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This paper focuses on the endogenous determination of trading rules. In many markets, as for example in the retail business, prices are simply posted by sellers, and the buyer has little direct influence on how much he has to pay. 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 markets 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. I 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.

The key insight of my analysis is that the price-determination aspects of market organization can also affect quality. 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. The incentive to provide quality in the posted-price regime is that the consumer may walk away to another store if the quality is too low. Switching costs may undermine this incentive because they create a lock-in effect. A seller who has a locked-in customer may reduce his cost by choosing a lower quality. This

argument is often used to advocate self-enforced bans on price advertising for providers of professional services such as doctors and lawyers.[1] While posted-pricing promotes *ex ante* price competition, it may lead to a deterioration in product quality.

In contrast with posted pricing, bargaining determines the price of the good *after* the buyer has arrived at a store and learned its quality. Here the incentive to provide quality is generated by the fact that the seller gets some fraction of the total surplus. 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 locked-in consumer 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 markets determines the competitiveness of these trading rules.[2]

There is a considerable literature studying the formation of prices in decentralized markets where pairs of agents bargain over the gains from trade.[3] This literature takes

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

[2]For a comparison of posted and negotiated pricing in a laboratory experiment, see James Hong and Charles Plott (1982).

[3]This includes work by Peter Diamond and Eric Maskin (1979), Ariel Rubinstein and Asher Wolinsky (1985), Douglas Gale (1986a,b), 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 with a bargaining game. Further references and a detailed discussion of bargaining in a market setting are found in the monograph by Martin Osborne and Rubinstein (1990).

the trading rule as 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 by Drew Fudenberg et al. (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. Beginning with the work of William Vickrey (1961), the choice of selling mechanisms is an important topic also in the auction literature.[4] It turns out that posting a fixed price is the optimal strategy for a monopolistic seller of a single good when he faces a single potential buyer. Similarly, with many buyers, posted pricing is optimal for the monopolist when he produces the good under constant returns to scale and can freely vary the amount offered for sale (see Milton Harris and Arthur Raviv, 1981a,b). Paul Milgrom (1987) embeds the auction model in a noncooperative-bargaining model in which the owner of the good always has the right to resell the item to other traders. He finds that conducting an auction allows a weak bargainer to benefit from the presence of stronger bargainers, so that typically the sale will be by auction rather than by private offer. The following features distinguish my model from this literature: there are many producers operating under constant returns to scale; these producers can compete by advertising prices; buyers are imperfectly informed about product quality; and buyers face switching costs and cannot negotiate with several sellers at the same time.

To address the problem, I study a simple model that allows one to derive an equilibrium solution both for negotiated and posted pricing. It is presented in Section I. Sections II and III investigate the equilibrium outcome under both trading rules. Based on this analysis, I endogenize the determination of trading rules in Section IV, where I

show that for each parameter constellation there is a unique equilibrium pricing mechanism. Concluding remarks are contained in Section V.

I. The Model

Consider a market with $N > 2$ identical firms. Each firm produces a single good at constant returns to scale. Before the market opens, each firm decides once-and-for-all on the quality $q \in \{q_h, q_\ell\}$ of its output, where $q_h > q_\ell$. The cost of producing one unit of quality q is $c(q)$ with $c(q_h) > c(q_\ell)$. In the model all consumers are identical. They do not interact strategically with each other. This together with the assumption of constant returns to scale allows one to consider each buyer in isolation independently of the total number of consumers. Each 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:

$$(1) \quad q_h - c(q_h) > v > q_\ell - c(q_\ell) > 0.$$

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

[4]See Preston McAfee and John McMillan (1987) and Paul Milgrom (1987) for a survey.

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, I can confine the analysis to situations where the sellers find choosing quality q_h to be optimal.

II. 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. He keeps a constant inventory of the good so that after each sale he incurs the cost $c(q)$ of producing one unit. Suppose the generalized Nash bargaining solution is the outcome of the bargaining.[5] Then the price upon which the parties agree is[6]

$$(2) \quad \varphi(q,d) \equiv \operatorname{argmax}_p [q - p - d]^\alpha$$
$$\times [p - c(q)]^{1-\alpha}$$

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

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 $q_\ell - c(q_\ell)$ 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.[7] 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

$$(3) \quad d(p) \equiv \max[\delta v, \delta(q_h - p)].$$

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

Definition: $\hat{p}$ is a *negotiated-price equilibrium* if (i) $q_h - \hat{p} \geq v$ and $\hat{p} \geq c(q_h)$; (ii) $\hat{p} = \varphi(q_h, d)$ and $d = d(\hat{p})$; and (iii) $\hat{p} - c(q_h) \geq \varphi(q_\ell, d) - c(q_\ell)$.

