On the Role of Formal and Informal Institutions in Development

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Abstract

We consider an economy with firms producing goods of high or low quality, where quality is unobservable to consumers, and low quality can stem from a bad productivity shock or low effort. We then link the degree of development of a country to the probability of a bad productivity shock, and compare two institutions that solve the moral hazard problem: an informal mechanism, *reputation*, achieved via consumers boycotting firms that produce bad quality, and a formal mechanism, *contract enforcement*, whose effectiveness can be reduced by firms by means of lobbying. In our model perfect contract enforcement is the first best mechanism sustaining high quality. However, firms' incentives to lobby and to decrease the quality of the legal system increase with the probability of a bad productivity shock, so that to sustain high quality in developing countries consumers have to rely more on the informal reputation mechanism. Developing countries therefore suffer both from the direct effect of more frequent bad productivity shocks, as well as from the indirect effect of higher difficulties to build good institutions.

1 Introduction

Good institutions have long been recognized as crucial for economic development. An extensive body of literature has by now documented how good institutions tend to foster economic development.[1] However, the question of which precise "institutions" are good, the reasons why they arise, how they work together and how they may be linked to the level of development of a country has not really been investigated, at least formally.

In this paper we attempt to understand how institutions arise and interact in the context of a moral hazard situation. We also study how the level of development of a country (or sector) affects the efficacy of institutions in solving the moral hazard problem. Specifically, consider a firm producing a good of variable quality, where consumers can observe the quality only after they have bought the good. Bad quality arises either because of a bad productivity shock (which – in full similarity with Kremer (1993) – proxies for the "degree of development" of a given sector or country), or because firms did not put the necessary effort required to deliver high quality, so that a moral hazard problem arises.

Such a structure can be found, for instance, in services, such as transportation. Assume that there is a fast and a slow service from city A to city B, and that consumers are willing to pay extra for the fast service. However, consumers can observe the quality of the service only after they have paid and have arrived at city B. If a bad shock happens or the firm puts low effort consumers would be better off with the slow service because it is cheaper; consumers would therefore prefer the firm to always put high effort, but if the firm fails to deliver the high quality service they cannot distinguish if it is because of a bad shock or because of low effort. Other examples include health care, water and electricity supply, and durable goods.

We consider two institutions that potentially solve the moral hazard problem and help in sustaining good quality: a "modern" or "formal" institution, *contract enforcement*, which relies on a well functioning independent judicial system, and a "traditional" or "informal" institution, *reputation*, which relies on social capital. We interpret social capital as the efficiency with which individual consumers are able to spread information across other consumers and/or as their ability to coordinate in punishing firms that deliver bad quality.

[1] See, for instance, North (1990), Putnam (1993), Knack and Keefer (1997), Hall and Jones (1999), Acemoglu et al (2001), and Rodrik, Subramaniam and Trebbi (2004).

Reputation and contract enforcement are often seen as "substitutes," as building up reputation is perceived as a second best institution arising when contract enforcement is poor. But little is known – at least from a formal point of view – on how these two institutions compete with or complement each in a particular sector or country. For instance, does increased contractual performance ease or deter reputation building? And does the presence of institutions that favor reputation building – such as high levels of social capital – ease or deter the creation of efficient legal systems?

We begin the analysis by characterizing the welfare maximizing price that sustains high quality for given levels of social capital and efficiency of the legal system, which corresponds to the lowest incentive compatible price under which firms put high effort. In doing so we extend the reputation model of Allen (1984) to allow for stochastic bad shocks and, in keeping with the reputation literature,[2] we show that under moral hazard firms have to price above marginal costs in order to produce high quality. Moreover, when we introduce unforeseen shocks there is also an increase in the expected marginal cost of production when the probability of a bad shock increases: this is the *direct* effect of low reliability levels on consumer welfare.

We then define the level of *social capital* in the economy as the probability that consumers are able to boycott a firm whenever it produces bad quality, while *legal efficiency* is defined as the probability that a consumer who bought bad quality goods gets reimbursed by going to court. We show that when "institutional quality" improves, consumers' welfare improves as well, since both institutions work by weakening the incentive compatibility constraint for firms and this reduces the "quality premium" paid by consumers. Also, absent problems of verifiability, perfect contract enforcement is the "first best" institution. This is because perfect contract enforcement is equivalent to a perfect enforcement strategy – each time that a consumer buys a bad quality good she gets reimbursed – so that firms price at marginal costs and no "quality premium" is needed.

But the quality of institutions also depends on the incentives to build (or destroy) them. Therefore, to analyze how institutions evolve and in-

[2]See, among others, Allen (1984), Klein and Leffler (1981), Shapiro (1983), Hörner (2002), and Kranton (2003).

teract with each other, we endogenize the quality of each institution. We allow firms to lobby courts and hence lower the efficacy of contract enforcement, while consumers can invest in social capital to improve the quality of information transmission and the coordination needed to punish firms effectively.

In keeping with received wisdom, the model predicts that the higher the efficiency of the judicial system, the less consumers need to invest in social capital to solve the moral hazard problem; similarly, the higher the level of social capital, the lower are firms' incentives to lobby because consumers are able to punish bad performing firms anyway. Consequently, at each level of reliability (interpreted as the probability of suffering a bad productivity shock) there exists a *unique* optimal institutional mix: how this unique mix varies with the reliability parameter is the second focus of this paper, and we call this the *indirect* effect of reliability on quality.

