Enforcing Contracts *

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March 12, 2006

Abstract

We examine the interaction of institutions that enforce contracts between two parties, producers and consumers, in a competitive market with one-sided asymmetric information and productivity shocks. We compare an informal enforcement mechanism, *reputation*, the efficacy of which is enhanced by consumers investing in "connectedness," with a formal mechanism, *judicial enforcement*, the effectiveness of which can be reduced by producers by means of bribes. When judicial enforcement is poor, consumers connect more with each other to improve informal enforcement; in contrast, a well-connected network of consumers reduces producers' incentives to bribe. In equilibrium, the model predicts a positive relationship between the the frequency of productivity shocks, bribing, and the use of informal enforcement, providing a *physical* explanation of why developing countries often fail to have efficient judicial systems. Firm-level estimations confirm the partial equilibrium implications of the model.

JEL: D02, D7, L14, O12.
Keywords: Contracts, Institutions, Corruption, Reputation, Uncertainty.

*We would like to thank Franklin Allen, Jonathan Cave, Philip Keefer, Andy Newman, Carlo Perroni, seminar participants at Georgetown University, University of Warwick, Vanderbilt University, the 2005 PET conference, the 2005 Conference on Liberalisation Experiences in Asia, and especially Avinash Dixit for extremely useful comments and discussions. The opinions expressed in this paper are its authors' and do not necessarily reflect the official position of the World Bank or its member countries. Corresponding author: Amrita Dhillon. Email: a.dhillon@warwick.ac.uk.

1 Introduction

Good institutions have long been recognized as crucial for economic transactions. A large literature has by now documented people's reliance on informal enforcement mechanisms when formal mechanisms work poorly.[1] However, less attention has been given to their interaction: how do institutions affect one another? How do they evolve over time? And how do they vary with the level of development? Institutions are not monoliths. They are influenced by technology (North, 1981), politics (Acemoglu *et al.*, 2005), and by people's transactions (Kranton, 1996). It is on the latter aspect that we focus attention.[2]

In this paper we examine how mechanisms that enforce contracts interact with one another and how shocks in the production process affect this interaction. We consider two mechanisms that potentially enforce contracts between two parties, producers and consumers, when consumers do not observe quality: a "formal" enforcement mechanism, *judicial enforcement*, and an "informal" mechanism, *reputation*. Shocks are crucial in our model since they increase information asymmetries: they 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,[3]. Moreover bad productivity shocks (high levels of uncertainty) are often associated with low levels of development (see e.g. Kremer, 1993). Our paper therefore provides a theory of how alternative contract enforcing institutions evolve through interactions with each other as a country develops.

Our theoretical framework develops the reputation model of Allen (1984) to allow for judicial enforcement, consumers' investment in connectedness, and stochastic, firm-level productivity shocks.[4] We consider a competitive economy

[1] See, for instance, Greif (1993) and Greif *et al.* (1994) for examples of contract enforcement in the Medieval Age; Esfahani (1991) for a discussion on informal enforcement mechanisms in developing countries; Battigalli and Maggi (2004) for how uncertainty and costly contracting influence the choice of contract; Besley *et al.* (1994) for a comparison of ROSCAS and credit markets; Kandori (1992) and Ellison (1994) for a discussion of the role of community enforcement in repeated games; and the discussions in Mookherjee (1999) and Dixit (2003).

[2] To the best of our knowledge Kranton (1996) and Acemoglu *et al.* (2005) are the sole exceptions. In Kranton (1996) the use of reciprocal exchange decreases with the use of money-based exchanges, and in Acemoglu *et al.* (2005) property rights are endogenously derived from the distribution of political power.

[3] 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).

[4] See also Klein and Leffler (1981), Shapiro (1983), Hörner (2002), and Kranton (2003).

where firms produce a good of variable quality, and consumers can observe the quality only after they have bought the good. Bad quality arises either because of a bad productivity shock, or because firms did not put in the effort required to produce high quality, so that a one-sided asymmetric information problem arises. In such an environment, we look at how the efficiency of judicial enforcement affects consumers' incentives to "connect" with other consumers to find out about bad performing firms, spreading at the same time firms' reputation. *Vice-versa*, we study how the efficiency of the reputation mechanism affects firms' incentives to bribe the judicial system. Because both consumers' connectedness decisions and firms' bribing decisions depend on the relative efficiency of the two mechanisms, an interaction arises between formal and informal mechanisms via consumers and firms' investment decisions.

