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May 28, 2001. Preliminary and Incomplete

Abstract

Do 'cultural' or 'historical' in‡uences determine competitive markets' outcomes? Using a dynamic model of Bertrand competition with unobservable quality, it is shown that buyers' expectations can determine price and quality sold in a self-fulling way. In most of these equilibria, quality supplied will not correspond to the e¢cient level. This will occur even though prices are costlessly observable, and there is full quality commitment (i.e., …rms are committed to their initial quality choice). Also, it is shown that if quality is costly, it will tend to be undersupplied. These results illustrate that competition might actually enhance the role of buyers' expectations ('culture') in determining market outcomes, contrary to the presumption that competition tends to neutralize such in‡uence.

1 Introduction

Are competitive markets' outcomes immune to 'cultural' or 'historical' in‡uences? In other words, given identical tastes, technology, market institutions, and information regarding these fundamentals, is there any reason to expect competitive markets to deliver di¤erent outcomes just on account of 'inherited' di¤erences in expectations or 'customs'? That two economies with the same fundamentals should deliver di¤erent equilibria, is, of course, a familiar possibility. The question here is rather whether 'inherited' expectations and patterns of behavior can play a decisive role in determining trade outcomes, even in the presence of vigorous competition.

Is there any presumption that competition would neutralize such in‡u-ences? I think there is. Take, for example, First World employers' complaints about the low work-ethic of their Third World employees. While such complaints are pervasive, they are nevertheless puzzling: After all, competition for (usually) very scarce jobs (and well paid jobs, at least for local standards), should induce employees to meet the e¤ort standards of employers. Another example (one closer to -an academic's- home) is provided by the low standards of campus' services (restaurants in particular). Often such low standards are attributed to the low expectations of the average student customer. Is this justi…ed? After all, regardless of how low customers expectations might be, suppliers should try and entice their rivals' customers by o¤ering improved services (note that it is being implicitly assumed that even student customers value quality enough for it to be pro…tably supplied). Such considerations suggest that competition should render 'cultural in‡uences' of this sort irrelevant. Yet, undeniably, work-ethic is low in many Third World locations, and quality provided by many a campus' business remains stubbornly sub-standard. Though alternative explanations exist (students might simply not value quality the way their teachers do; what employers regard as low work-ethic might just re‡ect health and education de…cits), the hypothesis explored in this paper is that, perhaps, there is something in the structure of these markets that prevents competition from neutralizing such cultural factors.

More speci…cally, the paper looks at this question in the context of a dynamic game of competitive trade with observable prices but unobservable quality. Since it is assumed that there is quality commitment (i.e., sellers commit to a quality level at the start of the game), it is relatively easy for sellers to modify buyers' beliefs regarding quality (only one purchase is needed to do so). Yet, the fact that sellers compete intensively for buyers (in a Bertrand fashion -choosing both prices and qualities simultaneously in the initial period; only prices at later periods), turns out to make it too costly in many cases for sellers to modify buyers' quality expectations. The end-result is that buyers' inherited expectations end up determining the terms of trade (price and quality) in a self-ful…lling way.

By the way it is shown that increasing costs of supplying quality bias the market towards ine¢ciently low quality (rather than ine¢ciently high quality). A feature that seems to describe the situation in many markets (at least this is this author's casual impression).

A key ingredient in the argument is the assumption that quality is not observable to buyers[1]. Actually, even this assumption can be justified by the existence of vigorous competition in the market, since, as will be argued below, the tendency of the latter to equalize the conditions of trade (both price and quality) leads buyers to refrain from spending resources in searching for the best deal (to the point that in the type of market considered here one can weaken this hypothesis to just positing vanishingly small costs of checking quality on the part of consumers).

The main lesson from this analysis is to suggest that competition, far from immunizing markets against 'predetermined' demand expectations, might instead make them very vulnerable to such influences, and thus lead to inefficient quality standards. One way out of this is for sellers to collude. Of course, the problem with such a 'solution' is that it will allow sellers to appropriate most of the surplus (and, in a more general setup, lead to additional distortions). Neither is it the case, at least in the model presented here, that collusive agreements are easier to maintain in this sort of market. In other words, the fact that a market is susceptible to demand culture does not make it susceptible to supply 'culture' (i.e., norms).

The paper is organized as follows: After briefly discussing some related literature, the basic model is presented in Section 2. Then in Sections 3 and 4, a class of equilibria for this game is presented and its key features discussed. Section 5 concludes.

1.1 Relation to the Literature

While there are quite a few theoretical papers that deal in one way or another with the relation between competitive markets and culture, this body of work can hardly be described as a literature on the subject. For starters, each paper emphasis a somewhat different aspect of the problem, depending on the notion of culture it adopts.

I can identify at least 4 different approaches (though most papers combine the various approaches, including the present one):

1) Culture as 'values' reflected in agents tastes. The seminal reference here seems to be Akerlof 1982 (see also the experimental work of Fehr et al. 1998). This line of enquiry proceeds by incorporating unconventional arguments into

[1] This assumption does seem adequate in the campus' services example just mentioned (who heeds claims of the sort "we serve the best burgers in campus" ?). In the work-ethic example it is not even clear prices (more precisely, wages) can be advertised effectively.

agents' objectives, which are meant to re‡ect notions of fairness, altruistic concerns, etc (in the case of Akerlof 1982 the wage is incorporated as an argument into workers' utilities. This is meant to re‡ect workers' concern for a fair remuneration).

2) Culture as predetermined expectations (i.e., expectations determined by non-market considerations). The present work follows this line. Note that this paper begs the question of what would happen if these predetermined expectations were not validated by the market (i.e., did not correspond to some equilibrium market outcome). A paper which takes this same basic approach is Goyal et al. 1995. In a repeated coordination game, some agents obtain information regarding the desirability of coordinating play at a new outcome, and must signal this information to uninformed players by changing their actions. This implies non-coordinated outcomes in a transitional stage, thus creating a sort of endogenous inertia which may prevent the better outcome from being reached. In the present model there is also a transitional cost which keeps sellers from adjusting quality towards e¢cient levels, yet this cost arises from the interaction between the prevailing structure of beliefs and competition. This results in a trade-o¤ between capturing informational rents and attracting new buyers.

