ENTRY AND THE SURVIVAL OF THE UN-FITTEST ♦

by

Kobi Kriesler and **Shmuel Nitzan**

Department of Economics, Bar-Ilan University

Ramat Gan, Israel 52900

Abstract

In most economic models of barriers to entry and market structure, potential new entrants are harmful to existing firms, and the actual new entrants are the fittest. This paper first establishes that enhanced competition that takes the form of entry of new firms into the industry can be advantageous to some existing firms. The implications of this result are then studied for a self-regulating industry. It is shown that in a self-regulating industry that applies a simple majority rule, the incentives to support entry are either ineffective, resulting in a stable (stagnant) industry, or effective, giving rise to quality decay (the survival of the un-fittest). Such decay is necessarily obtained when the rationality of the consumers is sufficiently bounded. Alternative democratic decision rules and their implications on the size of the industry and its quality are also explored, both under marginal and non-marginal entry decisions. The analysis of entry determination is finally used to rationalize the existence of multi-product firms (provide a new justification for branding) and to clarify the effect of entry on the consumers.

Key words: bounded rationality, random sampling, firm's sale probability, self-regulating industry, majority rule, barriers to entry, stability, quality decay, branding, consumer's expected quality.

♦ We are especially indebted to Arthur Fishman and Martin Kolmar for their insightful comments.
The second author is grateful to the CES at the University of Munich, the Tinbergen Institute at the University of Amsterdam and the CODE at the Universitat Autonoma de Barcelona for their hospitality that enabled the completion of this study.

1. Introduction

In most economic models of barriers to entry and market structure, the entry of new firms into the industry is accompanied by a reduction in prices and profits of the existing firms. Hence these firms try to prevent such entry by utilizing various strategies including pre-commitment capital investments (Dixit, 1980), price reduction (Milgrom & Roberts, 1982), investment in advertising and R&D (Fudenberg & Tirole, 1984) or signing long term contracts with customers (Aghion & Bolton, 1987).

Some studies show that, under certain conditions, the entry of new firms into the industry is accompanied by a rise in prices. For example, Salop (1979) assumes increasing returns to scale, and shows that in the long run, cost reduction may lead to an increase both in the number of firms and in prices. Satterthwaite (1979) proposes a model for *reputation goods* - goods that are purchased on the basis of reputation. He assumes that while all firms are, on average, of the same quality, different consumers prefer different firms, and shows that under positive search costs, as the number of sellers increases, the usefulness of the information concerning sellers that consumers possess tends to decline, each seller's demand becomes less price-elastic and the equilibrium price charged in the market increases. Rosenthal (1980) studies monopolistic competition, when sellers are unable to impose different prices between competitive and captive markets. Rosenthal argues that in such a case, more competition decreases the seller's probability to win the competitive market, drives him to focus on the captive market and yields higher prices. Belton (1987) and Casado & Izaga (1999) study a spatial free-entry model where firms commit themselves to a price-matching policy. They show that when such a policy is implemented, an increase in the number of firms entering the market leads to a rise in prices. Economides (1996) shows that with a sufficiently strong network effect, a monopolist has an incentive to support entry of competitors because this eventually enables him to sell higher quantities and charge a higher price. Note that in these models there is no trivial connection between the rise in prices and the firm's profits or social welfare. For example, in Rosenthal (1980), the increased price compensates the firm for a decrease in its probability to sell in the competitive market, but it does not increase its profits in equilibrium. Or, in the context of social welfare, according to Satterthwaite (1979), although an increase in the number of firms entering the market yields a price rise, it increases the probability that the consumer finds a firm best fitted to his needs, so the social welfare may actually rise. Unlike the aforementioned literature, the possibility that firms may benefit from competition, and the implications of this phenomenon in various contexts such as entry determination in self-regulating industries or the formation of multi-product firms, is explained in this study by the bounded rationality of consumers.

In general, entry has two effects: a quality effect and a pricing effect. Abstracting away from the pricing effect, the preliminary objective of this paper is to describe an environment where entry of new firms can be beneficial to some of the existing firms. In the proposed model, the n firms that produce indivisible units of some good are heterogeneous in their quality. The representative consumer, who does not know the quality of the firms, that is, their quality ranking, randomly samples k firms and purchases the good from the best of the sampled firms. The consumer who chooses the best firm sampled and not necessarily the best-quality firm is henceforth referred to as boundededly rational. Within this setting, we relate the effect of entry of a new firm on the sale probability of the existing firms to four parameters: the size of the industry, n; the number of firms the consumer samples, k; the quality ranking of the new entrant, r^*; and the quality ranking of the existing firm on which we focus, r. This relationship implies that a new entrant may harm the top-quality firms, harm or have no effect on the situation of low-quality firms and benefit the medium-quality firms.

The second and main objective of this study is to explore, in the proposed setting, the implications of self-regulation (i.e., internal industry control of entry; that is, the existing firms determine who can join them) on the number and expected quality of firms that serve the consumer. Lawyers, accountants, physicians and university faculty members are some examples of self-regulating industries/ professions. In the literature on self-regulating professions (see, for example, Leland, 1979; Shaked & Sutton, 1981; and Bortolotti & Fiorentini, 1997), it is argued that self-regulation leads to a less than socially-optimal number of firms, but to an industry consisting of high-quality firms. In other words, self-regulation prevents entry of low-quality firms, as expected by Akerlof (1970). The conclusion that emerges from the proposed model is very different. Specifically, we show that if the rationality of the consumers is below a certain threshold, then self-regulation based on a majority rule results in a continuous increase in the number of firms and in constant decline in their quality. If consumers' rationality exceeds that threshold, then such democratic self-regulation leads either to stability in the size and quality of the industry[1] or, again, to quality decay. This implies that, eventually, any unstable industry decays and, therefore, secures the survival of the least fit firms.

The third objective of this study is three-fold: to study entry decisions and their effect on quality under alternative democratic decision rules; to apply the proposed approach in the context of multi-product firms; and to examine the effect of marginal entry on consumers.

