Rational Rationing

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Quantity rationing is often observed to occur in actual markets where quality is difficult to observe. Standard theory suggests such markets must be in disequilibrium, since firms could increase profits by raising price. This paper develops a model in which consumers learn about firm quality from noisy observations of output quality. In equilibrium, quantity rationing may occur in which low price signals high quality (and vice-versa), and high-quality firms ration demand initially. Examples are luxury cars and fine restaurants.

Introduction

Central to economists' view of markets is the law of supply and demand: prices adjust so that markets clear. Yet in many cases, such as luxury cars, fine restaurants and the labour services of young professionals, price can be below the market-clearing level and excess demand is queued or denied. The persistence of such markets is difficult to reconcile with standard theory, since the seller's profits could apparently be improved by raising price to restrict demand.

In this paper we develop an adverse selection model, broadly applicable to many markets, for which there may exist an equilibrium in which low price signals high quality (and high price signals low quality), and new high-quality firms ration demand. We assume there are good firms and bad firms, each of which can buy a 'machine' (education, etc.) that lasts two periods. Bad firms always buy inexpensive bad machines. A good firm pays for the more expensive good machine, but with some probability actually receives (unbeknownst to them) a bad machine. Good machines are more likely to produce high-quality output than bad machines, but quality control is not perfect for either type. Consumers cannot observe either firm type or machine type, but can observe output quality; they revise their priors on firms' machine types (based on their knowledge of the model) after observing first-period output quality.

Equilibrium in this model can involve good firms that are new to the market signalling their type to consumers by charging a low first-period price. This signal increases consumers' priors that the firm has a good machine, and therefore the price the firm receives in the second period (conditional upon first-period quality) is higher. If there are not enough good firms to meet all demand, then bad firms will coexist with the good. Bad firms could not afford to charge such a low price, since their likelihood of recoupment in the second period is less than that for a good firm. New good firms are thus identified as good by their first-period price behaviour. Of course, all consumers would prefer to buy from such firms. However, if there are not enough of them to satisfy demand, the equilibrium involves a shortage. Since price cannot rise to clear the market without destroying its signalling role, non-price rationing occurs.

In markets in which quality control is perfect and firms make no errors in selecting inputs, experience is perfectly informative. A firm's quality is known
with certainty as soon as a single unit is consumed (as in Shapiro, 1983) or the initial price is published (as in Allen, 1984), and no signalling is necessary. In the more realistic case of a noisy environment, learning is slower and conditioning consumer expectations plays an important role (as in Allen and Faulhaber, 1988). In a related model (Allen and Faulhaber, 1989) the role of signalling in conditioning expectations is explored in explaining the underpricing of initial public offerings of equity in capital markets.

In economic settings with noisy environments, simple deterministic models often provide a good first approximation. The explicit addition of uncertainty and its attendant complexity in these cases contributes little to our understanding of the phenomena. In the model of this paper, however, the explicit inclusion of noise changes the nature of the equilibrium outcome in a significant way. Our understanding of information asymmetries from previous deterministic models sheds little light on underpricing to signal quality in a noisy environment.

In Section I, we consider various product and service markets in which rationing occurs, with low first-period price signalling high quality. We also relate this model to the existing literature on rationing. In Section II, we develop the model and state and prove the main theorem of the paper. Concluding remarks are in Section III.

I. RATIONING IN MARKETS

Non-price rationing of demand for the products of good firms in their initial period of operation seems to occur in a number of actual markets. One illustration is the market for luxury cars. In many countries, buyers of high-quality cars have to wait for months, or even years in some cases, before taking delivery, and as a result some cars are traded at a price well above that suggested by the manufacturer. For example, in Germany four- and five-year waiting lists quickly developed after the introduction of the Mercedes 300SL and 500SL; in the USA the waiting lists for these cars was about half as long and dealers received offers around 25 per cent higher than Mercedes' suggested price (Autoweek, 11 December, 1989, p. 10). When Toyota introduced the Lexus LS400 in Japan, a one-year waiting list soon developed. In order to avoid the delay, some Japanese customers bought the car in the USA and had it shipped back to Japan; the US purchase price plus the shipping fee was about 25 per cent higher than the Japanese purchase price (Autoweek, 18 December, 1989, p. 5).