We show that incentives to lobby and to lower the efficacy of judicial system *increase* with the probability of a bad shock. Intuitively, when the probability of a bad shock increases firms have higher incentives to bribe the courts because even under high effort they have to reimburse consumers more frequently. Similarly, when the probability of a bad shock increases consumers have higher incentives to invest in social capital. Equilibrium levels of both institutions therefore change when the reliability parameter decreases: specifically, social capital unambiguously decreases in the new equilibrium, and under some conditions on the responsiveness, so does the legal efficiency. Thus, in equilibrium *countries (sectors) with more frequent bad productivity shocks tend to have worse quality of both institutions.* If we believe that low reliability is a characteristic of developing countries, we can conclude that both the direct effect of more frequent bad productivity shocks, as well as the indirect effect on institutions exacerbates the problems of sustaining good quality in developing countries.

The paper is organized as follows. Section 2 presents the related literature. Section 3 presents the basic model under exogenous institutions, and Section 4 endogenizes social capital and judiciary efficiency.

2 Related Literature

Rodrik, Subramaniam and Trebbi (2004) provide a good overview of the recent research on institutions. They test the role of institutional factors in development, i.e., the "rules of the game in a society and their conduciveness to economic behavior". The importance of institutions is also a view strongly associated with North (1990). Hall and Jones (1999) focus on "social infrastructure" and carry out an econometric analysis of its importance. Social infrastructure is interpreted as government anti-diversionary policies, and is a weighted average of the rule of law, bureaucratic quality, risk of expropriation, corruption, and government repudiation of contracts. They find that social infrastructure has a strong and significant impact on productivity. Among others, Acemoglu et al (2001) focus on expropriation risk faced by investors and show that institutions have a strong effect on incomes.

Our interpretation of institutions however encompasses not only those that arise due to government policies but also those informal mechanisms which might conceivably substitute for formal institutions in developing countries. Greif (1989) chronicles two very different institutions that arose in 10th century mediterranean trade to overcome the moral hazard problem of entrusting agents to engage in trade on behalf of merchants. On one extreme there was the Genovese solution which relied on formal institutions and on the other there was the collectivist approach of the Maghribi traders which relied on reputation building among a close network. It is clear that the requirements for successful trading outcomes in each setting would rely on the quality of enforcement of contracts in the first case and on the quality of "social capital" (e.g. how quickly information about defaults is transmitted) in the second.

Our focus is thus close to Rodrik (1999), who questions the "blueprint" model of institutions: according to him institutions must be specific to local knowledge and experimentation. Also, Iyigun and Rodrik (2004) point to the importance of reliability or predictability of policy reform in determining private investment in a developing country. We suggest that in addition the interaction between them is a crucial consideration. In fact, they may complement each other or may substitute for each other, and these relationships may be different depending on the particular context in which market imperfections or incompleteness of information arises.

Our results point to the importance of reliability in sustaining good quality. Our view of economic development relates therefore to Kremer (1993), who proposes a technological explanation for low quality in developing countries – the O-Ring production function. He assumes that low skilled workers are more prone to mistakes, so that the larger relative supply of low skilled labour in developing countries could be responsible for more frequent bad productivity shocks and low quality.

The paper draws on the existing reputational literature which shows that in pure reputational equilibria, firms need to price above marginal costs such that consumers are able to punish firms delivering bad quality. This is known as the "quality premium" (see, for instance, Klein and Leffler (1981), Shapiro (1983), Allen (1984), Hörner (2002), and Kranton (2003)).

Finally our work complements related work on the endogenous choice of different contracts. The paper most closely related is Battigalli and Maggi (2004), who analyze the interaction between formal and informal mechanisms. Like our paper, they focus on the key role of the degree of uncertainty. Their model is quite different from ours, as we focus on a market situation with perfectly competitive firms, while they focus on contracts between two parties with writing costs.

3 A Basic Model of Reputation

In this section we extend the reputation model of Allen (1984) to an environment with shocks. The economy consists of a measure one of consumers and of N firms producing a homogenous good of variable quality. At every period firms can decide to produce a high or low quality good, and quality is unobservable to consumers un til they have paid for the good. Producing the low quality good is costless, while marginal costs of producing the high quality good are equal to c. If firms decide to produce the high quality good they are also subject to an exogenous "bad" shock that happens with probability $1 - \vartheta$, in which case the good becomes of low quality, so that the probability of producing a high quality good is equal to ϑ. If consumers buy a bad quality good they cannot observe if low quality is due a bad shock or to the firm's decision to produce low quality, so that a moral hazard problem arises. In full similarity with the O-ring theory of economic development (see Kremer, 1993), we link the degree of economic development of a country (or sector) to the *reliability* of the production process, and say that countries with higher ϑ's are more developed.