The analysis of marginal entry decisions is first extended to a self-regulating industry that applies two alternative rules: hierarchy and polyarchy. We then analyze non-marginal entry decisions; assuming that the potential entrants are inferior low-quality firms and that the self-regulating industry reaches its decision by using hierarchy, simple majority rule or polyarchy.

When there are no potential entrants, the existing firms may still establish new firms or subsidiaries or produce new brands of their product. The application of our analysis to the context of multi-product firms suggests a new justification for branding (versioning).

Finally, we clarify the effect of marginal entry on consumers. Assuming that the welfare of the consumer is represented by the expected ranking of the firm from which he ends up purchasing, we relate the effect of entry of a new firm on the consumer's welfare to n, k, r^* and r. This relationship implies that a decision by a self-regulating industry can never be beneficial to the consumer, as long as it is based on some democratic rule, not necessarily the simple majority rule.

The model and the main preliminary result are presented in section 2. We then proceed in section 3 to explore the endogenous determination of barriers to entry and market structure in the context of a self-regulating industry that resorts to a simple majority rule. Section 4 contains the analysis of entry decisions under alternative decision rules. The new rationalization for the existence of multi-product firms (branding) is presented in Section 5. The effect of decisions by a democratic self-regulating industry on the consumer's welfare is discussed in Section 6. The last section contains a brief summary and concluding remarks.

[1] Such stability can be conceived as desirable (quality standards are maintained) or as undesirable (the industry is stagnant; quality is not improved).

2. The model

Consider a market with $n \geq 3$ firms that produce indivisible units of some good under constant returns to scale. Examples of such goods are professional services, refrigerators, health-insurance policies, hotel rooms, or college degrees. The firms are heterogeneous in quality, which is represented herein only by the firms' quality ranking. The firms are assumed to know their relative quality ranking as well as that of potential entrants. The consumers are assumed to be homogeneous and to act independently. In particular, their preference between firms is based on the quality ranking of the firms. Under these assumptions we can henceforth refer to a single representative consumer. The boundedly rational consumers, who do not know the quality of the firms, that is, their quality ranking, randomly sample k firms, $1 \leq k \leq n$, and purchase the good from the best of these k firms.

Three remarks are in order. First, note that the consumer's choice is based on quality alone. This might be the case because firms are homogenous in terms of price or, when there is price variability, because prices are pre-committed and quality takes into account all aspects, including the different prices.

Second, notice that the random sampling assumption is plausible when there is a large number of small firms in the market and the firms (plumbers, moving companies, constructors or even divorce lawyers) are relatively unknown, because the consumer rarely uses their services.

Third, in our model k is assumed to be fixed; it does not vary with changes in the number of firms or changes in the quality of the industry. In particular, reduced quality does not induce the consumers to search more; that is, increase k. Although, for the sake of simplicity, in our model the fixed k is considered as a primitive, it may be the outcome of some maximization process. This is indeed the case when the consumers are assumed to secure some relative expected quality; that is, some minimal expected relative ranking, by sampling a minimal number of firms.[2] As

[2] To formally prove this assertion, note that by Proposition 4, the expected ranking of the firm the consumer purchases from is equal to $((n+1)/(k+1))$. The expected relative ranking is therefore equal to $((n+1)/(k+1)n)$. When the consumer insists on a relative ranking that does not exceeds α, the minimal k that secures this α is equal to $k^*=(\alpha /(1-\alpha))+(1/n(1-\alpha))$. And since $(1/n(1-\alpha)) <1$, if the consumer wants to secure α and do it by sampling the smallest number of firms, then indeed his optimal sample size is robust, that is, k^* is independent of n.

already pointed out, partial sampling, even if based on maximization, that does not necessarily result in the choice of the best firm is referred to as bounded rationality.

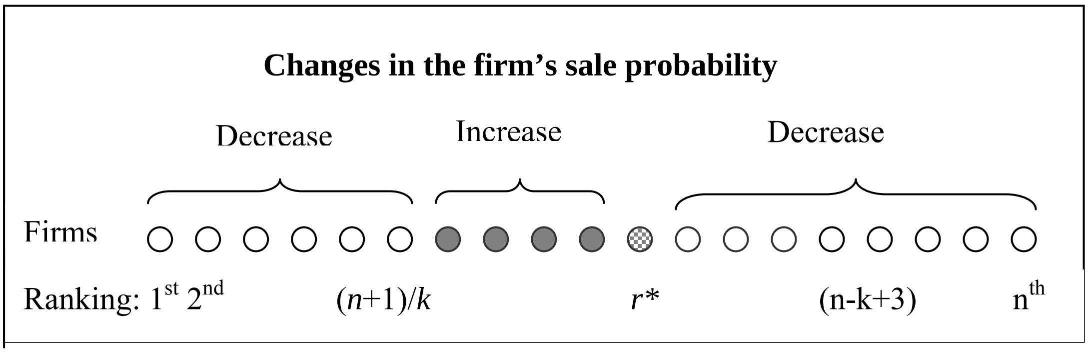
To focus on the relationship between entry and quality, prices are assumed to be exogenous. In particular, the prices of the goods charged by the existing firms are not affected by entry, that is, by the number or by the quality of new firms that enter the industry. Consider then a prospective entrant with a ranking r^*, $r^* \in \{1,2,\ldots,n+1\}$. Note that the entry of this firm positions it in the r^* place while increasing the ranking of all the firms of lower quality by one position.[3] The following proposition provides the necessary and sufficient conditions for the enhancement of a firm's interest (an increase in its sale probability) due to increased competition (entry of a new firm).