The model has both "partial" and "general" equilibrium implications. At the partial equilibrium level, results only partly confirm the common belief that formal and informal institutions substitute each other. More precisely, we find that *consumers invest more in building informal enforcement networks when judicial enforcement works poorly*; on the other hand, however, *well-performing informal enforcement networks improve judicial efficiency, as firms have less incentives to bribe courts*. This last result 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.

At the general equilibrium level, we study how the equilibrium institutional mix is affected by uncertainty in the production process, measured by the frequency of bad productivity shocks. *Ceteris paribus*, when uncertainty increases firms bribe more and consumers connect more with one another. Adding up all the partial effects, we obtain that higher uncertainty leads to lower judicial efficiency, and to increased reliance on informal enforcement mechanisms.

To conclude, we present empirical evidence of the link between uncertainty, corruption, and consumers' incentives to rely on informal enforcement mechanisms. We use firm-level data from the *Investment Climate Assessments* of the World Bank, which survey more than 28,000 firms in 58 countries, and provide information on firms' characteristics, firms' productivity, and the investment climate. In a context of intra-industry trade, firms are both producers and consumers: therefore we use *membership to business association* as a proxy for the use of informal enforcement networks. In accordance with the model, we find that firms that suffer more from corruption, and firms that face a more uncertain

production climate, are more likely to be members of business associations. Interestingly, the relationship keeps holding when we look at firms in Sub-Saharan Africa, Asia, Latin America, and Eastern Europe alone, suggesting that the results are not driven by region specific attributes. To the extent that developing countries face higher uncertainty in the production process, both the theoretical and empirical analyses point therefore to a *physical* explanation for why developing countries often fail to have well-performing judicial systems.

The paper is organized as follows. Section 2 presents the basic model under exogenous institutions; Section 3 endogenizes connectedness and judicial efficiency; Section 4 presents the empirics, and Section 5 concludes.

2 Contract Enforcement under Imperfect Institutions

The economy consists of a measure one of consumers, and of firms producing a homogenous good of variable quality. At every 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 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. Like in Kremer (1993), we relate the parameter ϑ to the *reliability* of the production process, and say that countries (sectors) with higher ϑ 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 due to the firm's decision to produce low quality. Shocks are persistent, 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 $U(p) = \overline{U} - p$ from high quality, and utility $0 - p$ from low quality. The maximum price consumers are willing to pay for high quality is thus $\overline{p} = \overline{U}$, 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

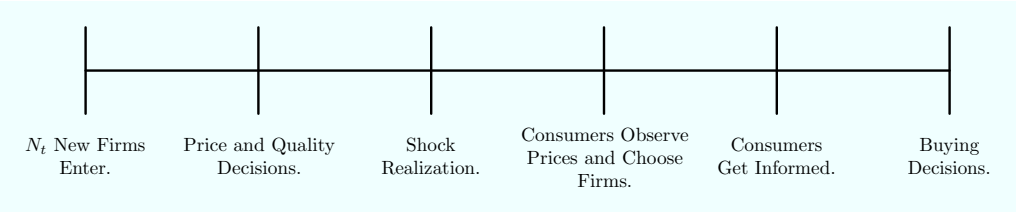

Figure 1: Timing of the stage game.

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. 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, and the number N_t of firms that enter the market in each period is such that entrants face zero expected profits.[5] Next, all firms choose prices and quality simultaneously, after which shocks are realised and firms produce either high or low quality. Consumers then 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 $1-\delta$. An *equilibrium* is therefore a sequence of prices and quality choices, along with consumers buying 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). In what follows, however, we restrict attention to *perfect Bayesian equilibria in stationary strategies* that maximize consumers' payoff. In a stationary equilibrium, there are $N/(1-\delta)$ firms in the market, and $N/(1-\delta\vartheta)$ good firms in each period.

