MUST SELL

LUÍS CABRAL

Faculdade de Economia
Universidade Nova de Lisboa and CEPR
1000 Lisbon, Portugal

JÓZSEF SÁKOVICS

Institut d'Anàlisi Econòmica, CSIC
Campus UAB
08193 Bellaterra (Barcelona), Spain

Why are moving sales a successful and widespread phenomenon? How can it be optimal for a seller to disclose her low valuation for the item to be sold? We propose an explanation based on the "lemons problem" in bargaining with asymmetric information about quality. Disclosing a low valuation signals that there are significant gains from trade, so that trade takes place when it wouldn't otherwise, and all agents are made better off.

1. INTRODUCTION

It is well known from bargaining theory that a seller with lower valuation or higher impatience obtains a smaller surplus in equilibrium. These results completely agree with intuition. In the first case, a lower seller valuation implies a lower surplus to be shared, and this decrease in surplus is split between seller and buyer. In the second case, the seller cannot choose her selling date optimally and, thus, has to give over part of the surplus to the buyer.

However, it is often observed in real-life bargaining that a seller discloses her impatience or her low valuation for the item to be sold. Thus, a student leaving campus explains to the prospective buyer that she (the student) "must sell" the item soon; a recent U.S. Ph.D. tells her prospective European employer that she has a high valuation for a job in Europe, which is equivalent to having a low reservation wage;

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a seller of a financial asset tries to signal that liquidity constraints are the motive for her desire to sell (as in the case of "sunshine" trading, e.g.); a store going out of business reveals that past some deadline it will not sell its remaining stock; and so on.

These observations pose the following puzzle: How can it be optimal for a party in a competitive situation to reveal his or her weakness, be it in terms of a lower seller valuation or a low discount factor (impatience)? As we have already pointed out, whenever trade takes place, this revelation has a negative effect on the seller's payoff. However, it is also important to note that trade does not necessarily occur with probability one in equilibrium (e.g., in games of incomplete information). Thus, it is conceivable that the exposed weakness of the seller increases the probability of trade to the point that in spite of getting a lower share, her expected payoff increases.

In this paper, we develop this intuition by considering the extreme case when revelation of weakness makes the trade viable where otherwise it would not occur. Specifically, we consider the "lemons problem" in bargaining with asymmetric information about quality. As first shown by Akerlof (1970), if the proportion of low-quality items on the market is very high, then no equilibrium exists in which high-quality items are sold. Now assume that a proportion of the sellers in the market have a lower valuation for the item they own; henceforth, we will refer to these as "must sell" sellers. Additionally, assume that the event of having a lower valuation is independent of quality. Under these circumstances, by credibly revealing a low valuation, a "must sell" seller signals to the buyer that conditional on owning a high-quality item, both she will accept a lower share than the rest of the high-quality sellers and that there are larger gains from trade. In addition, the free-riding, low-quality sellers will have to content themselves with less, further increasing the buyer's payoff in case she offers a price such that high-quality items are sold. The bigger pie and the larger share with the high-quality sellers plus the lower losses with the low-quality sellers thus make trade worthwhile for the buyer. At the same time, the increased—in the extreme case from zero to a positive value—gains from trade compensate the loss of bargaining power of *both high- and low-quality* sellers when they reveal themselves to be weak.

We formalize our intuition by considering different specifications of a bargaining game between a seller and a buyer who knows neither the quality of the item for sale nor the seller's valuation for it. First, we look at the case when the buyer is restricted to make a single take-it-or-leave-it offer—corresponding, for example, to a moving sale. We show that if weak sellers are allowed to send a signal to

the buyer then for a significant range of parameters, for which without this option high-quality items would not be sold in equilibrium, there is an equilibrium where "must sell" sellers reveal themselves as such and, thus, make a sale irrespectively of the quality of the item they hold. Of course, in this case any low-quality seller would prefer to signal that she is of the "must sell" type. To be able to analyze the comparative statics of this effect, we allow that the signals be less than fully credible. Naturally, the more credible the signal is, the sharper our results are.