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

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[5]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). Kenneth Binmore et al. (1986) derive the generalized Nash bargaining solution as the noncooperative equilibrium of an extensive game in which the parties alternate in making offers and counteroffers.

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

[7]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 choose q_ℓ.
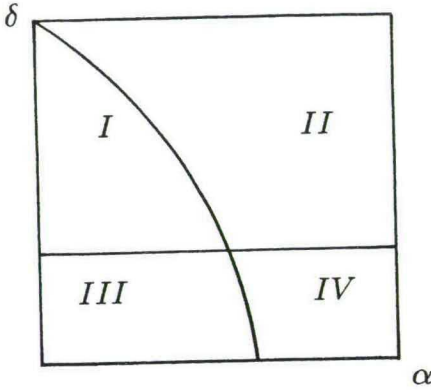
in the price negotiation is $d(\hat{p})$. Finally, (iii) guarantees that each single seller finds it in his own interest to select quality q_h. In equilibrium, the buyer is indifferent among all stores so that the sellers share the market equally. To state the main result of this section, I define the function

$$(4) \quad \delta_A(\alpha) \equiv \frac{v - \alpha[q_h - c(q_h)]}{(1-\alpha)v}.$$

By assumption (1), $\delta_A(\cdot)$ 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.

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

$$(5) \quad \varphi(q,d) = (1-\alpha)(q-d) + \alpha c(q).$$

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 the definition of δ_A, this is equivalent to $\delta \geq \delta_A(\alpha)$.

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 higher, the lower are 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 favorable 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. This kind of market failure is well known from the standard search model (see e.g., Joseph Stiglitz, 1979) in which prices are unilaterally set by sellers, and buyers have to visit stores to observe prices. Indeed, in the limiting situation where $\alpha = 0$ the negotiated-price

market becomes identical to the simplest search model with identical buyers and sellers. When $\alpha = 0$ the seller has all the bargaining power and effectively makes a take-it-or-leave-it offer to his customers. Proposition 1 shows that in this case $\hat{p} = q_h$ (i.e., each seller would charge the consumer's reservation price). This observation is the well-known "monopoly price paradox" of Diamond (1971): even with arbitrarily small search costs and a large number of firms, in market equilibrium the price is the monopoly price. If the buyer has to pay a cost for entering the market or can opt for some outside good, this paradox predicts total market failure.[8] In regions II and IV this unsatisfactory outcome is avoided because α is large enough to guarantee the buyer a sufficient share of the gains from trade.

Importantly, the proof of Proposition 1 reveals that the negotiated-price market involves no problem of moral hazard; that is, the incentive constraint (iii) is never binding. This perhaps surprising observation has a simple intuition: 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 does q_ℓ. Choosing quality q_h is a dominant strategy for the seller in the negotiated-price market.[9] This fact distinguishes this market from the posted-price market, which I turn to in the next section, where prices are set *before* the consumer becomes aware of qualities.[10]

III. The Posted-Price Market

In the posted-price market, the sellers act as Bertrand competitors by posting prices. Advertising price information enables the seller to guarantee his customers a price before they visit his store. In contrast we assume that communication of quality information is infeasible. This assumption is relevant in markets where quality is either too costly to communicate or is not verifiable to third parties. If a court finds it hard to determine whether a seller actually provides "high" quality, then buyers must distrust quality advertisements because they cannot be enforced.

The buyer observes the sellers' 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 finding quality q_ℓ.[11] 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.[12] 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 $q_\ell - p^* < d(p^*)$. In fact, we will assume that the buyer refuses to purchase low quality unless he is not actually worse off by departing.[13] This means

[8] In the literature, the typical way to avoid the Diamond result has been to assume that some consumers are well informed about prices (see Steven Salop and Stiglitz, 1977; Hal Varian, 1980; Dale Stahl, 1989).

[9] This conclusion is robust against affine transformations of the seller's and buyer's utilities. The reason is that the generalized Nash bargaining solution satisfies the axiom of independence of utility rescalings.

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

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

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

[13] 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) in the next (posted-price equilibrium) definition is impossible to satisfy if condition (ii) is replaced by $p^* > \pi(p^*)$.

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

(6) $\pi(p^*) \equiv q_\ell - d(p^*)$.

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. As in other signaling games, such an indeterminacy of out-of-equilibrium beliefs may lead to a multiplicity of equilibrium prices p^*. To avoid this problem, I 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 one may reasonably assume that this seller succeeds if he would not gain by posting p and selecting quality q_ℓ, even if his offer attracts the entire market. This prerequisite is fulfilled if low quality deters the customer from paying p for the good, that is, 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 a *posted-price equilibrium* if (i) $q_h - p^* \geq v$ and $p^* \geq c(q_h)$; (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 any of the sellers gaining 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

(7) $\delta_B \equiv 1 - (q_h - q_\ell)/v$.