3) Culture as norms (in the conventional game-theoretic sense). This way of looking at the question would be very close to the literature on collusion (e.g., Stigler ?, Green and Porter ?). Competition for customers is the main obstacle to maintaining such arrangements.

4) Culture as evolutionary inertia. This approach is exempli…ed by Vega Redondo

1993, and to a lesser extent, Young and Burke 2000 (though this latter work actually combines the evolutionary approach with the 'values' approach). The approach identi…es culture with the 'prevailing social pattern of behavior' which tends to persist due to imitation and contagion e¤ects of various sorts. The forces of competition work against this persistence by eliminating less advantageous patterns. Note that the story developed in this paper also has a strong inertial component. See the discussion under 3).

Besides the more theoretically oriented literature, there is a substantial body of experimental work attempting the ascertain the role of culture in determining market outcomes. In fact, one of the (few?) well established facts in the experimental literature concerns the robustness of competitive markets' outcomes to cultural di¤erences (see Kachelmeier and Shehata 1992, Roth et al. 1991 and references therein). These results raise a question as to the relevance of the present theoretical exercise. I think one should be careful in this respect: Note that the present paper studies a specific market structure which turns out to be extremely sensitive to culture. Whether such markets are rare or not is an issue that the experimental literature does not address. That literature only shows that double sided auctions (with homogenous quality) appear to be robust to cultural influences.

2 The Game

There will be an infinite (countable) number of infinitely lived sellers, and, each period, an infinite number of buyers. Buyers will live for two periods, in overlapping generations. Except for the initial period, this will mean that every period there will be one old and one young buyer for each seller.

Sellers produce an item of variable quality $q \in [0,\bar{q}]$, at a cost per unit of $c(q)$, with $c'(\cdot) \geq 0$, while buyers have unit demand for this item, with reservation values given by $v(q)$, with $v'(\cdot) > 0$. It will be assumed that there is an unique efficient quality level, i.e., q^e such that

$$q^e = \arg\max_q v(q) - c(q)$$

Every period a new generation of buyers will choose a seller to be matched with (and whether to trade or not with that seller) after having observed the prices charged by all sellers (but without observing the qualities chosen in the first period).

Buyers will be assumed not to be able to observe what happens outside their own matches (except for prices). Sellers, on the other hand, will be assumed, in principle, to know at the whole history of the economy (though the equilibrium presented below will specify Markov strategies).

The above game will be 'repeated' infinitely. The result will not be a conventional repeated game, as it will be assumed that sellers are committed to their initial choice of quality (i.e., quality is chosen only once at the start of the supergame)[2]. On the other hand, sellers will have the option to vary the price they charge from one period to the next. This seems an adequate

[2] An infinite horizon is not necessary here in the sense that, under the quality commitment assumption, the backward induction problem does not arise. In fact, a two period version would suffice to make the essential points of the paper. I stick to the infinite horizon formulation since it is not particularly more demanding, and, moreover, it dispels any doubts that might otherwise remain regarding the robustness of two-period results to

description of the situation prevailing in many markets: Quality changes often require considerable changes in the way a firm does business, and so, will take much longer to effect, and will be associated with substantial costs. Price changes, in contrast, can be made quite rapidly and at minimum cost (if any).

The remuneration to a buyer is then the discounted value of trade (at rate β) over his or her lifetime. The payoff to a seller is the discounted value of trade throughout the game (at rate β as well).

Note that this model differs from a (repeated) Bertrand competition model mainly in . the introduction of unobservable quality, and in the quality commitment feature.

3 Beliefs and Strategies

More formally, the game is as follows:

The horizon will be infinite[3] and time discrete, $t = 1; 2; 3; \ldots$. Let $S = \{1; 2; 3; \ldots\}$ be the set of (infinitely-lived) sellers[4], who will be denoted by a superscript j: There will be overlapping generations of two-period-lived buyers. Let $B_t = \{(1; t); (2; t); (3; t); \ldots\}$ be the set of buyers born at time t; each of whom will be denoted by a superscript $(i; t)$ (there will be one buyer per seller in the initial period, and two buyers per seller in later periods):

The outcome of the tth.period-game, o_t; is a list

$$\left\{ \left\{ q_1^j; p_t^j \right\}_{j=1}^{\infty}; \left(\left\{ m_{t;1}^{(i;k)}; t_{t;1}^{(i;k)} \right\}_{i=1}^{\infty} \right)_{k \in \{t-1;t\}} \right\}$$

Here, $q_1^j \in [0; \bar{q}]$ stands for the quality chosen by seller j in period 1 (and to which this seller is committed forever); $p_t^j \in [0; \infty)$ stands for the price to which seller j committed that period; $m_{t;1}^{(i;k)}$ refers to the $(i; k)$ buyer's choice

longer horizons.

The assumption of an infinity of sellers does not seem essential neither. It is made to be able to specify matching behavior in such a way as to avoid 'return' or 'carom' matchings (i.e., increased sales in the future resulting from current sacrifices of customers).

[3] An infinite horizon is not required here, in the sense that the 'backward induction problem' will not arise here given the assumption of initial quality commitment.

[4] It is assumed that there is an infinite number of sellers in order to avoid 'return' matchings, a feature that would only complicate the description of the equilibrium without changing the substance of the story.

of seller, while $t^{(i,k)}_{t,1} \in \{b, nb\}$, stands for this buyer's trade decisions after matching (buy, not buy).

The second subscript refers to the stage of the period-game: Each such period is subdivided into 2 stages, a pricing stage, which, for convenience, will be simply denoted by t, and a matching and trading stage, denoted by $t,1$.

