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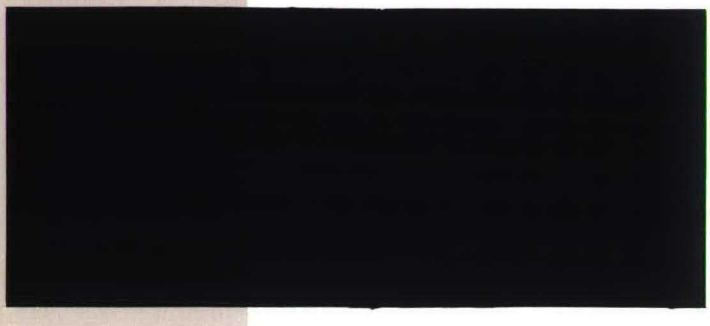

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BARGAINING VS. PRICE COMPETITION IN A MARKET WITH QUALITY UNCERTAINTY

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Abstract

This paper presents an endogenous determination of the equilibrium trading rule in a market where buyers are imperfectly informed about the quality of goods. Posted pricing may induce the sellers to select a suboptimal quality level. In contrast, negotiated pricing always leads to an efficient selection of quality. The lack of price competition, however, may allow the seller to exploit his customer. We show that this trade-off uniquely determines the pricing mechanism that the market participants will adopt. We specify the parameter constellations under which either posted pricing or negotiated pricing is an equilibrium.

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1 Introduction

Modern market economies have generated a variety of institutions for determining prices and conducting trade. In many markets prices are simply posted by sellers and the buyer has little direct influence on how much he has to pay. This pricing institution has become dominant in the retail business after mass retailers replaced the small owner-operated general store in the second half of the nineteenth century. In other markets prices are the outcome of bilateral negotiations so that both the seller and the buyer take an active part in setting the price. Examples include not only the bazaar of a less developed nation but also the market for used cars, real estate, antiques, and inputs for manufacturing firms. This paper provides a theoretical explanation of which pricing institution is likely to emerge in a market where buyers are imperfectly informed about the quality of goods or services. We compare the performance characteristics of posted-offer pricing with negotiated pricing and find that each arrangement has specific merits. These determine the equilibrium pricing policy as the outcome of competitive interactions between the market participants. Its nature depends on parameter constellations that reflect the seriousness of informational market imperfections and the distribution of bargaining power between buyers and sellers.

The analysis of markets in which each seller posts a selling price at the beginning of the trading period goes back to Joseph Bertrand (1883). He argued that posted pricing is highly competitive by observing that in the case of constant marginal costs the competitive outcome emerges even with only two price setting firms. This so-called 'Bertrand - Paradox' also demonstrates that negotiated pricing cannot be more competitive than posted pricing unless there are some market imperfections. Indeed, there has been some debate on the potential harms of posted pricing in markets with qualitative uncertainty. Suppose the buyer has to visit a firm to determine its choice of product quality and that he experiences switching costs when moving from one seller to another. Then these costs create a lock-in effect and a seller who has a locked-in customer may have an incentive to reduce his cost by choosing a lower quality at the posted price than would be efficient. This argument is often used to advocate self-enforced bans on price advertising

for providers of professional services such as doctors and lawyers[1]. When quality is not costlessly observable, the deterioration in product quality associated with posted pricing may provide a role for other trading mechanisms.

Our analysis shows that negotiated pricing induces the seller to choose the efficient quality level. The intuition is that, in contrast with posted pricing, bargaining determines the price of the good *after* the buyer has arrived at a store and learned its quality. As long as the bargaining outcome guarantees the seller a profit that increases with the total surplus to be divided, he will seek to maximize this surplus by selecting the socially efficient quality. As a result, the negotiated price market does not exhibit the moral hazard problem that characterizes the posted price market. However, the lock-in effect does not leave price bargaining unaffected. Because of the switching cost the buyer finds himself in a situation of partial bilateral monopoly with the seller. This allows the seller to exploit his customer and the bargaining may result in a relatively high price.

The different impact of switching costs on price and quality in the posted and the negotiated price market determines the competitiveness of these trading rules. When the buyers prefer shopping at stores with posted prices then negotiated pricing cannot survive competition among the sellers. We show that this always happens if switching costs are not too high. Conversely, if the moral hazard cost of posted pricing exceeds the benefit from price competition, then bargaining turns out to be more attractive for the consumer. This is the case when switching costs are high enough and the buyer's bargaining power is not too low.

The possibility that negotiated pricing is more efficient than posted pricing has been noted in a laboratory experiment by James Hong and Charles Plott (1982). Their experiment was designed to examine the claim that posted pricing would improve the operations of the transportation industry on inland waterways. In the existing market rates were typically set by individual negotiations between the barge operator and his customer. Interestingly, Hong and Plott (p. 16) concluded from their data that "price posting markets do not necessarily operate better than negotiated price markets under the parametric conditions we considered." In fact, the posted price policy resulted in

[1]Yuk-Shee Chan and Hayne Leland (1982) and William Rogerson (1988) examine this argument.

higher prices, reduced trading volume and efficiency losses. Even though the present model is not directly related to the specific environment of this experiment, it provides some theoretical insights that go in the same direction. Both studies give some evidence that in certain markets price competition between the sellers may not be the most efficient way of conducting trade.