Then, $\delta_B < 1$ because $q_h > q_\ell$.

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

PROOF:

By the first inequality in equilibrium condition (i), one has $\pi(p^*) = q_\ell - \delta(q_h - p^*)$. 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 $\delta \geq [q_\ell - c(q_h)]/[q_h - c(q_h)]$, only the first constraint is binding and so one has $p^* = c(q_h)$. Otherwise, only the second constraint is binding so that $p^* = \pi(p^*)$, that is, $p^* = (q_\ell - \delta q_h)/(1 - \delta)$. If $p^* = c(q_h)$, the first inequality in (i) is always satisfied. For $p^* > c(q_h)$ this inequality becomes $q_h - p^* = (q_h - q_\ell)/(1 - \delta) \geq v$ which, by definition of δ_B, is identical to $\delta \geq \delta_B$.

The posted-price equilibrium may fail to exist for low values of δ if $\delta_B > 0$, that is, if

(8) $q_h - q_\ell < v$.

This condition implies that the consumer prefers buying the outside good to purchasing quality q_h at a price $p > q_\ell$. It limits 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 $p > q_\ell$, he cannot be attracted by such a price offer. More generally, the lock-in effect becomes more serious when the difference between q_h and q_ℓ is decreased. This is so because the consumer's utility gain from quitting a low-quality seller and

going to a high-quality seller becomes smaller.[14]

Regions I and II of Figure 1 describe the area where a posted-price equilibrium exists. 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.

For δ close enough to unity, the posted price p^* equals $c(q_h)$. For lower values of δ, however, one observes that price exceeds marginal costs. The increase in the price above the cost of producing high quality gives the firms an incentive not to offer low quality. This is a familiar feature of search models in which prices signal product quality (see Asher Wolinsky, 1983; Rogerson, 1988). A similar mechanism appears also in experience good markets with repeat purchases, in which quality is learned after the good is bought. In the Benjamin Klein and Keith B. Leffler (1981) model, consumers pay a quality premium which prevents the seller from cutting quality. Michael Riordan (1986) assumes that firms make price and quality decisions which cannot be altered over the relevant period. A high price then signals a high quality since consumers would refuse a *second* purchase of low quality at a high price. In my model, the consumer learns about quality before buying the good and so he *never* purchases low quality at a high price.

The negotiated-price market is clearly more efficient than the posted-price regime 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 to be superior in region I, where the buyer refrains from entering negotiations because his bargaining power is too low. 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.

IV. The Stability of Competition

This section is devoted to analyzing 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 attract profitably 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 III, I will assume that the posted offer p convinces the consumer of quality q_h only if $p \geq \pi(\hat{p})$, where $\pi(\cdot)$ is defined by (6).

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

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[14] The same argument shows that the equilibrium quality must unravel to q_ℓ when quality is a continuous choice variable within some interval $[q_\ell, q_h]$. To avoid total market failure in this situation, one has to assume that some consumers are well informed about quality.
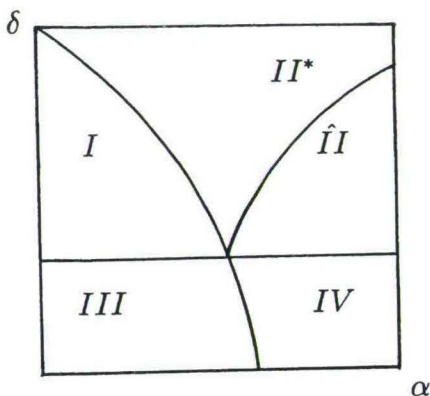
FIGURE 2. NEGOTIATED PRICING IS STABLE IN REGIONS $\widehat{II}$ AND IV; POSTED PRICING IS STABLE IN REGIONS I AND II*

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 for which this is true, I define the function

(9)
$$\delta_C(\alpha) \equiv \frac{\alpha(q_h - c(q_h)) - (q_h - q_\ell)}{\alpha(q_h - c(q_h)) - (1 - \alpha)(q_h - q_\ell)}.$$

Note that for

$$\alpha^* \equiv [q_h - q_\ell]/[q_h - q_\ell + q_h - c(q_h) - v]$$

one has

$$\delta_A(\alpha^*) = \delta_B = \delta_C(\alpha^*).$$

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 $\widehat{II}$.

