Development and the Interaction of Enforcement Institutions *

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Abstract
We examine how formal and informal contract enforcing institutions interact in a competitive market with asymmetric information where consumers do not observe quality before purchase. Firm level incentives for producing 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 show that formal and informal enforcement mechanisms do not necessarily substitute each other: while high levels of judicial efficiency decrease consumers' incentives to connect, higher consumers’ connectedness leads to higher levels of judicial efficiency. We then look at how the equilibrium institutional mix evolves with the level of development. In doing so we show the presence of a new, physical, channel that can affect institutions – i.e. the frequency of bad productivity shocks that, in less developed settings, can impact on firms’ incentives to cheat.

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1 Introduction

It is well recognized that informational and contracting constraints increase the difficulty of “doing business” in developing countries. This is widely perceived to be due to the lack of well functioning formal enforcement institutions, like courts. At the same time, there is ample evidence all over the developing and developed world of informal resolutions to these problems through informal contract enforcement based on relationships, networks, and reputation.\footnote{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 on contract enforcing institutions in Mookherjee (1999), Dixit (2003), Greif (2004), and MacLeod (2006).} Formal and informal modes of governance are however two extremes that are unlikely to be seen in reality, and the study of the interface between them remains an important and open question (Dixit, 2004).

In this paper we take a first step at answering this open question by developing a theory of institutional interaction where both formal and informal institutions co-exist and influence one another. The setting we study, as in Allen (1984) and Hörner (2002), is one of unobserved firm level shocks that lead firms to produce a poor quality good, which generates a moral hazard problem since consumers cannot distinguish whether poor quality stems from a shock, or firms’ cheating. To cope with the moral hazard problem, consumers rely on two enforcement mechanisms: an informal one, reputation, the efficacy of which is enhanced by consumers investing in “connectedness,” and a formal mechanism, legal enforcement (or judicial efficiency), the effectiveness of which can be reduced by means of bribes. In the model, the interaction between the formal and informal enforcement mechanisms happens through the equilibrium price of the good, which plays a central role since (even in a competitive setting) it needs to be set high enough to maintain firms’ incentives to produce high quality. More precisely, both consumers’ connectedness and judicial efficiency affect firms’ incentive compatibility constraint to produce high quality, and therefore the market price. But the reverse also holds: the equilibrium price affects consumers’ incentives to connect and firms’ incentives to bribe. The equilibrium institutional mix (and the effectiveness of both formal and informal enforcement mechanisms) is therefore the result of this double causality link where both institutions affect one another through the market price.
The theory makes two valuable contributions. First, it complements the diverse strand of literature (for example McMillan and Woodruff, 1999, 2000 and Kranston and Swamy, 1999) demonstrating how informal enforcement arrangements arise when formal institutions work poorly by showing that the reverse can also hold, that is, informal enforcement arrangements can also influence legal enforcement. In looking at the reverse causality, the model shows that formal and informal enforcement mechanisms do not necessarily substitute one another, since well-performing informal enforcement networks, by lowering the price of goods, improve legal efficiency as firms have less incentives to bribe. Our model therefore provides a theoretical underpinning to the literature that finds a positive relationship between social capital (interpreted often as trust), institutional quality, and economic performance (see, for instance, Putnam et al., 1993, Knack and Keefer, 1997, Tabellini, 2010). The paper also relates to the literature on product specialization (see Levchenko, 2007, Nunn, 2007) by showing how the market price needs to be higher conditional on product quality when legal systems do not function well.

The second contribution relates to the comparative statics determining the equilibrium institutional mix, which we link to the level of development. As in Kremer (1993), we measure the degree of development of a country or sector by the probability of high quality task completion. Such a measure of development is closely related to productivity-based measures such as GDP, but it also allows us to measure the effects of moral hazard on the institutional mix along the development path. In particular, we assume that the probability of high quality task completion remains lower in less developed settings due, for instance, to unskilled labor, poorer infrastructure, poorer institutional quality and, overall, a higher degree of asymmetric information. The model then suggests that higher reliability in the production process (i.e. higher probability of high quality task completion) unambiguously decreases consumers’ incentives to connect with one another (i.e. the use of the informal enforcement mechanisms) because of lower marginal costs, lower market prices, and an increase in the share of firms providing a high quality good. In contrast, the impact of development on judicial efficiency remains ambiguous since lower marginal costs of production (which lower incentives to bribe) are contrasted with lower consumers’ connectedness (which raises incentives to bribe). However, we show that, at least up to a certain reliability threshold, equilibrium corruption decreases with reliability.

Our paper therefore demonstrates a new, physical channel – i.e. the reliability of the production process – through which development can influence institutions.
While a formal empirical analysis goes beyond the scope of this paper, preliminary evidence suggests that such a channel could potentially play a significant role. In Table 1, using World Bank’s Investment Climate Assessments for 2002 and 2003 that cover six regions, we look at determinants of firms’ membership to business associations (which we interpret as a proxy for informal connectedness), and of firms’ perception of corruption. We give the value one to the variable MEMBER only if the firm belongs to a business association and identifies the ability to resolve disputes, to provide information on domestic product markets, or to accredit standards, as important functions of the association. We also give the value one to the variable CORRUPTION if the firm identifies corruption as an important business constraint. Finally, we construct a reliability index using the method of principal components based on whether firms identify electricity shortages, transport, and skills as relevant business constraints. We then run Probit regressions of membership to business associations and perception of corruption with country and sectoral dummies against our measure of reliability (plus some firms’ characteristics). Net of country and sector fixed effects, in all regions reliability has a statistically significant relation with both membership in business associations and corruption, that is, in accordance with the model, lower reliability is associated with higher likelihood of a firm being a member of a business association, and higher corruption. Complementing the literature on how institutions affect development, our paper suggests therefore that the reverse causality may be important as well.

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

In this section we build a model with exogenous institutions closely related to Allen (1984) and Hörner (2002). We then endogenize institutions in Section 3. The economy consists of a finite number of firms, and a continuum of overlapping generations of consumers, each of measure one, who live for two periods. In each period, firms produce a homogenous good of variable quality, and can choose to provide high or

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2 A more detailed discussion and description of the empirical analysis is available upon request from the authors.