Next, we consider the case when the buyer is allowed to make several offers, a model that better reflects the idea of actual bargaining taking place between buyer and seller—as, for example, in the case of the job market candidate who is looking for a job. We show that the opportunity for (intertemporal) price discrimination decreases the efficiency gain achieved by the introduction of the "must sell" signal. This confirms our intuition, since the "must sell" signal is useful exactly because it enables the buyer to price discriminate. However, the two effects are far from being perfect substitutes. While intertemporal price discrimination may be used to separate any two seller valuations—including high quality from low quality—the "must sell" signal only enables the buyer to separate sellers who have different valuation of the same quality. As we show, it can well be the case that the two instruments work as complements: where the "must sell" signal further refines the partition of seller values achieved by the sequence of prices.

To conclude this introduction, we make a brief reference to the related literature. Farrell and Gibbons (1989) show that cheap talk (payoff irrelevant preplay communication) can matter in bargaining situations. They show that there exist perfect Bayesian equilibria such that bargaining only takes place if at least one of the parties declares to be "keen" on bargaining (like the seller signaling that she "must sell"). Their paper differs from ours in several respects. First, what Farrell and Gibbons show is that there is an equilibrium in the game *including* a communication stage where bargaining (and, hence, a sale) only takes place if the signal is sent. What we show is that *adding* the possibility of sending a signal (i.e., a communication stage) will make trade possible. Second, they assume that preplay communication is not credible or verifiable, whereas we assume the contrary. This is important because cheap talk is only relevant in personal communication, while verifiable messages can be "advertised." Finally, they consider the case when seller and buyer valuations are independent, whereas we consider the case of common valuations (when the lemon problem arises).

On the empirical side, a relevant reference is Genesove (1993), who studies wholesale auctions of used cars. He shows that, restricting to sales of *old* used cars, new-car dealers sell on average a higher proportion of their trade-ins wholesale than used-car dealers do.[1] Moreover, they also get higher prices paid. The idea is that old cars are less valued by new-car dealers than they are by used-car dealers. Thus, in the terminology of our paper, new-car dealers are "must sell" types with respect to old cars.[2] Thus, in the wholesale used car market—just as our model predicts—"must sell" types sell more and for a higher price, corresponding to the fact that they are able to sell their "oranges."

2. Single-Offer Bargaining

Assume there is a seller of an indivisible item that can be of two different qualities. With probability m the good is of low quality, and with probability $1 - m$ it is of high quality. The seller values the high-quality item either at s or at z ($z < s$), with probabilities $1 - \alpha$ and α, respectively. The low-quality good she values at zero. We assume that *whether the seller is of the z type is independent of the quality of the item that she owns*. There is also a buyer who values the high-quality good at b and the low-quality good at zero. Assume that $b > s > z$, that is, it is common knowledge that there are gains from trade. Moreover, in order for the lemons problem to arise, assume that $z > 0$, so that the buyer cannot be sure of making a profit by offering a price equal to the high-quality seller's valuation.

We first consider the case when the buyer makes a single take-it-or-leave-it offer to the seller. Let

$$m_s^0 \equiv \frac{b - s}{b}, \tag{1}$$

$$m_s^z(\alpha) = 1 - \frac{s - z}{(1 - \alpha)(b - z)}, \tag{2}$$

and

$$m_z^0(\alpha) = 1 - \frac{z}{z + \alpha(b - z)}. \tag{3}$$

1. The reason why new-car dealers sell used cars is that many used cars are traded in for new cars.
2. The same difference between new- and used-car dealers does not occur with respect to recent model used cars. In fact, recent models are a close substitute to new cars, especially at times when economic conditions cause new car purchases to be depressed.

Proposition 1: *Equilibrium prices are characterized by the following (cf. Fig. 1):*

1. *If $m < m_s^0$ and $m < m_s^z(\alpha)$, then the buyer offers s.*
2. *If $m < m_z^0(\alpha)$ and $m > m_s^z(\alpha)$, then the buyer offers z.*
3. *If $m > m_s^0$ and $m > m_z^0(\alpha)$, then the buyer offers 0.*

Proof. It is easy to see that the buyer should choose the optimal price from the set $\{s, z, 0\}$. If he offers s, his expected profits will be $(1 - m)(b - s) - ms = (1 - m)b - s$, since that price will be accepted by all seller types. If he offers z, his expected profits will be $(1 - m)\alpha(b - z) - mz$, since that price will be accepted by all the "lemons" but only by the z-type, high-quality sellers. Finally, if he offers zero, his profits will also be zero. Equating pairwise these three profit expressions, we obtain m_s^0, $m_s^z(\alpha)$ and $m_z^0(\alpha)$. Figure 1 depicts in (m, α)-space the areas in which the different prices dominate. □

