firms that have always produced good quality in the past “good” firms, and firms that have produced bad quality at least once “bad” firms.

At each period, consumers and firms meet randomly in the market. Consumers need to buy one unit of the good each period, and derive utility  $U(p) = \bar{U} - p$  from high quality, and utility  $0 - p$  from low quality. The maximum price consumers are willing to pay for high quality is thus  $\bar{p} = \bar{U}$ , while consumers are not willing to spend money on low quality. However, consumers who decide not to buy from a firm have to wait until next period to randomly trade with another partner. Notice that consumers do not know why a given firm did not produce good quality in the past. Thus, their best reaction is to stop buying from *any* firm delivering low quality, since - given a high effort equilibrium - firms that produce low quality today will always produce low quality.

Figure 1 shows the timing of the stage game: Notice that the figure does not show the incompleteness of information in the stage game, which occurs as consumers do not observe quality before the purchase, but only the price. In each period there are  $N_t$  new firms entering the market and investing a sunk cost of  $T$  units in building capacity. The sunk cost allows them to produce up to one unit of output per period (i.e. we normalize everything by the total demand), and the number  $N_t$  of firms that enter the market in each period is such that entrants face zero expected profits.<sup>10</sup> Next, all firms choose prices and then effort levels simultaneously, after which shocks

<sup>9</sup>We could also have just started by assuming adverse selection and temporary shocks every period.

<sup>10</sup>We depart therefore from conventional models of reputation in that (see, among others, Klein and Leffler, 1982, Shapiro, 1983, Allen, 1984, Hörner, 2002, and Kranton, 2003): as in Hörner (2002), we introduce *shocks*.

are realized and firms produce either high or low quality. Effort is not observed (and is not verifiable) nor is the quality at the time of purchase (though it is verifiable). Consumers observe prices, go randomly to a firm posting a price at which they wish to buy the good, get informed about the firm's history, and decide whether to buy the good or not. Finally, after all transactions have occurred, each firm faces an exogenous probability of closure  $(1 - \delta)$ .

In each period  $t$ ,  $N_t$  firms enter. Of these, the expected number of firms that survive is  $\delta \vartheta N_t$ . In the steady state therefore the stock of firms  $S_{t+1} = S_t = S$ . This happens if the expected number of entering firms in every period is equal to the expected number exiting:  $N = S(1 - \delta)$ . Hence the steady state stock of all firms in any period is  $S = N/(1 - \delta)$ . In the same way the expected number of good firms in any period  $t$  is given by  $\frac{N}{1 - \delta\theta}$ . The expected market share for each good firm is then  $\frac{1 - \delta\theta}{N}$ : this is based on the random matching of consumers and firms.<sup>11</sup> To ensure zero profits with free entry, the expected profits of firms must equal  $T$ . Since expected profits depend on the expected market share of good firms, which is a function of  $N$  by the random matching assumption, this equation fixes  $N$ .

An *equilibrium* is a sequence of prices and quality choices, along with consumers buying decisions, an firm entry decisions such that consumers maximize utility given the firms strategies, new firms decide whether to enter or not, and all firms in the market choose prices and quality to maximize profits given the consumers strategies (see the Appendix for a formal discussion). Although the model leads to multiple equilibria, in what follows we restrict attention to symmetric *perfect Bayesian equilibria with Markov strategies* that maximize consumers' payoff. The choice of looking at strategies maximizing consumers' payoff is based on the desire to find the best equilibrium outcome for consumers for a given level of reliability.

We then consider two institutions that can induce firms to produce high quality: *reputation* and *legal enforcement*. Reputation works through the interaction of consumers and firms in the market, while legal enforcement works through the reimbursement of consumers who go to court after having experienced bad quality. We denote by  $\varphi_j$  the probability that firm  $j$  has to reimburse consumers if it delivers low quality, and by  $\Phi = \int \varphi_j dj$  the average level of legal efficiency in society

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<sup>11</sup>Notice that while consumers are a continuum, the number of firms is finite. Hence though each firm has the capacity to produce "1 unit" this unit is equivalent to producing enough to satisfy all the market demand. If both were finite and there were  $M < S$  consumers, each firm could produce  $M$  units with sunk costs of  $T$  because it is possible that one firm gets all the consumers but in expected terms would be able to sell only  $\frac{M}{S}$  units. This is equivalent to our focus on expected market share.