New firms can enter the market at every period conditional on paying an initial sunk cost of $T \cdot \bar{x}$ units, where $\bar{x} \leq 1$ represents the maximal number of units a firm can produce given the initial investment $T \cdot \bar{x}$. We shall also assume that the initial investment is not substantial, so that $T < Rc$. This assumption does not affect any of our results, but assures that rents extracted in a pure reputational equilibrium are always sufficient to cover firms' costs (see below for details). We depart therefore from conventional models of reputation in two ways. First, we put a stronger emphasis on *shocks*. Second, to obtain that firms make zero profits in equilibrium we introduce sunk and not fixed costs, so that firms can price at marginal costs and perfect competition among firms becomes possible.[3] Notice, also, that in our settings the *size* and *number* of firms remains undetermined.

Consumers need to buy one unit of the good each period and derive utility $U(p) = \overline{U} - p$ from the high quality good, and utility $0 - p$ from the low quality good. The maximum price consumers are ready to pay for the high quality good is thus $\overline{p} = \overline{U}$, while they are not willing to spend money on low quality. Reputation arises because consumers and firms meet repeatedly in the market, and consumers are able to stop buying from firms that sold bad quality. It is easily shown that the stronger the punishment the lower is the incentive compatible price under which firms produce high quality (see Allen (1984) and below), so that ideally consumers would like to stop buying forever from firms delivering bad quality. Nonetheless, such a punishment strategy requires two conditions to be satisfied. First, consumers need to get informed about which firms produce bad quality. Second, consumers need to be able to coordinate the punishment actions. In what follows we link those abilities to the level of *social capital* q in the economy, which represents the probability under which punishment succeeds and consumers are able to stop buying forever from a firm delivering bad quality.

The timing of the game is the following: in period t new firms first decide whether to enter and if so the level of sunk costs $\bar{x}$ to incur (i.e. capacity).

[3]See, among others, Klein and Leffler (1982), Shapiro (1983), Allen (1984), Hörner (2002), and Kranton (2003). To the best of our knowledge Hörner (2002) is the only paper introducing shocks. However, he focuses more on adverse selection, and does not link the ability to sustain high quality to institutional quality.

Then all firms choose prices and quality simultaneously. Next consumers observe prices and decide whether to buy or not given the history at period t.

An equilibrium is a sequence of prices and quality choices along with consumers buying decisions such that consumers maximize utility given the firms strategies, and firms decide on entry/exit and choose prices and qualities to maximize profits given the consumers strategies. We restrict attention to subgame perfect stationary equilibria in Markov strategies that maximize consumers' payoff. Assume that $\bar{U}$ is sufficiently high so that consumers always prefer high quality. Then under high quality equilibria expected utility in each period is equal to $\vartheta\bar{U} - p$, so that the welfare maximizing price is the lowest possible price that sustains high quality.

We show next that the strategy maximizing consumers welfare imposes *maximum punishment* to the firm, i.e. consumers should stop buying from a firm that has produced bad quality independently from the effort firms put (see also Hörner, 2002). Thus, given a level of social capital q, consumers stop buying forever from a firm delivering a bad quality product with probability q (in which case the firm exits the market), while with probability $1 - q$ information does not spread and the firm can continue to operate.

We now look for the lowest stationary price under this punishment strategy. Consumers buy randomly from firms that always delivered a high quality product, so that given a price p the expected payoff of a firm always putting high effort is equal to:

$$V_H = (p - c) \cdot x + \frac{1}{R}(\vartheta + (1 - \vartheta)(1 - q)) \cdot V_H \tag{1}$$

where $\vartheta + (1 - \vartheta)(1 - q)$ represents the survival probability of the firm under the high effort equilibrium, $x \leq \bar{x}$ the actual market share of the firm, and R the interest rate. In contrast, the expected payoff from low effort is equal to:

$$V_L = px + \frac{1}{R} \cdot (1 - q)V_L \tag{2}$$

Firms are willing to put high effort at every period only if $V_H \geq V_L$, so that the minimum price sustaining the high effort equilibrium is given by:

$$p^{NM} \geq \frac{R-(1-q)}{\vartheta q}\; c \tag{3}$$

We call inequality (3) the *No Milking Condition* (see Shapiro, 1983, and Allen, 1984), and denote the lowest price that satisfies (3) as the *No Milking Price* $p^{NM}(\vartheta, q)$. The no milking condition is a necessary condition to sustain high effort in the long run. It shows that sustaining high effort necessitates a "carrot and stick" strategy, as in order to be able to punish firms that put low effort price must be above marginal costs (the carrot), and consumers must punish firms who do not deliver the promised service otherwise firms would always put low effort (the stick). Notice that p^{NM} is a decreasing function of q, so that the higher the level of social capital, the stronger can be the punishment, and therefore the lower is the price sustaining the high effort equilibrium. Thus, it is indeed optimal to punish firms delivering bad quality with "maximum punishment," which, in our case, corresponds to a probability q. The no milking price p^{NM} represents therefore the lowest possible stationary price under which firms put high effort:

PROPOSITION 1 p^{NM} *is the lowest stationary price that can be achieved as the outcome of a subgame perfect equilibrium with firms putting high effort.*

In the Appendix we also describe the game and strategies leading to a high quality equilibrium with firms pricing at p^{NM}. Kranton (2003) shows that there exist non-stationary equilibria where consumers can be better off (for instance, firms can decrease their price at period zero and still produce high quality); nonetheless, in our case we are interested in long–run contractual performance, so that stationary prices are a better measure of comparison.