A history at the start of period t, h_t, is a list of the 'outcomes' in each period-game up to t (not including that period's), that is, $(o_1, ..., o_{t-1})$. The strategy of a seller j, s^j, is, generally[5], a sequence of mappings, $\left\{s^j_t\right\}_{t=1}^{\infty}$, one for each period, each going from the set of possible histories up to the beginning of that period, H_t, to the actions available then. That is,

$$s^j_1 \in [0, \bar{q}] \times [0, \infty)$$

$$s^j_t : H_t \to [0, \infty) \quad t > 1$$

The first such mapping, s^j_1, is simply a pair $\{q^j_1, p^j_1\}$, where the first entry denotes the chosen quality, the second the chosen price. Mappings corresponding to later periods specify a price only.

The strategy of a buyer (i,t) consists of two mappings, one for each period of the buyer's life. The first one will be simply a mapping from observed prices to matching and trade decisions,

$$\sigma^{(i,t)}_1 : [0, \infty)^{\infty} \to S \times \{b, nb\}$$

The second mapping is given by

$$\sigma^{(i,t)}_2 : H^{(i,t)}_2 \to S \times \{b, nb\}$$

with $H^{(i,t)}_2$ denoting histories of the form

$$\left(p_{t+1}, q^{(i,t)}_E\right)$$

where $q^{(i,t)}_E$ stands for 'quality experience' of this buyer in her first period of life. It is defined as follows,

$$\left(q^{(i,t)}_E\right)_j = q^j_1 \quad \text{if} \quad \sigma^{(i,t)}_1 = \{j, b\}$$

$$\left(q^{(i,t)}_E\right)_j = \emptyset \quad \text{if} \quad \sigma^{(i,t)}_1 = \{i, \cdot\},\ i \neq j \quad \text{or} \quad \sigma^{(i,t)}_1 = \{j, nb\}$$

[5] Further down, when describing a 'norm' equilibrium for this game, sellers' strategies will be specialized to Markov strategies, i.e., strategies that only depend on payoff-relevant features of history.

Note that buyers condition only on part of the history of the economy, namely, the decisions they themselves have taken, the quality of their own purchase, plus the profile of prices charged each period (which are assumed public).

This being a game of imperfect information, one needs to specify buyers' beliefs. Beliefs refer here to the prevailing quality constellation, more precisely, are an element of $\Delta\{[0,\bar{q}]^{\infty}\}$. It suffices to specify beliefs at stage $t,1$; i.e., after a buyer (i,t') has observed the posted prices,

$$a_{t,1}^{(i,t)} : p_t \rightarrow \Delta\{[0,\bar{q}]^{\infty}\}$$

$$a_{t,1}^{(i,t-1)} : H_2^{(i,t-1)} \rightarrow \Delta\{[0,\bar{q}]^{\infty}\}$$

3.1 Demand Norms

The general idea behind what I refer to as a 'demand norm' is that buyers enter the market with 'exogenously' formed beliefs, which they will only change if their trading experience forces them to. Sellers on the other hand, are less likely to approach things in this way. Their beliefs are more likely to have resulted from trying to understand the way the market works, i.e., are more likely to be equilibrium determined in the usual manner[6].

To capture this idea, it will be assumed that, in the absence of quality observations (i.e., as long as buyers have not experienced the quality supplied by a seller), buyers associate each price with a specific quality level. This quite independently of the overall pattern of prices, or identity of the seller making the price offer. This strong link between prices and qualities in consumers' minds, I will call a "demand norm", and it will represented by a function

$$n^{(i,t)}(p) : [0,\infty) \rightarrow [0,\bar{q}]$$

with

$$n^{(i,t)}(p) = n(p) \quad \forall (i,t)$$

The only way that a seller can modify a buyer's norm is by actually supplying this buyer a quality different from the one originally specified in the norm.

[6] Note that there is a tension here with the usual Nash approach, in which beliefs are partially equilibrium determined, not a datum of the game. Of course, there might be equilibria which confirm prior (buyer) beliefs, and this paper focuses precisely on such equilibria. On the other hand, there would seem to be a whole range of issues which cannot be dealt with in the conventional manner, see Section ?.

In such an instance, it will be assumed that the rest of the norm remains unchanged (i.e., the buyer continues to apply the norm to other sellers who have not yet deviated when selling to this buyer), the only change being that now this buyer will believe that this seller will always provide this quality at whatever price (this the buyer must believe -by consistency). So, while the norm is relatively immune to sellers' actions, it is not completely so (and could not be under the quality commitment assumption). In short, beliefs embodied in a 'demand norm' will be assumed invariant to registered deviations in non-quality decisions.

Hence, beliefs in a demand norm equilibrium will satisfy the following restriction,

$$a_{t;1}^{(i;t-1)}(\cdot)(q')_j = 0$$

$$\forall \{q' \text{ s.t. } \left(q_E^{(i;t-1)}\right)_j = q_1^j \neq q' \text{ or } \left(q_E^{(i;t-1)}\right)_j = \emptyset \wedge q' \neq n\left(p_t^j\right)\}$$

A 'demand norm' equilibrium of this game is then a profile of strategies, $\left[\{s^j\}_{j=1}^{\infty}; \left\{\left\{\sigma^{(i;t)}\right\}_{i=1}^{\infty}\right\}_{t=1}^{\infty}\right]$, and buyers' beliefs, $\left\{\left\{a^{(i;t)}\right\}_{i=1}^{\infty}\right\}_{t=1}^{\infty}$; such that individual decisions are optimal given this profile and associated beliefs, and the latter are consistent and correspond to the norm.