There is a considerable literature studying the formation of prices in decentralized markets where pairs of agents bargain over the gains from trade. Most of these articles analyze search and matching markets and focus on the relation between the bargaining equilibrium and the perfectly competitive outcome[2]. The trading rule, however, is exogenously given; the sellers are prohibited from competing with each other by posting prices. The optimal selling strategy of a monopolistic seller is studied by John Riley and Richard Zeckhauser (1983) and Drew Fudenberg, David Levine, and Jean Tirole (1987). Their analysis is concerned with the question of whether a fixed posted price yields a higher payoff for the seller than a haggling strategy. Our approach differs from this work in that we look at equilibrium trading rules in a competitive market.

To address the problem we study a simple model that allows us to derive an equilibrium solution both for negotiated and posted pricing. It is presented in Section II. Sections III and IV investigate the equilibrium outcome under both trading rules. Based on this analysis we endogenize the determination of trading rules in Section V where we show that for each parameter constellation there is a unique equilibrium pricing mechanism. Concluding remarks are contained in Section VI.

2 The Model

We consider a market with $N > 2$ identical firms. Each firm produces a single good at constant returns to scale. Before the market opens, it decides once-and-for-all on the

[2]This includes work by Peter Diamond and Eric Maskin (1979), Ariel Rubinstein and Asher Wolinsky (1985), Douglas Gale (1986), and myself (1988). A different context is considered in my (1989) paper, where I replace the price-setting stage of the standard spatial competition model by a bargaining game. Further references and a detailed discussion of bargaining in a market setting are found in the monograph by Martin Osborne and Ariel Rubinstein (1990).

quality $q \in \{q_h, q_l\}$ of its output, where $q_h > q_l$. The cost of producing one unit of quality q is $c(q)$ with $c(q_h) > c(q_l)$. In the model consumers do not interact strategically with each other. This allows us to consider each buyer in isolation independently of whether there is just single consumer or a set of many identical consumers. The consumer purchases at most one unit of the good. His utility from purchasing quality q at the price p is given by $q - p$. Alternatively, he may not purchase the good from any of the N firms and consume some 'outside good' instead. The price and the quality of the outside good are exogenously fixed so that the consumer enjoys the net benefit v from buying it.

The buyer does not directly observe the firms' choice of quality. He learns the quality q sold at a particular store only by visiting the store. There is a cost to visiting a store. Switching from one of the N sellers to another or to consuming the outside good takes one time unit. As the buyer discounts future benefits by the discount factor $0 < \delta < 1$, this creates a switching cost. We will view δ as a measure of these costs and investigate its impact on the formation of prices in this market. This is done under the following assumption:

$$q_h - c(q_h) > v > q_l - c(q_l) > 0 \quad . \tag{1}$$

Thus, in the full-information equilibrium with perfect competition all firms would produce quality q_h and the consumer would buy the high-quality good at the price $p = c(q_h)$. Consuming the outside good would yield a lower utility level. In addition, the surplus from producing the low-quality good is taken to be too low to compete with the outside good. This implies that under imperfect information the buyer will never visit a store that he suspects to offer quality q_l. Accordingly, we can confine our analysis to situations where the sellers find choosing quality q_h optimal.

The full-information equilibrium may no longer be feasible when the consumer can determine quality only by going to a store. The cost of switching sellers may give rise to a lock-in effect: Once a consumer ends up in a low quality store, he may be left with no better choice than to purchase low quality. For low values of δ visiting another seller may simply be too costly. As a consequence, the sellers may be induced to select quality q_l rather than q_h. Indeed, at the given price $p = c(q_h)$ producing low quality yields higher profits as $c(q_l) < c(q_h)$, and so the full-information equilibrium unravels if δ is sufficiently

low.

To study the selection of qualities in the presence of switching costs, we maintain the additional assumption

$$q_h - q_l < v \quad . \tag{2}$$

This condition implies that the consumer prefers buying the outside good to purchasing quality q_h at a price $p > q_l$. It makes the model interesting by limiting the use of prices as signals of quality in the posted price market. Even though the buyer may reasonably be convinced that prices above q_l indicate high quality, because he would always quit a low-quality store with $p > q_l$, he cannot be attracted by such a price offer.