(we assume therefore that *ex-post* quality could be verifiable by uncorrupt courts). Similarly, we denote by  $q_i$  the probability that consumer  $i$  is informed about the firm she is trading with, and refer to the average level of information in society  $Q = \int q_i di$  as *connectedness*, because consumers need to “connect” to other (old) consumers to be informed about bad firms. In this section we assume  $q_i$  and  $\varphi_j$  to be exogenous and equal across people and firms, so that  $q_i = Q, \varphi_j = \Phi$ . Finally, we consider a situation where  $\bar{U}$  is sufficiently high so that consumers always prefer firms producing high quality. The expected utility of consumer  $i$  in each period is thus equal to:

$$U_i = \frac{1 - \delta}{1 - \delta\vartheta} \{ \vartheta\bar{U} - (1 - \Phi(1 - \vartheta))p \} - \frac{\delta(1 - \vartheta)}{1 - \delta\vartheta} (1 - q_i)(1 - \Phi)p \quad (1)$$

Equation (1) reads as follows. The variable  $p$  is the price of the good, and  $\frac{1 - \delta}{1 - \delta\vartheta}$  is the share of good firms in the economy. Good firms have then a bad shock in the current period with probability  $1 - \vartheta$ , in which case the consumer gets utility  $0 - (1 - \Phi)p$  as she will be reimbursed with probability  $\Phi$ . Therefore, conditional on meeting a good firm, each consumer has a utility equal to  $\vartheta(\bar{U} - p) - (1 - \vartheta)(1 - \Phi)p = \vartheta\bar{U} - (1 - \Phi(1 - \vartheta))p$ . Similarly, consumer  $i$  meets a bad firm with probability  $\frac{\delta(1 - \vartheta)}{1 - \delta\vartheta}$ . If she is informed (which happens with probability  $q_i$ ), she does not buy from that firm and gets utility  $U = 0$ , while if she is uninformed (which happens with probability  $1 - q_i$ ), she buys at price  $p$  and is reimbursed with probability  $(1 - \Phi)$ .

Notice that consumers’ welfare is maximized when  $p$  is minimized, and that price competition between firms guarantees that the equilibrium price is the lowest stationary price that is compatible with high quality. We shall therefore derive next the lowest incentive compatible price under which firms deliver high quality. Given a price  $p$ , the expected payoff of a good firm  $j$  from always putting in high effort is:

$$V_j^H = (1 - \varphi_j(1 - \vartheta))px_H - c \cdot x_H + \frac{\delta}{R} \{ \vartheta V_j^H + (1 - \vartheta)V_j^B \} \quad (2)$$

where  $x_H = (1 - \delta)/N$  represents the share of consumers per firm; the first term in (2) comprises the likelihood that even if firms produce high quality, they may suffer a bad shock with probability  $1 - \vartheta$ , in which case they have to reimburse consumers with probability  $\varphi_j$ ;  $1/R$  is the discount rate; the second term in (2) is the continuation value (which depends on whether firms faced a good or bad

shock); and  $V_j^B = R(1 - \varphi_j)px_L/(R - \delta)$  represents the discounted profits of a bad firm facing judicial efficiency  $\varphi_j$ , where  $x_L = (1 - Q)x_H$  represents the share of *uninformed* consumers that buy from bad firms.<sup>12</sup>

On the other hand, if firm  $j$  shirks, it faces an expected payoff equal to  $V_j^L = (1 - \varphi_j)px_H + (\delta/R)V_j^B$ , as in the first period all consumers will be uninformed – so that the firm will be able to capture a high market share – but subsequently, even if it did not face a bad shock, the firm will be seen by consumers as a bad one. In order to sustain high quality we must have that  $V_j^H \geq V_j^L$ . Thus, as  $q_i = Q$  and  $\varphi_j = \Phi$  are equal across agents and firms, high quality equilibria are sustainable only if:

$$p(\vartheta, \Phi, Q) \geq \frac{Rx_H}{\delta(1 - \Phi)(x_H - x_L) + R\Phi x_H} \frac{c}{\vartheta} \quad (3)$$

We call inequality (3) the *No Milking Condition* (see Shapiro, 1983, and Allen, 1984), and the lowest price that satisfies condition (3) the *No Milking Price*  $p^{NM}(\vartheta, \Phi, Q)$ . The no milking condition shows that sustaining high effort requires a “carrot and stick” strategy: in order to be able to reward firms for high effort, price must be above marginal costs (the carrot); on the other hand, consumers must also punish shirking firms by boycotting them (the stick). Notice that the no milking price  $p^{NM}$  has two components: the *marginal cost* component  $c/\vartheta$ , and the *markup* component (represented by the first fraction in (3)). The markup is required to sustain high quality when legal enforcement is less than perfect, and decreases with the efficiency of either institution:<sup>13</sup>

PROPOSITION 1  $p^{NM}$  is the lowest stationary price that can be achieved as the outcome of a Perfect Bayesian equilibrium where no firm shirks. Moreover,  $\partial p^{NM}/\partial Q < 0$ , and  $\partial p^{NM}/\partial \Phi < 0$ .