In what follows we separate in the no milking price p^{NM} the *marginal costs* component c/ϑ, which corresponds to the perfectly competitive price that can be achieved under perfect observability and in the absence of sunk costs, from the *markup* $(R-(1-q))/q$, which corresponds to the extra amount consumers have to pay to solve the moral hazard problem. Notice that the markup is a decreasing function of q, so that the higher the level of social capital, the closer is p^{NM} to the perfectly competitive price; reputation, however, cannot influence the marginal costs component c/ϑ of the price that directly stems from exogenous "reliability" factors that increase the probability of bad productivity shocks. Notice, also, that expected profits are equal to:

$$\begin{aligned} \Pi(p^{NM}) &= \sum_{t=0}^{\infty}\left(\frac{\vartheta+(1-\vartheta)(1-q)}{R}\right)^{t}(p^{NM}-c)\cdot x \\ &= \frac{R}{\vartheta q}c\cdot x > T\cdot x \end{aligned} \tag{4}$$

so that under pure reputational equilibria expected profits always *exceed* the initial investment. Because nothing restricts the entrance of new firms in the market, under pure reputational equilibria firms therefore *overinvest* in capacity up to the point where expected profits equals zero; that is, firms will invest up to the point where $\Pi(p^{NM}) = T\cdot\bar{x}$, but because of free entry firms overinvest in capacity: $x/\bar{x} < 1$.

Sustaining high quality with reputation delivers therefore a second-best outcome, as if quality would be observable consumers could pay a lower price for the same outcome. Intuitively, firms need to price above marginal costs in order to have the incentives to produce high quality; and since firms make zero profits in equilibrium, all the excess profits translate into excess capacity.

Contracts

Having presented the basic model under reputation we introduce next in the model *contract enforcement* as an alternative institution sustaining high quality. We assume that if a firm delivers bad quality consumers can costless "go to court," which will rule in favor of the consumers with probability φ, in which case firms must reimburse consumers. We interpret φ as a measure of the efficiency of the legal system; alternatively φ can represent the level of "institutional capital" that improves the efficiency of the legal system – such as money spent in law enforcement. Notice that we do not rule out reputation as a discipline device, as the two institutions can coexist and consumers can independently from the court decision decide to "punish" a bad performing firm.

If the courts work perfectly then consumers have no need to use punishment strategies as firms price *de facto* at marginal costs. If law enforcement is not perfect, however, consumers can decide to punish firms in addition to courts punishment. Next, we look again at the stationary welfare maximizing strategy. Notice that the strategy still involves achieving the lowest incentive compatible price, as utility under high effort is still equal to $\vartheta\bar{U}-p$.

To characterize this price, we look at firms' incentives to put high effort given a punishment probability $\beta \leq q$, where the level of social capital q represents the *maximal* extent to which consumers are able to punish firms. Thus, if the firm always put high effort expected profits are equal to:

$$V^H = (1-\varphi(1-\vartheta))p - c + \frac{1}{R}(\vartheta + (1-\vartheta)(1-\beta)) \cdot V^H \tag{5}$$

where we have assumed that the reputational punishment is independent from consumers winning or losing in court. On the other hand, if firms always put low effort their expected profits are equal to:

$$V^L = (1-\varphi)p + \frac{(1-\beta)}{R} \cdot V^L \tag{6}$$

To sustain high quality we must have that in equilibrium $V^H \geq V^L$, so that the no milking price equals the following:

$$p^{NM}(\vartheta, \varphi, \beta) = \frac{R-(1-\beta)}{(\beta+\varphi(R-1))}\frac{c}{\vartheta} \tag{7}$$

Notice that $\partial p^{NM}/\partial\varphi \leq 0$, so that increased contractual performance decreases the rent necessary to convince firms to put high effort, and that under contracts as well the markup is independent from the probability of a bad productivity shock $1-\vartheta$. Equation (7) also shows that under perfect contract enforcement ($\varphi = 1$), p^{NM} does not depend on β. This is because if consumers get reimbursed for low quality anyway then building reputation is not needed anymore, as there is no gain from cheating. In contrast, when social capital reaches its maximum so that consumers are able to punish all firms who cheat ($q = \beta = 1$), improving contractual performance still reduces the no milking price p^{NM}.

However, with the addition of contract enforcement to reputation firms participation constraint might become binding. Specifically, if firms are punished "too much" the non-negativity condition on profits is violated.

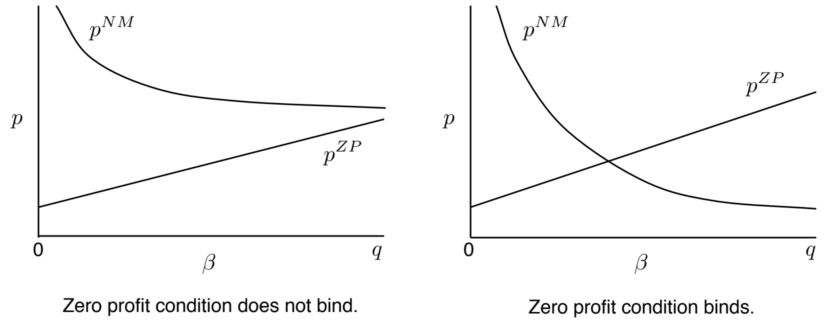

Figure 1: No Milking and Zero Profit prices as a function of the punishment levelβ.