We then consider two institutions that can induce firms to produce high quality: *reputation* and *judicial enforcement*. Reputation works through the repeated

[5]We depart therefore from conventional models of reputation in two ways (see, among others, Klein and Leffler, 1982, Shapiro, 1983, Allen, 1984, Hörner, 2002, and Kranton, 2003): first, as in Hörner (2002), we introduce *shocks*. Second, as we aim to analyze the interaction of institutions in a competitive setting where firms do not internalize the consequences of their own bribing on institutions, we introduce sunk rather than fixed costs, so that a single firm cannot capture all the market share.

interaction of consumers and firms in the market, while judicial enforcement works through the reimbursement of consumers who go to court after having experienced bad quality. We denote by φ_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 judicial efficiency in society.[6] 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 consumers to be informed about "bad" firms. In this section we assume q_i and φ_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:

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

where 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 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 Φ. On the other hand, if the consumer meets a bad firm and she is informed, she will not buy from that firm and gets utility $U = 0$, while if she is uninformed 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. Hence, given a price p, the expected payoff of a good firm j from always putting in high effort is:

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

where $1/R$ is the discount rate and $V_j^B = R(1-\varphi_j)px_L/(R-\delta)$ represents the discounted profits of a bad firm facing judicial efficiency φ_j.[7] On the other hand, if firm j shirks it faces an expected payoff equal to $V_j^L = (1-\varphi_j)px_H + (\delta/R)V_j^B$. 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

[6] Thus, we assume that *ex-post* quality is verifiable.

[7] Equation (2) implicitly assumes that consumers stop buying from a bad firms 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.

only if:

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

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/ϑ, and the *markup* component (represented by the first fraction in (3)). The markup is required to sustain high quality when judicial enforcement is less than perfect, and decreases with the efficiency of either institution:

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}. Observe that in the reputational equilibrium (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 (Φ, Q) firms' participation constraint can be violated, as firms cannot recover their sunk costs even under full capacity production $x_H = 1$, in which case consumers and firms need to coordinate on a price *above* p^{NM}. However, we do not discuss this case (see Esfahani, 1991).

3 Reputation and Judicial Enforcement as Endogenous Institutions

We now let consumers invest in their own connectedness 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 judges 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 Φ. 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 $q'(0) = \infty$, $q'(\infty) = 0$.[8] In deciding how much to invest, consumers take the price p^{NM}, average connectedness Q, and judicial efficiency Φ as given, so that for constant values of ϑ, Φ, Q the consumers' maximization problem is:

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

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

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

Intuitively, consumers invest in connectedness to be informed about bad firms in the market, and as ϑ increases, the share of bad firms decreases. Moreoever, the gain of an extra unit of information per firm is decreasing with the price (which also decreases with ϑ), while the marginal cost is constant. Thus, as ϑ increases consumers invest less in connectedness, both because of the direct effect on the share of bad firms, and of the indirect effect on p^{NM} (the same logic holds for judicial efficiency Φ). Note, also, that the costs of going to court are implicit in the parameter Φ faced by consumers.

We now turn to firm behaviour. Firms can decrease the probability of having to reimburse consumers by bribing. We presume that bribing has decreasing

[8] 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 connectedness increases proportionally more if other consumers also invest in connectedness. This adds significant algebraic burden while conveying similar results.

returns, so that $\varphi'(m_f) < 0$, $\varphi''(m_f) > 0$, and we also assume that $\varphi(m_f)$ satisfies the Inada conditions. For constant values of ϑ, Φ, Q, the maximization problem of a firm that delivered low quality is:

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

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 Φ:

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

Intuitively, in the high effort equilibrium an increase in ϑ lowers p^{NM} via marginal costs. Therefore, when ϑ is high, bad firms have lower incentives to bribe the judicial system because gains are lower. Bribing, however, also has a general equilibrium effect because it increases the equilibrium price p^{NM}, and hence firms' profits: it is to rule out this perverse effect through Φ that Proposition 3 requires the condition on $\varphi(m_f)$.[9]

We conclude by looking at the overall equilibrium institutional mix. Figure 2 shows the consumers' and firms' reaction functions $Q_C(\Phi), Q_F(\Phi)$: the reaction functions are monotonic and opposite in slope, hence the equilibrium is unique. Moreover, an increase in reliability ϑ shifts both consumers' and firms' reaction functions downwards, so that connectedness Q unambiguously decreases with reliability ϑ. In contrast, the effect of changes in reliability ϑ on judicial efficiency Φ remains *a priori* ambiguous, as whether judicial efficiency Φ increases or decreases with ϑ depends on whether the firms' reaction curve Q_F moves downwards more or less 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 ϑ:

PROPOSITION 4

1. *Equilibrium connectedness Q always decreases with reliability ϑ.*

[9] A similar effect also acts on consumers' investment decisions in connectedness q, but for consumers the indirect effect has the "right" sign.