Proposition 1: Let r be the ranking of firm x. A new firm, ranked r^*, that enters the market increases the sale probability of firm x iff:

$$\min[(n-k+3), r^*] > r > \frac{n+1}{k}.$$

Proof: See Appendix

The following graph illustrates Proposition 1 (for the case where $r^* < (n\text{-}k+3)$):



The firm's sale probability is equal to the probability that the firm is sampled, multiplied by its conditional sale probability (the probability that the firm sells if it is sampled). A new entrant decreases the probability that the firm will be sampled. The conditional sale probability of the firm depends on the quality of the new entrant: the

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3 Recall that the ranking of a firm is inversely related to its quality.

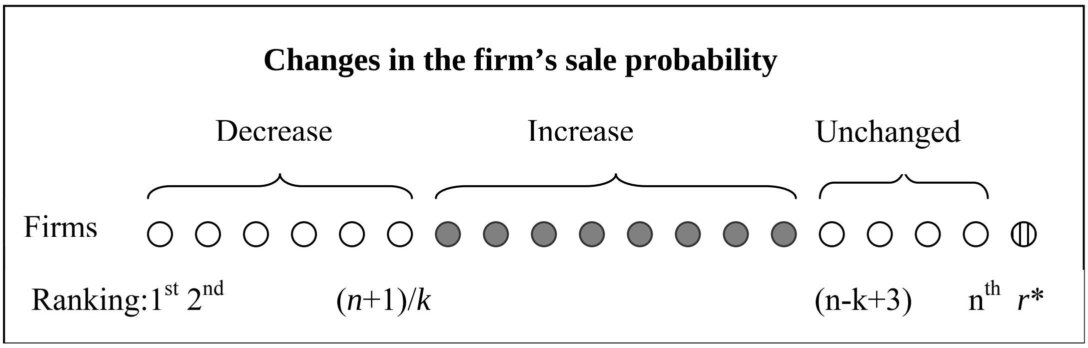
entry of an inferior firm increases this probability while the entry of a superior firm decreases it. Hence, a new entrant can only increase the sale probability of firms that are superior to it. By Proposition 1, a new inferior entrant increases the sale probability of other firms that are not ranked very low (they do not belong to the top $(n+1)/k$)- quality firms) or very high (such that their sale probability is 0 before and after entry).

When the quality of the prospective entrant (say a junior lawyer) is inferior to the quality of all the existing firms, that is, $r^* = n+1$, by Proposition 1, we obtain:

Corollary 1: Let *r* be the ranking of firm *x*. A new inferior firm that enters the market increases the sale probability of firm *x* iff:

$$(n - k + 3) > r > \frac{n+1}{k}.$$

The following graph illustrates Corollary 1: [4]



For example, assume that $k = n$. In this case the consumer samples all the firms and purchases from the best firm, which is ranked 1^{st}. A new inferior firm that enters the market, when *k* remains fixed, reduces the sale probability of the 1^{st} ranked firm to $(n/(n+1))$ (there is a $(1/(n+1))$ probability of sampling *n* firms that do not include the 1^{st}-ranked firm), increases the sale probability of the 2^{nd} ranked firm to $(1/(n+1))$ and leaves the sale probability of the remaining firms unchanged at 0%. This is consistent with Corollary 1, according to which, in such a case only the sale probability of the second best firm, the firm ranked in the second position ($r = 2$), increases, because $3 > r > (1+(1/n))$.

[4] Note that Corollary 1 is also valid in the more general case where $r^* \geq (n-k+3)$; that is, when $(n-k+3) = \min[(n-k+3), r^*]$.

In our setting, inferior firms (existing or prospective entrants) may face zero sale probability. Although the incentive for such firms to enter or to remain in the market is not explicitly specified in our stylized model, we allow this possibility because such firms may have a fixed income (a salary in the case of academic faculty members). Furthermore, the existence of such a firm may also be due to the fact that other firms benefit from its existence and, in turn, have an incentive to subsidize it. Below (see Section 5), we will clarify that a high-quality firm may even found such a firm or produce an inferior brand of its product.

To sum up, by Proposition 1 (and, of course, by corollary 1 that focuses on the special case where $r^* = n+1$), increased competition can adversely affect firms inferior to the new entrant whose ranking is higher than r^*, the ranking of the new entrant, as well as some high-quality firms whose ranking is smaller than r^*, and positively affect the remaining high-quality firms (if there are any). This latter effect is essentially due to k being smaller than $(n+1)$.

3. Self regulation under simple majority

In a self-regulating industry or profession, the "current members, being the sole suppliers of a certain type of service, are free to determine, in one way or another, whether or not to admit a potential recruit" (Shaked & Sutton, 1981, p. 217). Suppose that approval of entry of a new firm is determined by simple majority rule; that is, the decision to approve entry of a new firm is made only if it gets the support (vote) of a simple majority. An existing firm votes in favor of entry of a new firm provided that such entry strictly increases its sale probability. The new firm is admitted to the industry if at least half of the existing firms approve its entry. [5]

An industry is called *stable* if the existing firms prevent any entry, regardless of the prospective entrant's quality. Note that stability implies "no inflow of fresh blood" that in some industries may be viewed as a disadvantage. However, such stability at least prevents deterioration in quality. A *decaying industry* is an unstable industry, which is vulnerable to decay; that is, it is vulnerable to an endogenous decline in the expected quality of the firms. In other words, the existing firms in a decaying industry approve only prospective entrants that reduce the average quality of the firms. The

[5] Recall that, by assumption, the firms know the relative quality ranking of potential entrants.

following proposition describes the dynamics in a self-regulating industry that applies a simple majority rule and provides a sufficient condition for decay.

Proposition 2: A self-regulating industry that applies a simple majority rule to approve entry is either stable or decaying. Assuming that the consumer samples $k \geq 3$ firms, a sufficient condition for decay is that $k \leq 0.5n$.

Proof: See Appendix.