In the Appendix we describe strategies and beliefs that support the high quality equilibrium with firms pricing at  $p^{NM}$ . Notice that  $p^{NM}$  is the most plausible sta-

<sup>12</sup>Equation (2) implicitly assumes that informed consumers stop buying from a bad firm independent from winning or losing in court, as in a high quality equilibrium firms deliver bad quality only if they have been hit by a bad shock.

<sup>13</sup>Also observe that  $\lim_{\Phi \rightarrow 1} p^{NM} = \frac{c}{\vartheta}$ , while  $\lim_{Q \rightarrow 1} p^{NM} > \frac{c}{\vartheta}$ . Therefore, abstracting from the costs of setting up either institution, and from the firms’ participation constraint, our model suggests that legal enforcement can in principle achieve higher consumer welfare.

tionary outcome, as competition between firms and free entry ensure that stationary equilibria with prices higher than  $p^{NM}$  are not chosen. Moreover, if firms were to price lower than  $p^{NM}$  consumers would know with certainty that they are buying low quality. Thus, any firm that prices lower than  $p^{NM}$  will get no market share, so that there are no stationary separating equilibria in our model.

Observe that in reputational equilibria (i.e.,  $\Phi < 1$ ) firms overinvest in capacity. This is because firms need to price above marginal costs to have the incentives to produce high quality, but because of the free entry of firms, all firms' profits translate into excess capacity ( $x_H < 1$ ). Notice, also, that at high levels of institutional efficiency  $\Phi, Q$ , firms' participation constraint can be violated, as firms cannot recover their sunk costs even under full capacity production  $x_H = 1$ . Therefore, if  $\Phi, Q$  are too high, consumers and firms need to coordinate on a price *above*  $p^{NM}$ . However, we do not discuss this case (see Esfahani, 1991).

## Discussion of the Modeling Assumptions

Our repeat purchase mechanism model is set up to capture in a simple way the impact of legal enforcement and consumer connectedness on the incentive compatible price. We need both moral hazard and adverse selection in the model. We need moral hazard because we want to capture the differential effect of the level of development  $\vartheta$  on firms' incentives to put in high effort. But we also need adverse selection (i.e., shock persistence), as without shock persistence the past would not provide information about the present, and no consumer would have private incentives to get informed. Notice that shock persistence is not necessary: adverse selection and temporary shocks would do as well. Moreover, free entry, sunk costs, and an exogenous survival rate, ensures a competitive, stationary equilibrium with a constant share of bad and good firms. Finally, random matching between surviving firms and consumers ensures that the (stationary) punishment for bad quality only comes from the lower market share faced by bad firms. This captures the features of a market (e.g. surgeries, real estate) where purchases are made rarely so that the role of old consumers is only to provide information to new consumers.

In our model we allow consumers to make use of both formal and informal institutions: there is no explicit cost to going to courts. We do this because our focus is on the *performance* of institutions and on how the interaction influences the performance of each. Allowing consumers to choose should then imply that the use of the formal mechanism only occurs when the performance is sufficiently high

to compensate for the costs. There are no externalities in our model that occur because of more people using one mechanism or the other: scale effects are ruled out. Kranton (1996), Kali (1999), and Li (1999) are all models based on scale effects.

We do not allow firms to offer warranties. While this may be a realistic depiction in developed countries, it is rare to see warranties in markets of the type we are interested in: real estate, health services etc. To the extent that warranties exist, should they be considered formal or informal? Our view is that they should be considered informal *if they do not rely on courts for enforcement*. In this event, firms care about honoring their warranties for the same reason that they care about high quality. We can then expect that both informal mechanisms influence the incentives to bribe. Of course there can be a number of informal and formal mechanisms to solve the same problem. The basic point we make remains the same: the interaction is important.

The informal mechanism in our model is characterized by truthful revelation of information through connections to an informal consumer network of old consumers. As information is obtained in a *decentralized* manner, its verifiability is a minor issue, because consumers have no incentives to lie (Dixit (2003) considers instead the case of an information intermediary who can be bribed by both sides of the market). Finally, note that although our informal network is consumer based, the same analysis would hold for producer's networks in the context of intra-industry trade (Kali (1999) and Pyle (2005) provide evidence of such relational contracts between firms).