To see this, notice that the equilibrium price must satisfy firms' zero profit condition, which under the high effort equilibrium can be written as:

$$\sum_{t=0}^{\infty}\left(\frac{\vartheta+(1-\vartheta)(1-\beta)}{R}\right)^{t}((1-\varphi(1-\vartheta))p-c)\cdot x \geq T\cdot\bar{x} \qquad (8)$$

Whenever the zero profit condition (8) is binding firms operate at full capacity, so that we shall assume $x=\bar{x}$. Thus, given a level of punishment β and of contract enforcement φ the minimum price guaranteeing firms' zero profits is equal to:

$$p^{ZP}(\vartheta,\varphi,\beta)=\frac{1}{1-\varphi(1-\vartheta)}\left\{\frac{R-\vartheta-(1-\vartheta)(1-\beta)}{R}\;T+c\right\} \qquad (9)$$

Figure 1 shows the no milking and zero profit prices as a function of the punishment level β for a level of contractual performance φ_0 where the zero profit condition does not bind, and a level $\varphi_1>\varphi_0$ where the zero profit condition binds. Whenever the zero profit condition binds (that is, $p^{ZP}>p^{NM}$) firms under the no milking price do not make enough profits to cover the costs, and consumers must therefore coordinate on a higher price. Figure 1 then shows that the most efficient way to provide firms with higher rents is by *decreasing* the punishment rate β along the zero profit line $p^{ZP}(\beta)$.

Intuitively, increasing the tolerance level reduces firms' turnover. Firms have therefore more time to recover the initial investment and can charge a lower price to recover their initial investment. Also notice that given our initial assumption about fixed costs ($T < Rc$), the zero profit condition binds only for high levels of contract enforcement φ.

If the zero profit condition binds for $\beta = q$ we are therefore in a situation where there is *too much* social capital in society because in equilibrium agents are going to choose a lower punishment level $\beta < q$, so that there is no need for information to spread across consumers with probability q. Given a level of legal capital φ we can thus characterize the "optimal" level of social capital q by equating the no milking price $p^{NM}(\vartheta, \varphi, \beta = q)$ with the zero profit price $p^{ZP}(\vartheta, \varphi, \beta = q)$ to obtain that:

$$q^*(\vartheta, \varphi) = \frac{Rc(1-\varphi)}{\vartheta T} - \varphi(R-1) \tag{10}$$

where we have omitted the boundaries $\{0, 1\}$ in case q^* is negative or $q^* \geq 1$. Equation (10) shows that the optimal level of social capital decreases with the level of legal capital φ, and increases with the amount of uncertainty $1-\vartheta$; consequently, the model suggests that for a given level of legal capital φ developing countries need to build up *more* social capital to reach the lowest incentive compatible equilibrium price. Notice, also, that there is not need to build any amount of social capital under perfect contract enforcement ($\varphi = 1$), since firms always reimburse consumers and thus there is no need to punish firms. Also, under perfect contract enforcement firms price at expected marginal cost ($p = c/\vartheta + (R-1)T/R$), so that asymmetric information does not represent a problem anymore and the first-best outcome can be achieved. Contract enforcement, at least under the form represented here, is therefore a better institution than reputation.

4 Social and Legal Capital as Endogenous Institutions

We now endogenize legal and social capital, and assume that while consumers can invest in social capital to improve the efficiency of the reputation mechanism, firms can invest in lobbying (or corruption) to *decrease* the efficiency of the legal system.

Firms

Suppose now that firms can lobby the court to get decisions in their favor, and consider a representative firm. The function $\varphi = \varphi(m_f)$ defines how the probability that consumers get reimbursed varies with the amount spent by firms on lobbying m_f. We assume that $\varphi' < 0$, so that the higher is m_f the lower is the probability that consumers get reimbursed, and that $\varphi'' > 0$, such that the more firms spend on lobbying, the lower the marginal returns to them from doing so. Finally, in this section we shall presume that the zero profit condition is not binding (i.e. $q < q^*$) and consider p^{NM} as the equilibrium price.

The firm will choose m_f to maximize its expected future profits $E(\pi)$ given q and $p^{NM}(\vartheta, q, \varphi(m_f))$, so that the firm's objective is then:

$$\max_{m_f} \frac{R}{R-y} \left\{ (1 - \varphi(1-\vartheta))\, p^{NM} - c \right\} x - m_f \cdot x \qquad (11)$$

where $y = (\vartheta + (1-\vartheta)(1-q))$, x represents the market share of the firm, and we have assumed that the cost of lobbying is a one–time investment and proportional to the actual market share of the firm. The next proposition states that if a maximum exists then when social capital q is higher firms have *less* incentives to lobby the government to weaken the judiciary system:

Proposition 2 *Assume that there exists a local maximum to the maximization problem (11), and that the zero profit condition is not binding. Then locally $d\varphi/dq > 0$.*

Proposition 2 states that when social capital is high firms have *less* incentives to lobby the government in their favor. Intuitively, at high levels of social capital consumers do punish anyway firms producing the bad quality good, so that even if courts rule in firms' favor consumers stop buying from the firms anyway; hence, at high levels of social capital q returns to lobbying decrease. Notice that Proposition 4 does not prove the existence of a maximum. In the Appendix we provide, however, a sufficient condition for the existence of a global maximum.