3 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).
low effort. If they choose low effort they produce a low quality good that is costless, while if they put in high effort they produce a high quality good with probability $\vartheta \in (0, 1)$, incurring a marginal cost of $c$. We interpret $1 - \vartheta$ as the probability of an exogenous “bad” productivity shock, in which case the good becomes of low quality. We also assume that the shock is persistent. Our uncertainty variable $\vartheta$ captures in a simple way production uncertainty faced by firms, such as problems related to infrastructure, regulation uncertainty, or the prevalence of an unreliable labor force, which reduce the probability of high quality task completion. As in Kremer (1993), we link uncertainty to development, and say that countries (sectors) with a higher parameter $\vartheta$ are more developed.

Consumers live for two periods. In the first period young consumers choose whether to buy the good in the market or not, based on their information. In the second period of their life, the role of old consumers is to transmit information to young consumers about firm performance. Our model therefore captures markets where purchases are rare and costly relative to income: e.g. surgery or buying a house. Young consumers need to buy one unit of the good, and derive utility $U(p) = U - p$ from high quality; utility $0 - p$ from low quality; and utility 0 by not buying the good. The maximum price consumers are willing to pay for high quality is thus $p = U$, while consumers are not willing to spend money on low quality. 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 to the firm’s effort decision. Because shocks are persistent, 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.

We now introduce the 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. Specifically, we denote by $q_{i,t} \in (0, 1)$ the probability that consumer $i$ is informed about the full history of the firm she is trading with in period $t$ (which gives her information about the firm having sold “good” or “bad” quality in the past). On the other hand, legal enforcement works through the reimbursement of consumers who go to court after having experienced bad quality. We denote by $\varphi_{j,t} \in (0, 1)$ the probability that firm $j$ has to reimburse consumers if it delivers low quality in period $t$ (we assume therefore that ex-post quality could potentially be verified if courts were not corrupt), and consider a
situation where $\overline{U}$ is sufficiently high so that consumers always prefer firms putting in high effort, even if the price is higher.

In this section we will assume $q_{i,t}$ and $\varphi_{j,t}$ to be exogenous and equal across time, so that $q_{i,t} = q_i$. We then refer to the average level of information in society $Q = \int q_i \, di$ as connectedness, because consumers need to “connect” to old informed consumers to be informed about bad firms. While, under exogenous institutions, only the proportion of informed consumers $Q$ matters, how information gets transmitted will be important in the next section, where connectedness $Q$ is endogenous. Similarly, we denote the average level of cheating firms’ likelihood to reimburse consumers $\varphi_{j,t}$ across all firms as $\Phi$, and call $\Phi$ judicial efficiency.

The game between consumers and firms is an infinite horizon game with discrete time. Figure 1 shows the timing of the stage game. At the beginning of each period there is a stock of old firms, and a proportion $q_0$ of young consumers who are informed (where $q_0 = Q$ in this section). In each period there are $N_t$ new firms entering the market and investing a fixed cost of $T$ units in building capacity, which allows them to produce up to one unit of output per period. Next, all firms first choose prices simultaneously, then effort levels (conditional on observed prices), after which 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). There is Bertrand competition between firms at the price setting stage. Next, young consumers observe the vector of prices, form beliefs about firms’ efforts, and choose a firm posting the price at which they wish to buy the good. Since price is the only (imperfect) signal of quality, we assume that consumers randomize between firms posting the same price. Once they are matched with a particular firm, they get informed about the firm’s full history with probability $Q$, and decide

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4The 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.
whether to buy the good or not. After the good has been bought consumers can observe quality, and go to court if they bought a bad quality good – in which case they get reimbursed with probability Φ. Finally, after all transactions have occurred, each firm faces an exogenous probability of closure $1 - δ$, where we assume $δ \in (0, 1)$. This latter assumption serves to guarantee a steady state distribution of good and bad firms.

An equilibrium is a sequence of prices and effort choices, along with consumers buying decisions and firm entry decisions, such that consumers maximize utility given the firms strategies and their beliefs, new firms decide whether to enter or not, and all firms in the market choose prices and effort to maximize profits given the consumers strategies and beliefs (see the Appendix for a formal discussion). Although the model admits multiple equilibria, in what follows we restrict attention to symmetric and stationary pure strategy (high effort) Markov perfect Bayesian equilibria that maximize consumers’ payoff and in which firms make zero expected profits net of fixed costs. Observe that such an equilibrium consists of the minimal constant price level $p^{NM}$ that guarantees incentives for good firms to put in high effort given the consumers’ beliefs and strategies; a high (low) effort decision by all good (bad) firms across periods; and a constant stock of (good and bad) firms in the market. Notice, also, that this is a pooling equilibrium since all firms post the same price in equilibrium. The model does not allow for a pure strategy separating equilibrium in prices, since we assume that consumers prefer not to buy the good rather than buy low quality.

Such an equilibrium is supported by the assumption that consumers choose randomly among firms that post the lowest price that is higher or equal than $p^{NM}$ (so that competition drives firms to post a price equal to $p^{NM}$), which is supported by the beliefs that a price lower than $p^{NM}$ is not compatible with high quality. Once consumers are matched with a firm, uninformed consumers (a proportion equal to $1 - Q$) always buy the good, while informed consumers (a proportion equal to $Q$) do not buy the good if the firm ever produced bad quality in the past. The equilibrium is supported by the out-of-equilibrium beliefs that once a firm has put in low effort, it will always put in low effort. A formal presentation of the repeated game and equilibrium strategies is presented in the Appendix.

Next, we characterize $p^{NM}$ and show that it is the lowest stationary price that can be achieved as the outcome of a pure strategy symmetric Markov Perfect Bayesian equilibrium where no firm shirks. To this end, we begin by computing the steady
state values of the stock of firms using our condition of zero expected profits. Assume, first, that at the steady state \( N \) new firms enter the market in each period, and observe that a proportion \( 1 - \delta \in (0, 1) \) of all firms \( S_t \) in the market closes in each period. At the steady state, therefore, we have that \( S_{t+1} = S_t \Leftrightarrow S = N/(1 - \delta) \).