### **3 Reputation and Legal enforcement as Endogenous Institutions**

We now let consumers invest in their own connectedness to old consumers to increase the probability with which they are informed about the firm they are trading with. Similarly, we let firms choose how much to bribe court officials to decrease the probability of having to reimburse consumers. To be sure, a more general model would conceivably allow for consumers and firms influencing both variables  $Q$  and  $\Phi$ . Nevertheless, what we want to capture here is the fact that consumers have a comparative advantage in investing in connectedness, while firms have an advantage in bribing.

We begin by describing the consumers' maximization problem. Let  $m_c(i)$  denote

consumer  $i$ 's investment in her own connectedness. Then individual connectedness is equal to  $q(m_c(i))$ , where  $q' > 0$ ,  $q'' < 0$ , and to exclude corner solutions we assume that  $q$  satisfies the Inada conditions  $q'(0) = \infty$ ,  $q'(\infty) = 0$ .<sup>14</sup> In deciding how much to invest, consumers take the price  $p^{NM}$ , average connectedness  $Q$ , and judicial efficiency  $\Phi$  as given, so that for constant values of  $\vartheta, Q, \Phi$  the consumers' maximization problem is:

$$\max_{\{m_{c,t}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \frac{1}{R^t} \{U(\vartheta, \Phi, q(m_{c,t}), p^{NM}) - m_{c,t}\} \quad (4)$$

Notice that each consumer faces the same maximization problem (4). Thus, *ex post*  $q_i = Q$ , and we can use the first order conditions of the maximization problem to characterize the average level of connectedness  $Q$ :

**PROPOSITION 2** *For each  $(\vartheta, \Phi)$  there exists a unique level of connectedness  $Q$  resulting from the consumers' maximization problem (4). Moreover,  $\partial Q / \partial \vartheta < 0$ ,  $\partial Q / \partial \Phi < 0$ , and  $\partial Q / \partial p^{NM} > 0$ .*

Intuitively, consumers invest in connectedness to be informed about bad firms in the market, and as  $\vartheta$  increases, the share of bad firms decreases. Moreover, the gain of an extra unit of information per firm is decreasing with the price (which also decreases with  $\vartheta$ ), while the marginal cost is constant. Thus, as reliability  $\vartheta$  increases consumers invest less in connectedness, both because of the direct effect on the share of bad firms, and of the indirect effect on the equilibrium price  $p^{NM}$ . The same logic holds for judicial efficiency  $\Phi$ , which captures the net benefits of going to court. Observe that consumers do not internalize the effect of their actions on the equilibrium price, and therefore *under-invest* in connectedness.

We now turn to firm behaviour. Firms can decrease the probability of having to reimburse consumers by bribing courts. We presume that bribing has decreasing returns, so that  $\varphi'(m_f) < 0$ ,  $\varphi''(m_f) > 0$ , and we also assume that  $\varphi(m_f)$  satisfies the Inada conditions, i.e.  $\varphi'(0) = -\infty$ ,  $\varphi'(\infty) = 0$ . For constant values of  $\vartheta, \Phi, Q$ , the maximization problem of a firm that delivered low quality can then be expressed

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<sup>14</sup>In a previous version we considered the case where  $q_i$  also depends on *average* investment  $M_c = \int_0^1 m_c(i) di$ , capturing the idea that individual connectedness increases proportionally more if other consumers also invest in their own connectedness. This adds significant algebraic burden while conveying similar results.

as follows:

$$\max_{m_f} (1 - \varphi(m_f)) p^{NM} x - m_f x \quad (5)$$

Notice that firms bribe the court *after* a case has been brought against them, so that  $x = x^{L,H}$ . Using the first order condition of (5), we can characterize judicial efficiency  $\Phi$  as follows:

**PROPOSITION 3** *Let  $\varphi(m_f)$  satisfy  $\varphi''/|\varphi'| > 1/c$ . Then for each  $(\vartheta, Q)$  there exists a unique level of judicial efficiency  $\Phi$  resulting from the firms' maximization problem (5). Moreover,  $\partial\Phi/\partial\vartheta > 0$ ,  $\partial\Phi/\partial Q > 0$ , and  $\partial\Phi/\partial p^{NM} < 0$ .*

Observe that in the firms' maximization problem (5), reliability  $\vartheta$  and connectedness  $Q$  only enter through the market price  $p^{NM}$ . Changes in judicial efficiency  $\Phi$  depend therefore on how  $p^{NM}$  varies with  $\vartheta$  and  $Q$ , as when  $p^{NM}$  decreases, bad firms have lower incentives to bribe because gains are lower. Bribing, however, also has an indirect effect because it increases the equilibrium price  $p^{NM}$ , and hence firms' profits: it is to rule out this perverse effect through  $\Phi$  that Proposition 3 requires the condition on  $\varphi(m_f)$ .<sup>15</sup> Note that firms as well do not internalize the effect of their actions on the market price: in this sense, they also bribe less than what would be optimal for them.