As expected, when the proportion of low-quality sellers is very high, the buyer prefers not to offer a positive price: The lemons problem arises. On the other hand, when the proportion of lemons is low, the buyer disregards the existence of z-type sellers and directly offers

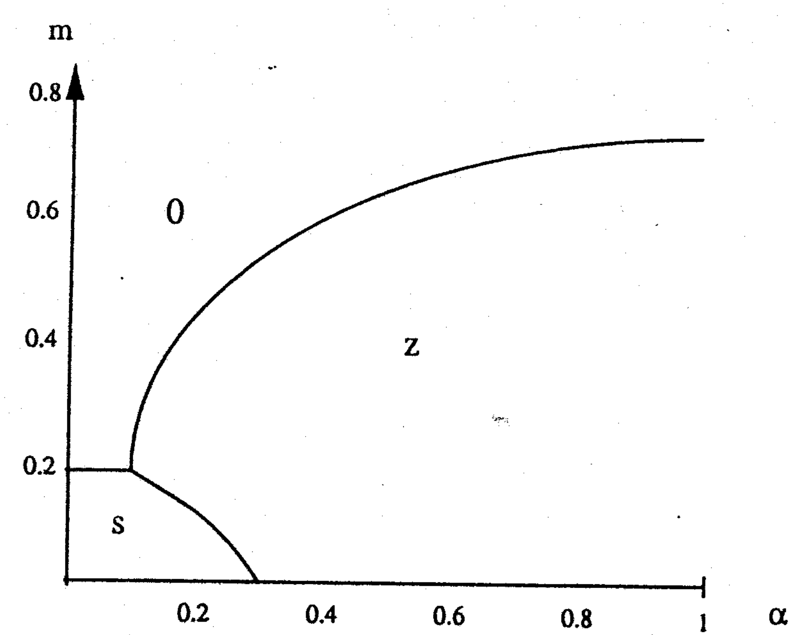

FIGURE 1. THE EQUILIBRIUM PRICE OFFERS IN (m, α)-SPACE.

s, thereby making sure that every seller type accepts. If the proportion of "must sell" sellers is sufficiently high, then, in the medium range of the fraction of lemons, the buyer finds it more advantageous to offer z. By doing so, he foregoes buying from high-quality s-type sellers in exchange for a lower price.

Let us now consider a different game. Assume that, before the buyer makes his offer, a z-type seller can reveal herself as such. We show that there exists an equilibrium of this augmented game in which the z types do reveal themselves, and a sale occurs for a larger set of parameters than in the previous equilibrium. To make the analysis more complete, we assume that the seller's signal is not fully credible. In particular, we assume that, independently of the quality of the item they own, a proportion β of the s types can falsely declare themselves to be of the z type. Let

$$M_z^0(\alpha) = \frac{\alpha(b - z)}{b\alpha + (1 - \alpha)\beta z} \quad (4)$$

and

$$M_s^0 \equiv 1 - \frac{s(1 - \beta)}{b}. \quad (5)$$

Proposition 2: *If $m > M_s^0$, then the augmented game has an equilibrium where all the z types and a fraction β of the low-quality s types claim valuation z for a high-quality item. In the continuation of this equilibrium, the buyer offers z if $m < M_z^0(\alpha)$ and 0 otherwise (cf. Fig. 2).*[3]

Proof. Make the equilibrium hypothesis that all z-type sellers, a fraction β of the low-quality s types, and none of the high-quality s types reveal themselves to be z types. In that case, upon observing a z signal, the buyer's posterior will be that the seller owns a high-quality item with probability $\alpha(1 - m)/(\alpha + (1 - \alpha)m\beta)$. He will not want to offer s, since by the equilibrium hypothesis only low-quality s-type sellers send the z signal. Upon offering z, he expects a profit of $[\alpha(1 - m)/(\alpha + (1 - \alpha)m\beta)]\, b - z$. This profit is nonnegative whenever $m \leq M_z^0(\alpha)$.