Observe, also, that a new firm will enter if and only if the discounted expected future profits from entry \( V^H \) are higher than the fixed cost \( T \), and competition implies that new firms will enter until \( V^H(N) = T \). This fixes the steady state number of firms \( N \) that enter every period (we provide a characterization of \( V^H(N) \) below).

The steady state number of “good” firms, \( S_g \), is then equal to \( S_g = N(1 - \delta) \), and the number of “bad” firms is equal to \( S_b = S - S_g = \frac{N \delta (1 - \vartheta)}{(1 - \delta)(1 - \delta \vartheta)} \).

Having determined the number of firms at the steady state, we can then compute the share of consumers that buy from good and bad firms. Recall that consumers choose a firm randomly among those firms that post a price bigger than or equal to \( p_{NM} \). Since every consumer buys from a good firm, but only uninformed consumers buy from bad ones, good firms have an expected share of consumers equal to \( x_g = 1/S \), and bad firms have an expected share of consumers equal to \( x_b = (1 - Q)x_g \).

We can now derive \( p_{NM} \), which is the lowest incentive compatible price under which the equilibrium is sustained. Given a price \( p \), the expected payoff of a good firm \( j \) from always putting in high effort in equilibrium is:

\[
V^H_j = (1 - \varphi_j(1 - \vartheta))px_g - c \cdot x_g + \frac{\delta}{R} \{ \vartheta V^H_j + (1 - \vartheta)V^B_j \}
\]  

(1)

where the first term in (1) is 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 \( \varphi_j \); \( 1/R < 1 \) is the discount rate; the second term in (1) is the continuation value (which depends on whether firms faced a good or bad shock); and \( V^B_j = R(1 - \varphi_j)px_b/(R - \delta) \) represents the discounted profits of a bad firm facing judicial efficiency \( \varphi_j \). Observe that Equation (1) implicitly assumes that informed consumers stop buying from a bad firm independent from winning or losing in court, as in equilibrium firms deliver bad quality only if they have been hit by a bad shock.

On the other hand, if firm \( j \) shirks and puts in low effort, it faces an expected payoff equal to \( V^L_j = (1 - \varphi_j)px_g + (\delta/R)V^B_j \), as in the first period after it shirks all consumers will be uninformed (so that the firm will be able to capture a high market

\footnote{This comes from \( N = (1 - \delta)\vartheta S_g + (1 - \vartheta)S_g \).}
share, but informed consumers will subsequently boycott the firm in every period, consistent with their beliefs that a firm that cheats once will always cheat (which in equilibrium will be true). Hence the continuation payoff for a firm that shirks even once is the same as that of firms that never shirked but that got a bad shock. In order to sustain high quality we must have that $V_j^H \geq V_j^L$. Thus, as $q_i = Q$ and $\phi_j = \Phi$, this high effort equilibrium is sustainable if and only if:

$$p(\vartheta, \Phi, Q) \geq \frac{Rx_g}{\delta(1 - \Phi)(x_g - x_b)} + \frac{R\Phi x_g}{\delta} c$$ \hspace{1cm} (2)

We call inequality (2) the No Milking Condition (see Shapiro, 1983, and Allen, 1984), and the lowest price that satisfies condition (2) 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 (2)). The markup is required to sustain high quality when legal enforcement is less than perfect, and decreases with the efficiency of either institution.\footnote{Also observe that $\lim_{\Phi \to 1} p^{NM} = \vartheta$, while $\lim_{Q \to 1} p^{NM} > \vartheta$. 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.}

**Proposition 1** $p^{NM}$ is the lowest symmetric stationary price that can be achieved as the outcome of a pure strategy Markov Perfect Bayesian equilibrium where no firm shirks, and consumers randomize between firms posting the same price. Moreover, $dp^{NM}/d\vartheta < 0$, $dp^{NM}/dQ < 0$, and $dp^{NM}/d\Phi < 0$.

The proof and out-of-equilibrium beliefs to sustain $p^{NM}$ are presented in the Appendix. Notice that $p^{NM}$ is a plausible stationary outcome, as the free entry assumption means that the composition of firms in the market is changing all the time, making it difficult for firms to collude on prices higher than $p^{NM}$. Similarly, while it is possible that firms could price lower than $p^{NM}$ given different consumer beliefs and strategies (e.g. consumers do not randomize between firms posting the same price), this would require more complex equilibria and sets of beliefs, such as mixed strategies (where good firms mix between high and low effort), non-symmetric, or
non-stationary strategies. Notice, also, that \( p^{NM} > 0 \), so that (gross of fixed costs) firms’ participation is guaranteed since \( V^H \geq V^L > 0 \) in equilibrium. Nevertheless, at high levels of institutional efficiency \( \Phi, Q \), firms’ participation constraint may be violated as firms cannot recover their fixed costs even under full capacity production \( x_g = 1 \). Therefore, if \( \Phi, Q \) are too high, consumers and firms need to coordinate on a price above \( p^{NM} \). We do not discuss this case (see Esfahani, 1991).

We conclude the section by computing consumers’ expected utility, which will inform the next section. The expected equilibrium utility of a consumer \( i \), conditional on observing an incentive compatible equilibrium price \( p \geq p^{NM} \), and before she is informed of the history of the firm, is equal to:

\[
U_i = \frac{1 - \delta}{1 - \delta \vartheta} \{ \vartheta U - (1 - \Phi(1 - \vartheta))p \} - \frac{\delta(1 - \vartheta)}{1 - \delta \vartheta} (1 - q_i)(1 - \Phi)p
\]  

Equation (3) reads as follows. The variable \( p \) is the equilibrium price of the good, and \( (1 - \delta)/(1 - \delta \vartheta) \) is the equilibrium share of good firms in the economy (i.e. the probability that a consumer meets a good firm). Good firms have then a bad shock in the current period with probability \( 1 - \vartheta \), in which case the consumer gets expected 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 \( \vartheta(U - p) - (1 - \vartheta)(1 - \Phi)p = \vartheta U - (1 - \Phi(1 - \vartheta))p \). Similarly, consumer \( i \) meets a bad firm with probability \( \delta(1 - \vartheta)/(1 - \delta \vartheta) \). 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 not reimbursed with probability \( (1 - \Phi) \). Observe that in equilibrium it must be that uninformed consumers strictly prefer to trade, which is satisfied when \( U \) is sufficiently high.\(^7\) To conclude, notice that consumers’ expected welfare in equilibrium is maximized when the incentive compatible price \( p \) is minimized and set equal to \( p = p^{NM} \).