That is, self-regulation based on the simple majority rule results either in stability (stagnation) or in quality decay. By Proposition 1, a potential entrant of above-average quality is rejected by all the firms of less than average quality and by some top-quality firms; hence a majority of the firms never approves entry of such a firm. Only entrants of less than average quality can be approved and this happens when the sufficient condition is satisfied. Notice that if *k* is sufficiently high relative to *n*, then a prospective entrant, regardless of quality, is never approved and the industry is stable. For example, suppose that $k = n$. By Proposition 1, the majority of the firms; that is, the 1st ranked firm as well as the n-2 = k-2 low-quality firms reject the entrant, and only the 2nd ranked firm approves it. If *k* is sufficiently small relative to *n*, then an inferior prospective entrant is approved. For example, suppose that $k = 3$ and $n = 100$. By Proposition 1, the 33 top-quality firms as well as the 100th ranked firm reject the entrant, where the majority of the firms (66 of them) approve it. By Proposition 2, given *n*, the threshold sampling size is k=0.5n. That is, if the rationality of the consumer is sufficiently bounded[6], i.e., he samples half or fewer of the existing firms, then the industry decays. Put differently, given k, if the existing number of firms exceeds a certain threshold, $n \geq 2k$, then self-regulation based on the simple majority rule necessarily results in quality decay. Suppose, for example, that $k = 3$ and that a new inferior firm considers entering the market. The following table specifies the number of firms that vote in favor of its entry. In this case, if the number of the existing firms equals to or exceeds 6, then entry of the inferior firm is approved and the industry decays. When the number of the existing firms is smaller than 6, the industry is stable or decays.

[6] This observation is not valid in the extreme cases where $k = 1$ or 2 and *n* is odd. By proposition 1, in the former case all the existing firms reject entry. In the latter case, a majority of the firms reject entry.

No. of firms in the industry	$\frac{n+1}{k}$	Firms that vote against the new entrant			Firms that vote in favor of the new entrant		Entry approved
		Top-quality		Low-quality			
		Decreased sale probability if $r < \frac{n+1}{k}$	Unchanged sale probability if $r = \frac{n+1}{k}$	Unchanged sale probability	Number[7]	%	
3	1.3	1		1	1	33%	No
4	1.7	1		1	2	50%	Yes
5	2	1	1	1	2	40%	No
6	2.3	2		1	3	50%	Yes
7	2.7	2		1	4	57%	Yes
8	3	2	1	1	4	50%	Yes
9	3.3	3		1	5	56%	Yes
10	3.7	3		1	6	60%	Yes
11	4	3	1	1	6	55%	Yes
12	4.3	4		1	7	58%	Yes
13	4.7	4		1	8	62%	Yes
14	5	4	1	1	8	57%	Yes
15	5.3	5		1	9	60%	Yes

An inferior firm may be perceived as a public good because some firms may benefit from its entry (while the effect of its entry on other firms may be harmful). In this case, some of the firms may have an incentive to subsidize such a new inferior firm (like a pool insurance firm that offers expensive insurance and is subsidized by the insurance industry), while other firms may have an incentive to lobby against the entry of such inferior firms. In the next section we illustrate how entry of inferior firms is determined independently and strategically under a polyarchy not in a dichotomous setting (the analysis there is analogous to the analysis of voluntary provision of a public good).

Finally, note that the basic model (i.e., heterogeneous firms, a consumer that samples *k* firms and a barrier to entry based on majority rule) can easily be extended to a multi-period model. Suppose that there are j periods such that in each period t_i, $i \in \{1,2,\ldots,j\}$, there is a prospective entrant of ranking r_i. This ranking is known to the other firms. Furthermore, suppose that all the firms have the same discount factor δ,

[7] Note that the number firms which vote in favor of the new entrant (column 6), is derived by subtracting the number firms which vote against the new entrant (columns 3-5) from the total number of firms in the industry (column 1).

$0 \leq \delta \leq 1$, and that each firm maximizes its discounted sale probability. For a small enough δ (such as in the myopic case where $\delta = 0$), the results for each period are identical to those obtained in the one-period model. In such a case, the self-regulating industry would demonstrate either stability or continuous growth in the number of firms, accompanied by an endogenous decline in the industry's expected quality.

4. Entry determination under alternative decision rules

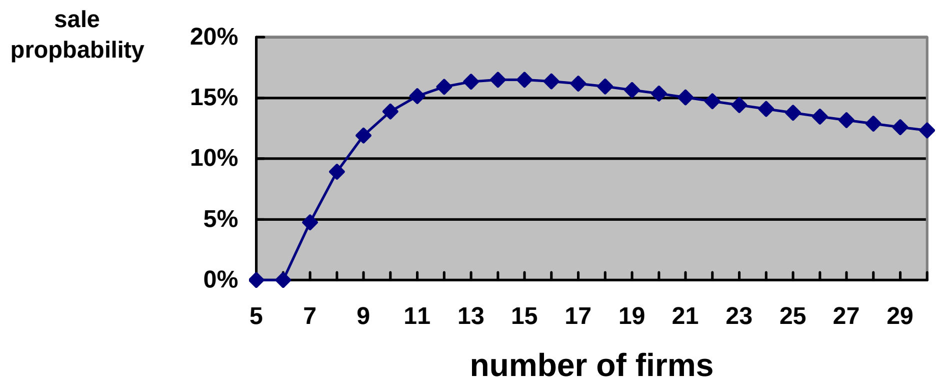
The self-regulating industry can apply alternative dichotomous democratic rules to determine whether a potential entrant is approved or rejected. Two extreme such rules are the dichotomous hierarchy and polyarchy rules (see Sah & Stiglitz, 1986). Under hierarchy, a potential entrant is approved if all the existing firms vote for its entry. Otherwise it is rejected. Under polyarchy, a potential entrant is approved if at least one of the existing firms votes for its entry. Otherwise it is rejected. Clearly, by Proposition 1, under hierarchy, no firm enters the industry and therefore the existing quality is maintained. Under polyarchy, a firm ranked r^* enters the industry iff there exists r, such that $\min[(n-k+3), r^*] > r > \frac{n+1}{k}$. Entry of a high-quality firm (possibly, with above-average quality) with ranking $r^* > [(n+1)/k]+1$, is therefore approved under polyarchy. Although a firm with above-average quality can be admitted to the industry, in general, the effect of marginal entry on quality under polyarchy is ambiguous. Sufficient conditions for quality decay under polyarchy can, however, be provided. For example, it can be verified that if the ranking r^* of a prospective entrant is uniformly distributed over the possible rankings 1 to n, then the quality of an approved entrant is lower than the average quality, i.e., in such a case there is quality decay under polyarchy. Notice that by Proposition 2, in the dichotomous setting where entry of a candidate is approved or rejected, the application of the simple majority rule, that can never improve quality, is more harmful to the industry quality than the application of polyarchy.