4 A Demand Norm Equilibrium

It will be assumed in all what follows that the demand norm satisfies,

$$p^* = \arg\max_p \left(v(n(p)) - p\right)$$

$$\text{with } p^* > c(n(p^*))$$

$$v(n(p^*)) - p^* \geq 0$$

that is, that the norm admits a unique price such that expected buyers' surplus is maximized, and that trading this quality at this price be profitable for both sellers and buyers. The corresponding 'optimal' quality will be denoted $q^* = n(p^*)$:

Costs of quality will be given by

$$c(q) \geq 0; \; c'(q) > 0$$

In order to focus the discussion, I will further specialize as follows,

$$\text{i) } v'(.) > 0;\ v''(.) < 0;\ v(0) = 0$$

$$\text{ii) } c'(.) = c > 0$$

With the exception of the assumption that $v(0) = 0$; most of these additional assumptions do not seem to have any major implications. Now, the assumption that buyers' reservation value for the lowest quality is 0; together with the restriction that prices be positive, implies that sellers cannot make offers that can't be refused, i.e., charge a price guaranteeing a buyer his or her opportunity value regardless of quality supplied. In its absence, additional restrictions on parameters would have to be imposed in order to guarantee existence of a 'demand norm' equilibrium (see Subsection 4.2).

Proposition 1 Any price-quality pair $(p^*; q^*)$ satisfying the following conditions can be sustained as a demand norm equilibrium (for a suitably specified norm satisfying the conditions above),

i) $q^* \in [\underline{q}; \overline{q}]$

with $\underline{q} : \min_{q \in [0;q^e]} q \text{ s.t. } c(q) - c(q^e) \leq \frac{\beta}{1+\beta}[v(q) - v(q^e)] + \beta S(q)$

$\overline{q} : \max_{q \in [q^e;\overline{q}]} q \text{ s.t. } c(q) - c(q^e) \leq \frac{\beta}{1+\beta}[v(q) - v(q^e)] + \beta S(q)$

with $S(q) \equiv v(q) - c(q)$; $q^e : v'(q) - c'(q) = 0$

ii) $v(q^*) \geq p^* \geq \frac{1}{\beta}[c(q^*) - c(0)] + c(q^*)$

Proof.

Rather than provide a full description of strategies (i.e., a course of action for every possible history), I will give here only a partial description of sellers' strategies, specifying equilibrium path actions. In an appendix, I specify sellers' actions for histories along which no two agents deviated simultaneously. It seems to me that such a description suffices to establish sequential rationality of sellers, given the focus on individual deviations in Nash analysis.

Define a state variable, the number of incumbent buyers, $\#I$; i.e., the number of buyers who have experienced this seller's quality in the past. Note that in the absence of simultaneous deviations, there can be at any $t > 1$ at most 2 incumbents for any given seller.

Sellers' actions along the equilibrium path are given by,

$$s_1^j(,) = \{q^*, p^*\} \quad \forall j \in S$$

$$s_t^j(\# I = 1, q^*) = p^* \quad \forall j \in S,\ t > 1$$

In order to describe buyers' strategies, it is convenient to define a modified 'experience' variable, $q_E^{(i,t)'}$, which will correspond to the 'experience' variable defined previously, except that whenever the latter took an empty value, this modified version will be equated to the norm, i.e.,

$$\left(q_E^{(i,t)'}\right)_j = q_1^j \quad \text{if} \quad \sigma_1^{(i,t)} = \{j, b\}$$

$$\left(q_E^{(i,t)'}\right)_j = n\left(p_{t+1}^j\right) \quad \text{if} \quad \sigma_1^{(i,t)} = \{i, .\},\ i \neq j \ \text{ or } \ \sigma_1^{(i,t)} = \{j, nb\}$$

Buyers' strategies will be as follows,

$$\sigma_1^{(i,t)}(.) = \{k, b\}$$

$$k = \min_{j \geq i}\left\{\arg\max_S v\left(n\left(p_t^j\right)\right) - p_t^j\right\}$$

$$\text{if} \quad v\left(n\left(p_t^k\right)\right) - p_t^k \geq 0$$

$$\sigma_1^{(i,t)}(.) = \{1, nb\} \quad \text{else}$$

$$\sigma_2^{(i,t)}(.) = \{k, b\}$$

$$k = \min_{j \geq m_{t,1}^{(i,t)}}\left\{\arg\max_S v\left(\left(q_E^{(i,t)'}\right)_j\right) - p_{t+1}^j\right\}$$

$$\text{if} \quad v\left(\left(q_E^{(i,t)'}\right)_k\right) - p_{t+1}^k \geq 0$$

$$\sigma_2^{(i,t)}(.) = \{1, nb\} \quad \text{else}$$

Note that the minimizations above are non-empty under the restriction of no simultaneous deviations.

Beliefs are given by

$$a_{t;1}^{(i;t-1)}(.)\left(q^{0}\right)_{j} = 0$$

$$\forall q^{0} \text{ s.t. } \left(q_E^{(i;t-1)^{0}}\right)_j \neq q^{0}$$

Sequential Rationality of Sellers: 1) At $t = 1$; charging a price different from p^{*} will lead 'her' current buyer to switch to another seller, given the specified 'normal' beliefs. Since simultaneous deviations are excluded, the matching rule as specified implies that loosing this buyer today will not generate additional sales in the future. As selling today at p^{*} generates strictly positive profits (when choosing quality q^{*}), this cannot pay.