\(^7\)More precisely, by substituting \( \Phi = q_i = 0 \), (the worst case scenario) in (3), we have that \( U_i > 0 \) for \( U > p(1 - \delta \vartheta)/(1 - \delta \vartheta) \).
3 Reputation and Legal enforcement as Endogenous Institutions

In this section, we investigate consumers incentives to get connected with each other and firms incentives to bribe, when both anticipate the same high effort equilibrium discussed above. Recall that our modeling of institutions is non-strategic, in the sense that consumers choose how much to invest in connectedness to maximize utility along the equilibrium path taking prices as given. Similarly, firms take prices as given while choosing the level of bribing that maximizes their profits. In what follows we will first derive the equilibrium from the consumers’ side (taking $\Phi$ as a given parameter), then from the firms’ side (taking $Q$ as a given parameter).

Specifically, in Proposition 2 we will let consumers invest in their own connectedness to increase the probability $q_{i,t}$ with which they are informed about the firm they are trading with, taking $\Phi$ as given: this determines the average (steady state) level of connectedness $Q$, which we call the consumers’ equilibrium. In Proposition 3 we let firms choose how much to bribe court officials to decrease the probability of having to reimburse consumers, $\phi_{j,t}$, taking $Q$ as given. This determines the average (steady state) level of bribing $\Phi$, which we call the firms’ equilibrium. In Proposition 5 we then let both $Q$ and $\Phi$ be endogenous and interact with one another, and analyze the equilibrium implications: we shall call this (in an abuse of terminology) the general equilibrium. Since we consider only steady state equilibria where $Q_{t-1} = Q_t$ and $\Phi_{t-1} = \Phi_t$, in what follows we omit the time index $t$ for the clarity of the presentation.

We begin by describing the consumers’ maximization problem. We assume that the likelihood a consumer gets informed about the firm she is trading with depends on her own investment in connectedness $m_{c,i}$, and the share of old informed consumers $Q_{old} = Q_{t-1}$. The underlying motivation is that consumers’ likelihood to be informed about the full history of the firm they are trading with depends on the size of existing networks interpreted as a repository of information, and we capture the size of networks by the share of old informed consumers. Specifically, we assume that individual connectedness is equal to $q_i = q(m_{c,i}, Q_{old})$, where $\partial q / \partial m_{c,i} > 0$; $\partial q / \partial Q_{old} \geq 0$; $\partial^2 q / \partial m_{c,i}^2 < 0$; $\partial^2 q / \partial m_{c,i} \partial Q_{old} \leq 0$; $\lim_{m_{c,i} \to 0}$ or $Q_{old} \to 0$ $q = 0$; and $\lim_{m_{c,i} \to \infty}$ or $Q_{old} \to 1$ $q = 1$. To avoid corner solutions, we also assume that $q$ sat-

\footnote{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.}
sifies the Inada conditions in $m_{c,i}$: $\partial q(0, Q^{old})/\partial m_{c,i} = \infty$, $\partial q(\infty, Q^{old})/\partial m_{c,i} = 0$; and finally, to guarantee the uniqueness of an equilibrium, we shall assume that the previous generation of informed consumers $Q^{old}$ does not exert an excessive direct influence on current connectedness, so that $\partial q/\partial Q^{old} < 1$.

Consumers decide how much to invest in connectedness after having observed the price in the market, and having chosen a firm that has an incentive compatible price, so that their expected utility is equal to (3). In deciding how much to invest, consumers take the price $p$, the proportions of informed consumers $Q$ and $Q^{old}$, and judicial efficiency $\Phi$ as given, so that the consumers’ maximization problem can be written as:

$$\max_{\{m_{c,i}\}} U \left( \vartheta, \Phi, q(m_{c,i}, Q^{old}), p \right) - m_{c,i}$$

where investment costs are equal to $m_{c,i}$ and $p \geq p^{NM}$. Notice that each young consumer faces the same maximization problem (4). Thus, ex post, in the steady state we have that $q_i = Q = Q^{old}$, and we can use the first order conditions of the maximization problem to characterize the average level of connectedness $Q$:

**Proposition 2 [Consumers’ Equilibrium].** Consider judicial efficiency $\Phi$ as exogenous. Then the following holds:

1. For each $\vartheta, \Phi, Q^{old}$, and incentive compatible price $p$, there exists a unique interior level of connectedness $Q$ resulting from the consumers’ maximization problem (4). Moreover, $Q$ increases with the equilibrium price: $dQ/dp > 0$.

2. For $p = p^{NM}(\vartheta, \Phi, Q)$, the lowest stationary incentive compatible price that maximizes consumers’ welfare, there exists a unique interior steady state level of connectedness $Q$, where $Q = Q^{old}$. Moreover, $dQ/d\Phi < 0$, and $\partial Q/\partial \vartheta < 0$.

Observe that in the first part of Proposition 2 the price $p$ is taken as exogenous, in the sense that it does not depend on $\vartheta, \Phi, Q$. Intuitively, when the price $p$ increases

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9 Without this assumption the analysis would continue to hold since the relevant interaction is between $Q$ and $\Phi$, and not between $Q^{old}$ and $\Phi$. Nonetheless, a substantive direct effect of $Q^{old}$ on $q$ may generate multiple equilibria, and the resulting analysis would only hold locally around the selected equilibrium.

10 We have denoted the derivative $\partial Q/\partial \vartheta$ as a partial derivative to distinguish it from the derivative in Proposition 5, where we consider the additional interaction between $Q$ and $\Phi$. 