Suppose now that entry decisions are not made on the margin; that is, the issue is no longer whether to admit or reject a potential entrant, but to determine the number of firms in the industry. The equilibrium number of firms in the industry naturally hinges on the mechanism applied by the industry to determine its size and on the preferences of the existing firms regarding industry size. The following result identifies the most preferred number of firms from the viewpoint of a firm ranked r, given that the consumer samples k firms.

Proposition 3: Suppose that the consumer samples k firms. The maximal sale probability of a firm of ranking r is obtained when the number of firms in the market is equal to $n_r = kr$.

Proof: See Appendix.

For example, assume that 5 firms are sampled, $k = 5$. The following graph illustrates the sale probability (in %) of a firm ranked 3^{rd}, $r = 3$, as a function of the number of firms in the industry.



The maximal sale probability of a firm ranked 3^{rd} is 16.5% and it is achieved when the number of firms in the market is equal to 15 (by Proposition 3, $n_r = kr = 3*5$).

Suppose now that, in the current non-dichotomous setting, the democratic self-regulating industry applies one of the following rules: hierarchy, simple majority rule or polyarchy. Under the extreme hierarchy rule, a particular industry size is the choice of the self-regulating industry, if it is supported by all the existing firms that take part in the decision. If such unanimous support cannot be secured, the status quo; that is, the existing industry size n, is the chosen alternative. Under the commonly used simple majority rule, the chosen industry size is the Condorcet winner; namely, the proposal that by a simple majority defeats any other proposal. If such a winner does not exist, the status quo n is the chosen alternative. Under the extreme polyarchy rule, every firm i, $i = 1,\ldots,n$, makes a proposal e_i regarding the number of entrants that should be admitted to the industry, and every proposal is approved, which means that the self-regulating industry approves entry of $e=e_1+e_2+\ldots+e_n$ new firms. The chosen industry size is therefore $(n+e)$. Note that given the above three rules, we allow strategic decisions by the voters (the existing firms). That is, a firm is not assumed to behave sincerely, to make a sincere proposal. To apply Proposition 3 in determining the preferred industry size for every voter, we preserve the ranking r of every firm by assuming that potential entrants are inferior low-quality firms (the ranking of a potential entrant r^* is larger than n).

By Proposition 3, we obtain the following three corollaries:

Corollary 2: Under hierarchy, the self-regulating industry chooses to prohibit entry.

Proof: See Appendix. That is, under hierarchy, n is the chosen industry size.

Corollary 3: Suppose that the number of existing firms n is odd. Then the equilibrium industry size in a self-regulating industry that applies a simple majority rule is $k(n+1)/2$. That is, the n existing firms approve entry of $\{k(n+1)/2 - n\}$ new inferior low-quality firms.

Proof: See Appendix

Thus, in a democratic self-regulating industry that applies a simple majority rule, the median-quality firm is actually decisive; the equilibrium number of firms (the Condorcet winning alternative) maximizes its sale probability ($(k(n+1))/2$ is the most preferred industry size of the median-quality firm, the firm ranked $(n+1)/2$).

Corollary 4: Under polyarchy, the (Nash) equilibrium industry size is nk. That is; the existing n firms approve the entry of $(k-1)n$ inferior low-quality firms.

Proof: See Appendix.

Under polyarchy, when the size of the industry is strategically determined by the existing firms analogously to the voluntary provision of a public good, the lowest-quality firm is actually decisive; the equilibrium number of firms maximizes its sale probability ($n_n k = nk$ is the most preferred industry size of the lowest-quality firm, the firm ranked n).[8] By the above corollaries, as in the dichotomous setting of the previous section where entry of a candidate is approved or rejected, hierarchy prohibits entry because the highest-quality firm that objects to entry is decisive. Hence, hierarchy is superior to polyarchy and to the simple majority rule in terms of its effect on industry quality. However, in contrast to the superiority of polyarchy to the simple majority rule in the context of dichotomous (marginal) entry decisions, in the current setting of non-marginal industry size determination, the simple majority rule is preferable to polyarchy. The reason for this reversal in the effect on quality of these two rules is the following: Under marginal entry decisions, the decisive firm is of lower quality under the simple majority rule than under polyarchy. In the former case, the ranking of the decisive firm is $d = [(n+1)/k]+[(n+1)/2]$,[9] whereas under the latter case its ranking is $[(n+1)/k]+1$. Consequently, entry of a high-quality firm (possibly with above-average quality) of a ranking r^*, $d > r^* > [(n+1)/k]+1$, is prevented under the simple majority rule, but approved under polyarchy. Under non-marginal entry decisions, the decisive firm is of higher quality under the simple majority rule than under polyarchy. In the former case, the ranking of the decisive firm is $(n+1)/2$, the decisive firm is the median voter, whereas under the latter case, the ranking of the decisive firm is n, the decisive firm is the lowest-quality firm. Consequently, more inferior low-quality firms enter the industry under polyarchy than under the simple majority rule, $\{kn - n\} > \{k(n+1)/2 - n\}$.