Another example, familiar to many, is the practice of most high-quality restaurants to offer low prices during their initial period of operations. These low prices persist even after reservations become difficult to obtain and customers queue for meals. Often, the prices charged at such restaurants are lower than those charged in establishments of longer standing but lower quality. The very fact that queueing occurs at a new restaurant is taken by consumers as a signal of quality. And yet, such restaurants do not raise their prices until a significant period of time has passed.

In recent years a large literature on rationing in credit and labour markets has developed (see the survey by Stiglitz, 1987). However, these models explain phenomena rather different from those described above. Wilson's (1980) results
include signalling and a form of rationing related to ours. He identifies a ‘discriminating sellers’ equilibrium’ in a ‘lemons’-type market. In this equilibrium, sellers’ private information is fully revealed, as in our model. However, in contrast to our results, higher price corresponds to higher quality. Further, high quality is in excess supply, not excess demand: the higher the seller’s quality, the lower the probability of making a sale. This equilibrium can occur because sellers with higher-quality items have a higher reservation value and so are willing to accept a lower chance of selling in order to receive a higher price. In contrast, the equilibrium of our model is characterized by low first-period price signalling high quality, and therefore rationing occurs. This strategy is worthwhile for good firms because the more favourable the beliefs of consumers about the firm in the first period, the higher will be its returns in subsequent periods.

Another related work deals with introductory advertising and discounts as signals. Milgrom and Roberts (1986) seek to explain the ‘Nelson phenomenon’ (Nelson 1970) in which otherwise wasteful expenditures, such as uninformative advertising, are undertaken by firms to signal that they are of high quality. In principle, the menu of signals available to a firm extends well beyond price—to charitable contributions, uninformative advertising, use of celebrities in expensive television ads for product endorsements or any other expenditure equivalent to ‘burning money’. Non-price signals have the drawback that they may not be observed by all (or even most) consumers, and some (such as charitable giving) require costly monitoring to be credible. Underpricing as a signal requires no monitoring and is perceived by all purchasers, because purchasers are the direct beneficiaries. In addition, there are no inefficiencies of the type associated with ‘burning money’ since the purchasers receive the benefit.¹

We therefore restrict our focus to price signalling and non-price rationing. In addition, we explicitly model the Bayesian learning which links market behaviour in each of the two periods; our results suggest that the existence of a separating equilibrium in models in which price signals quality is more delicate than might be inferred from the Milgrom–Roberts general functional formulation. Bagwell (1987) derives low introductory price as a signal of low costs (and hence of low second-period price), in a model in which search costs tend to tie consumers to firms they initially choose.

II. The Model

In each period, a continuum of firms can enter the market by incurring the cost of a fixed input, such as setting up an organization, buying capital equipment or developing a product design. For ease of exposition, we refer to this fixed input as a ‘machine’, which produces output (capacity constrained to be no more than one consumption unit) at zero marginal cost in each of two successive periods, after which the firm ceases to exist. Since a new cohort of firms becomes available for entry in each period, both new firms and experienced firms coexist and compete in the market.

Firms are either good or bad. Good firms pay $c_G$ for machines that are good with probability $\lambda$ and bad with probability $(1 - \lambda)$, $0 < \lambda < 1$. The quality of a machine cannot be directly observed, even by the firm that has purchased
it. Bad firms buy bad machines for $c_B < c_G$. Both good machines and bad can produce high-quality output, but good machines yield high quality with probability $\pi_G$, and bad machines yield high quality with probability $\pi_B < \pi_G$. In each period, output is either all high quality or all low; however, the draws in the two periods are independent. Firms are risk-neutral and maximize expected profits, discounting second-period receipts by the factor $\delta < 1$. We assume that the measure of firms from both cohorts is sufficient to supply all consumer demand in a period, but that there may not be enough good firms to meet all possible demand.\(^4\) We normalize the measure of total consumer demand to unity, and denote by $\theta$ the measure of good firms that can exist in the market at any time. The measure of bad firms is in excess of $1 - \theta$; however, we assume that there are not enough good firms to meet all demand, so that entry occurs in each period.\(^4\)

Note that if outcomes are observable without error by consumers ($\pi_G = 1$, $\pi_B = 0$), consumers can observe each firm’s choice of quality without error after one period, and there is no scope for price signalling (similar to Allen, 1984). More subtle is the need for $\lambda < 1$; if firms can choose strategies without error ($\lambda = 1$), then consumers can deduce firms’ strategies (from relative profits for good and bad machines). If consumers believe the firm chooses a good machine for sure, then it is optimal for the firm to choose a bad machine; thus the only equilibrium is the bad-machine equilibrium, as discussed in Allen and Faulhaber (1988). Only in the case of $\lambda < 1$ do non-degenerate equilibria emerge in which high quality is produced.