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the marginal gains of investing in connectedness also increase, and consumers have stronger incentives to invest in connectedness – so that \( Q \) increases with \( p \). The second part of Proposition 2 focuses on the lowest stationary investment compatible price \( p^{NM} \), which “endogenous” as it depends on \( \vartheta, \Phi, Q \) (see Proposition 1). Results can be intuitively explained as follows. As reliability \( \vartheta \) 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 behavior. Firms can decrease the probability of having to reimburse consumers by bribing court officials, and the reimbursement probability is a function of the bribe \( m_{f,j} \): \( \phi_j = \varphi(m_{f,j}) \), where \( \varphi'(m_{f,j}) < 0, \varphi''(m_{f,j}) > 0 \) (i.e., decreasing returns to bribing), \( \lim_{m_{f,j} \to \infty} \phi_j = 0 \), and \( \lim_{m_{f,j} \to 0} \phi_j = 1 \). We also assume that \( \varphi(m_{f,j}) \) satisfies the Inada conditions \( \varphi'(0) = -\infty, \varphi'(\infty) = 0 \). For constant values of \( \vartheta, \Phi, Q \), the maximization problem of a firm that delivered low quality and has been brought to court can then be expressed as follows:

\[
\max_{m_{f,j}} (1 - \varphi(m_{f,j})) px - m_{f,j} x
\]  

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

**Proposition 3 [Firms’ Equilibrium]**

1. For each \( \vartheta, Q, \) and incentive compatible price \( p \), there exists a unique interior level of judicial efficiency \( \Phi \), where \( d\Phi/dp < 0 \).

2. Let \( \varphi(m_{f,j}) \) satisfy \( \varphi''/|\varphi'| > 1/c \). Then for \( p = p^{NM}(\vartheta, \Phi, Q) \), the lowest stationary incentive compatible price, there exists a unique interior steady state level of judicial efficiency \( \Phi \) resulting from the firms’ maximization problem (5). Moreover, \( d\Phi/dQ > 0 \), and \( \partial\Phi/\partial \vartheta > 0 \).
The first part of Proposition 3 simply states that incentives to bribe increase with the equilibrium price \( p \). The comparative statics behind the second part, where the equilibrium price \( p^{NM} \) is endogenous, is slightly more complex. 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 \( Q \). When \( p^{NM} \) decreases, bad firms have lower incentives to bribe because gains are lower (see the first part of Proposition 3). 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 \( \varphi(m_{f,j}) \).

As with consumers, note that firms also 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.

Proposition 2 and 3 show the relevance of the market price in determining the efficacy of each institution. For connectedness, the market price determines the "losses" consumers make from not being informed; and for judicial efficiency, the market price determines the punishment through the reimbursement. In fact, most of the institutional interaction happens through the market price \( p^{NM} \). Any factor lowering the equilibrium 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 \( p \) for high quality reduces firms’ bribing (i.e. 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. The result of Proposition 4 is also consistent with the observed empirical relationship between competition and corruption (see Ades and di Tella, 1999), although it provides a complementary

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\(^{11}\) A similar effect also acts on consumers' investment decisions in connectedness \( q(m_{c,i}) \), but for consumers the indirect effect has the "right" sign.

\(^{12}\) We assume throughout the analysis that the penalty is limited to reimbursement, i.e. equal to the price of the purchased good, and do not consider the potential for punitive damages. This is the case for instance of the Lemon Laws that are operative in the United States, where the standard measure of damages for fraud is "rescission," i.e. the ability to void the deal. However, our results would continue to hold as long as there is a positive correlation between the punishment and the price. We would like to thank an anonymous referee for pointing this out.
Figure 2: Equilibrium levels of connectedness and of judicial efficiency.

Our model, 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 in equilibrium, anticipations of $Q$ and $\Phi$ are correct, and 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 [General Equilibrium]** For every level of reliability $\vartheta$ there exists a unique level of connectedness $Q$ and judicial efficiency $\Phi$ such that both consumers and firms equilibrium conditions are satisfied. Moreover:

1. Equilibrium connectedness always decreases with the reliability $\vartheta$ of the production process.
There exists a threshold $\vartheta$ 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 incentive compatible 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. The paper also looks at how the insti-
tutional mix evolves 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 economic environment.

A natural extension of the model would let consumers repeatedly interact with
firms. Empirically, it would also be interesting to find ways to identify the reverse
causality link suggested by the model, i.e. the effects of the performance of informal
institutions on formal ones. Another extension could look at how institutions affect
reliability, thus providing a simultaneous determination of the institutional mix, and
economic growth. We leave these extensions to future work.

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### Appendix

#### Stage Game

The stage game is as follows. Let $S^t$ be the set of firms in a period $t$. Denote a price system $p$ as a vector of prices, one for each firm in the market. Let $E = \{0, 1\}$ denote the two effort levels of a firm. Price systems are in the set $P^t = \{p_i | p_i : S^t \to [0, \infty)\}$. Let $I(s) = \{0, 1, 2\}$ denote the information state of a consumer when he is matched with firm $s$, where he could be uninformed, denoted as state 0; informed that the firm never produced bad quality, denoted as state 1; or informed that the firm has produced bad quality in the past, denoted as state 2. Consumers $i \in [0, 1]$ observe the vector of prices $p$ in the market, choose a firm $j$, and if informed, decide whether to buy ($a_i = 1$) or not to buy ($a_i = 0$). Hence, consumers’ pure strategies are a 2-tuple: a function from vectors of prices to a choice of firm, which is a probability distribution: $c_i : P^t \to \Delta(S^t)$ and a function from their information set given the choice of firm to a buying decision. Observe that the choice could be probabilistic, but given the realized choices of all consumers, the matching function tells us which consumer is matched with which firm: $m(i) : [0, 1] \to S^t$. We also denote the function from their information set given the choice of firm to a buying decision as $d : I(m(i)) \to \{0, 1\}$. We now specify the beliefs of consumers: a degenerate "price" or
$p$-belief for consumer $i$ in period $t$ is a function $pb : P^t \rightarrow E^{|S^t|}$, and a degenerate “quality” or $q$-belief of a consumer $i$ in period $t$ is a function $qb : P^t \otimes I(j) \rightarrow E_j$, that specifies the beliefs on effort for a firm $j$ that has posted a price $p^t_j$ and for which the consumer has got information in the set $I(j)$. 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 $U - p^t_j$ 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 $-p^t_j$.