Supplying a quality different from q^{*}; on the other hand, is not profitable if q^{*} satisfies the conditions in the proposition: To see this:

Let $p(q^{j})$ be given by the solution to

$$v\left(q^{j}\right) - p = v(q^{*}) - p^{*}$$

and $V_{t+1}^{j}(\#I; q^{j})$ designate the value function under the equilibrium.

a) Deviating to a lower quality:

i) When deviating to lower quality associated with lower surplus, i.e., to a quality $q^{j} < q^{*}$ such that $S(q^{j}) < S(q^{*})$ (while charging a price p^{*}), it can never pay to charge the price $p(q^{j})$ next period. To see this: At such a price, the incoming customer will not buy, therefore the seller will obtain only a revenue

$$p\left(q^{j}\right) - c\left(q^{j}\right)$$

(from the incumbent customer). If the seller had instead charged a price p^{*}; he or she would have obtained a revenue of

$$p^{*} - c\left(q^{j}\right)$$

Since it is being assumed that $S(q^{j}) < S(q^{*})$; it must be that

$$p\left(q^{j}\right) - c\left(q^{j}\right) < p^{*} - c\left(q^{j}\right)$$

On the other hand, the continuation payoff with one incumbent at any given quality level is at least as large as that with no incumbents, i.e.,

$$V_t^{j}\left(N; q^{j}\right) \cdot V_t^{j}\left(1; q^{j}\right) \quad t > 1$$

(with an incumbent one can always charge p^* and thus induce the incoming customer to buy, even if this might mean loosing the incumbent).

So, in deviating to such a quality, the seller must be planning to loose the incumbent's custom next period. In that case, it is best to deviate to the lowest cost quality, and set $q^j = 0$. But by the lower bound in condition ii) in the proposition, we have

$$(p^* - c(0)) \leq (1+\beta)[p^* - c(q^*)] \qquad \text{(i)}$$

This implies that such a deviation does not pay. To see this, note that

$$V_t^j(N;0) = \frac{p^* - c(0)}{1-\beta} \quad t > 1$$

This follows from the fact that $p^* - c(0) \geq 0$, and the previous argument about it not being profitable for the seller to trade the custom of an incoming buyer for that of an incumbent.

Moreover,

$$V_t^j(1;q^*) = \frac{2(p^* - c(q^*))}{1-\beta} \quad t > 1 \qquad \text{(ii)}$$

This follows since no buyer will accept a price offer generating an expected surplus lower than $v(q^*) - p^*$ (so long as there are other sellers offering a price that leads buyers to expect a surplus of this magnitude, which will be always the case along any history with no simultaneous deviations).

In the initial period, a seller deviating to lowest quality can hope to obtain at most

$$[p^* - c(0)] + \beta V_1^j(N;0) = \frac{p^* - c(0)}{1-\beta}$$

while a seller sticking to the prescribed behavior would obtain

$$[p^* - c(q^*)] + \beta V_1^j(1;q^*) = \frac{1+\beta}{1-\beta}[p^* - c(q^*)]$$

If this latter expression is to exceed the former, then the inequality (i) must be satisfied.

ii) When deviating to a lower quality associated with a higher surplus, i.e., to a quality $q^j < q^*$ such that $S(q^j) > S(q^*)$ (while charging a price p^*), charging a price $p(q^j)$ will dissuade the incoming customer from buying, as before. But now it is not clear that the strategy of sacrificing the incoming customer is dominated by the strategy of sacrificing the incumbent, as

$S(q^j) > S(q^*)$. In any case, adoption of the latter strategy is not profitable (relative to following the prescribed behavior), by condition (i). Adoption of the former strategy, is not profitable either whenever $q^* \in [\underline{q}, \overline{q}]$. To see this. For this to be so, it must be that

$$[p^* - c(q^j)] + \beta [p(q^j) - c(q^j)] + \beta^2 V_3^j (N, q^j) \leq (1 + 2\beta) [p^* - c(q^*)] + \beta^2 V_2^j (1, q^*) \tag{iii}$$

Note that a seller pursuing the strategy of sacrificing the incoming customer (after choosing quality q^j) finds herself at the start of the third period in exactly the same situation as at period 1, given her choice of quality. So, if it paid to pursue this strategy of sacrificing the incoming customer at $t = 1$, it should also pay to do so at $t = 3$. This means that

$$V_3^j \left(N, q^j \right) = \frac{[p^* - c(q^j)] + \beta [p(q^j) - c(q^j)]}{1 - \beta^2}$$

Hence, since the left-hand side of (iii) is given by

$$\frac{1 + \beta}{1 - \beta} [p^* - c(q^*)]$$

the inequality (iii) is equivalent to

$$\left[p^* - c\left(q^j \right) \right] + \beta \left[p\left(q^j \right) - c\left(q^j \right) \right] \leq \left(1 + 2\beta + \beta^2 \right) [p^* - c(q^*)] \tag{iv}$$

The last inequality can be rewritten using the definition of $p(q^j)$,

$$c(q^*) - c\left(q^j \right) \leq \frac{\beta}{1 + \beta} \left[v(q^*) - v\left(q^j \right) \right] + \beta [p^* - c(q^*)]$$

Now, since p^* is bounded above by $v(q^*)$, if the previous inequality is to be satisfied, it must be satisfied when $p^* = v(q^*)$. Substituting this value into this inequality, one obtains

$$c(q^*) - c\left(q^j \right) \leq \frac{\beta}{1 + \beta} \left[v(q^*) - v\left(q^j \right) \right] + \beta S(q^*) \tag{v}$$

Note that the only way there can be deviation to a lower quality q^j such that $S(q^j) > S(q^*)$, is if $q^* > q^e$. Given the curvature assumptions on $v(\cdot)$ and

$c(.)$; for any such $q^* > q^e$; if the above inequality is satisfied for $q^j = q^e$; it will be satisfied for any $q^j < q^*$. Hence, the strategy of sacrificing the incoming buyer does not yield a higher payoff than following the candidate equilibrium strategy, as $q^* \in [\underline{q}; \overline{q}]$.

b) Deviating to higher quality: Since producing higher quality means incurring higher costs, the only way such a deviation could be profitable is, 1) if the surplus associated with this higher quality is higher than the one associated with the equilibrium quality, and 2) the seller plans to follow a strategy of dumping the incoming buyer (otherwise, this seller would just be trading a profit of $p^* - c(q^*)$ for a lower one of $p^* - c(q^j)$). Hence, such a deviation is only profitable if $q^* < q^e$; and, moreover, condition (ii) above is violated.

c) Note that there is no profitable price that a seller can charge that would guarantee a buyer a surplus above $v(q^*) - p^*$; since it is assumed that $v(0) = 0$; and prices are restricted to be non-negative.