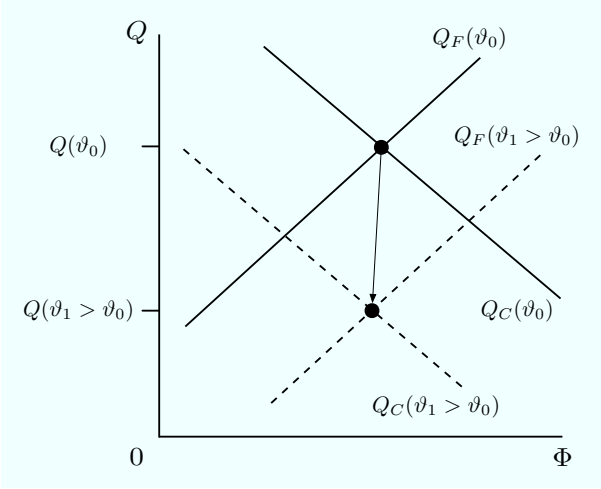

Figure 2: Equilibrium levels of connectedness and of judicial efficiency.

2. *There exists a threshold* $\overline{\vartheta}$ *such that judicial efficiency* Φ *improves with reliability* ϑ *for* $\vartheta < \overline{\vartheta}$.

Thus, when reliability is low consumers rely more on informal enforcement, and, at least up to a certain reliability threshold $\overline{\vartheta}$, bribing is also higher.

4 Empirics

In a context of intra-industry trade, firms are often consumers of other firms' products, and a stated reason for the existence of firms associations is often to get information about other firms. We use this interpretation to test Proposition 2 – i.e. that consumer's incentives to connect with each other (by becoming, in our case, members of business associations) are affected by corruption and by uncertainty in the production climate.

We test this implication at the firm level using data from the *Investment Climate Assessments (ICA)* of the World Bank, which survey more than 28,000 firms in 58 countries between 2000 and 2004, and provide information on firms' characteristics, firms' productivity, and the investment climate. Because not all questions are asked in each survey, our final sample consists of 19,000 firms spread over 49 countries. The survey is not nationally representative, but is representative of specific sectors that are consistently surveyed across countries: thus firms

in the manufacturing sector represent 72% of the sample, firms in services 21%, and the remaining 7% of the sample consists of firms operating in agriculture and construction.

As a proxy for connectedness we use the variable *MEMBER*, which indicates whether a firm is a member of a business association. Memberships to business associations are rarely compulsory, and there are usually few binding contractual obligations arising from membership. Therefore, business associations can be considered informal institutions that "connect" their members by mitigating information asymmetries, providing a basis for solving disputes with trade partners, and easing the transmission of information. This role of business associations is strongly supported by a recent study of Pyle (2005).

To be sure, a positive association between corruption, uncertainty, and membership to business associations could potentially also stem from bad governance, leading in the long term to low quality services, and firms' increased incentives to lobby. Therefore, we apply the following safeguards to avoid capturing such a relationship. First, we give the value one to the variable *MEMBER* only if the firm identifies the ability to resolve disputes, to provide information on domestic product markets, or to accredit standards, as important functions of the business association: these functions should capture the ability of a business association to spread information about other firms and to coordinate punitive actions, and give less importance to lobbying intentions. Moreover, our analysis is at the firm level, so that the macro-economic relationship between corruption and lobbying should be captured by the country fixed effect. Finally, we construct an uncertainty index from variables that have (at least in the short run) little relationship with governance and lobbying. Specifically, we construct two uncertainty indexes using the following variables:

$$U_{ic} = 0.51\ ELEC_{ic} + 0.35\ SKILL_{ic} + 0.52\ TRANSP_{ic} \tag{6}$$

$$\begin{aligned} \widetilde{U}_{ic} \;\; = \;\; & 0.34\ ELEC_{ic} + 0.29\ SKILL_{ic} + 0.36\ TRANSP_{ic} \\ & +0.35\ CRIME_{ic} + 0.29\ MACRO_{ic} \end{aligned}$$