3. This is not the only possible equilibrium even when $m > 1 - s(1 - \beta)/b$. In fact, there exists another class of equilibria where only a fraction λ $(0 < \lambda \leq 1)$ of the low-quality, z-type sellers reveal a low valuation, and only low-quality items are sold. In this case, it does not pay for the high-quality z types to deviate, since their move would have no effect on the buyer's beliefs. Of course, the existence of this equilibrium does not affect the explanatory power of the proposition, since what we claim is that in practice (either because of some sort of collective rationality or as a result of a learning process), the other equilibrium obtains.

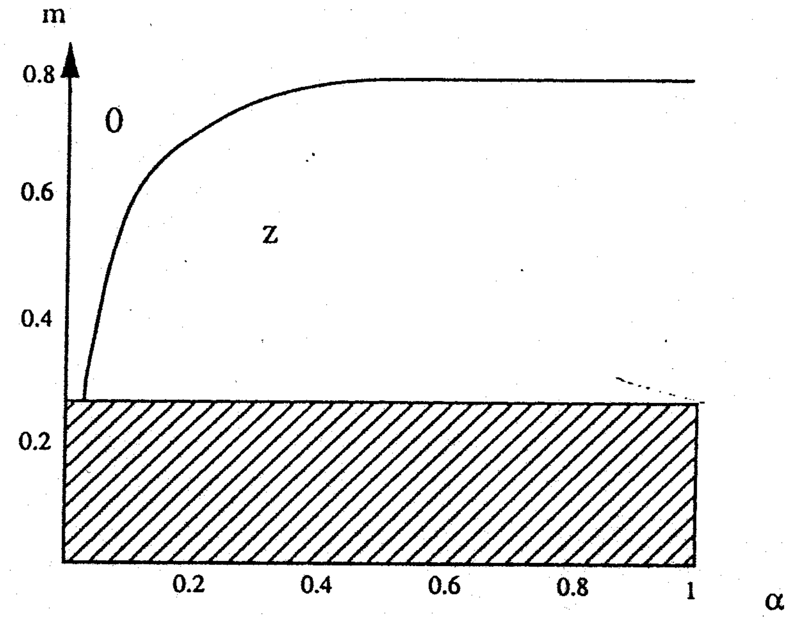

FIGURE 2. THE EQUILIBRIUM PRICE OFFERS OF THE AUGMENTED GAME IN (m, α)-SPACE.

In the absence of a z signal, the buyer's posterior about a high-quality item will be $(1 - m)/(1 - \beta)$. He will not offer z, since only low-quality sellers would accept (those s types who couldn't lie). Moreover, he will want to offer s if and only if $(1 - m)/(1 - \beta)(b - s) > (m - \beta)/(1 - \beta)s$, that is, when $m < M_s^0$. Since in the rest of the cases he will offer 0, this implies that, consistently with our equilibrium hypothesis, whenever $m > M_s^0$, it is optimal for both the z-type sellers and the lying s types to send the z signal. Finally, the high-quality s types are indifferent between sending or not the z signal.[4] □

Notice that, if m and α are small, then the equilibrium in the simple game is for the buyer to offer s. In this case, a z-type seller would not reveal her type in the augmented game, since her payoff

4. Note that if we made a fraction β of the high-quality s sellers send the z signal, the area for which our equilibrium is valid would be even bigger. Implicitly, we are assuming that sending a signal is costly, so players who are indifferent should not do it.