Consumers are (homogeneous) price-takers and expected utility-maximizers who consume at most one unit per period; they value high-quality output at $v > 0$, and low-quality output at 0. They cannot observe the quality of output at the time of purchase, but after purchase and consumption the quality of first-period output of each active firm becomes common knowledge to all consumers. Consumers know $\pi_G$ and $\pi_B$, so they are willing to pay

$$w_i = \pi_i v$$

for the output of a machine they know to be of type $i$.

To simplify the analysis, we assume that the expected net value produced by a good firm is greater than the expected net value produced by a bad firm, and both are greater than zero:

$$(1 + \delta)w_G + (1 - \lambda)(1 + \delta)w_B - c_G > (1 + \delta)w_B - c_B \geq 0.$$  

(2)

We shall assume throughout that these inequalities are satisfied.

If consumers could observe firms’ types, and if there were enough good firms to meet all demand (that is if $\theta \geq 1$), then in the competitive equilibrium good firms would compete the price down to $p = c_G / (1 + \delta)$, bad firms would not find it profitable to enter at any price that would induce consumers to buy from them (from (2)), and the first-best outcome would be achieved. We assume, however, that firm type cannot be observed by consumers.\(^5\) Consumers can observe the quality of output they receive, but not until it is purchased and consumed. Since $0 < \pi_B < \pi_G < 1$, consumers learn the firm’s machine type only imperfectly from observing output quality. Consumers have a prior probability $r_i$ that a firm’s machine is good; using Bayes’s rule, we can express the consumer’s posterior probability that the machine is good, having observed
a high or low quality output, respectively, as:

\[ r_H(r_o) = \frac{r_o \pi_G}{r_o \pi_G + (1 - r_o) \pi_B} \]
\[ r_L(r_o) = \frac{r_o (1 - \pi_G)}{r_o (1 - \pi_G) + (1 - r_o) (1 - \pi_B)}. \]

Firms’ first-period performances affect consumers’ willingness to pay in the second period through this posterior. Conditional upon firms’ first-period performance (high or low quality), consumers are willing to pay

\[ w_j(r_o) = r_j \pi_G v + (1 - r_j) \pi_B v. \]

Note that consumers’ second-period willingness to pay depends upon their prior \( r_o \) regarding a firm as well as the first-period experience of that firm.

In general, firms in the market will differ in their experience and the prior beliefs consumers hold about them. In order that the market clear, prices must be such that consumers are indifferent among all firms. For firms for which consumers hold prior beliefs \( r_o \) that they are good, the price for new firms \( p_0 \) and the prices for experienced firms (for which consumers held the same initial beliefs) \( p_H \) and \( p_L \) that clear the market must satisfy

\[ w_j(r_o) - p_j(r_o) = w_0(r_o) - p_0(r_o). \]

If for some firms consumers hold the prior \( r_0 \), while for others their prior is \( r_0' \), then market-clearing prices must satisfy

\[ w_0(r_o) - p_0(r_o) = w_j(r_o') - p_j(r_o'), \quad j = 0, H, L. \]

If in equilibrium consumers strictly prefer one set of firms over others (that is, if either (5) or (6) does not hold for some set of firms), then markets will not clear and rationing will occur.

Equation (4) can be substituted into (5) to express prices in terms of the prior and posterior probabilities \( r_j \). Then the difference in expected profit between a good firm and a bad one, given that consumers’ priors about both are \( r_0 \), can be expressed as

\[ \Delta(r_o) = \lambda \delta v [r_H(r_o) - r_L(r_o)] (\pi_G - \pi_B)^2 - (c_G - c_B). \]

Would new good firms be interested in signalling their type to consumers using first-period price (their only available instrument)? In our model with input and output quality noise, firms may be able to affect their second-period receipts (conditional upon first-period quality) by changing consumers’ priors about them. For example, if a firm can use its first-period price to convince consumers that it is good, then consumers would be willing to pay \( w_j(\lambda) \) for that firm’s output in the second period, \( j = H, L \). However, if consumers could not distinguish good firms from bad in the first period, and there were only \( \theta < 1 \) good firms in the new-firm pool, then consumers would only be willing to pay \( w_j(\lambda \theta) \) for the firm’s output in the second period, \( j = H, L \). Since \( w_j(\lambda) > w_j(\lambda \theta) \), good firms might have an incentive to separate themselves by first-period price signalling.