where *ELEC*, *SKILL*, *TRANSP*, *CRIME*, and *MACRO* are dummies equal to one if a firm identifies respectively electricity losses, the lack of skills in the workforce, transportation, crime, and macro-economic instability as important business con-

straints, and the weights are derived using the method of principal components.[10] Note that the second index "expands" the first with with socio-political variables, but is more likely to pick up bad governance-lobbying relationships. Finally, as a measure of corruption C_{ic} we use a dummy variable equal to one if firm i identifies corruption as a relevant business constraint. We then estimate the following Probit model:

$$P[MEMBER_{ic} = 1] = P[\beta_0 + U_{ic}\ \beta_U + C_{ic}\ \beta_C + Y'_{ic}\ \beta_Y + \varepsilon_{ic} > 0] \qquad (7)$$

where i denotes firms and c countries, U_{ic} is the uncertainty index, C_{ic} the corruption index, Y_{ic} represents firm characteristics, and the theoretical model predicts that both β_U and β_C are positive (see Proposition 2). Notice that the model also predicts a reverse causal relationship between average consumers' connectedness and corruption. However, as we estimate the probability of a *single firm* being a member of a business association, it can be shown that the estimates are consistent. Note, also, that we diverge from the theoretical model in two ways. First, we allow different firms to face different levels of corruption. This is because in the model all firms are producing the same product, but in the data firms are substantively different from each other and in principle could "suffer" differently from corruption. Second, strictly speaking the model requires U_{ic} to be the level of uncertainty faced by the *business partners* of firm i: unfortunately, this information is not available. As firms with similar activities and uncertainty levels tend to trade more often with each other, we assume that the level of uncertainty of each firm is a good proxy of the uncertainty level faced by its business partners.

Table 2 presents the results of the Probit estimation: Column 2 shows the estimation for all countries, while Columns 3–6 show the estimation by geographic region. In all regressions we have included country and sector dummies, have clustered the errors by country, and have weighted each observation by the total number of observations in the country. To obtain a better representation we also increased the number of observations by pooling surveys from different years.

In accordance with the theory, higher levels of corruption and more uncertain production climates are both associated with a higher probability of firms being members of business associations. The relationship continues to hold when we disaggregate the analysis by region: with the exception of corruption in Sub-

[10] See Theil (1971) and Alesina and Perotti (1996) for a description of the method of principal components and macro-economic applications.

Saharan Africa, higher levels of corruption and uncertainty remain positively and significantly related to membership of business associations in all five regional estimations. Table 3 presents the results with the expanded uncertainty index: the results remain basically the same for uncertainty, while the corruption variable becomes insignificant in Eastern Europe and Central Asia. This result is not surprising, as the new variables added in the uncertainty index tend to correlate more with corruption.

5 Conclusions

In this paper we focused on the relationship between formal (state sponsored) and informal (self-enforcing) institutions that prevent opportunistic behaviour. Our findings are only partly consistent with the common belief that formal and informal institutions substitute each other: we find that when judicial enforcement works poorly, consumers invest more in connecting with other consumers to enhance enforcement via the reputation mechanism; on the other hand, however, better informal enforcement *improves* judicial enforcement because it reduces firms' incentives to bribe. The model also predicts a positive equilibrium relationship between uncertainty in the production process, bribing, and the use of informal enforcement. Empirical evidence appears to support the predictions of the model: using firm-level data, we find that firms are more likely to become members of business associations when they see corruption and uncertainty in the production process as severe business contraints. Our analysis suggests therefore a *physical* explanation (i.e. uncertainty) for why developing countries often fail to have well-performing judicial systems.

The paper, however, abstains from studying how changes in the institutional mix affect consumers' welfare. When reliability in the production process increases, consumers' welfare is affected both directly by better performing firms, but also indirectly through the institutional mix. As both consumers and firms do not consider the impact of their investment decisions on equilibrium prices, the effect of a change in the institutional mix on consumers' welfare remains a priori ambiguous, and is subject for future research.

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Appendix

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 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 $(G^0, P^0); \ldots; (G^{t-1}, P^{t-1})$, where $G^t = (g_j^t, x_j^t)_{j\in[0,N^t]}$, and of consumer actions $(a_i^0); \ldots; (a_i^{t-1})$. 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).