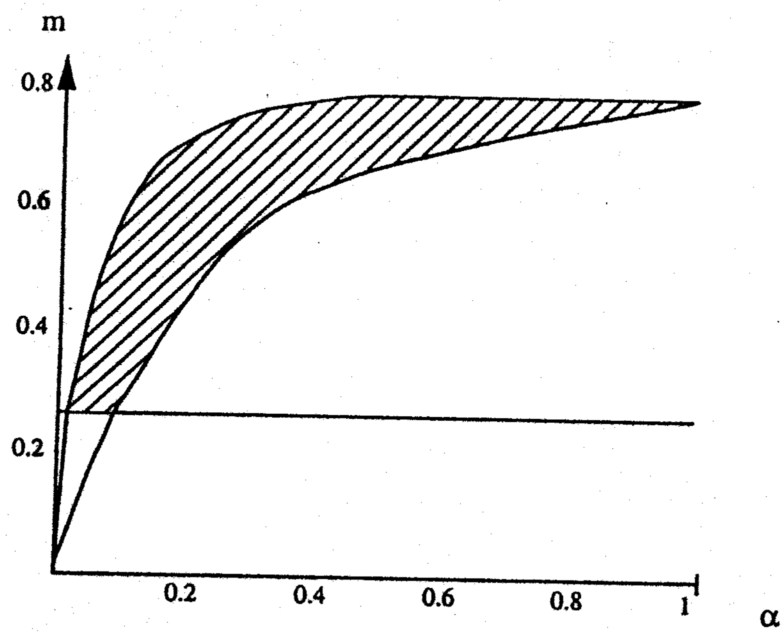

FIGURE 3. THE AREA OF STRICT PARETO IMPROVEMENT.

would decrease to z from s. This corresponds to the common intuition that revealing a low valuation is a bad strategy for a seller. However, if m is sufficiently high, then the alternatives are between selling at z and not selling at all: The strategy of revealing a low valuation may indeed be optimal.

Finally, the following corollary can be easily verified.

COROLLARY 1: *If $\beta < 1 - z/s$, then there exist (m, α) such that $m > m_z^0(\alpha)$, $m < M_z^0(\alpha)$ and $m > M_s^0$ (cf. Fig. 3). For this set of parameters, in the equilibrium described by Proposition 2, all z types reveal themselves, and they all make a sale, whereas no high-quality items are sold in the simple game.*

Note that, when $\beta < 1 - z/s$, the option of revealing a lower valuation results in a Pareto improvement: In the "triangle" defined by the corollary, the low-quality z types and the buyer strictly improve their profits. (Otherwise payoffs remain unchanged.)[5]

5. Not surprisingly, the signal has to meet a certain reliability standard in order to have a beneficial effect.

It is also interesting to note that even the truth-telling s types may gain from the existence of the "must sell" signal. Observe that, whenever β is positive, $M_s^0 > m_s^0$, and, therefore, for all m in between, in the absence of a z signal, high-quality s sellers sell, even though they would not in the simple game. The reason for this is easy to see. Since a fraction β of the low-quality s types is imitating the z types, in the virtual s type population the probability of a lemon decreases from m to $m(1 - \beta)/(1 - m\beta)$.

3. SEQUENTIAL BARGAINING

To some extent, the "lemons" problem considered in the previous section may be alleviated in a process of sequential bargaining. Giving the buyer the option to make a sequence of offers opens the way for him to employ intertemporal price discrimination, buying the low-quality item early, for a low price, and the high-quality item later, for a high price. In fact, as Evans (1989) and Vincent (1989) show, if the buyer is sufficiently patient relative to the seller, then bargaining results in a sale being made, although a sale would not occur if only one offer were allowed.

In this section, we show that, even if sequential offers are allowed, there will still be situations in which it is optimal for the seller to reveal her low valuation. As before, the reason for this is that revealing a low valuation induces a sale to be made when it wouldn't otherwise.

Bargaining is modeled by a sequence of two unilateral offers by the buyer (the uninformed party). In the first period, the buyer first makes an offer. The seller can accept this offer, in which case trade takes place instantly, or she can reject it, in which case the buyer makes a new, take-it-or-leave-it offer in the second period. The buyer and the seller's discount factors are given by δ_b and δ_s, respectively. As in the previous section, we assume that sellers can be of four types: high- or low-quality, s or z types.

We begin our analysis by showing that, with sequential offers and a relatively patient buyer, the set of values (m, α) for which a sale occurs is strictly greater than in the case of a single take-it-or-leave-it offer. Let

$$mm_s^0 = 1 - \frac{\delta_s s}{\delta_s s + \delta_b(b - s)}, \tag{6}$$

$$mm_z^z(\alpha) = 1 - \frac{z(1 - \delta_s)}{\delta_b(1 - \alpha)(b - s) + \alpha(b - z)(1 - \delta_b) + z(1 - \delta_s)}, \tag{7}$$

$$mm_z^s(\alpha) = 1 - \frac{z - \delta_s s}{\alpha(b(1 - \delta_b) - \delta_b s - z) + z - \delta_s s}, \tag{8}$$

$$mm_z z^0(\alpha) = 1 - \frac{z}{\delta_b(1 - \alpha)(b - s) + \alpha(b - z) + z}, \tag{9}$$

$$mm_s^z(\alpha) = 1 - \frac{(s - z)\delta_s}{\delta_b(b - s - \alpha(b - z)) + (s - z)\delta_s} \tag{10}$$

and

$$mm_z^0(\alpha) = 1 - \frac{\delta_s z}{\delta_s z + \delta_b \alpha(b - z)}. \tag{11}$$