2) Finally, note that the details of sellers' contingent plans off the equilibrium are not important: The key features in evaluating sequential rationality of the suggested equilibrium are, 1) that a seller cannot attract buyers, only loose them; 2) the matching rule is such that, when a seller sacrifices a buyer, that seller cannot hope for additional sales in the future as a consequence (no 'return or carom matchings'), at least along histories entailing no simultaneous deviations. Given these, what exactly happens to a buyer who switches to a new seller is not relevant for evaluating the original seller's payoff[7].

Sequential Rationality of Buyers: Generally, a buyer will buy from a seller offering the buyer the highest expected surplus, given that buyer's experience if any, and the prevailing norm. Of course, the buyer will only purchase if the expected surplus is positive.

In particular, prior to trading with a seller, a buyer will believe that if a price different from p^* is charged; the seller charging such price will supply a surplus lower than $v(p^*) - p^*$. Hence, it pays for the buyer to switch to a seller charging the price p^*.

Also, the matching rule for buyers is operational in the absence of simultaneous deviations. In that case, there will always be at least one seller charging p^* and supplying q^* with a superscript higher or equal than any other

[7] And so, the fact that the description of sellers' off-equilibrium responses given above is not very informative, is not an impediment to evaluating sequential rationality.

seller ;moreover, a buyer will only expect a surplus higher than $v(q^*) - p^*$ if the buyer is an incumbent, hence the matching rule for incumbents is 'best response compatible'.

Consistency of Beliefs: Since in this equilibrium p^* will always be charged, and quality q^* supplied, Bayes' Rule requires only that buyers believe that when this price is charged, this quality will be supplied. Otherwise, due to quality commitment, all that consistency implies is that a buyer who has bought a given quality from a seller expects that same quality to be supplied by that seller at any price. ■

The basic logic behind the previous result is simple: New customers cannot be attracted by means of lower prices due to quality uncertainty. At the same time, this very same uncertainty and the presence of other sellers demanding the 'normal' price, means that charging a price different from the 'normal' one will induce incoming customers to switch sellers. These features, plus the increasing cost of producing higher quality (on this, see the discussion that follows), make changing buyers' beliefs costly on two counts: Supplying a higher (costlier) quality than expected at a given price implies sacrificing current revenues. In addition, extracting future informational rents from supplying a more efficient quality means sacrificing the custom of incoming buyers. Thus a transition cost arises, which allows the expectations of buyers to be sustained even if this means supplying less than efficient quality.

4.1 The Role of Increasing Costs

A special symmetric values' and constant quality costs case helps clarify the role of the increasing costs assumption. In such an scenario, the following is an immediate corollary of the previous result,

Corollary 2 Let

$$\text{i) } v(q) = (K - q)q$$

$$\text{ii) } c'(.) = 0$$

The quality levels sustainable in norm equilibria are symmetric around the efficient quality level, i.e., $\underline{q} = q^e - \kappa$ and $\overline{q} = q^e + \kappa.$

Proof. This follows immediately from condition i) defining $\underline{q}$ and $\overline{q}.$ ■

Now, let $c'(\cdot) > 0$; while retaining the symmetric specification of values: It is easy to see that

Corollary 3 *Given*

$$\text{i) } v(q) = (K - q)q$$

$$\text{ii) } c'(\cdot) > 0$$

the quality levels sustainable in norm equilibria shift downwards, i.e.,

$$\underline{q} < q^e - \kappa$$

$$\overline{q} < q^e + \kappa.$$

Proof. Again, this is easy to see from condition i) in the previous proposition. ■

This bias towards sustaining lower quality levels results from the fact that a higher than efficient quality level is 'harder' to sustain than a lower than efficient one, as starting from the former, transiting to the efficient level will (under increasing costs) generate a one-time cost saving (rather than a cost increase as would transiting from a lower to a higher quality). Of course, regardless of whether costs are constant or increasing, capturing the associated rents from incumbents will invariably require sacrificing sales to incoming buyers. In this sense, increasing costs are not really needed to sustain norm equilibria, but they provide an explanation for why markets might be more likely to get stuck supplying inefficiently low quality[8].

Note that allowing for increasing quality costs also introduce 'run of the mill' moral hazard considerations (condition ii) in the previous proposition), but such considerations are merely 'incidental'.

4.2 'Offers too good to be refused'

Note that for this type of equilibrium to work, it must not be the case that sellers can make 'offers too good to be refused', i.e., be able to charge a price that guarantees buyers a surplus at least as large as the norm. If such offers are possible then sellers might be able to 'break the norm'. In the model

[8] It is not easy to tell from casual experience whether markets tend to get stuck in supplying too low rather than too high quality (in a value-for-money sense), yet it would seem that complaints about excessive quality are rare.

of this paper such offers are excluded by assuming that $v(0) = 0$; and non-negative prices. More generally though, a strategy of 'offers too good to be refused' will not be profitable if

$$[p(0) - c(\hat{q})] + \beta [p(\hat{q}) - c(\hat{q})] \leq 0$$

with $\hat{q}$ defined by the solution to

$$\beta [v'(q) - c'(q)] = c'(q)$$

Else, it would pay to make an irresistible offer $(p(0) + \varepsilon;\ \varepsilon > 0)$, and thus attract all buyers, generating unbounded profits for this seller[9]. Rewriting the above condition, it is easily seen that it imposes an upper bound on the normal price,

$$p^* \leq v(q^*) + \left[c(\hat{q}) - \frac{\beta}{1+\beta} v(\hat{q}) \right]$$

An alternative way of obviating the need to consider this type of condition is to posit a range of qualities which is not bounded below.