3 The Negotiated Price Market

In the negotiated price market the consumer has the option of purchasing the outside good or visiting one of the N stores to bargain about the price of the good. Upon entering a store, he observes the quality q actually chosen by the seller and so the price negotiations proceed under symmetric information. The 'disagreement point' in this bilateral bargaining situation represents the payoffs of the buyer and the seller, respectively, if no sale takes place and the buyer quits; it will be denoted as $(d, 0)$. Of course, the buyer's payoff d depends upon his switching cost and the net benefit that he expects from bargaining with another seller or simply from consuming the outside good. Accordingly, in equilibrium d will be determined endogenously; the seller's profit from not making a sale is zero. Suppose the Generalized Nash Bargaining Solution is the outcome of the bargaining[3]. Then the price upon which the parties agree is[4]

$$\varphi(q, d) \equiv \arg\max_{p} \quad [q - p - d]^{\alpha}[p - c(q)]^{1-\alpha}\,, \tag{3}$$

with $0 < \alpha < 1$. This solution splits the surplus so that the buyer receives the fraction α. The parameter α may therefore be interpreted as expressing the buyer's 'bargaining

[3]The generalized Nash solution is studied by John Harsanyi and Reinhard Selten (1972). An axiomatization of this solution is given by Ehud Kalai (1977) and Alvin Roth (1979).

[4]Of course, an agreement will be reached only if the surplus $q - c(q) - d$ is non-negative. This condition is always fulfilled in the equilibrium defined below.

power'; by varying α from zero to unity we can obtain any price that is individually rational both for the buyer and the seller. Much of our analysis will focus on the joint impact of the bargaining parameter α and the friction parameter δ on the market outcome.

As Thomas Schelling (1960, p. 22) points out, 'bargaining power' does not necessarily reflect intelligence or skillfulness; instead bargaining situations may involve "the paradox that the power to constrain an adversary may depend on the power to bind oneself; that, in bargaining, weakness is often strength." Recent developments in non-cooperative bargaining theory incorporate such commitment possibilities in the description of the bargaining procedure. The power weights α and $1-\alpha$ may then reflect possible asymmetries in the speed of communication or in the parties' beliefs concerning the likelihood of a breakdown of negotiations. Indeed, Kenneth Binmore, Ariel Rubinstein, and Asher Wolinsky (1986) take this approach to demonstrate that the Generalized Nash Bargaining Solution can be obtained as the equilibrium of an extensive game in which the parties alternate in making offers and counteroffers.

In the event of breakdown in the negotiations, the buyer can either switch to another bargaining partner or he can purchase the outside good. As the surplus $q_l - c(q_l)$ is less than v, the buyer will not go to one of the N stores unless he is convinced that he will find quality q_h[5]. In the equilibrium of the negotiated price market the buyer expects high quality and he anticipates that the bargaining will result in some price p. Given these expectations and the delay cost of switching, his expected utility from disagreement is

$$d(p) \equiv \max[\delta v,\ \delta(q_h - p)] \quad . \tag{4}$$

In equilibrium the consumer's price-quality expectations have to be consistent with the market outcome.

[5]As will be shown below, choosing q_h is a dominant strategy for each seller. This precludes the possibility of a mixed equilibrium in which some sellers choose q_h and others q_l.

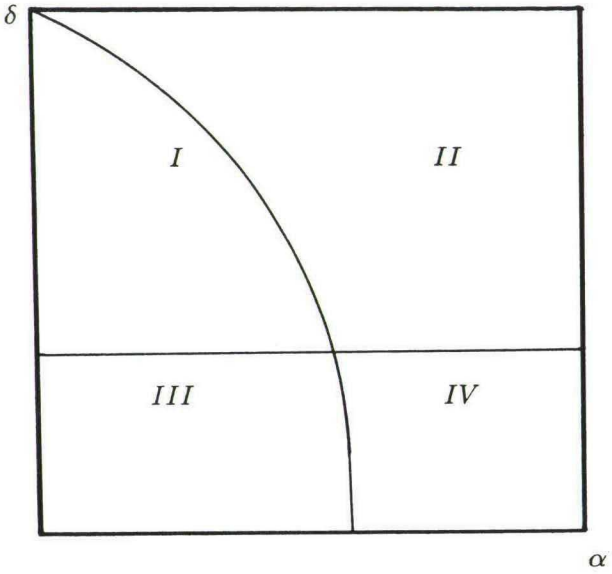

Figure 1

Definition: $\hat{p}$ is a *Negotiated Price Equilibrium* if

(i) $q_h - \hat{p} \geq v$ and $\hat{p} \geq c(q_h)$; and

(ii) $\hat{p} = \varphi(q_h, d)$ and $d = d(\hat{p})$; and

(iii) $\hat{p} - c(q_h) \geq \varphi(q_l, d) - c(q_l)$.

The first of these conditions ensures that both the sellers and the buyers are willing to participate in the market. If (i) fails to hold, then none of the N sellers is active and the consumer purchases the outside good. By (ii), the equilibrium price $\hat{p}$ is determined by the bargaining solution, taking into account that the buyer's threat point in the price negotiation is $d(\hat{p})$. Finally, (iii) guarantees that each single seller finds it in his own interest to select quality q_h. In equilibrium the buyer is indifferent between all stores so that the sellers share the market equally. To state the main result of this Section, we define the function

$$\delta_A(\alpha) \equiv \frac{v - \alpha(q_h - c(q_h))}{(1-\alpha)v} \quad . \tag{5}$$

By assumption (1), $\delta_A(.)$ is decreasing, $\delta_A(0) = 1$, and $\delta_A(\alpha) \geq 0$ for all $\alpha \leq v/(q_h - c(q_h))$. In Figure 1 the function $\delta = \delta_A(\alpha)$ represents the borderline between the two regions $I + III$ and $II + IV$.