Observe also that for both consumers and firms *all the institutional interaction happens through the market price  $p^{NM}$* , as  $Q$  and  $\Phi$  do not enter directly each side's maximization problem. In fact, any factor lowering the market price – such as lower production costs or, in a model of monopolistic competition, higher competition among firms – would affect in a similar way formal and informal institutions. The result is therefore worth mentioning independently:

**PROPOSITION 4** *Everything else being equal, a decrease in the market price  $p^{NM}$  reduces firms' bribing (increases  $\Phi$ ), and lowers consumers connectedness,  $Q$ .*

Under asymmetric information, the incentive compatible price is therefore key in determining equilibrium levels of bribing and connectedness. If the market price

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<sup>15</sup>A similar effect also acts on consumers' investment decisions in connectedness  $q(m_{c,t})$ , but for consumers the indirect effect has the "right" sign

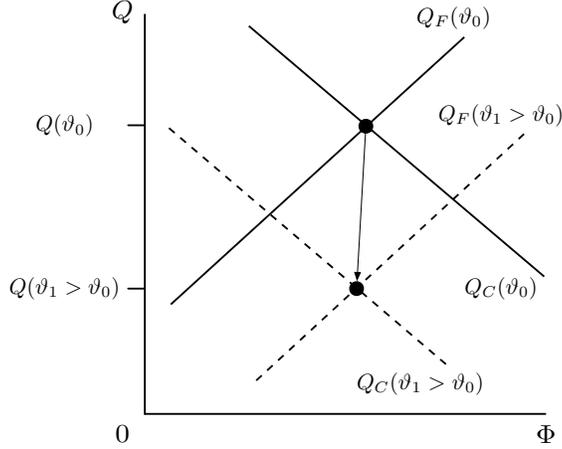


Figure 2: Equilibrium levels of connectedness and of judicial efficiency.

remains high, consumers have high incentives to connect because they suffer high losses when they meet a bad performing firm, and firms find it more profitable to bribe. The result of Proposition 4 is also consistent with the observed empirical relationship between competition and corruption (see Ales and di Tella, 1999), although it provides a complementary explanation through the market price. Our paper, however, pushes the analysis further by looking in addition at how institutions affect one another via the market price, and at how development – measured by a reliability parameter – affects the overall institutional mix.

This institutional interaction is presented in Figure 2, which shows the consumers' and firms' reaction functions  $Q_C(\Phi), Q_F(\Phi)$ . Note that the reaction functions are monotonic and opposite in slope, hence the equilibrium is unique. Moreover, an increase in reliability  $\vartheta$  shifts both consumers' and firms' reaction functions downwards, so that connectedness  $Q$  unambiguously decreases with reliability  $\vartheta$ . In contrast, the effect of changes in reliability  $\vartheta$  on judicial efficiency  $\Phi$  remains *a priori* ambiguous, as whether judicial efficiency  $\Phi$  increases or decreases with  $\vartheta$  depends on whether the firms' reaction curve  $Q_F$  is more or less elastic than the consumers' reaction curve  $Q_C$ . At low levels of reliability, however,  $Q_F$  is more elastic than  $Q_C$ , so that bribing also decreases with  $\vartheta$ :

PROPOSITION 5

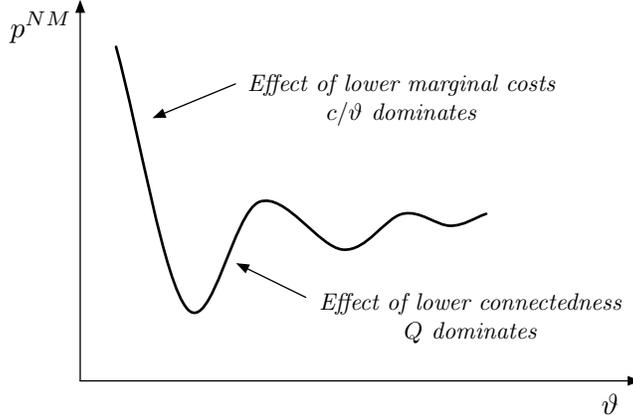


Figure 3: EquilibriumPrice

1. *Equilibrium connectedness always decreases with the reliability of the production process.*
2. *There exists a threshold  $\bar{\vartheta}$  such that judicial efficiency improves with reliability  $\vartheta$  for  $\vartheta < \bar{\vartheta}$ .*