We specify consumers’ beliefs conditional on a firm’s first-period price by defining \( r(p) \) to be consumers’ prior probability that a firm’s machine is good
if its first-period price is \( p \). The equilibrium concept is Nash, with the restriction that agents always behave rationally with respect to their beliefs \( r(p) \), and their beliefs are correct in equilibrium. We also add the restriction that equilibria must satisfy the Intuitive Criterion of Cho and Kreps:

There exists no out-of-equilibrium (first-period) price \( p \) which (i) bad firms would find unprofitable to charge under any consumer beliefs; and (ii) good firms would prefer to charge if consumers therefore believed they were good (that is, \( r(p) = \lambda \)).

(Cho and Kreps 1987, p. 202.)

This condition rules out equilibria in which consumers have seemingly perverse beliefs: that a firm is bad even though its first-period price is inconsistent with bad-firm profit maximization.

We state and prove the main result of the paper.

**Theorem.** If \( 0 < \pi_B < \pi_G < 1, \lambda < 1, \) and \( \Delta(\lambda) > 0 \), then

(a) for \( \theta \geq 1 \), an equilibrium exists in which \( r(p) = \lambda \) for all \( p \), only good firms are in the market, and prices adjust so that they earn zero expected profit. The first-best outcome is achieved. First-period price is

\[
p_0 = \frac{c_B - \delta v(\pi_G - \pi_B)[r_H(\lambda) - r_L(\lambda)][\lambda \pi_G + (1 - \lambda) \pi_B] - [\lambda - r_L(\lambda)]}{1 + \delta}
\]

and second-period prices \( p_H \) and \( p_L \) are given by (5), with \( r_0 = \lambda \).

(b) for \( \theta < 1 \), a separating equilibrium exists, with

\[
r^*(p) = \begin{cases} 
\lambda, & \text{for } p \leq p_0^* \\
0, & \text{for } p > p_0^* 
\end{cases}
\]

where \( p_0^* \) is the first-period price at which bad firms earn zero profits if they masquerade as good firms:

\[
p_0^* = c_B - \delta[\pi_B p_H + (1 - \pi_B) p_L]
\]

\[
= \frac{c_B}{1 + \delta} - \delta v(\pi_G - \pi_B)[r_H(\lambda) \pi_B + r_L(\lambda)(1 - \pi_B)].
\]

In the first period, good firms charge \( p_0^* \). Bad firms earn zero profits, and charge the same price \( p_B = c_B/(1 + \delta) > p_0^* \) in each period. In the second period, good firms charge prices \( p_H \) and \( p_L \) given by (6), with \( r_0 = 0 \) and \( r'_0 = \lambda \). Good firms earn positive profits.

(c) In the equilibrium of (b), the first-period output of good firms is always rationed.

**Proof.** See Appendix.

The intuition regarding (b) and (c) is straightforward. Only good firms, whose subsequent-period performance is better than bad firms, can afford to underprice in the first period. By so signalling their quality, good firms condition consumers’ expectations (in the form of their priors) so that this subsequent performance is more highly rewarded than if consumers’ expectations were lower. Because the good firm’s first-period price is used to signal, it need not clear the market; in fact, first-period price is below the market-clearing price. Therefore, non-price rationing occurs.
This separating equilibrium is not the only equilibrium of the model. There always exists an ‘all-bad firm’ equilibrium, with \( r(p) = 0 \) for all \( p \), and price in each period equal to a bad firm’s discounted cost. Clearly, the separating equilibrium of the theorem Pareto-dominates this ‘all-bad firm’ equilibrium. Also, if \( \theta < 1 \) and \( \Delta(\lambda \theta) > 0 \), there may exist a pooling equilibrium as well, in which good firms charge a higher initial price than in the separating equilibrium and consumers cannot distinguish among initial-period firms. This pooling equilibrium may or may not be more profitable for good firms than the separating equilibrium of the theorem. In addition, there may exist a partial pooling equilibrium, in which \( \phi < \theta \), good firms choose to pool with bad firms, and the remainder choose to separate themselves by charging a low first-period price, if the profits from each action for good firms are identical.\(^7\) We focus on the equilibrium with rationing because of its potential to explain seemingly anomalous market behaviour.