5. The multi-product firms application: A new justification of branding

When there are no potential entrants, existing firms may still establish new firms or subsidiaries or produce new brands of their product. Our approach and the above results can therefore be applied in the context of an industry that does not face external entry, but where the existing firms can create new firms or produce low-quality brands of their product. Suppose therefore that a certain firm can produce lower-quality brands relative to its existing brand or that it can establish new firms or subsidiaries that produce such brands. In this case, the sale probability of its leading

[8] In fact, it can be shown that under polyarchy the same result is valid, even if the quality of potential entrants is not restricted to being inferior.

[9] By Proposition 1, the firm ranked $(n+1)/k$ and the higher-quality firms reject the new entrant. To be approved by a simple majority, the potential entrant must secure the support of at least $(n+1)/2$ of the highest quality firms amongst the remaining firms. That means that the ranking of the decisive firm; that is, the highest quality firm that secures a simple majority, is equal to $[(n+1)/k]+[(n+1)/2]$.

brand may strictly increase when new low-quality brands (or new firms that produce them) are introduced. This implies that the firm may have an incentive to introduce such low-quality brands, even if such brands have very small or zero sale probability. When the firm can produce low-quality brands at zero cost,[10] by Proposition 3, the optimum number of such brands; that is, the number that maximizes the sale probability of the leading brand, is equal to $(kr\text{-}n)$. For example, if, there are 13 firms in the market, $n = 13$, and, as above, $k = 5$, a firm ranked 3rd, introduces two low-quality brands in order to maximize the sale probability of its leading brand. By Corollary 3, when the number of existing firms n is odd and every firm can produce any number of low-quality brands at zero cost, the equilibrium industry size in a self-regulating industry that applies a simple majority rule is $k(n+1)/2$. That is, the n existing firms introduce $\{n(k\text{-}2)+k)/2\}$ new low-quality brands. By Corollary 4, if every firm can produce any number of low-quality brands at zero cost, then under independent branding decisions, the (Nash) equilibrium industry size is nk. That is; the lowest-quality firm introduces $(k\text{-}1)n$ new low-quality brands.

The literature on multi-product firms and product differentiation deals with discriminatory behavior of a monopoly (Mussa & Rosen, 1978; Stokey, 1979; Salant, 1989) as well as with competing multi-product firms. In the latter context, products are differentiated by horizontal (location) characteristics (Shaked & Sutton, 1990; Klemperer, 1992), vertical (quality) characteristics (Champsaur & Rochet, 1989; Johnson & Myatt, 2003), or both (Katz, 1984; Gilbert & Matutes, 1993; Canoy & Peitz, 1997). Sale of a new product by a multi-product firm can be warranted because it may attract new consumers to the market, it may cause consumers who purchase products from competing firms to switch to the new product or it may "cannibalize" the firm's own line of products. According to the existing literature, the firm's incentives for introducing a new product are basically based on the existence of a tradeoff between the extra profit from the new product and the adverse effect of its introduction on the firm's profits from the existing line of products. In particular, new and inferior products (like the IBM Laser Printer that prints 5 pages per minute, that was created by adding a speed-limiting chip to IBM's Laser Printer of 10 pages p.m., Deneckere & Mcafee, 1996), may be introduced for various reasons intended to

[10] A plausible assumption when products are "virtual", like some unattractive products in brochures that are never meant to be sold, or when the products are versions of an existing product, possibly a damaged product, that just carry new labeling.

exploit the heterogeneity in the consumers' preferences or income, to deter prospective entrants or to "fight" actual new entrants.[11] Unlike any of the existing models, by Proposition 3, the sale probability of the leading brand in our setting may increase when new low-quality brands (or new firms that produce them) are introduced. This implies that, due to k being relatively small (the sufficiently bounded rationality of consumers) or n being relatively large (the fact that the existing size of the industry is sufficiently large relative to the number of firms sampled by the consumer), and not due to the heterogeneity of the consumers' income or preferences, a firm may have an incentive to introduce such low-quality brands, even if such brands have very small or zero sale probability.[12]

6. A democratic self-regulating industry and the consumer's welfare

The consumer purchases the good from the best possible firm; that is, from the best sampled firm. In our probabilistic setting, the consumer's preferences are represented by the expected quality of the firm from which s/he purchases the good. Note that this is an ordinal measure because, given the quality of the existing firms in the industry, we assume that a firm's quality is represented by its ranking. In particular, the ranking of a potential entrant is represented by his ranking relative to the ranking of the *n* existing firms. The use of such an ordinal measure implies that the representative consumer is only concerned about how well he can do, given the existing quality of the industry. The application of the measure is therefore not plausible for inter-industry consumer welfare comparisons because, obviously, buying from the best-quality firm in one town, for example, is not necessarily better than buying from a medium-quality firm in another town. For simplicity, we assume in this section that the quality of a new firm is equal to the quality of one of the existing firms or lower than all the existing firms. In the former case, when such a firm enters the industry,

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[11] Note that the explanation for producing essentially identical goods under different brands can also be based on an "insurance" motive (i.e., if households decide to "punish" one brand, one can still sell the other) or on the consumers' love of variety.

[12] When there are no potential entrants and the size of the industry *n* cannot be changed by establishing new firms or by producing new brands, the existing firms may affect the sample size *k,* for example, by controlling consumers' information on the firms (allowing advertising, requiring that the firms' qualifications are known, etc.). In such a case, by Proposition 3, the maximal sale probability of a firm ranked *r* is obtained when $k_r = n/r$. The implications of this observation on the endogenous determination of *k* through information control can be worked out under alternative decision rules, as in corollaries 2, 3, and 4.

we have two firms of the same ranking. The following proposition presents a necessary and sufficient condition for entry to adversely affect consumers´ welfare.

Proposition 4: For all n and k such that $n \geq k$, a new firm, ranked r^*, that enters the market reduces the consumer's welfare (increases the expected ranking of the firm from which the consumer purchases) iff $\frac{n+1}{k+1} < r^*$.

Proof: See Appendix.