PROPOSITION 3: *If $\delta_s < z/s$, then equilibrium prices are characterized by the following (cf. Fig. 4):*

1. *If $m < mm_s^0$, $m > mm_z^s(\alpha)$ and $m < mm_s^z(\alpha)$, then the buyer offers $(\delta_s s, s)$.*
2. *If $m < mm_z^0(\alpha)$, $m > mm_z^s(\alpha)$ and $m > mm_s^z(\alpha)$, then the buyer offers $(\delta_s z, z)$.*

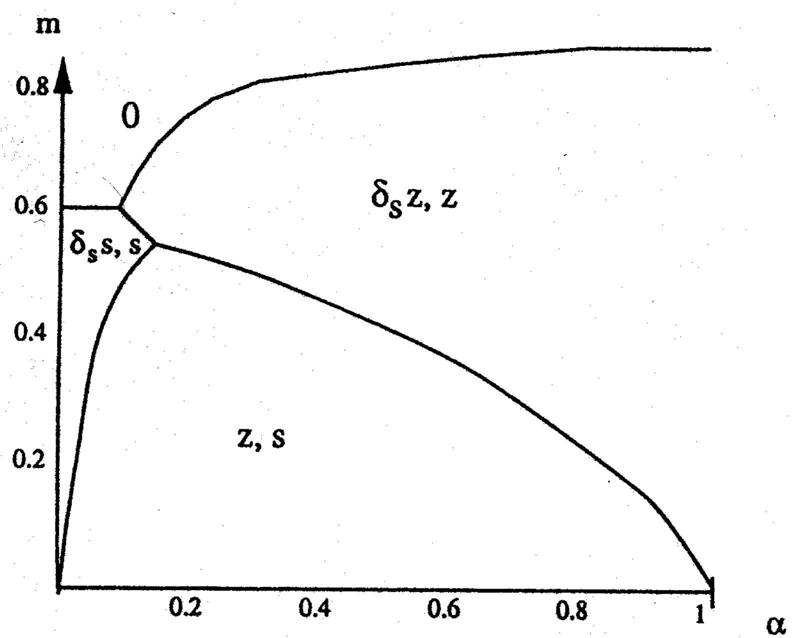

FIGURE 4. THE TWO-PRICE EQUILIBRIA IN (m, α)-SPACE.

3. *If $m < m_z z^0(\alpha)$, $m < mm_z^z(\alpha)$ and $m < mm_s^z(\alpha)$, then the buyer offers (z, s).*
4. *If $m > mm_s^0$, $m > mm_z z^0(\alpha)$ and $m > mm_z^0(\alpha)$, then the buyer offers $(0, 0)$.*

Proof. Just as in the single-offer game, the buyer's optimal offer in the second period must be 0, z, or s. The first-period optimal price then has to be such that either some high-quality items are sold or some low-quality sellers are indifferent between selling or not.[6] Therefore, we have the following price sequences for consideration: (z, s), $(\delta_s z, z)$, $(\delta_s s, s)$, and $(0, 0)$.

In the first case, since $z > \delta_s s$, all lemons and the high-quality z types are sold in the first period and the high-quality s types in the second. Thus, the buyer's expected profits are $-zm + (1 - m)(\alpha(b - z) + \delta_b(1 - \alpha)(b - s))$.

With the second price sequence, again all the lemons are sold in the first period, whereas high-quality z types wait to sell in the second period, and high-quality s types do not sell. Expected buyer profits are given by $-\delta_s zm + \delta_b(1 - m)\alpha(b - z)$.

In the third candidate price sequence, all lemons are sold in the first period, and all high-quality goods are sold in the second period. Expected buyer profits are given by $-\delta_s sm + \delta_b(1 - m)(b - s)$.

Finally, offering zero in both periods yields an expected profit of zero. It is straightforward to check that the indifference conditions are then as above. □

It is straightforward to check that $mm_s^0 > m_s^0$ and $mm_z^0(\alpha) > m_z^0(\alpha)$, for all α. Consequently, the introduction of "negotiation" strictly improves efficiency (i.e., the probability of trade), as conjectured earlier.