4.3 The Role of Competition

In a way, it is competition that allows buyers' exogenous beliefs to play such a crucial role. To make this point, consider a monopoly version of the previous game: There is only one seller confronting a sequence of two-period overlapping generations of buyers (only one buyer alive in the initial period). Everything else is the same as before.

Proposition 4 In the monopoly case, under any continuous 'demand norm' satisfying

$$v(n(p)) \geq p \geq c(n(p)) \quad \forall p \in [0; v(\bar{q})]$$

the only equilibrium (if it exists) entails efficient quality being sold at price $v(\bar{q})$ the first period, and at $v(q^e)$ each period thereafter.

[9]Note that $\hat{q}$ is the quality level at which the seller is exactly indifferent between incurring higher (lower) costs today in order to extract a bigger surplus tommorow (at the expense of the surplus extractable from incumbents tommorrow). Since by making an irresistible offer today, the seller can attract an infinity of buyers, foregone earnings from future incoming buyers are neglected.

Proof. Now, a buyer will purchase whenever he or she expects a non-negative surplus. Since under a continuous demand norm satisfying the above condition it must be that

$$v\left(n\left(v\left(q^e\right)\right)\right) - v\left(q^e\right) \geq 0$$

the strategy of choosing any quality but the efficient one is dominated by the strategy of initially charging the highest price associated with a non-negative surplus (which is $v(\bar{q})$ for any norm in the class of norms postulated), and then charging $v(q^e)$. Note that both incumbents and incoming buyers will buy under such prices.

Such an equilibrium will exist iff

$$\frac{v(\bar{q}) - c(0)}{1-\beta} \leq \left[v(\bar{q}) - c\left(q^e\right)\right] + \frac{\beta^2\left[v\left(q^e\right) - c\left(q^e\right)\right]}{1-\beta}$$

This follows since, otherwise, a seller would pursue a strategy of sacrificing the incumbent buyer in exchange for extracting the maximum surplus from incoming buyers. ■

Of course, allowing for norms outside the class specified here would generate additional equilibria. But the point is that, in the competitive scenario, even with norms restricted to this class, it was possible to sustain a multiplicity of equilibria.

The intuition for this is simple: The intense competition reduces the ability of sellers to manipulate prices without sacrificing sales. In other words, competition amongst sellers enhances the power of buyers, and thus allows their expectations to be self-fulfilling..

4.4 The Assumption of Unobservable Quality

It is easy to see that, with observable quality, the only equilibrium would entail efficient quality, with all surplus going to buyers[10].

Given the central role the assumption of unobservable quality plays here, one might wonder how robust the results in this paper are to 'weakening'

[10] Note that besides sustaining an inefficient quality, the demand norm also determines (within limits) the division of the surplus between buyers and sellers, and that, moreover, there does not seem to be any reason within this framework why all surplus should go to buyers. This even though competition amongst sellers here is quite vigorous (there are an infinite number of active sellers, and buyers can choose to be matched with any of them at no cost).

of this feature. In this section I present a simple ‘toy’ model illustrating what seems to me is an interesting interaction between Bertrand Competition (simultaneous choice of prices and qualities) and the observability of quality. It will be argued that in the presence of such competition, even a vanishingly small cost of checking quality suffices to induce no checking whatsoever in equilibrium, precisely due to the fact that competition leads all sellers to offer exactly the same price-quality package.

This model will be a one-period multi-stage version of the dynamic model presented previously, with

$$c(\cdot) \geq 0; c'(\cdot) = 0$$

and

$$v(0) = 0; v'(\cdot) > 0; v''(\cdot) < 0$$

Hence, the efficient quality will be the highest quality (as far as I can tell, this specialization is harmless). The extensive form will be as follows: An infinity of sellers choose simultaneously prices and qualities; an infinity of buyers observe the prices, and, if they so choose, can incur a small cost $\varepsilon > 0$ to observe the profile of qualities as well. After this, buyers choose which seller to be matched with, and whether to trade or not.

Proposition 5 *In any pure strategy norm equilibrium of this game, all sellers will choose the same quality and prices; and no checking of quality will take place.*

Proof. A seller who charges a price different from the normal one, will not sell. On the other hand, if any two sellers plan to produce differing qualities (while charging the normal price), then it will pay for buyers to incur the vanishingly small cost of checking qualities. In this case, the seller offering the worse deal will not sell, so, this seller will have an incentive to deviate. ■

In a sense, then, competition can also be invoked to justify the assumption of hidden qualities, reinforcing the main message of the analysis, namely, that competition need not immunize markets against ‘inherited’ expectations[11].

[11] Note the similarity of the reasoning to the result of Grossman and Stiglitz 1980. The difference is that here no one searches since competition tends to homogenize the terms of trade, while in the latter reference no one invests in adquiring information (searches, broadly speaking) if price fully reveal that information.

4.5 On Sellers' Culture

An interesting question in this context is whether in this type of market there is additional scope for sellers to collude, i.e., in a sense, to implement their own 'norms' (using this word now in the more conventional game-theoretic sense), overriding thus any inherited expectations on the part of consumers. It is easy to see that in the model of this paper the temptation to cheat on any collusive agreement is as great as ever. So, while market structures of the sort we study are susceptible to demand culture, they continue to be immune to supply culture (i.e., collusion). This might appear surprising given that demand is not price sensitive in the equilibrium presented (implying, apparently, that it is not possible to poach customers from rivals). The key is, of course, that demand is not price sensitive only at the normal price. Since this price is associated in buyers minds with the best possible deal, starting from any other price it is always possible to attract an infinite demand by charging the normal price instead. Threats of future punishment will not deter such behavior since a deviant seller will be earning unbounded profits today.

5 Final Remarks

One could obtain versions of this repeated game by varying the degree of commitment by sellers to their initial price-quality choices. On the one extreme, one could take a seller's initial price-quality decisions to be definitive (full commitment), while on the other sellers could be assumed to be able to vary price and quality each period (while remaining committed to their choice within the stage game). In this sense, the version in this paper represents an intermediate case, which, seems to me, is also the most realistic one. In any case, I would guess that equilibria in which buyers' expectations control the terms of trade are, if anything, easier to obtain in both these extreme cases than in the intermediate case considered here.