Since the expression $((n+1)/(k+1))$ decreases by k, the entry of a new firm with quality r^* can improve (worsen) the consumer's welfare if he samples a small (large) number of firms. For example, suppose that there are 100 firms in the market, $n = 100$. If $k = 5$, then the expected ranking of the firm from which the consumer purchases is 16.83, whereas if $k = 10$, then the expected ranking of the firm from which the consumer purchases is 9.18. Adding a firm with a ranking quality of $r^* = 12$ increases the consumer's welfare (reduces the expected ranking of the firm from which he purchases) in the first case, and reduces its expected quality in the second case.

When the quality of the new entrant is inferior to that of the existing firms; that is, $r^* = n+1$, we obtain

Corollary 5: For all n and k such that $n \geq k$, a new inferior firm that enters the market increases the expected ranking of the firm from which the consumer purchases by $\frac{1}{k+1}$.

Proof: See Appendix.

That is, entry of an inferior firm adversely affects the consumer's welfare. In this case, the expected ranking of the firm from which the consumer purchases is inversely related to the number of firms that he samples, which means that the more firms he samples, the less he is harmed. For example, for $k = n$, the expected ranking of the firm from which the consumer purchases is 1 (the consumer samples all the firms and purchases from the 1st ranked firm). When a new inferior firm enters the market, assuming that k is fixed, the consumer purchases from the 1st ranked firm with a probability of (n/(n+1)) and from the 2nd ranked firm with a probability of (1/(n+1)). Hence, in this case, as implied by Corollary 2, the expected ranking of the firm from which the consumer purchases is equal to $\frac{n}{n+1} * 1 + \frac{1}{n+1} * 2 = 1 + \frac{1}{n+1} = 1 + \frac{1}{k+1}$.

Although different voting rules[13] may lead to different results in terms of the industry quality, as we have seen in Section 4, the expected welfare of the consumers cannot be improved under any self-regulating industry that resorts to a democratic voting rule. That is,

Proposition 5: A self-regulating industry that resorts to a democratic voting rule never makes a decision that benefits the consumer.
Proof: See Appendix.

Basically, if a new potential entrant has high enough quality (higher than (n+1)/(k+1)), so that the consumer benefits from its entry, all the firms of higher quality vote against it (they belong to the ((n+1)/k top-quality firms) and so do the firms of lower quality. Since all the existing firms reject such a potential entrant, no democratic voting rule applied by the self-regulating industry can benefit the consumer. Proposition 5 thus implies that the consumers can be "saved" only by outside or external regulation.

Note that the expected quality ranking of the firm from which the consumer purchases the good is equal to (n+1)/(k+1), whereas the average industry quality is (n+1)/2. Since (n+1)/(k+1) < (n+1)/2, for all k > 1, a new entrant may improve industry quality yet harm the consumer. For example, when $k = n = 10$, the consumer samples all the firms and purchases the good from the best firm which is ranked 1st. In such a case, there are voting rules that allow the entrance of better than average firms. New firms with ranking $r = 3$ improve the industry's quality; yet harm the consumer (he might end up with the 2nd best firm). To sum up, by Proposition 4, the effect of increased competition on the consumer may be harmful or beneficial, depending on the quality of the new entrant and the sampling size of the consumer. Specifically, a new entrant of ranking $r*$ may enhance (adversely affect) the consumer's welfare if

[13] The voting rules are assumed to be based on the votes of the firms and, furthermore, to be monotone responsive to the firms' votes.

the latter samples a small (large) number of firms. However, by Proposition 5, if entry decisions are made by a democratic self-regulating industry, then the consumer's welfare is never enhanced.

7. Conclusion

In most economic models of barriers to entry and market structure, due to the pricing effect of entry, new entrants harm the existing firms so these try to prevent such entry, while the new firms, if any, that manage to enter the market and thrive, are the fittest.

In this study the market comprises firms of heterogeneous quality and consumers who do not know the firms, randomly sampling a number of firms and purchasing the good from the best-sampled firm. Under the above assumptions, disregarding the pricing effect of entry, an existing firm may become strictly better off due to enhanced competition; that is, when new firms enter the market. More specifically, by Proposition 1, the new entrant may harm the top-quality firms, harm or not change the situation of the low-quality firms and benefit the medium-quality firms. The analysis then focuses on the implications of the model in the context of a self-regulating industry; an industry in which the existing firms control marginal entry. By Proposition 2, if the self-regulating industry resorts to simple majority rule, then the result is either stability or continued growth in the number of firms, which is accompanied by an endogenous decline in the industry's quality. A sufficient condition for such quality decay is that $k \leq 0.5n$; that is, the rationality of the consumers is sufficiently bounded, or, alternatively, the existing industry size is sufficiently large relative to the number of firms the consumers sample. Stability of the industry is also secured under hierarchy, but not necessarily under polyarchy. We proceed by establishing in Proposition 3 that, given sample size k and the ranking of a firm r, a firm maximizes its sale probability when $n_r = k*r$; that is, when the number of firms in the market is equal to the sample size multiplied by the ranking of the firm. Hence, if the firm can affect the number of firms in the market, for example, by introducing low-quality brands at no cost or sufficiently low cost, it may have an incentive to do so, even if such brands have very small or zero sale probability, in order to maximize the sale probability of its leading brand. Proposition 3 thus suggests a new justification for branding or versioning. This proposition enables the derivation of the non-marginal equilibrium industry size when the democratic self-regulating industry resorts to hierarchy, polyarchy or simple majority rule. As in the dichotomous marginal entry setting where entry of a potential entrant is approved or rejected, hierarchy is superior to polyarchy and to the simple majority rule in terms of its effect on the industry quality, because it preserves quality by preventing entry. In contrast, however, to the superiority of polyarchy to the simple majority rule in the context of dichotomous (marginal) entry decisions, when the self-regulating industry determines its overall size, the simple majority rule is preferable to polyarchy. The last part of the paper focuses on the question of how a democratic self-regulating industry affects the consumer's welfare. Proposition 4 presents a necessary and sufficient condition for marginal entry to be welfare-enhancing. By Proposition 5, such entry cannot be approved by a democratic self-regulating industry.