Next, we characterize how for a given level of social capital q firms' reaction function change with the reliability level ϑ. We show that at sufficiently low reliability levels ϑ lobbying *decreases* with reliability:

PROPOSITION 3 *For $\vartheta < R/2$ lobbying is a decreasing function of reliability ϑ, so that the efficiency of the legal system increases with ϑ: $\partial\varphi/\partial\vartheta > 0$.*

CONSUMERS

In our model the parameter q relates to the ability of consumers to spread information about and to coordinate actions against firms delivering bad quality. Such actions – which include starting up newspapers, creating guilds, producers, and consumers' associations, or participating in community life – are costly. Let therefore $m_c \in [0, \infty)$ denote the cost of punishing firms producing bad quality with probability $q(m_c)$, and let $q(m_c)$ being an increasing and concave function of m_c. Then consumers choose m_c to maximize:

$$\max_{m_c} \frac{R}{R-1} \left\{ \vartheta\bar{U} - p^{NM}(\vartheta, q(m_c), \varphi) - m_c \right\} \tag{12}$$

where the efficiency of the legal system φ is given. Notice that we have assumed that consumers must invest in social capital q at every period. The next Proposition states that the optimal level of social capital $q(\varphi, \vartheta)$ is a decreasing function of φ and ϑ:

PROPOSITION 4 *the optimal level of social capital $q(\varphi, \vartheta)$ is a decreasing function of φ and ϑ: $\partial q/\partial\varphi < 0$, and $\partial q/\partial\vartheta < 0$.*

We are now ready to compare firms' and consumers' reaction functions and to look at the general equilibrium effect.

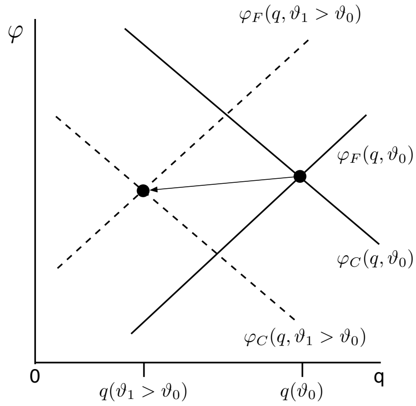

Figure 2: Equilibrium levels of social and legal capital.

4.1 Legal and Social Capital under Asymmetric Information

Figure 2 shows the consumers and firms reaction functions $q(\varphi), \varphi(q)$ as a function of each other. As firms' reaction function is upwards sloping while the reaction function of consumers has opposite slope the equilibrium is unique. Moreover, notice that an increase in reliability ϑ shifts both consumers' and firms' reaction functions *inwards*, so that *an increase in reliability ϑ unambiguously decreases the level of social capital, while the effect on legal capital remains ambiguous.* In order to characterize better the equilibrium we will therefore rely on numerical simulations.

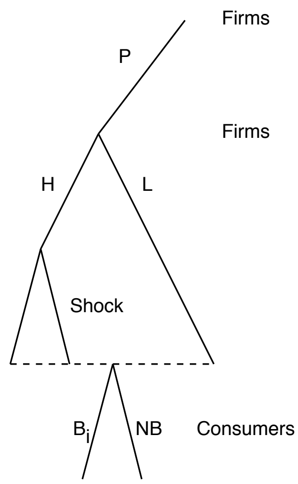

Figure 3: Stage Game.

5 Appendix

Proof of Proposition 1

Without loss of generality we only consider the case where $q = 1$, so that consumers can always punish firms delivering bad quality. The game we consider is an infinitely repeated game with imperfect information between firms and consumers. Firms are allowed to enter at the beginning of each period by paying a sunk cost $T \cdot \bar{x}$, and to exit the market at the end of any period, so that the set of firms N^t may change between periods while consumers are long lived agents. We first show that p^{NM} can be sustained as the outcome of a subgame perfect equilibrium in pure strategies, and then argue that is is the lowest possible stationary price.

Figure 3 shows the stage game. At period t there are N^t firms that simultaneously post prices $P^t = (p_i^t)_{i \in [0,N^t]}$, and decide whether to produce the high or the low quality good, so that $q_i^t = (H, L)$. Consumers $j \in [0,1]$ observe the vector of prices P^t in the market and decide from which firm to buy, or not to buy at all. We denote the action taken by each consumer as a_j^t, where $a_j^t = B_i$ if consumer j buys from firm i, and $a_j^t = NB$ if consumer j does not buy any good in period t. For clarity purposes we omit the time index t when unnecessary. We denote the share of consumers of firm i at period t as $x_i^t \leq \bar{x}_i$.

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 $\bar{U} - p_i$ if they bought the good from firm i at price p_i and the quality is good, while if quality is bad they get $-p_i$. On the other hand, the payoffs to firm i is equal to $(p_i - c) \cdot x_i$ if it produces the high quality good and x_i consumers bought it, and to $p_i \cdot x_i$ 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, and we assume that both consumers and firms have the same discount factor $\delta = 1/R$ (allowing for differences in the discount factors would not change the main results).