Proof of Proposition 1

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* $\min\left(p_j^t | p_j^t \geq p^{NM}\right)$.
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* ϑ*, 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 always produces 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[11], since, given the consumers' strategies,

[11]The only imperfect information comes from the simultaneous price game.

incomplete information about other firms' types does not influence payoffs. Hence 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 then 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 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 condition:

$$G \equiv \frac{\delta(1-\vartheta)}{1-\delta\vartheta}(1-\Phi) \cdot p(\vartheta, \Phi, q(m_c))q'(m_c) = 1 \tag{8}$$

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

$$\begin{aligned}
\frac{\partial G}{\partial m_c} &= \frac{\delta(1-\vartheta)}{1-\delta\vartheta}(1-\Phi) \cdot \left\{ \frac{\partial p}{\partial q}\left(\frac{dq}{dm_c}\right)^2 + p\frac{d^2q}{dm_c^2} \right\} < 0 \qquad (9)\\
\frac{\partial G}{\partial \Phi} &= \frac{dq}{dm_c}\frac{\delta(1-\vartheta)}{1-\delta\vartheta}\left\{ -p + (1-\Phi)\frac{\partial p}{\partial \Phi} \right\} < 0\\
\frac{\partial G}{\partial \vartheta} &= -\frac{\delta(1-\Phi)}{1-\delta\vartheta}\frac{dq}{dm_c}\frac{1-2\delta\vartheta+\delta\vartheta^2}{\vartheta(1-\delta\vartheta)}p < 0
\end{aligned}$$

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 $\partial m_c/\partial\vartheta = -G_\vartheta/G_{m_c} < 0$. Finally, the fact that $\partial G/\partial m_c < 0$ ensures that there is a unique equilibrium.
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:

$$F \equiv \Phi'(m_f) + \frac{\delta(1-\Phi)Q + R\Phi}{R}\frac{\vartheta}{c} = 0 \tag{10}$$

and therefore, the partial derivatives are equal to:

$$\begin{aligned}
\frac{\partial F}{\partial Q} &= \frac{\delta\vartheta(1-\Phi)}{Rc} > 0 \\
\frac{\partial F}{\partial \vartheta} &= \frac{\delta(1-\Phi)Q + R\Phi}{Rc} > 0 \\
\frac{\partial F}{\partial m_f} &= \Phi''(m_f) + \Phi'(m_f)\frac{\vartheta(R-\delta Q)}{Rc} > \Phi'' - \frac{|\Phi'|}{c} > 0
\end{aligned} \tag{11}$$

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 $\partial\Phi/\partial\vartheta = -\Phi' F_\vartheta/F_{m_f} > 0$.
End of Proof.

Proof of Proposition 4
The partial derivative of the consumers' reaction function Q_C is as follows:

$$\frac{\partial Q_C}{\partial \vartheta} = -\frac{1-\delta\vartheta(2-\vartheta)}{\vartheta(1-\vartheta)(1-\delta\vartheta)}\frac{1}{\frac{\delta(1-\Phi)}{\delta(1-\Phi)Q+R\Phi} + |q''|/(q')^2} \tag{12}$$

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:

$$\frac{\partial Q_F}{\partial \vartheta} = -\frac{\delta(1-\Phi)Q + R\Phi}{\delta\vartheta(1-\Phi)} \tag{13}$$

The sign of $\partial\phi/\partial\vartheta$ depends on whether $|\partial Q_F/\partial\vartheta| \gtrless |\partial Q_C/\partial\vartheta|$. Hence, judicial efficiency increases if and only if:

$$\frac{1}{\delta(1-\Phi)} > \frac{1-\delta\vartheta(2-\vartheta)}{(1-\vartheta)(1-\delta\vartheta)}\frac{1}{\delta(1-\Phi)+C\xi} \tag{14}$$

where $C = \delta(1-\Phi)Q + R\Phi$, and $\xi = |q''|/(q')^2$. Note that for $\vartheta \to 0$ the inequality (14) is always satisfied, while for $\vartheta = 1$ the inequality is never satisfied. Now, the first fraction of the RHS of (14) is an increasing function of ϑ: therefore, for $\xi_1 > \xi_2$ we have that

$\overline{\vartheta}(\xi_1) > \overline{\vartheta}(\xi_2)$. Moreover, for $Q = const.$ we have that $\xi = \infty$, so that inequality (14) is always satisfied.
End of Proof.