The intuition behind Proposition 5 shows the relevance of the market price  $p^{NM}$  in determining the institutional interaction. When reliability  $\vartheta$  increases, there is a first, direct effect lowering connectedness  $Q$  via lower marginal costs and an increase in the share of good firms. As this direct effect is the only exogenous driver of the change in institutional mix, connectedness  $Q$  unambiguously decreases with higher reliability  $\vartheta$ . On the other hand, reliability does not affect directly judicial efficiency. Therefore, how judicial efficiency reacts to increases in reliability depends only on the behavior of the equilibrium price  $p^{NM}$ , on which two opposing forces act: lower marginal costs  $c/\vartheta$  that decrease  $p^{NM}$ , and lower connectedness  $Q$  that increases it. As marginal costs behave as  $\sim 1/\vartheta$ , at low levels of reliability they dominate the behavior of  $p^{NM}$ , and judicial efficiency  $\Phi$  improves with  $\vartheta$ . Instead, at higher levels of reliability both effects become of similar magnitude, and the behavior of  $p^{NM}$  and  $\Phi$  becomes ambiguous (see Figure 3).

## 4 Conclusions

This paper contributes to the literature on the endogenous determination of institutions by endogenizing their mutual interaction in a competitive setting, and by demonstrating a new channel – the market price – through which development can affect institutions. Results are only partly consistent with the common belief that formal and informal institutions substitute one another: when legal enforcement works poorly, consumers invest more in connecting with other consumers to enhance contract enforcement via the reputation mechanism; on the other hand, however, better informal enforcement *improves* legal enforcement because it reduces firms’ incentives to bribe. Along the development path, the model demonstrates – up to a certain threshold – a decrease in bribing and in the use of informal enforcement, and explains it via improvements in the reliability of the production process.

Our analysis suggests therefore a *physical* explanation for why developing countries often fail to have well-performing judicial systems. A natural extension of the model would let institutions affect reliability, thus providing a simultaneous determination of the institutional mix, and economic growth. We leave this to future work.

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## Appendix

### PROOF OF PROPOSITION 1

Without loss of generality we only consider the case where  $Q = 1$ . The stage game is as follows. At period  $t$  there are  $N^t$  firms that simultaneously post prices  $P^t = (p_j^t)_{j \in [0, N^t]}$ , and then decide whether to produce the high or the low quality good, so that  $g_j^t = (H, L)$  for good firms, and  $g_j^t = L$  for bad firms. Consumers  $i \in [0, 1]$  observe the vector of prices  $P^t$  in the market, go to a firm  $j$ , and decide whether to buy ( $a_i^t = B_j$ ) or not to buy ( $a_i^t = NB_j$ ). We assume that once consumers have bought the good they can observe the quality perfectly. Thus the stage payoff to consumers at the end of the period is equal to  $\bar{U} - p_j^t$  if they bought the good and the quality is good, 0 if they did not buy any good, while if quality is bad they get  $-p_j^t$ . On the other hand, the payoff to firm  $j$  is equal to  $(p_j^t - c) \cdot x_j^t$  if it produces the high quality good and  $x_j^t$  consumers bought it, and to  $p_j^t \cdot x_j^t$  if it produces the bad quality good. Payoffs to firms and consumers in the game as a whole correspond to the discounted sum of payoffs in each period. The game is repeated over an infinite horizon, so that a history  $h^t$  at period  $t$  is a sequence of quality and price vectors  $(G^0, P^0); \dots; (G^{t-1}, P^{t-1})$ , where  $G^t = (g_j^t, x_j^t)_{j \in [0, N^t]}$ , and of consumer actions  $(a_i^0); \dots; (a_i^{t-1})$ . Finally, consumers' information sets at time  $t$  are defined by all price combinations  $\Pi^t = (p_j \in [0, \bar{p}])_{j \in [0, N^t]}$  for each possible history  $h^t$ , which for simplicity we refer to a consumer's information set

as  $(P, h^t)$ . The Markov strategies and beliefs that achieve  $p^{NM}$  as the outcome of a perfect Bayesian equilibrium are the following:

**FIRMS' STRATEGY.** New firms enter as long as expected profits net of sunk costs are positive. Bad firms always produce bad quality and price at  $p^{NM}$ . Good firms have the following strategy:

1. If  $p_j^t \geq p^{NM}$ , put in high effort.
2. If  $p_j^t < p^{NM}$  put in low effort.
3. Set  $p_j^t = p^{NM}$ , regardless of history.

**CONSUMERS' STRATEGY**

1. Do not buy if  $\max p_j^t < p^{NM}$ .
2. Match randomly among firms posting a price equal to  $\min(p_j^t | p_j^t \geq p^{NM})$ .
3. If a firm has produced bad quality in  $t - 1$ , do not buy.