The history $h^t_j \in H^t_j$ of firm $j$ at period $t$ is a sequence of quality and price vectors, market shares across firms, and consumers’ actions $(N^0, g^0_j, P^0, e^0_j, x^0_j, A^0_j); \ldots; (N^{t-1}, g^{t-1}_j, P^{t-1}, e^{t-1}_j, x^{t-1}_j, a^{t-1}_j)$, where $N^t$ denotes the number of firms that survive at the end of period $t$, $g^t_j$ represents the quality of goods sold by firm $j$ in period $t$ (i.e. high/low quality); $e^t_j \in \{0, 1\}$, the effort decision of firm $j$, $P^t = (p^t_j)_{j \in S^t}$ the price vector in period $t$; $x^t_j$ the share of consumers of firm $j$ in period $t$; and $a^t_j = (a^t_i(j))_{i \in [0,1]}$ the action of each consumer $i$ in period $t$ (i.e. buy/not buy from firm $j$).

Finally, a pure strategy for a firm is a 3-tuple: a function from the number of firms in the market at the beginning of time $t$ (or end of period $t-1$) to an entry decision, $d : N_0 \rightarrow \{0, 1\}$, a function from the history of firm $j$ at time $t$, to a pricing decision, $p^t_j : H^t_j \rightarrow P^t_j$, and an effort decision $e^t_j : H^t_j \otimes P^t \rightarrow E^t_j$. The payoff to firm $j$ is equal to $(p^t_j - c) \cdot x^t_j$ if it puts in high effort ($e^t_j = 1$) and $x^t_j$ consumers bought it, and to $p^t_j \cdot x^t_j$ if it puts in low effort ($e^t_j = 0$). Payoffs to firms in the game as a whole correspond to the discounted sum of payoffs in each period. The game is repeated over an infinite horizon.

**Proof of Proposition 1**

A firm is “bad” in period $t$ if it produced bad quality in period $t-1$. A “good” firm in period $t$ is one that has never produced bad quality. The Markov strategies and beliefs that achieve $p^{NM}$ as the outcome of a perfect Bayesian equilibrium are then the following:

**Firms’ Strategy.** New firms enter as long as expected profits net of sunk costs are positive, given the stock of firms that survived at the beginning of period $t$. Bad firms always choose $e^t_j = 0$ and price at $p^{NM}$ for all $t$, regardless of history. Good firms have the following strategy: 1. If $p^t_j \geq p^{NM}$, set $e^t_j = 1$, regardless of history; 2. If $p^t_j < p^{NM}$ set $e^t_j = 0$, regardless of history; 3. Set $p^t_j = p^{NM}$, regardless of history. **Firms’ Beliefs.** Firms’ beliefs about types of other firms when all other firms set $p^t_j = p^{NM}$ are any beliefs leading to the steady state values of $x_g, x_b$. Choose any beliefs off the equilibrium path.

We now turn to consumers’ strategies. Let $\hat{S}^t(p^{NM}) = \{j | p^t_j = \min \{ p^t_k | p^t_k \geq p^{NM} \} \}$. We denote the cardinality of this set as $|\hat{S}^t|$. **Consumers’ Strategy.** 1. $c_i(p^t) = \frac{1}{|\hat{S}^t|}$ for all $j$ such that $j \in \hat{S}^t(p^{NM})$, and $c_i(p) = 0$ otherwise; 2. $d(0) = d(2) = 1, d(1) = 0$. **Consumers’ Beliefs.** 1. $pb(p^t_j) = 1$ if $p^t_j \geq p^{NM}$; 2. $qb(p^t_j, \cdot) = 0$ for all $p^t_j < p^{NM}$; 3. $q(p^t_j, 0) = 1, q(p^t_j, 1) = 1$, and $q(p^t_j, 2) = 0$ for all $p^t_j \geq p^{NM}$ Observe that point 3. in the consumers’
beliefs implies that if a firm ever shirked in the past, informed consumers believe it will shirk in period $t$ even if in between it may have produced good quality.

**Symmetric Markov Perfect Equilibrium.** It is easy to prove that this strategy profile represents a Markov Perfect equilibrium. On the equilibrium path, consumers never buy from firms that price lower than $p_{NM}$, and they buy from the firm that posts the lowest price that is higher or equal than $p_{NM}$. The best response for firms (given their equilibrium beliefs) is therefore to price at $p_{NM}$, given that all other firms price at $p_{NM}$. At $p_{NM}$, given consumers strategies and firms beliefs on market shares and the incentive compatibility condition $p_j^t \geq p_{NM}$, firms put in high effort as long as there is no bad shock. Consider then any subgame off the equilibrium path where prices of some firms are lower than $p_{NM}$. Given consumers strategies and beliefs in the continuation game, the unique Bertrand equilibrium is obviously to price at $p_{NM}$ and firms will put in high effort as long as there is no bad shock. If the price of any firm is higher than $p_{NM}$ it gets no market share as long as there is at least one firm pricing at $p_{NM}$. If all other firms price above $p_{NM}$, then the best response is to set $p_{NM} - \epsilon$ as the firm then gets all of the consumers. Finally, consumers strategies are also best responses given their beliefs: if consumers observe a price lower than $p_{NM}$, they believe that they will get bad quality for sure, hence they do not buy. Moreover, given the permanence of shocks and equilibrium beliefs, if a firm produces bad quality once, the best response is never to buy from this firm again. QED.

**Lowest Incentive Compatible Price.** We prove by contradiction that $p_{NM}$ is the lowest stationary incentive compatible price in a pooling (in price) high effort equilibrium, where consumers randomize between firms posting the same price. Assume that there exists a symmetric stationary price $\tilde{p} < p_{NM}$ under which firms put in high effort. Since all firms put in high effort (by assumption), consumers randomize between firms who post the same price, so that the market share of all good firms must be equal to $x_g$. This violates however the incentive compatibility constraint in (2): a contradiction. QED.