Now assume that, before the first offer is made, a z-type seller can reveal herself as such. As before, we allow for the possibility of a proportion β of the s types to declare themselves falsely to be of the z type.

Let

$$MM_z^0(\alpha) = \frac{\alpha(b - z)\delta_b}{(\alpha + (1 - \alpha)\beta)\delta_s z + \alpha(b - z)\delta_b} \tag{12}$$

6. To reduce the multiplicity of equilibria, we assume that the seller sells whenever indifferent between selling or not. This assumption has no important effects on our qualitative results.

and

$$MM_s^0 \equiv \frac{(b - s)\delta_b}{(1 - \beta)\delta_s s + (b - s)\delta_b}. \tag{13}$$

PROPOSITION 4: *If $m > MM_s^0$, then the augmented game has an equilibrium where all the z types and a fraction β of the low-quality s types claim valuation z for a high-quality item. In the continuation of this equilibrium, the buyer offers the price sequence $(\delta_s z, z)$ if $m < MM_z^0(\alpha)$ or (0, 0) otherwise (cf. Fig. 5).*

The proof is very similar to that of Proposition 2 and is left to the reader. The following corollary is also easy to demonstrate.

COROLLARY 2: *If $\beta < b(s - z)/(s(b - z))$, then there exist (m, α) such that $m > mm_z^0(\alpha)$, $m < MM_z^0(\alpha)$ and $m > MM_s^0$ (cf. Fig. 6). For this set of parameters, in the equilibrium described by Proposition 4, all z types reveal themselves, and they all make a sale, whereas no high-quality items are sold in the simple game.*

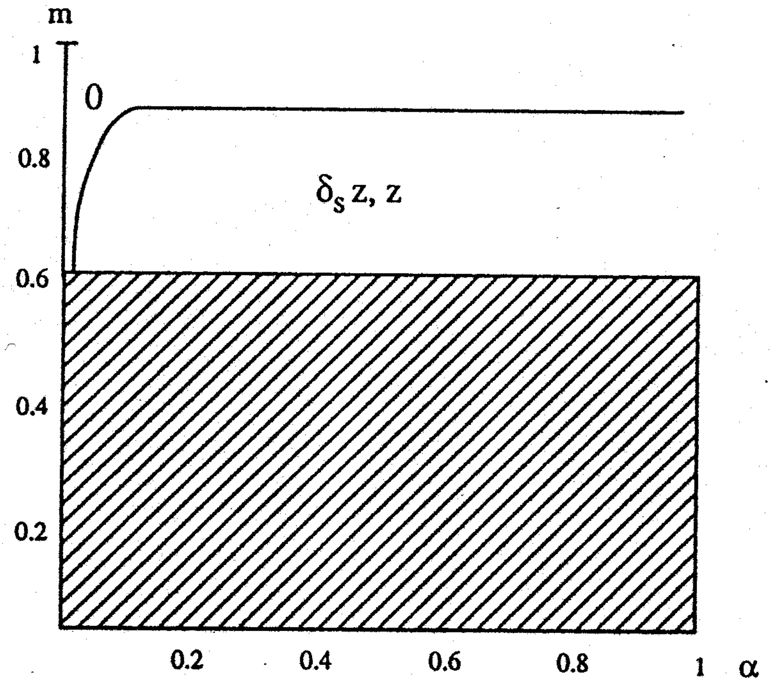

FIGURE 5. THE EQUILIBRIUM PRICE OFFERS OF THE AUGMENTED SEQUENTIAL OFFERS GAME IN (m, α)-SPACE.