— insert Figure 1 here —

Proposition 1: *There is a Negotiated Price Equilibrium if and only if* $\delta \geq \delta_A(\alpha)$. *If* $\delta \geq \delta_A(\alpha)$, *the Negotiated Price Equilibrium is unique with*

$$\hat{p} = \frac{(1-\alpha)(1-\delta)q_h + \alpha c(q_h)}{1-(1-\alpha)\delta}.$$

Proof: The Generalized Nash Bargaining Solution is defined by the necessary and sufficient first-order condition

$$\varphi(q, d) = (1-\alpha)(q-d) + \alpha c(q) \quad . \tag{6}$$

Accordingly, $\varphi(q,d) - c(q) = (1-\alpha)[q - c(q) - d]$ so that by assumption (1) equilibrium condition (iii) is satisfied for any $\hat{p}$ satisfying condition (ii). By the first inequality of condition (i), one must have $d(\hat{p}) = \delta(q_h - \hat{p})$. Therefore, solving (ii) for $\hat{p}$ yields the unique solution stated in the proposition. This solution always satisfies the second inequality in (i); the first inequality in (i) is identical to $\alpha[q_h - c_h]/[1-(1-\alpha)\delta] \geq v$. By definition of δ_A this is equivalent to $\delta \geq \delta_A(\alpha)$. Q.E.D.

The inequality $\delta \geq \delta_A(\alpha)$ is satisfied in regions *II* and *IV* of Figure 1. For these parameter constellations the consumer purchases the high-quality good at the price $\hat{p}$. As $\hat{p}$ exceeds $c(q_h)$, the presence of market frictions enables the sellers to earn positive profits. These are the higher, the lower δ and α. Interestingly, $\hat{p}$ approaches $c(q_h)$ both in the limit when $\delta \to 1$ and in the limit when $\alpha \to 1$. The first of these properties justifies viewing the perfectly competitive outcome as the limiting point of a market with negligible switching costs.

Why does the consumer purchase the outside good for values of δ and α in regions *I* and *III*, where a negotiated price equilibrium fails to exist? The reason is that these parameter values violate equilibrium condition (i). With high switching costs and little bargaining power the buyer cannot get a favourable deal once he has entered a store. Knowing this ex ante keeps him from going to a store and induces him to consume the outside good.

Importantly, the proof of Proposition 1 reveals that the negotiated price market involves no problem of moral hazard; i.e. the incentive constraint (iii) is never binding. This perhaps surprising observation has a simple intuition: As a characteristic of the negotiated price market, the price at which the good is sold is determined *after* the buyer has learned its quality. The bargaining outcome guarantees the seller a fraction $(1-\alpha)$ of the bargaining surplus. As a result, he is always better off by producing q_h because this quality yields a higher surplus than q_l. Choosing quality q_h is a dominant strategy for the seller in the negotiated price market. This fact distinguishes this market from the posted price market, which we turn to in the next Section, where prices are set *before*

the consumer becomes aware of qualities[6].

4 The Posted Price Market

In the posted price market the sellers act as Bertrand competitors by posting prices. The buyer observes these price quotations and compares their attractiveness with the outside option utility v. After entering a store and learning its quality he can either make a purchase at the posted price or switch to another seller. By assumption (1), he will not go to a store if he anticipates to find quality q_l[7]. In the posted price equilibrium the buyer expects q_h in each store and so all sellers post the same price p^*. As all stores appear identical to the buyer, he visits one of them at random. To confirm his expectations, competition must induce the suppliers to offer quality q_h[8]. As q is not directly observable, each single seller has an incentive to select q_h at the posted price p^* only if the buyer would quit after observing quality q_l. Given his expectations about qualities at other stores, the buyer will certainly do so if $q_l - p^* < d(p^*)$. In fact, we will assume that the buyer refuses to purchase low quality unless he is not actually worse off by departing[9]. This means that each single seller will choose quality q_h if and only if the equilibrium price p^* satisfies the restriction $p^* \geq \pi(p^*)$, where

$$\pi(p^*) \equiv q_l - d(p^*) \quad . \tag{7}$$

While $p^* \geq \pi(p^*)$ ensures the provision of high quality, a key factor in the determination of p^* is that prices are a signal of quality. Should some seller deviate from p^* by posting $p < p^*$, then the buyers will use the observed price to draw inferences about this seller's quality. If they interpret p as a signal of quality q_l, they will not be attracted even though $p < p^*$. The opposite happens if p is regarded as a signal of quality q_h.