**Comparative Statics.** Recall that:

$$p_{NM} = \frac{Rx_g}{\delta(1 - \Phi)(x_g - x_b)} + \frac{R \Phi x_g}{\delta(1 - \Phi)Q + \Phi \delta} = \frac{R}{\delta(1 - \Phi)Q + \Phi \delta}$$

where $x_g - x_b = Qx_g$. Hence we have that $\frac{dp_{NM}}{d\rho} = -\frac{p_{NM}}{\rho} < 0$; $\frac{dp_{NM}}{dQ} = -p_{NM} \frac{\delta(1 - \Phi)}{\delta(1 - \Phi)Q + \Phi \delta} < 0$; and $\frac{dp_{NM}}{d\Phi} = -p_{NM} \frac{R - \delta Q}{\delta(1 - \Phi)Q + \Phi \delta} < 0$. QED.

**End of Proof.**

**Proof of Proposition 2.** In Proposition 2 we treat judicial efficiency $\Phi$ as exogenous, so that all derivatives of $q$ with respect to $p$, $\nu$, $\Phi$ are marked as total derivatives.

**Exogenous Price p.** Notice that connectedness is characterized by the following first order condition:
where because of symmetry across consumers we have omitted the index $i$. Given our assumptions on the second derivatives and the Inada conditions, this yields a unique interior solution for $m_c^\ast$. To compute the derivative $dq/dp$, notice that $G_{m_c} = \frac{\partial G}{\partial m_c} = \frac{\delta(1-\vartheta)}{1-\delta \vartheta} (1-\Phi)$ and that $G_p = \frac{\partial G}{\partial p} = \frac{\delta(1-\vartheta)}{1-\delta \vartheta} (1-\Phi) \frac{\partial q}{\partial m_c} > 0$. Hence, using the implicit function theorem, we have that $\frac{dq(m_c^\ast)}{dp} = -\frac{\partial q}{\partial m_c} \frac{G_p}{G_{m_c}} > 0$. QED.

**Endogenous Price – Existence.** In this section we let the price be endogenously determined and equal to $p^{NM}(Q, \Phi, \vartheta)$, where $p^{NM}$ is equal to (6), so that the first order condition becomes: $\frac{\delta(1-\vartheta)}{1-\delta \vartheta} (1-\Phi) \frac{\partial q}{\partial m_c} (m_c^\ast, Q^{old}) = \frac{\delta(1-\Phi) q(m_c^\ast) + R \Phi}{c}$. We then show that there is a unique, interior steady state level of connectedness $1 > Q = q(m_c^\ast, Q^{old}) = Q^{old}$. Observe that the LHS of the FOC is decreasing in $m_c$, while the RHS is increasing, so that for any $1 \geq Q^{old} > 0$, the Inada conditions imply that there exists a unique level of $m_c^\ast$ solving the first order condition. We can therefore solve for $m_c^\ast(Q^{old})$, and consider the FOC as an implicit function from $Q^{old}$ to $q$. As the function goes from $Q^{old} \in [0, 1]$ to $q \in [0, 1]$, by Brouwer’s fixed point theorem there exists a fixed point where $q = Q^{old}$. To conclude, we need to prove that the fixed point is an interior solution i.e. $Q = Q^{old} \in (0, 1)$. This follows again from the Inada conditions since $m_c^\ast$ is always interior for every $Q^{old}$. QED.

**Endogenous Price – Uniqueness.** We now have to prove uniqueness. Recall that $\frac{\partial^2 q}{\partial m_c \partial Q^{old}} \leq 0$ and $\frac{\partial^2 q}{\partial m_c^2} < 0$. Using (7) and the implicit function theorem, we thus have that:

$$\frac{dm_c^\ast}{dQ^{old}} = -\frac{p^{NM} \frac{\partial q}{\partial m_c} + \frac{\partial p^{NM}}{\partial q} \frac{\partial q}{\partial m_c} \frac{\partial q}{\partial Q^{old}}}{p^{NM} \frac{\partial^2 q}{\partial m_c^2} + \left( \frac{\partial q}{\partial m_c} \right)^2 \frac{\partial p^{NM}}{\partial q}} < 0 \tag{8}$$

Therefore, we have that $dq(m_c^\ast, Q^{old})/dQ^{old} = \partial q/\partial m_c^\ast dm_c^\ast/dQ^{old} + \partial q(m_c^\ast, Q^{old})/\partial Q^{old} < 1$ for $\partial q/\partial Q^{old} < 1$. The function $q^\ast(Q^{old})$ therefore intersects the equality line $q^\ast(Q^{old}) = Q^{old}$ only once, and the solution is unique. QED.

**Endogenous Price – Comparative Statics.** Using $p = p^{NM}$ in Equation (7) we have that: $\frac{\partial G}{\partial m_c} = \frac{\delta(1-\vartheta)}{1-\delta \vartheta} (1-\Phi) \left\{ \frac{\partial p^{NM}}{\partial q} \left( \frac{dq}{dm_c} \right)^2 + p^{NM} \frac{\partial^2 q}{\partial m_c^2} \right\} < 0$; $\frac{\partial G}{\partial q} = \frac{dq}{dm_c} \frac{\delta(1-\vartheta)}{1-\delta \vartheta} \left\{ q - p^{NM} (1 - \Phi) \frac{\partial q}{\partial m_c} \right\} < 0$; and $\frac{\partial G}{\partial \vartheta} = \frac{\delta(1-\vartheta)}{1-\delta \vartheta} \frac{dq}{dm_c} \frac{1}{1-\delta \vartheta} \frac{\partial^2 q}{\partial m_c^2} \frac{p^{NM}}{Q^{old} - 1} < 0$ 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 $\frac{dm_c^\ast}{dQ^{old}} = -G_{\vartheta}/G_{m_c} < 0$, and that $\frac{dm_c^\ast}{d\vartheta} = -G_{\vartheta}/G_{m_c} < 0$. Recall that $\frac{dm_c^\ast}{dQ^{old}} \geq 0$. Hence, $\frac{dQ}{dQ^{old}} = \frac{\partial q(m_c^\ast, Q^{old})}{\partial m_c} = -\frac{dq(m_c^\ast, Q^{old})}{dm_c} G_{\vartheta}/G_{m_c} < 0$, and $\frac{dQ}{d\vartheta} = -\frac{dq(m_c^\ast, Q^{old})}{dm_c} G_{\vartheta}/G_{m_c} < 0$. QED.