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 $(Q^0, P^0); \ldots; (Q^{t-1}, P^{t-1})$, where $Q^t = (q_i^t)_{i \in [0, N^t]}$, and of consumer actions $(a_j^0); \ldots; (a_j^{t-1})$. Finally, consumers' information sets at time t are defined by all price combinations $\Pi^t = (p_i \in [0, \bar{p}])_{i \in [0, N^t]}$ for each possible history h^t, as these prices can come with low or high quality since quality is not observed by consumers; for simplicity we refer to a consumer's information set as (P, h^t). Next, we describe Markov strategies that achieve p^{NM} as the outcome of a subgame perfect equilibrium. The strategies are the following:

Firms:

1. $p_i^t = p^{NM}$.
2. *If* $p_i^t < p^{NM}$ *produce bad quality. If* $p_i^t \geq p^{NM}$ *produce high quality.*

Consumers:

1. *If a firm produces bad quality in period* $t-1$ *stop buying from that firm forever.*
2. *Do not buy if* $\max\ p_i^t < p^{NM}$ *regardless of* h_t.
3. *Buy randomly among firms posting a price equal to* $\max\left\{\min p_i^t, p^{NM}\right\}$ *regardless of* h_t.

It is easy to prove that this strategy profile represents a Nash equilibrium, as if consumers do not buy goods with price below p^{NM} the best response is to price at p^{NM}, and at p^{NM} firms are better off to produce the high quality good.

By the one–step deviation property, to prove subgame perfection we need to show that it is optimal for consumers *not to buy* from firms posting a price strictly lower than p^{NM}. Assume therefore that a firm deviates and posts a price below p^{NM} at period zero, and that then it goes back to the equilibrium strategy of posting p^{NM}. Since consumers do not buy at a price below p_{NM} the firm's best response is to produce bad quality, and given bad quality production consumers' best response is not to buy. Both consumers and firms are therefore better off by staying on the equilibrium path, so that the equilibrium is subgame perfect.

To conclude, we show that p^{NM} represents the lowest possible stationary price under subgame perfect strategy profiles where firms put high effort. Assume therefore that there exist a stationary price $\tilde{p} < p^{NM}$ under which firms put high effort. The no milking condition (3) indicates then that such a strategy profile is strictly dominated by firms cheating at every period. Similarly, assume that consumers *do not* stop buying forever from a firm that has produced bad quality. Under such a strategy the value of cheating (at least in some periods) V_L can only increase, so that the minimum stationary price under which firms sustain high effort must increase.
End of Proof.

Proof of Proposition 2
The first order condition of the maximization problem (11) is equal to:

$$F \equiv \frac{R}{R-y}\varphi' \left\{ (1-\varphi(1-\vartheta))\frac{dp^{NM}}{d\varphi} - (1-\vartheta)\, p^{NM} \right\} - 1 = 0 \tag{13}$$

where:

$$\frac{dp^{NM}}{d\varphi} = -p^{NM}\frac{R-1}{q+\varphi(R-1)} \tag{14}$$

$$\frac{d^2p^{NM}}{d\varphi^2} = -2\;\frac{dp^{NM}}{d\varphi}\frac{R-1}{q+\varphi(R-1)} \tag{15}$$

Notice that if a local maximum exists then $F_{m_f} < 0$. By the envelope theorem we then have that $\frac{dm_f^*}{dq} = -\frac{F_q}{F_{m_f}}$. Observe, also, that F_q is given by the following expression:

$$\begin{aligned} F_q \quad = \quad & \frac{R\varphi'}{R-y}\left\{ (1-\varphi(1-\vartheta)\frac{R-1}{q+\varphi(R-1)} + (1-\vartheta) \right\} \cdot \\ & \left\{ p^{NM}\frac{(1-\vartheta)}{R-y} - \frac{dp^{NM}}{dq}] \right\} + \\ & + \frac{R\varphi'}{R-y}p^{NM}(1-\varphi(1-\vartheta))\frac{(R-1)}{(q+\varphi(R-1))^2} \end{aligned} \tag{16}$$

It is easy to see that $F_q < 0$, since $\frac{dp^{NM}}{dq} < 0$. Thus, $\frac{dm_f^*}{dq} < 0$, and $d\varphi/dq > 0$.
End of Proof.

Lemma 1 *Let ϵ_1 denote the elasticity of p^{NM} with respect to φ, ϵ_2 denote the elasticity of φ with respect to m_f while ϵ_3 denotes the elasticity of φ' with respect* *to m_f. If $\epsilon_3 < 2\epsilon_1\epsilon_2$ the solution to the maximization problem (11) has a unique global maximum.*

Proof of Lemma 1

The second order conditions of the maximization problem (11) are as follows:

$$\begin{aligned} & \frac{R}{R-y}(\varphi')^2 \left\{-2(1-\vartheta)\frac{dp^{NM}}{d\varphi} + (1-\varphi(1-\vartheta))\frac{d^2p^{NM}}{d\varphi^2}\right\} \\ + & \frac{R}{R-y}\,\varphi'' \left\{-(1-\vartheta)p^{NM} + (1-\varphi(1-\vartheta))\frac{dp^{NM}}{d\varphi}\right\} < 0 \end{aligned} \tag{17}$$