Table 1: Variable definitions.

Variable	*Definition*	*Average*
MEMBER	Dummy variable with value one if the firm is a member of a business association *and* an important function of the business association the ability to resolve disputes, to provide information on domestic product markets, or to accredit standards.	0.21
CORR	Dummy variable with value one if the firm identifies corruption as a relevant business constraint.	0.51
ELEC	Dummy variable with value one if the firm identifies electricity shortages as a relevant business constraint.	0.38
SKILL	Dummy variable with value one if the firm identifies the lack of skills in the workforce as a relevant business constraint.	0.39
TRANSP	Dummy variable with value one if the firm identifies transportation as a relevant business constraint.	0.27
CRIME	Dummy variable with value one if the firm identifies crime & vandalism as a relevant business constraint.	0.42
MACRO	Dummy variable with value one if the firm identifies macro-economic instability as a relevant business constraint.	0.62
LARGE	Dummy variable with value one if the firm's size is large or very large.	0.26
EXP/IMP	Dummy variable with value one if the firm exports part of its output, or import at least 40% of its inputs.	0.12
FOREIGN	Dummy variable with value one if the firm's largest shareholder is foreigner.	0.31
PUBLIC	Dummy variable with value one if the firm is owned by the state.	0.08

Table 2: Firm-level Probit with exogenous uncertainty index.

Dep. Variable: MEMBER	*All Countries*	*Latin America*	*Eastern Europe & Central Asia*	*Sub-Saharan Africa*	*South Asia*	*East Asia*
Corruption	.11	.20	.09	.08	.25	.11
	(.03)**	(.08)**	(.05)*	(.08)	(.10)**	(.02)**
Uncertainty	.08	.07	.08	.09	.13	.08
	(.02)**	(.04)*	(.03)**	(.04)**	(.05)**	(.02)**
Large firm	.37	.31	.42	.26	.40	.47
	(.04)**	(.03)**	(.06)**	(.08)**	(.04)**	(.13)**
Exporter/importer	.26	.31	.30	.23	.05	.18
	(.04)**	(.08)**	(.06)**	(.07)**	(.04)	(.04)**
Foreign ownership	.03	.009	.05	.05	-.26	-.11
	(.04)	(.07)	(.06)	(.10)	(.02)**	(.10)
Public ownership	.05	-.04	.03	.06	.51	.46
	(.06)	(.30)	(.07)	(.16)	(.15)**	(.05)**
Observations	19173	3916	8327	2215	2414	1400
Countries	49	6	30	7	3	2

All regressions include country and sectorial dummies, and errors have been clustered by country. Algeria is the only North African country. Standard errors are in parenthesis. * Significant at the 10% level. ** Significant at the 5% level.

Table 3: Firm-level Probit with expanded uncertainty index.

Dep. Variable: MEMBER	*All Countries*	*Latin America*	*Eastern Europe & Central Asia*	*Sub-Saharan Africa*	*South Asia*	*East Asia*
Corruption	.08	.16	.06	.02	.21	.05
	(.03)**	(.07)**	(.05)	(.07)	(.08)**	(.004)**
Uncertainty (expanded)	.10	.09	.08	.14	.11	.10
	(.02)**	(.05)*	(.03)**	(.05)**	(.01)**	(.02)**
Large firm	.37	.31	.43	.24	.39	.46
	(.04)**	(.03)**	(.06)**	(.08)**	(.03)**	(.13)**
Exporter/importer	.26	.31	.29	.23	.06	.17
	(.04)**	(.08)**	(.06)**	(.07)**	(.04)	(.04)**
Foreign ownership	.03	.02	.05	.05	-.25	-.11
	(.04)	(.07)	(.06)	(.10)	(.02)**	(.10)
Public ownership	.06	-.01	.03	.06	.52	.45
	(.06)	(.30)	(.07)	(.15)	(.16)**	(.06)**
Observations	19173	3916	8327	2215	2414	1400
Countries	49	6	30	7	3	2

All regressions include country and sectorial dummies, and errors have been clustered by country. Algeria is the only North African country. Standard errors are in parenthesis. * Significant at the 10% level. ** Significant at the 5% level.