[6]The relationship between ex ante and ex post pricing in a model without qualitative uncertainty is explored by Douglas Gale (1988).

[7]Of course, the buyer presumes that no seller offers the good at a price below cost.

[8]We assume that each seller selects q_h when he is indifferent between q_h and q_l.

[9]This tie-breaking rule is necessary to avoid the open set problem that would occur if there were no lowest price that signals high quality. Indeed, equilibrium condition (iii) below is impossible to satisfy if condition (ii) is replaced by $p^* > \pi(p^*)$.

As in other signalling games, such an indeterminacy of out-of-equilibrium beliefs may lead to a multiplicity of equilibrium prices p^*. To avoid this problem, we will restrict the buyers' beliefs to satisfy the 'intuitive criterion' proposed by In-Koo Cho and David Kreps (1987). Suppose some seller wants to undercut his competitors by some price p slightly below p^* and, at the same time, wishes to convince the consumer that he offers high quality. Then we may reasonably assume that this seller succeeds if he would not gain by posting p and selecting quality q_l, even when his offer attracted the entire market. This prerequisite is fulfilled if low quality deters the customer from paying p for the good, i.e. if $p \geq \pi(p^*)$. Summing up, in the posted price equilibrium p^* only prices $p \geq \pi(p^*)$ are considered as a signal of high quality.

Definition: p^* is *Posted Price Equilibrium* if

(i) $q_h - p^* \geq v$ and $p^* \geq c(q_h)$; and

(ii) $p^* \geq \pi(p^*)$; and

(iii) there is no $p \geq \pi(p^*)$ such that $p < p^*$ and $p - c(q_h) > [p^* - c(q_h)]/N$.

The first of these conditions is the same as in the definition of the negotiated price equilibrium. Requirement (ii) represents the sellers' incentive-compatibility constraint to provide high quality. Condition (iii) precludes that any of the sellers can gain by unilaterally posting some price p below p^* that signals high quality. Here we assume that if all sellers post the same price p^*, each store has the same chance of attracting consumers so that its market share equals $1/N$. The equilibrium outcome depends on the level of switching costs; let

$$\delta_B \equiv 1 - \frac{q_h - q_l}{v} \quad , \tag{8}$$

then $0 < \delta_B < 1$ because of assumption (2) and $q_h > q_l$.

Proposition 2: *There is a Posted Price Equilibrium if and only if* $\delta \geq \delta_B$. *If* $\delta \geq \delta_B$, *the Posted Price Equilibrium is unique with*

$$p^* = \max[c(q_h),\ (q_l - \delta q_h)/(1 - \delta)].$$

Proof: By the first inequality in equilibrium condition (i) one has $\pi(p^*) = q_l - \delta(q_h - p^*)$. As $p^* \geq c(q_h)$ and $N \geq 2$, condition (iii) is satisfied if and only if p^* minimizes p subject to $p \geq c(q_h)$ and $p \geq \pi(p^*)$. For $\delta \geq [q_l - c(q_h)]/[q_h - c(q_h)]$ only the first constraint is binding and so one has $p^* = c(q_h)$. Otherwise only the second constraint is binding so that $p^* = \pi(p^*)$, i.e. $p^* = (q_l - \delta q_h)/(1 - \delta)$. If $p^* = c(q_h)$, the first inequality in (i) is always satisfied. For $p^* > c(q_h)$ this inequality becomes $q_h - p^* = (q_h - q_l)/(1 - \delta) \geq v$ which, by definition of δ_B, is identical to $\delta \geq \delta_B$. Q.E.D.

Regions *I* and *II* of Figure 1 describe the area where a posted price equilibrium exists. For δ close enough to unity, the posted price p^* equals $c(q_h)$. For lower values of δ, however, we observe that price exceeds marginal costs. More specifically, this happens when $\delta_B \leq \delta < [q_l - c(q_h)]/[q_h - c(q_h)]$ because the incentive restriction (ii) is binding. For this intermediate level of switching costs only prices above $c(q_h)$ are considered as a credible signal of high quality. This signalling effect also explains why positive profits may be consistent with Bertrand competition in markets with imperfect information. Undercutting is not profitable because prices below p^* eliminate the seller's incentive to supply high quality and, therefore, do not attract the consumer. For values of δ below δ_B the lock-in effect becomes too strong and leads to a deterioration of product quality. As a consequence, the institution of posted offer pricing precludes the sellers from being active in the market and results in consumption of the outside good in regions *III* and *IV*.

Because moral hazard is present only in the posted price market but not in the negotiated price market, the latter pricing institution may be more efficient. This is clearly the case when the parameter values of δ and α lie in region *IV* of Figure 1. Here the N firms remain inactive in the posted price market, whereas negotiated pricing results in production of the high-quality good with positive payoffs both for the sellers and the buyers. In contrast, the posted price market appears superior in region *I*. In this region the buyer refrains from entering negotiations because his bargaining power is too low. Price posting enables the sellers to overcome this problem by committing them to sell the good at a sufficiently low price. In region *II* both pricing rules allow the sellers

to participate actively in the market.