We show existence of equilibrium by exhibiting parameter values that lead to a separating equilibrium. Suppose that consumers value the high-quality product at \( v = 100 \), the discount factor is \( \delta = 0.85 \), there are only 30 per cent as many good firms as there is demand for them (\( \theta = 0.3 \)), a good firm’s chance of obtaining a good machine is \( \lambda = 0.5 \), and they must pay \( c_G = 30 > 18 = c_B \). Output noise is \( \pi_G = 0.9 > 0.1 = \pi_B \). A separating equilibrium exists in which bad firms charge a price \( p_B = 9.73 \) in each period. Good firms charge 1.55 in the first period, and second-period prices are 73.26 if the firm produced high quality in the first period and 13.37 if the firm produced low quality. Good firms earn an expected profit of 0.22 and bad firms of course earn zero profit. There is no pooling or partial pooling equilibria for these parameter values.

It should be noted that, in a separating equilibrium, consumers faced with rationing have an incentive to make a side-payment. Clearly, the firm cannot accept such a payment, since that would destroy the signalling value of the low price. However, intermediaries may be able to capture the premium. In the case of luxury cars, dealers may charge a price well above the manufacturers’ suggested retail price (possibly through extra ‘delivery charges’). For fine restaurants, the maître d’hôtel may accept bribes (in the form of lavish ‘tips’) as a rationing device.

Why are scarcity of good firms, input noise, output noise and Bayesian learning necessary to obtain the rationing result? The role of scarcity in the model is suggested by part (a) of the theorem. With enough good firms, bad firms are driven from the market and a good-firm competitive equilibrium obtains.

The role of noise in the model is to ensure that non-trivial Bayesian learning occurs, and that what consumers think of a firm in the first period (prior) affects how they interpret the firm’s track record (posterior) in their second-period willingness to pay (\( w_H \) and \( w_L \)).

— If there is no output noise (\( \pi_G = 1, \pi_B = 0 \)), then we have a standard reputation model, in which second-period prices are dictated solely by first-period output quality and not by first-period beliefs. Thus, good firms will not find it worth while to signal with low first-period prices.

— If there is output noise but not input noise (\( \lambda = 1 \)), then from (7) it can be seen that \( \Delta(1) < 0 \), and the conditions of the theorem do not hold. Since bad firms would earn zero profits in any potential separating equilibrium,
good firms would therefore earn negative profits, and consequently no such equilibria exist.
— If there is both input and output noise, consumers’ willingness to pay in the second period is affected not only by experience but also by their first-period beliefs about the quality of firms. In this model, firms that are better thought of by consumers in the first period receive higher prices in the second period conditional on first-period output quality. However, a good first-period outcome is more highly valued in the second period for all feasible consumer beliefs. Since a good firm is more likely to have a good first-period outcome, its expected revenue in the second period will be greater than that of a bad firm even if consumers have the same prior about both. It is this property that enables good firms to separate themselves from bad firms, and signal their quality to consumers, resulting in the equilibrium of the theorem.

III. Concluding Remarks

In this paper, we develop an adverse selection model in which consumers learn imperfectly of firms’ types from experience. Good firms can find it profitable to signal their type to consumers with a low first-period price (their only available signal). The resulting excess demand for their output cannot elicit an increase in price without destroying its signalling role. We have shown that in this equilibrium low price signals high quality and vice-versa, and high-quality firms ration demand in their first period.

APPENDIX: PROOF OF THEOREM

(a) With enough good firms to meet all consumer demand ($\theta \geq 1$), this is the competitive equilibrium. Good firms earn zero profit; since $\Delta(\Delta) > 0$, bad firms do not enter since they can at best anticipate negative profit. $\square$

(b) It must be shown that (i) both good and bad firms make non-negative profits; (ii) neither good nor bad firms have any incentive to change their price decisions; (iii) consumers’ priors are correct.