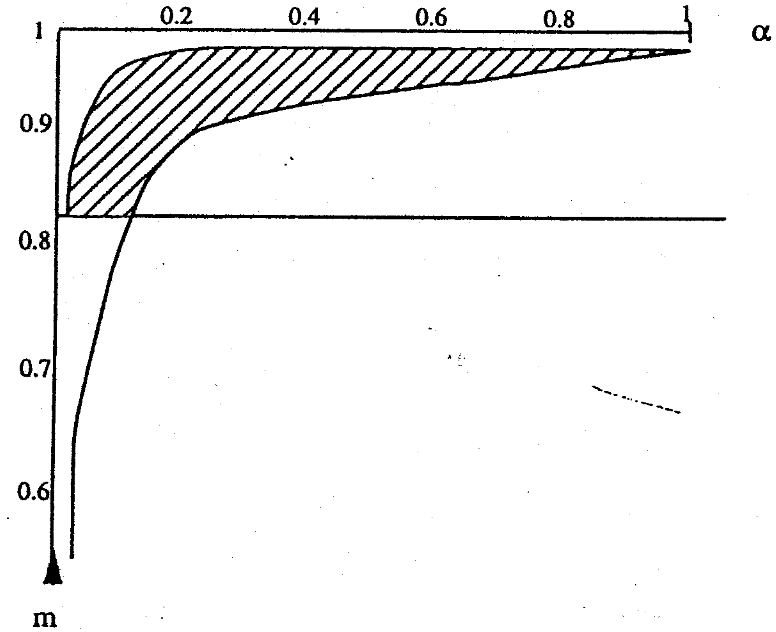

FIGURE 6. THE AREA OF EFFICIENCY GAIN OF THE AUGMENTED GAME IN (m, α)-SPACE.

The intuition for this result is similar to the one in the previous section. Consider the limiting case when $\beta = 0$ and suppose that the buyer offers the price sequence $(\delta_s z, z)$. If no announcement is allowed, then the probability of buying a lemon, conditional on making a purchase, is given by $m/(1 - (1 - m)(1 - \alpha)) > m$. However, if the buyer knows that the seller is a z type, then this probability falls to $m\alpha/\alpha = m$. This difference may be sufficiently important so as to make bargaining viable when otherwise it wouldn't be.

4. FINAL REMARKS

We have shown that disclosing a low valuation may be an optimal strategy for a seller when adverse selection destroys the market for high-quality goods (the lemons problem).

For brevity and clarity of exposition, we have only presented the simplest possible models. However, we are convinced that our results generalize in a number of ways. First, we can consider the case of a potentially infinite bargaining procedure (cf. Evans, 1989) and a finite number, or even a continuum, of quality levels (cf. Vincent, 1989). An increase in the number of bargaining rounds or that of quality levels has no qualitative impact on our results. Having more quality levels would make our model more appealing in the sense that in that case, all but the highest-quality z-type sellers would make a positive profit from revealing their weakness, not just the free-riding lemon seller as in our simple model.

Second, we can consider other trading procedures. In fact, if we take into account that our bargaining procedures give all the bargaining power to the buyer, we should expect the seller's incentives to reveal a low valuation to be even greater when bargaining power is shared more equitably.[7] The specific bargaining institution does not seem to have an important effect on the point we are making: What matters is that expected gains from trade increase as a result of the seller's announcement; how these gains are divided is of secondary importance.

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7. This can actually be seen from our results. For note, that in a range of parameter values where the availability of the signal does not increase efficiency, the buyer's revenues do increase.

Marketing Channels and the Durable Goods Monopolist: Renting versus Selling Reconsidered

Devavrat Purohit
Haas School of Business
University of California, Berkeley
Berkeley, CA 94720

Research on durable goods has shown that because of a time inconsistency problem, a monopolist manufacturer prefers to rent rather than sell its product. We reexamine the relative profitability of renting versus selling from a marketing perspective. In particular, using a simple linear demand formulation, we assume a durable goods monopolist has to use downstream intermediaries to market its product. In contrast to the case of an integrated monopolist, we find that when the monopolist has to rely on intermediaries, then it prefers to go through an intermediary that sells rather than one that rents its product. Similarly, the intermediary that sells the product is more profitable than the intermediary that rents the product. However, if the monopolist can commit to a set of prices, then the intermediary that rents is more profitable than the intermediary that sells.

1. Introduction

Most manufacturers of durables do not have company-owned distribution channels and instead rely on intermediaries to sell or lease their products to end users. For example, auto manufacturers use independent dealers to lease or sell cars to consumers, aircraft manufacturers sell many of their planes to large holding companies (e.g., GPA Group, PLC and GE Capital) that then lease these planes to airlines, and personal computer manufacturers sell their products through various independent retailers that range from small college bookstores to chains like CompUSA. Choosing the right intermediary is crucial not only because channel structures involve relatively long-term commitments that are difficult to change, but also because the

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