The key insight from Propositions 1 and 2 is that the two categories of trading institutions involve a trade-off: Price bargaining avoids the moral hazard problem in the firms' selection of qualities. Yet, as the price is determined ex post after the buyer has chosen the seller, it may not guarantee the buyer a sufficient fraction of the surplus to make bargaining attractive ex ante. Ex ante pricing, as in the posted price market, does not suffer from this drawback. But, when the price is fixed ex ante, the lock-in effect may have a negative impact on the seller's incentive to produce high quality. The relative importance of these considerations depends on the parameters δ and α. The following Section will demonstrate that the trade-off between the two pricing institutions can explain which will emerge as an equilibrium trading rule in a given environment.

5 The Stability of Competition

This Section is devoted to analysing which pricing mechanism is stable against competition. A particular trading rule can survive only if no trader can gain by deviating and using another trading rule. Applying this idea to the negotiated price market means that no seller should be able to profit from posting a price ex ante in a situation where all the other sellers rely on ex post pricing. That is, it must be impossible to profitably attract the demand of all consumers by undercutting the negotiated price equilibrium $\hat{p}$ and posting $p < \hat{p}$. The reason why such an attempt may fail is that prices below $\hat{p}$ may be viewed as an indication of low quality. Using the same restrictions on beliefs as in Section 4, we will assume that the posted offer p convinces the consumer of quality q_h only if $p \geq \pi(\hat{p})$, where $\pi(.)$ is defined by (7).

Definition: The Negotiated Price Equilibrium $\hat{p}$ is *stable* against price competition if there is no $p < \hat{p}$ such that

(i) $p \geq \pi(\hat{p})$; and

(ii) $p - c(q_h) > [\hat{p} - c(q_h)]/N$.

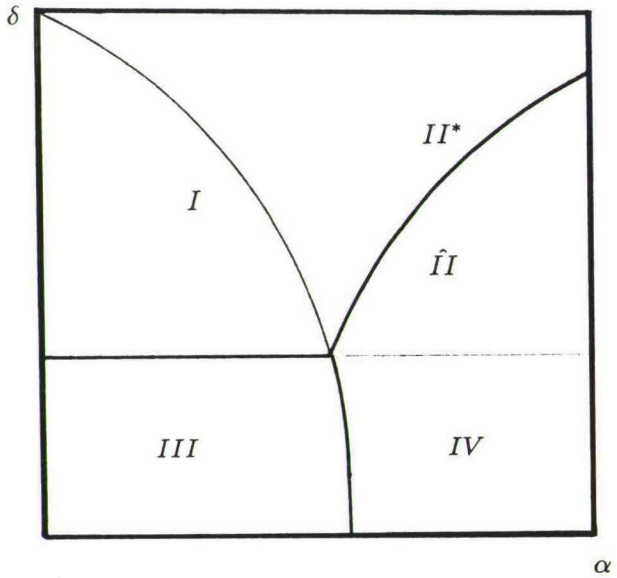

Figure 2

In other words, the institution of negotiated pricing cannot be eroded by price posting if any offer below $\hat{p}$ is either viewed as a low-quality signal or fails to increase the seller's profit even when he serves the whole market. To determine the range of parameter values where this is true, we define the function

$$\delta_C(\alpha) \equiv \frac{\alpha(q_h - c(q_h)) - (q_h - q_l)}{\alpha(q_h - c(q_h)) - (1-\alpha)(q_h - q_l)} \quad . \tag{9}$$

Note that for $\alpha^* \equiv [q_h - q_l]/[q_h - q_l + q_h - c(q_h) - v]$ one has

$$\delta_A(\alpha^*) = \delta_B = \delta_C(\alpha^*) \quad . \tag{10}$$

Moreover, $\delta_C'(\alpha) > 0$ for all $\alpha \in (\alpha^*, 1)$. In Figure 2 the function $\delta = \delta_C(\alpha)$ is depicted for $\alpha \in (\alpha^*, 1)$; it divides the former region II of Figure 1 into the regions II^* and $\hat{II}$.

— *insert Figure 2 here* —

Proposition 3: *The Negotiated Price Equilibrium $\hat{p}$ is stable against price competition if and only if $\alpha \geq \alpha^*$ and $\delta \leq \delta_C(\alpha)$.*

Proof: As $\hat{p} > c(q_h)$ and $N \geq 2$, there is always a $p < \hat{p}$ satisfying (ii) in the definition of stability. As $q_h - \hat{p} \geq v$, condition (i) is identical to $p \geq q_l - \delta(q_h - \hat{p})$. Therefore, $\hat{p}$ is stable if and only if there is no $p < \hat{p}$ satisfying (i). This means one must have $\hat{p} \leq q_l - \delta(q_h - \hat{p})$. Using $\hat{p}$ from Proposition 1, this condition is equivalent to

$$\delta[\alpha(q_h - c(q_h)) - (1-\alpha)(q_h - q_l)] \leq \alpha(q_h - c(q_h)) - (q_h - q_l) \quad . \tag{11}$$