(i) Since there is an excess supply of potential bad firms and entry occurs in each period, it follows that known bad firms make zero profits. Since their price is the same in each period, it must be $p_B = c_B / (1 + \delta)$. $p^*_B$ is defined to be the price at which bad firms that consumers thought to be good would make zero profits. Since $\Delta(\Delta) > 0$, good firms that consumers think to be good make positive profits at $p^*_B$. $\square$

(ii) Any firm that charges a price $p > p_B$ is perceived as bad by consumers but cannot sell any output since cheaper bad firms available to consumers. Bad firms that charge $p^*_B < p < p_B$ are still perceived by consumers as bad, but cannot cover their costs. Bad firms that charge $p \leq p^*_B$ are perceived by consumers as good, but cannot earn positive profits. Therefore, $p_B$ is their profit-maximizing price. Good firms that charge $p^*_B < p < p_B$ are perceived as bad firms but their costs are higher and so would be unprofitable. Good firms that charge $p < p^*_B$ are still perceived as good, but make lower profits than at $p^*_B$. Therefore, $p^*_B$ is their profit-maximizing price. $\square$

(iii) In equilibrium, consumers find only good firms charging $p^*_B$, which conforms to their prior $r^*(p^*_B) = \lambda$. They find only bad firms charging $p_B$, which conforms with their prior $r^*(p_B)$. Therefore, $r^*(\cdot)$ is correct in equilibrium. $\square$

(c) We must show that consumers strictly prefer to buy from first-period good firms rather than bad firms (or, equivalently, from second-period good firms); that is,
\[ w_0(\lambda) - p^*_B > w_B - p_B. \] We first note that \( \pi_G > \pi_B \) and \( 1 > \lambda > 0 \) implies
\[ w_0(\lambda) > w_0(0) = w_B \quad \text{and} \quad w_H(\lambda) > w_L(\lambda) > w_B, \]
so
\[ \pi_B w_H + (1 - \pi_B) w_L > w_B; \]
therefore
\[ w_0 + \delta[\pi_B w_H + (1 - \pi_B) w_L] > w_B + \delta w_B \Rightarrow w_0 + \delta[\pi_B w_H + (1 - \pi_B) w_L] - c_B > (1 + \delta)[w_B - c_B/(1 + \delta)]. \]

Using (5) and (6), we have
\[ w_0 - (w_B - p_B) > c_B - \delta[\pi_B p_H + (1 - \pi_B) p_L] = p^*_0 \Rightarrow w_0 - p^*_0 > w_B - p_B. \]

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NOTES

1. Underpricing can have further advantages as a signal. For example, the underpricing of Cabbage Patch dolls in 1983 in the USA by Coleco Industries led to a great deal of publicity about the doll.
2. The model can be generalized to give good firms the option of buying a bad machine at the cost \( c_B. \) This does not significantly alter the analysis or the results.
3. Since 'good' and 'bad' are intrinsic characteristics of the firms, it is possible that the desirable property of 'good' is under-represented in the gene pool relative to demand for the services of good firms. Good chefs, for example, may command rents because they are in scarce supply relative to demand, if good chefs are born, not made.
4. For expositional simplicity, we restrict attention to the competitive case. Results are similar for the monopoly case, with only minor differences in detail.
5. We make the standard assumption of the reputation literature that warranties are not feasible.
6. This equilibrium is unique in the prices realized but not in consumer beliefs. Indeed, any consumer believes \( r(p) \) for which \( r(p^*_B) = \lambda, r(p_B) = 0, \) and for any other \( p' \) is sufficiently small (zero, in the case of \( r^*(p) \)) that neither type of firms wishes to deviate to \( p' \) will support these prices. In addition, there are possible equilibria involving consumer beliefs of the same form as \( r^*(p) \), but with a 'cut-off' price \( p < p^*_B \). Such equilibria can support positive profits for good firms at the low initial price of \( \hat{p} \) with negative profits for bad firms that might attempt to mimic good firms. This suggests a continuum of separating equilibria; however, these equilibria do not satisfy the Cho–Kreps Intuitive Criterion: consumers know that a bad firm charging a price between \( \hat{p} \) and \( p^*_B \) would be unprofitable, but that a good firm that did so, and that consumers believed to be good, would prefer such a price to \( \hat{p} \). Hence, all consumer beliefs satisfying the Intuitive Criterion must have \( r(p) = \lambda \) for all \( p \geq p^*_B \), thus ruling out multiple equilibria.
7. As in Milgrom and Roberts (1986) these pooling and partial pooling equilibria can be eliminated for some but not necessarily all values of the exogenous parameters by restricting consumer beliefs to those that satisfy the Intuitive Criterion.

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