Using equations (14) and (15), the second order condition can be simplified as:

$$\begin{aligned} & \frac{R}{R-y}\,p^{NM}\left\{(1-\vartheta) + (1-\varphi(1-\vartheta))\frac{R-1}{q+\varphi(R-1)}\right\}\cdot \\ & \left\{2(\varphi')^2\,\frac{R-1}{q+\varphi(R-1)} - \varphi''\right\} < 0 \end{aligned} \tag{18}$$

Thus the second order conditions are satisfied if and only if $\varphi'' > \frac{2(\varphi')^2(R-1)}{q+\varphi(R-1)}$. Note that $\frac{R-1}{q+\varphi(R-1)} = -\frac{dp^{NM}}{d\varphi}\frac{1}{p^{NM}}$, so that the above is equivalent to $\varphi'' > -2(\varphi')^2\frac{dp^{NM}}{d\varphi}\frac{1}{p^{NM}}$. Let then ϵ_1 denote the elasticity of p^{NM} with respect to φ, ϵ_2 denote the elasticity of φ with respect to m_f while ϵ_3 denotes the elasticity of φ' with respect to m_f (the absolute value is taken for the elasticity). Then the sufficient conditions can be written as $\epsilon_3 < 2\epsilon_1\epsilon_2$.

End of Proof.

Proof of Proposition 3

By the envelope theorem we have that $\frac{\partial m_f}{\partial\vartheta} = -\frac{F_\vartheta}{F_{m_f}}$, where:

$$\begin{aligned} F_\vartheta \;=\; & \frac{R\varphi'}{R-y}\left\{-\frac{1-\varphi(1-\vartheta)(R-1)}{q+\varphi(R-1)} - (1-\vartheta)\right\}\cdot \\ & \left\{\frac{q}{R-y}\,p^{NM} + \frac{dp^{NM}}{d\vartheta}\right\} + \\ & +\frac{R\varphi'}{R-y}\,p^{NM}\left\{1 - \frac{\varphi(R-1)}{q+\varphi(R-1)}\right\} \end{aligned} \tag{19}$$

where $1 - \frac{\varphi(R-1)}{q+\varphi(R-1)} = \frac{q}{q+\varphi(R-1)} > 0$. Note that $\frac{dp^{NM}}{d\vartheta} = -\frac{p^{NM}}{\vartheta}$. Hence:

$$\frac{q}{R-y}\,p^{NM}+\frac{dp^{NM}}{d\vartheta} = p^{NM}\left(\frac{q}{R-y}-\frac{1}{\vartheta}\right) = p^{NM}\frac{q\vartheta-(R-y)}{\vartheta(R-1+q(1-\vartheta))} \tag{20}$$

Thus, $F_\vartheta < 0$ if $q\vartheta - (R-y) < 0$ and this is so if $\vartheta < R/2$. Hence, $\partial\varphi/\partial\vartheta > 0$.
End of Proof.

Proof of Proposition 4
Consumers' first order condition can be rewritten as follows:

$$G \equiv q'\frac{1}{\vartheta}\left\{\frac{x}{q+y}(\rho-1)\right\}-1=0 \tag{21}$$

where $x = 1-\varphi(1-\vartheta)$, $y = \varphi(R-1)$, and $\rho = (R-(1-q))/(q+y) > 1$. The second order condition is therefore equal to:

$$G_{m_c} = (q')^2\frac{\partial}{\partial q}\frac{1}{\vartheta}\left\{\frac{x}{q+y}(\rho-1)\right\}+q''\frac{1}{\vartheta}\left\{\frac{x}{q+y}(\rho-1)\right\} = -(q')^2\,\frac{2}{\vartheta}\left\{\frac{x}{q+y}(\rho-1)\right\}+q''\frac{1}{\vartheta}\left\{\frac{x}{q+y}(\rho-1)\right\}<0 \tag{22}$$

so that the second order condition is always satisfied. By the Envelope theorem we have that $\frac{\partial m_c}{\partial\varphi} = -G_\varphi/G_{m_c}$. Taking therefore the derivative of G with respect to φ we obtain that:

$$G_\varphi = q'\frac{1}{\vartheta}\left\{\left(\frac{x'}{q+y}-\frac{x}{(q+y)^2}y'\right)(\rho-1)+\frac{x}{q+y}\rho'\right\}<0 \tag{23}$$

and therefore $\partial m_c/\partial\varphi < 0$. Similarly, by the Envelope theorem we have that $\frac{\partial m_c}{\partial\vartheta} = -G_\vartheta/G_{m_c}$. Taking the derivative of G with respect to ϑ we obtain that:

$$G_\vartheta = -q'\frac{1}{\vartheta^2}\left\{\frac{x}{q+y}(\rho-1)\right\}+q'\frac{1}{\vartheta}\left\{\frac{x'}{q+y}(\rho-1)\right\} = q'\frac{\rho-1}{\vartheta(q+y)}\left\{\varphi-\frac{1-\varphi(1-\vartheta)}{\vartheta}\right\} = q'\frac{\rho-1}{\vartheta(q+y)}\left\{\frac{\varphi-1}{\vartheta}\right\}<0 \tag{24}$$

and therefore $\partial m_c/\partial\vartheta < 0$.
End of Proof.

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