As $\delta < 1$, this inequality cannot hold if the l.h.s. is negative. Accordingly, by definition of $\delta_C(\alpha)$, (11) holds if and only if $\alpha > [q_h - q_l]/[q_h - c(q_h) - (q_h - q_l)] \equiv \bar{\alpha}$ and $\delta \leq \delta_C(\alpha)$. Note that $\delta_C(\alpha)$ is strictly increasing for $\alpha > \bar{\alpha}$ and that $\delta_A(\alpha^*) = \delta_C(\alpha^*)$. Accordingly, by Proposition 1 there is no Negotiated Price Equilibrium $\hat{p}$ for $\alpha \in (\bar{\alpha}, \alpha^*)$ and $\delta \leq \delta_C(\alpha)$. This means, condition (11) applies if and only if $\alpha \geq \alpha^*$ and $\delta \leq \delta_C(\alpha)$. Q.E.D.

Proposition 3 states that negotiated pricing cannot be sustained as a Nash equilibrium in the firms' choice of pricing policies for parameter constellations in regions I and II^* of Figure 2. Negotiated pricing constitutes an equilibrium only in regions $\hat{II}$ and IV. Interestingly, we notice that such an equilibrium necessitates a certain amount of market frictions. As $\delta_C(1) < 1$, bargaining is not a stable pricing institution when δ is close to unity. Negotiated pricing is unlikely to survive in a highly competitive, almost frictionless environment. At first sight it may appear paradoxical that for $\delta < \delta_C(1)$ the sellers will rely on price bargaining when the buyer's bargaining power is rather high. But, this is so because competition forces them to adopt a trading rule that is advantageous for the buyer.

To complete our analysis, we now investigate the stability of posted pricing. We assume that posting p^* legally commits the seller only in the sense that he cannot ask his customers to pay more than p^*. However, this does not constrain the parties not to jointly revise the terms of the transaction. If in the course of bargaining they both reach an agreement, then this replaces the posted price. Accordingly, the buyer accepts the seller's posted offer p^* only if he does not see a chance to pay less after bargaining.

Definition: The Posted Price Equilibrium p^* is *stable* against bargaining if, given $d = d(p^*)$, $\varphi(q_h, d) \geq p^*$.

Given that the buyer cannot induce a price reduction by bargaining, he has to pay p^* after switching to another store. Therefore, his threat point in a stable posted price equilibrium is $d(p^*)$, as defined by (4).

Proposition 4: *The Posted Price Equilibrium p^* is stable against bargaining if and only if either $\alpha \leq \alpha^*$ or $\alpha \geq \alpha^*$ and $\delta \geq \delta_C(\alpha)$.*

Proof: Using (6), p^* is stable if and only if $p^* \leq (1-\alpha)[q_h - d(p^*)] + \alpha c(q_h)$. As

$d(p^*) = \delta(q_h - p^*)$, this is equivalent to

$$p^* \leq [(1-\alpha)(1-\delta)q_h + \alpha c(q_h)]/[1-(1-\alpha)\delta] \quad . \tag{12}$$

By Proposition 2 this condition always holds if $\delta \geq [q_l - c(q_h)]/[q_h - c(q_h)]$ because then $p^* = c(q_h)$. For $\delta \in ([q_l - c(q_h)]/[q_h - c(q_h)], \delta_B)$, $p^* = (q_l - \delta q_h)/(1-\delta)$ so that (12) is identical to

$$\delta[\alpha(q_h - c(q_h)) - (1-\alpha)(q_h - q_l)] \geq \alpha(q_h - c(q_h)) - (q_h - q_l) \quad . \tag{13}$$

As $0 < \delta < 1$, (13) always holds if the l.h.s. is negative, i.e. if $\alpha \leq [q_h - q_l]/[q_h - c(q_h) - (q_h - q_l)] \equiv \bar{\alpha}$. For $\alpha > \bar{\alpha}$, (13) is equivalent to $\delta \geq \delta_C(\alpha)$. By Proposition 2, p^* exists if and only if $\delta \geq \delta_B$. As $\delta_B \geq \delta_C(\alpha)$ for $\alpha \in (\bar{\alpha}, \alpha^*)$, any p^* is stable if $\alpha \leq \alpha^*$. For $\alpha \in [\alpha^*, 1)$, one has $\delta_B \leq \delta_C(\alpha) < [q_l - c(q_h)]/[q_h - c(q_h)]$ so that over this range (12) holds if and only if $\delta \geq \delta_C(\alpha)$. Q.E.D.