A Sellers' Strategies for Off-Equilibrium Histories Involving No Simultaneous Deviations

$$s_t^j(N; q^j) = \begin{cases} p^* & \text{if } p^* - c(q^j) \geq 0 \vee [p^* - c(q^j)] + \beta[p(q^j) - c(q^j)] \geq 0 \\ c(q^j) & \text{else} \end{cases} \qquad t > 1$$

$$s_t^j(\#I; q^j) = \begin{cases} p(q^j) & \text{if } q^j < q^* \wedge \\ & (\#I)\,[p(q^j) - c(q^j)] + \beta V_{t+1}^j(N; q^j) > [p^* - c(q^j)] + \beta V_{t+1}^j(1; q^j) \wedge \\ & (\#I)\,[p(q^j) - c(q^j)] + \beta V_{t+1}^j(N; q^j) \geq 0 \\ p(q^j) & \text{if } q^j > q^* \wedge \\ & (\#I)\,[p(q^j) - c(q^j)] + \beta V_{t+1}^j(N; q^j) > (\#I + 1)\,[p^* - c(q^j)] + \beta V_{t+1}^j(1; q^j) \wedge \\ & (\#I)\,[p(q^j) - c(q^j)] + \beta V_{t+1}^j(N; q^j) \geq 0 \\ p^* & \text{if } q^j < q^* \wedge \\ & (\#I)\,[p(q^j) - c(q^j)] + \beta V_{t+1}^j(N; q^j) \leq [p^* - c(q^j)] + \beta V_{t+1}^j(1; q^j) \wedge \\ & [p^* - c(q^j)] + \beta V_{t+1}^j(1; q^j) \geq 0 \\ p^* & \text{if } q^j > q^* \wedge \\ & (\#I)\,[p(q^j) - c(q^j)] + \beta V_{t+1}^j(N; q^j) \leq (\#I + 1)\,[p^* - c(q^j)] + \beta V_{t+1}^j(1; q^j) \wedge \\ & (\#I + 1)\,[p^* - c(q^j)] + \beta V_{t+1}^j(1; q^j) \geq 0 \\ p^* & \text{if } q^j = q^* \\ p > p^*; p(q^j) & \text{else} \end{cases}$$

1) At $t > 1$; if there are no incumbent buyers for this seller, charging a

price different from p^* will prevent any sales from taking place -under the norm, and in the absence of simultaneous deviations. Clearly, if $q^j \leq q^*$; this cannot pay, for the reasons pointed out in the main proof. Similarly, for any $q^j > q^*$ such that $p^* \geq c(q^j)$; it would pay to charge p^*; rather than pass up the opportunity of selling. If, on the other hand, $q^j > q^*$, $p^* < c(q^j)$ but

$$\left[p^* - c\left(q^j\right)\right] + \beta\left[p\left(q^j\right) - c\left(q^j\right)\right] \geq 0$$

then it would pay to sell, pursuing a strategy of dumping the incoming buyer every other period. Note, in particular, that if $S(q^j) < S(q^*)$; then it is best not to sell: The only reason to incur a loss today, is if it can be recovered later on by charging an incumbent customer a higher price. Yet, if $S(q^j) < S(q^*)$; the highest price that would induce an incumbent to purchase (namely, $p(q^j)$) would be lower than p^*:

2) a) A seller who has $\#I$ incumbents and who has committed to quality $q^j < q^*$; confronts the choice of either charging p^*; keeping the incoming customer, but losing the incumbents (for $v(q^j) - p^* < v(q^j) - q^j$), or charging $p(q^j)$; and selling to the incumbents, but losing the incoming customer.

b) A seller who has $\#I$ incumbents and who has committed to quality $q^j > q^*$; faces a different option, as now, charging a price p^* will lead both, incumbents and incoming buyer, to buy.

c) A seller will only sell if he expects non-negative revenues.

References

[1] Akerlof G. (1982), "Labor Contracts as Partial Gift Exchange", *The Quarterly Journal of Economics*, 97, 543-69.

[2] Fehr E., E. Kirchler, A. Weichbold, and S. Gächter (1998), "When Social Norms Overpower Competition: gift Exchanges in Experimental Labor Markets", *Journal of Labor Economics*;16, 324-351.

[3] Goyal S., M.C.W. Janssen (1995), "Dynamic Coordination Failures and The Efficiency of the Firm", *Journal of Economic Behavior and Organization*, 28, 223-239.

[4] Grossman S., and J. Stiglitz (1980), "On the Impossibility of Informationally Efficient Markets", *The American Economic Review*, 70, 393-408.

[5] Kachelmeier S.J. and M. Shehata (1992), “Culture and Competition: A Laboratory Market Comparaison between China and the West”, Journal of Economic Behavior and Organization, 19, 145-148.

[6] Peyton Young H. and M. Burke (2000), “Competition and Custom in Economic Contracts: A Case Study of Illinois Agriculture”, Center on Social and Economic Dynamics, Working Paper No. 11.

[7] Pitchik C. and A. Schotter (1994), “Norms and Competition in Markets with Asymmetric Information: An Experimental Study of the Development of Industry Ethics”, Metroeconomica, 45, 188-207.

[8] Rothe A., V. Prasnikar, M. Okuno-Fujiwara and S. Zamir (1991), “Bargaining and Market Behavior in Jerusalem, Ljubljana, Pittsburgh, and Tokyo: An Experimental Study”, The American Economic Review, 81, 1068-1095.

[9] Vega-Redondo F. (1993), “Competition and Culture in an Evolutionary Process of Equilibrium Selection: A Simple Example”, Games and Economic Behavior, 5, 618-631.