End of Proof.
Proof of Proposition 3. In Proposition 3 we treat connectedness \( Q \) as exogenous, so that all derivatives of \( \varphi \) with respect to \( p, \vartheta, Q \) are written as total derivatives.

Exogenous Price \( p \). The firms’ first order conditions are: \(-\varphi'(m_{f,j}) = 1/p\). Under the Inada conditions and our assumptions on second derivatives, there exists a unique symmetric and interior solution \( m^*_{f,j} = m^*_{f,j} = m^*_j \in (0, \infty) \). Moreover, using the implicit function theorem we obtain that:

\[
\frac{d\varphi}{dp} = \varphi' \frac{1}{p^2} \varphi''(m_f) < 0.
\]

QED.

Endogenous Price – Existence and Uniqueness. We now consider the case of \( p = p^{NM} \), and drop again the firm index \( j \) because of symmetry. In the firms’ equilibrium we have that \( \varphi = \Phi \), so that the fixed point must satisfy \( F = -\varphi'(m_f) - \frac{\delta}{R} (1-\varphi(m_f)) Q + R \varphi(m_f) \vartheta / c = 0 \). The following also holds:

\[
\frac{dF}{dm_f} = \frac{d}{dm_f} \left(-\varphi' - \frac{1}{p^{NM}(\varphi)}\right) = -\varphi'' - \frac{\vartheta R - \delta Q}{c} \varphi' < -\left(\varphi'' - \left|\frac{\varphi'}{c}\right|\right) < 0
\]

where the last inequality holds for \( \varphi''/|\varphi'| > 1/c \). Observe therefore that \( F \) is decreasing in \( m_f \); and that by the Inada conditions \( F(0) = \infty \) and \( F(\infty) < 0 \), so that there is a unique solution satisfying the FOC.

Endogenous Price – Comparative Statics. Rewrite the first order condition as follows: \( F = \Phi'(m_f) + \frac{\delta}{R} (1-\varphi(m_f)) Q + R \varphi(m_f) \vartheta / c = 0 \), where we have used the fact that, in equilibrium, \( \varphi = \Phi \). The partial derivatives of \( F \) are then equal to: \( \frac{\partial F}{\partial \varphi} = \frac{\delta (1-\varphi)}{R c} > 0 \); \( \frac{\partial F}{\partial m_f} = \Phi''(m_f) + \Phi'(m_f) \frac{\delta Q}{R c} > \Phi'' - \left|\frac{\varphi'}{c}\right| > 0 \), where the last inequality holds for \( \Phi''/|\varphi'| > 1/c \). Using the implicit function theorem we then have that \( \frac{d\Phi}{dQ} = -\Phi'(m^*_f) F_Q / F_{m_f} > 0 \), and that \( \frac{d\Phi}{d\vartheta} = -\Phi'(m^*_f) F_\vartheta / F_{m_f} > 0 \). QED.

End of Proof.

Proof of Proposition 5. In Proposition 5 we let \( Q \) and \( \Phi \) interact with one another through the equilibrium price \( p^{NM} \), so that the derivatives of \( Q, \Phi \) with respect to \( \vartheta \) derived in the previous Propositions only hold as partial derivatives.

Existence and Uniqueness. Observe that Proposition 2 implies the existence of a continuous function \( Q = q(\Phi, \vartheta) \) and proposition 3 implies the existence of a continuous function \( \Phi = \varphi(Q, \vartheta) \). In the “general equilibrium” we have that \( \Phi^* = \varphi(q(\Phi^*, \vartheta), \vartheta) \). This is a continuous monotonically decreasing function from \([0, 1]\) to \([0, 1]\). Moreover, by the Inada conditions we know that \( \Phi^* \in (0, 1) \). Hence, using Brouwer’s Fixed Point Theorem, there exists a unique interior solution. QED.

Equilibrium Connectedness. The proof is given by Figure 2 and Propositions 2 and 3, which show that \( \partial Q / \partial \vartheta < 0, dQ / d\Phi < 0 \), and \( \partial \Phi / \partial \vartheta > 0, d\Phi / dQ > 0 \). QED.
Equilibrium Judicial Efficiency. In equilibrium, anticipations of $Q$ and $\Phi$ are correct, and following Figure 2 we have that $Q_F(\Phi^*, \vartheta) = Q_C(\Phi^*, \vartheta)$. Define therefore $D \equiv Q_F(\Phi^*, \vartheta) - Q_C(\Phi^*, \vartheta)$: since in equilibrium $D = 0$, we can use the implicit function theorem again to compute $d\Phi^*/d\vartheta$ as follows:

$$d\Phi^*/d\vartheta = -\frac{\partial Q_F}{\partial \vartheta} - \frac{\partial Q_C}{\partial \vartheta}$$

(9)

Next, the partial derivative of the consumers’ reaction function $Q_C$ is as follows:

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

(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: $\frac{\partial Q_F}{\partial \vartheta} = -\frac{\delta(1 - \Phi)Q + R\Phi}{\delta(1 - \Phi)Q + R\Phi}$. Since $\frac{\partial Q_F}{\partial \vartheta} > 0$ and $\frac{\partial Q_C}{\partial \vartheta} < 0$, the denominator of $\frac{d\Phi^*/d\vartheta}$ is always positive. Hence the sign of $\frac{d\Phi^*/d\vartheta}$ depends on the numerator of (9). Since $\partial Q_F/\partial \vartheta = -(\partial \Phi_F/\partial \vartheta)/(\partial \Phi_F/\partial Q_F) < 0$, $\partial Q_F/\partial \vartheta < 0$, 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:

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

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

End of Proof.
Table 1: Firm-level Probit with exogenous reliability index.

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</tbody>
</table>

All regressions include country and sector dummies (there are 5 sectors), and errors have been clustered by country. Algeria is the only North African country. Additional regressors include a dummy for large firms; a dummy on whether a firm exports part of its output or imports at least 40% of its inputs; and dummies for foreign and public ownerships. Standard errors are in parenthesis. * Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level.