**CONSUMERS' BELIEFS:**

1. If  $p_j^t < p^{NM}$  then the firm has produced bad quality with probability one.
2. If  $p_j^t \geq p^{NM}$  then the firm has put in high effort and the probability of getting good quality is  $\vartheta$ , as long as the previous history did not have bad quality.
3. If a firm has produced bad quality in period  $t - 1$  then it will always produce bad quality.

It is easy to prove that this strategy profile represents a Nash equilibrium. Notice that firms never face a non-trivial information set, since, given the consumers' strategies, incomplete information about other firms' types does not influence payoffs. Hence, the only imperfect information comes from the simultaneous price game, and it is sufficient to look for subgame perfection in firms' strategies. Consider any subgame off the equilibrium path where prices of some firms are lower or higher than  $p^{NM}$  regardless of quality history, or where consumers do not follow their equilibrium strategies. Given consumers strategies in the continuation game, the best response is obviously to price at  $p^{NM}$  and put in high effort as long as there is no bad shock. Moreover, if consumers buy at a price lower than  $p^{NM}$  they believe that they will get bad quality, and this belief is consistent with firms strategies. Given the permanence of shocks and equilibrium strategies of firms, if a firm produces bad quality once the best response is never to buy from this firm again. Finally, assume that there exist a stationary price  $\tilde{p} < p^{NM}$  under which firms put high effort. The no milking condition (3) ensures that, given other firms strategies and consumer's strategies, a firm charging  $\tilde{p}$  would strictly prefer to cheat in every period.

END OF PROOF.

**PROOF OF PROPOSITION 2**

Since  $q(m_c)$  satisfies the Inada conditions the solution of the maximization problem lies in  $m_{c,t} \in (0, \infty)$ , and we can use the first order conditions of the maximization problem to characterize the optimal investment  $m_{c,t}^*$ . Notice that utility is maximized when  $m_{c,t}$

maximizes the per period utility. Notice, also, that each consumer faces the same first order conditions, and that in equilibrium  $Q \equiv q_i$ , so that connectedness is characterized by the following first order condition:

$$G \equiv \frac{\delta(1-\vartheta)}{1-\delta\vartheta}(1-\Phi) \cdot p(\vartheta, \Phi, q(m_c))q'(m_c) = 1 \quad (6)$$

where  $p = p^{NM}$ . By the implicit function theorem the following then holds:

$$\frac{\partial G}{\partial m_c} = \frac{\delta(1-\vartheta)}{1-\delta\vartheta}(1-\Phi) \cdot \left\{ \frac{\partial p}{\partial q} \left( \frac{dq}{dm_c} \right)^2 + p \frac{d^2q}{dm_c^2} \right\} < 0 \quad (7)$$

$$\frac{\partial G}{\partial \Phi} = \frac{dq}{dm_c} \frac{\delta(1-\vartheta)}{1-\delta\vartheta} \left\{ -p + (1-\Phi) \frac{\partial p}{\partial \Phi} \right\} < 0$$

$$\frac{\partial G}{\partial \vartheta} = -\frac{\delta(1-\Phi)}{1-\delta\vartheta} \frac{dq}{dm_c} \frac{1-2\delta\vartheta+\delta\vartheta^2}{\vartheta(1-\delta\vartheta)} p < 0$$

where  $1-2\delta\vartheta+\delta\vartheta^2$  is minimized for  $\vartheta = 1$ , so that  $\partial G/\partial \vartheta < 0$ . By the implicit function theorem we then have that  $\partial m_c/\partial \Phi = -G_\Phi/G_{m_c} < 0$ , and that  $\partial m_c/\partial \vartheta = -G_\vartheta/G_{m_c} < 0$ . The fact that  $\partial G/\partial m_c < 0$  ensures that there is a unique equilibrium. Recall that  $\frac{\partial q}{\partial m_c} = q' > 0$ . Hence,  $\frac{\partial q}{\partial \Phi} = q' \frac{\partial m_c}{\partial \Phi} = -q' G_\Phi/G_{m_c} < 0$ , and  $\partial q/\partial \vartheta = -q' G_\vartheta/G_{m_c} < 0$ .

It is obvious from expression (4) that  $\partial Q/\partial p^{NM} > 0$ .

END OF PROOF.