PROPOSITION 3: *The negotiated-price equilibrium $\hat{p}$ is stable against price competi-*

tion 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 $p \geq q_\ell - \delta(q_h - \hat{p})$. Therefore, $\hat{p}$ is stable if and only if there is no $p < \hat{p}$ satisfying (i). This means one must have $\hat{p} \leq q_\ell - \delta(q_h - \hat{p})$. Using $\hat{p}$ from Proposition 1, this condition is equivalent to

(10) $\delta[\alpha(q_h - c(q_h)) - (1 - \alpha)(q_h - q_\ell)]$

$$\leq \alpha(q_h - c(q_h)) - (q_h - q_\ell).$$

As $\delta < 1$, this inequality cannot hold if the left-hand side is negative. Accordingly, by the definition of $\delta_C(\alpha)$, (10) holds if and only if $\alpha > [q_h - q_\ell]/[q_h - c(q_h) + q_h - q_\ell] = \bar{\alpha}$ 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 that condition (10) applies if and only if $\alpha \geq \alpha^*$ and $\delta \leq \delta_C(\alpha)$.

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 a stable equilibrium only in regions $\widehat{II}$ and IV. 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. This is so, however, because competition forces sellers to adopt a trading rule that is advantageous for the buyer.

Interestingly, notice that a stable negotiated price market 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. The empirical implication is that bargaining tends to be replaced by posted pricing when im-

provements in the communication and transportation technology reduce the buyer's search cost. Switching costs in combination with imperfect quality information provide a role for negotiated pricing in regions $\widehat{\text{II}}$ and IV. This may explain why there is relatively little haggling in markets where the consumer is well informed about product quality as, for example, in the market for mass-produced brand goods. Also, bargaining is observed less frequently in the market for new automobiles than in the used-car market, where quality uncertainty is more important. Other examples for negotiated pricing are the markets for antiques and real estate, where the buyer has to inspect quality before making a purchase.

To complete the analysis, I now investigate the stability of posted pricing. I 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 revise jointly 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 $d = d(p^*)$, it is the case that $\varphi(q_h, d) \geq p^*$.

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 (3).

PROPOSITION 4: *The posted-price equilibrium p^* is stable against bargaining if and only if either $\alpha \leq \alpha^*$ or $\alpha > \alpha^*$ and $\delta \geq \delta_C(\alpha)$.*

PROOF:
Using (5), 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

(11) $p^* \leq [(1-\alpha)(1-\delta)q_h$

  $+ \alpha c(q_h)]/[1-(1-\alpha)\delta]$.

By Proposition 2 this condition always holds if $\delta \geq [q_\ell - c(q_h)]/[q_h - c(q_h)]$ because then $p^* = c(q_h)$. For $\delta \in (\delta_B, [q_\ell - c(q_h)]/[q_h - c(q_h)])$, one has $p^* = (q_\ell - \delta q_h)/(1 - \delta)$, so that (11) is identical to

(12) $\delta[\alpha(q_h - c(q_h)) - (1 - \alpha)(q_h - q_\ell)]$

  $\geq \alpha(q_h - c(q_h)) - (q_h - q_\ell).$

As $0 < \delta < 1$, (12) always holds if the left-hand side is negative, that is, if

$\alpha \leq [q_h - q_\ell]/[q_h - c(q_h) + q_h - q_\ell] \equiv \bar{\alpha}.$

For $\alpha > \bar{\alpha}$, (12) 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 $\delta_B \leq \delta_C(\alpha) < [q_\ell - c(q_h)]/[q_h - c(q_h)]$, so that over this range (11) holds if and only if $\delta \geq \delta_C(\alpha)$.

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 $\widehat{\text{II}}$ of Figure 2, our model predicts that Bertrand competition will prevail in regions I and II* and negotiated pricing will prevail in regions $\widehat{\text{II}}$ and IV. Using Propositions 1 and 2, it is easily established that $p^* < \hat{p}$ in region II* whereas $\hat{p} < p^*$ in region $\widehat{\text{II}}$. 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 of situation. They all end up with lower profits because the negotiated price $\hat{p}$ makes undercutting profitable. In contrast, in region $\widehat{\text{II}}$ the signaling effect associated with posted pricing results in a price level p^* that makes bargaining more efficient for coping with the moral-hazard problem.

V. Conclusion

I have explored how different pricing mechanisms affect the determination of quality and price in a market with quality uncertainty and switching costs. In sum-

mary, posted pricing involves moral hazard, whereas negotiated pricing is not very competitive. I have shown that in my model this trade-off between the two trading institutions uniquely determines the equilibrium pricing policy. The equilibrium trading mechanism has the interesting property that it ensures the consumer the highest possible utility level.

My 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, I 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.[15] This may favor posted pricing. In general, however, it is not clear a priori which is the most efficient pricing institution when information and incentive problems are involved.

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[15] 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, for example, 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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