Propositions 3 and 4 demonstrate that whenever the N sellers are active in the market, a unique stable pricing institution emerges. As the stability criterion eliminates posted pricing in region $\hat{I}I$ of Figure 2, our model predicts Bertrand competition to prevail in regions I and II^* and negotiated pricing in regions $\hat{I}I$ and IV. Using Propositions 1 and 2, it is easily established that $p^* < \hat{p}$ in region II^* whereas $\hat{p} < p^*$ in region $\hat{I}I$. The endogenous determination of trading rules thus maximizes the consumer's equilibrium utility. In region II^* the sellers are trapped in a Prisoner's Dilemma type situation. They all end up with lower profits because the negotiated price $\hat{p}$ makes undercutting profitable. In contrast, in region $\hat{I}I$ the signalling effect associated with posted pricing results in a price level p^* that makes bargaining more efficient to cope with the moral hazard problem.

6 Conclusion

We have explored how different pricing mechanisms affect the determination of quality and price in a market with quality uncertainty and switching costs. Posted pricing allows the sellers to commit themselves to a price before the consumer enters a store.

This commitment together with competitive behavior restricts their ability to exploit the customer in terms of prices. However, it creates an incentive to use the quality dimension for this purpose. This means price competition runs the risk of reducing quality competition. This does not happen in the negotiated price market where prices are determined by bargaining after the consumer has observed quality. Yet, the disadvantage of this trading procedure is that the consumer may ex post end up paying a high price. In short, posted pricing involves moral hazard whereas negotiated pricing is not very competitive.

We have shown that in our model this trade-off between the two trading institutions uniquely determines the equilibrium pricing policy. As long as the departure from the perfectly competitive model of a frictionless market is not too large, Bertrand pricing leaves no room for price bargaining. Negotiated pricing necessitates some level of frictions and occurs when the buyer's bargaining power is sufficiently high to prevent exploitation. Also, the equilibrium trading mechanism has the interesting property that it ensures the consumer the highest possible utility level.

Our model stresses the role of quality uncertainty for the determination of pricing rules. Of course, this leaves out a number of other considerations that may be important. For instance, we have assumed that bargaining proceeds under symmetric information so that negotiations are costless. Asymmetric information bargaining models can generate costs in the form of delay in agreement[10]. In addition, they imply some ex ante uncertainty about the outcome. Such factors may favor posted pricing. In general, however, it is not a priori clear which is the most efficient pricing institution when information and incentive problems are involved.

[10]The simplest model of this type assumes one-sided uncertainty about the buyer's valuation of the good and considers an extensive game in which the seller makes a sequence of offers to the buyer as, e.g., in Joel Sobel and Ichiro Takahashi (1983). For the role of delay in bargaining, see also Anat Admati and Motty Perry (1987) and Faruk Gul and Hugo Sonnenschein (1988).

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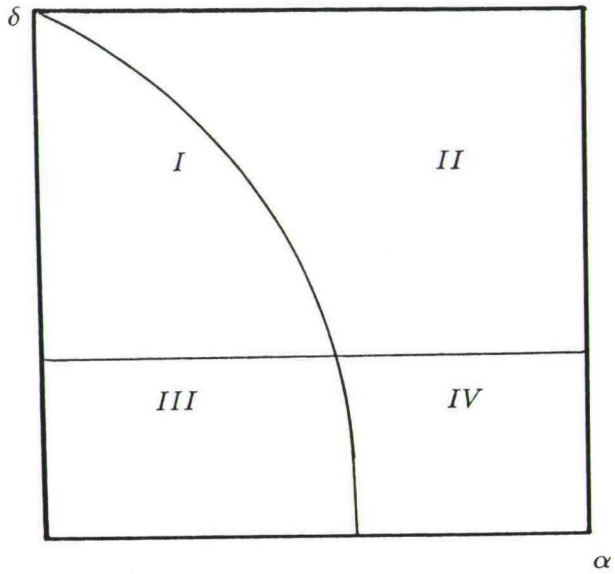

Figure 1

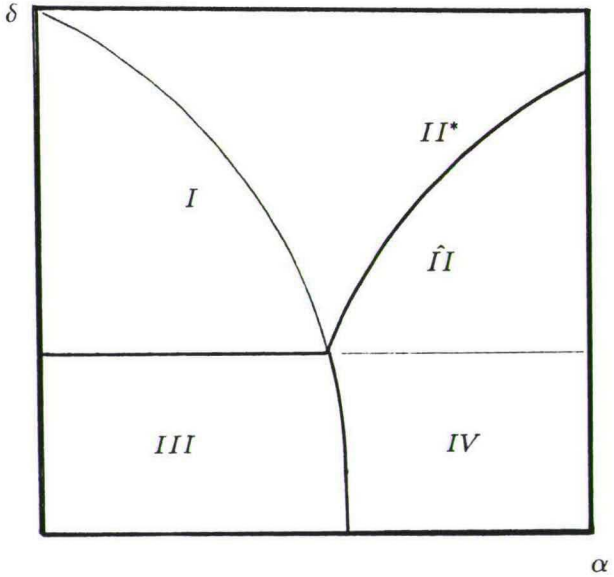

Figure 2

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