### PROOF OF PROPOSITION 3

The firms' first order conditions are equal to:  $-\varphi'(m_f) = 1/p^{NM}$ . The aggregate firms' implicit function is therefore equal to:

$$F \equiv \Phi'(m_f) + \frac{\delta(1-\Phi)Q + R\Phi}{R} \frac{\vartheta}{c} = 0 \quad (8)$$

Under the Inada conditions there exists then a unique solution  $m_f \in (0, \infty)$  to equation (8). The partial derivatives are then equal to:

$$\frac{\partial F}{\partial Q} = \frac{\delta\vartheta(1-\Phi)}{Rc} > 0 \quad (9)$$

$$\frac{\partial F}{\partial \vartheta} = \frac{\delta(1-\Phi)Q + R\Phi}{Rc} > 0$$

$$\frac{\partial F}{\partial m_f} = \Phi''(m_f) + \Phi'(m_f) \frac{\vartheta(R-\delta Q)}{Rc} > \Phi'' - \frac{|\Phi'|}{c} > 0$$

where the last inequality holds for  $\Phi''/|\Phi'| > 1/c$ . Using the implicit function theorem we then have that  $\partial\Phi/\partial Q = -\Phi'F_Q/F_{m_f} > 0$ , and that  $\partial\Phi/\partial\vartheta = -\Phi'F_\vartheta/F_{m_f} > 0$ .

It is obvious from expression (4) that  $\partial\Phi/\partial p^{NM} < 0$ .

END OF PROOF.

#### PROOF OF PROPOSITION 5

The partial derivative of the consumers' reaction function  $Q_C$  is as follows:

$$\frac{\partial Q_C}{\partial\vartheta} = -\frac{1 - \delta\vartheta(2 - \vartheta)}{\vartheta(1 - \vartheta)(1 - \delta\vartheta)} \frac{1}{\frac{\delta(1-\Phi)}{\delta(1-\Phi)Q + R\Phi} + |q''|/(q')^2} \quad (10)$$

where  $\partial p^{NM}/\partial Q = -p^{NM}\delta(1 - \Phi)/(\delta(1 - \Phi)Q + R\Phi)$ . Rewriting judicial efficiency as  $\Phi_F(Q_F(\Phi, \vartheta), \vartheta)$ , notice that  $\Phi_F(Q_F(\Phi, \vartheta), \vartheta) - \Phi = 0$ . Thus, using the implicit function theorem we have that  $\partial Q_F/\partial\vartheta = -(\partial\Phi_F/\partial\vartheta)/(\partial\Phi_F/\partial Q_F)$ , which implies that:

$$\frac{\partial Q_F}{\partial\vartheta} = -\frac{\delta(1 - \Phi)Q + R\Phi}{\delta\vartheta(1 - \Phi)} \quad (11)$$

In equilibrium we also have that  $Q_F(\Phi^*, \vartheta) = Q_C(\Phi^*, \vartheta)$ . Define therefore  $D \equiv Q_F(\Phi^*, \vartheta) - Q_C(\Phi^*, \vartheta)$ : as in equilibrium  $D = 0$ , we can use the Implicit Function Theorem again to compute  $d\Phi^*/d\vartheta$  as follows:

$$\frac{d\Phi^*}{d\vartheta} = -\frac{\frac{\partial Q_F}{\partial\vartheta} - \frac{\partial Q_C}{\partial\vartheta}}{\frac{\partial Q_F}{\partial\Phi} - \frac{\partial Q_C}{\partial\Phi}} \quad (12)$$

Since  $\frac{\partial Q_F}{\partial\Phi} > 0$  and  $\frac{\partial Q_C}{\partial\Phi} < 0$ , the denominator is always positive. Hence the sign of (12) depends on the numerator. Since  $\partial Q_F/\partial\vartheta = -(\partial\Phi_F/\partial\vartheta)/(\partial\Phi_F/\partial Q_F) < 0$ ,  $\partial Q_C/\partial\vartheta < 0$ , the sign of  $d\Phi^*/d\vartheta$  depends on whether  $|\partial Q_F/\partial\vartheta| \geq |\partial Q_C/\partial\vartheta|$ . Hence, judicial efficiency increases if and only if:

$$\frac{1}{\delta(1 - \Phi)} > \frac{1 - \delta\vartheta(2 - \vartheta)}{(1 - \vartheta)(1 - \delta\vartheta)} \frac{1}{\delta(1 - \Phi) + C\xi} \quad (13)$$

where  $C = \delta(1 - \Phi)Q + R\Phi$ , and  $\xi = |q''|/(q')^2$ . For  $\vartheta \rightarrow 0$  the inequality (13) is always satisfied, while for  $\vartheta = 1$  the inequality is never satisfied, so that there exists a threshold  $\bar{\vartheta}$  below which judicial efficiency increases with  $\vartheta$ . Finally, Figure 2 shows that when  $\vartheta$  increases, connectedness  $Q$  decreases.

END OF PROOF.