It seems then that our model predicts some basic undesirable features of self-regulating industries, whether a professional group of lawyers, accountants or physicians interested in selling their service to the public, an academic faculty that is interested in certain privileges (the award of grants or prizes, selection to some prestigious jobs and so on) or a political group that consists of members that expect nomination to important positions. The combination of selfish agents who are interested in being chosen (chosen by the consumers, by expert committees, by civil servants or by party members), random sampling of these agents, and the fact that the self-regulating industry resorts to simple majority rule leads to either stability or quality decay. The welfare of the consumer is adversely affected by the decisions of the self-regulating industry, not only when it resorts to simple majority rule, but also when it applies any democratic rule which is positively related to the votes of existing firms.

Our analysis implies that in our setting, where the pricing effect of entry is disregarded, the driving forces behind the expected quality decay in democratic self-regulating industries are the small number of firms the consumers sample relative to the size of the industry and the reliance on simple majority rule. The fact that the consumers choose the best firm resorting to random sampling of k firms leads to the existence of incentives for some existing firms to approve entry of mediocre quality entrants and, possibly, to engage in low-quality branding. When k is sufficiently small (or n sufficiently large), $k \leq 0.5n$, the entry of an inferior firm secures the support of a majority of the existing firms; the self-regulating industry approves entry of inferior firms. The adverse effect of bounded rationality (or of the large industry size relative to the number of firms sampled by the consumer) on the quality of an industry that applies simple majority rule has been illustrated assuming random sampling. Alternative non-random sampling assumptions or alternative assumptions regarding the applied decision rule may also result in quality decay. The identification of such alternative patterns of bounded rationality or such alternative collective decision rules certainly warrants further study.

Appendix

Proof of Proposition 1:

The probability that a consumer purchases from firm *x*, when *k* firms are sampled, is:

(1)
$$\frac{(n-r)!(n-k)!k}{(n-r-k+1)!n!}$$

The probability that a consumer purchases from firm *x*, when *k* firms are sampled, and a new inferior firm enters the market, is:

(2)
$$\frac{(n-r+1)!(n-k+1)!k}{(n-r-k+2)!(n+1)!}.$$

Thus, the entrance of a new inferior firm increases the probability that a consumer purchases from firm *x* if:

(3)
$$\frac{(n-r+1)!(n-k+1)!k}{(n-r-k+2)!(n+1)!} > \frac{(n-r)!(n-k)!k}{(n-r-k+1)!n!}$$

or, by rearranging (3), if:

(4)
$$r > \frac{n+1}{k}.$$

Furthermore, firms ranked in the last *k*-1 positions (the last *k*-2 positions when an inferior firm is added) have zero sale probability. Since ranking in one of the last *k* positions is equal to ranking in position (*n*-*k*+1) or onward (for example, ranking in one of the last 10 positions when there are 100 firms is equal to ranking in the 91st position or onward), firms ranked in position (*n*-*k*+2) or onward (positions (*n*-*k*+3) or onward when an inferior firm is added) have a zero sale probability. Hence, a necessary condition for the sale probability of a firm to be positive when an inferior firm enters the market is:

(5)
$$(n-k+3) > r$$

By (4) and (5), if *k* firms are sampled, the entrance of a new inferior firm to the market increases the sale probability of firm *x*, ranked in position *r*, iff:

(6)
$$(n-k+3) > r > \frac{n+1}{k}.$$

The probability that a consumer purchases from firm *x* when *k* firms are sampled, and a new *superior* firm enters the market, is:

(7)
$$\frac{(n-r)!(n-k+1)!k}{(n-r-k+1)!(n+1)!}$$

There is no positive k such that the expression in (7) is larger than the expression in (1), hence a firm of quality r^* decreases the sale probability of all the firms that are ranked lower than r^*. Combining this result with (6), we get that entry of a new firm ranked r^* increases the sale probability of firm x iff:

$$\min[(n - k + 3), r^*] > r > \frac{n+1}{k}. \blacksquare$$

Proof of Proposition 2:

The industry faces a dichotomous choice; whether or not to approve the entry of a prospective entrant. An entrant with above-average quality is rejected by:

1. All the firms of lower quality, in particular, all the firms of equal or less than average quality.
2. $((n+1)/k)$ top quality firms.

Hence, the majority of firms never approves such an entrant. Only entrants with less than average quality can be approved. To prove that the industry is decaying, it suffices to show that the self-regulating industry is unstable, approving entry of inferior firms. So suppose that $k \geq 3$ and that the industry considers the candidacy of an inferior firm and let us prove that $k \leq 0.5n$ is a sufficient condition for the majority approval of this candidate. Denote by INT[i] the integer part of any real number [i]. By Proposition 1, when a new inferior firm enters the market, the number of top quality firms whose sale probability does not increase is:

$$\text{(8)} \qquad \text{INT}[(n+1)/k]$$

and the number of low-quality firms whose sale probability does not increase is:

$$\text{(9)} \qquad k-2$$

Hence, by (8) and (9), the proportion of firms whose sale probability does not increase when a new inferior firm enters the market, is:

$$\text{(10)} \qquad \frac{\text{INT}[(n+1)/k] + k - 2}{n}$$

If $n = 2k$, then (10) takes the form:

$$\text{(11)} \qquad \frac{\text{INT}[(2k+1)/k] + k - 2}{2k} = \frac{2 + \text{INT}[1/k] + k - 2}{2k} = \frac{1}{2}$$

and the new firm is approved since only half of the firms vote against it.

For $n > 2k$ then, let $n = 2k+a$, where a is a positive integer. (10) now takes the form:

(12) $$\frac{\text{INT}[(2k+a+1)/k]+k-2}{2k+a}=\frac{2+\text{INT}[(a+1)/k]+k-2}{2k+a}$$

The new firm is approved if half or fewer of the firms vote against it; that is, if:

(13) $$\frac{1}{2} \geq \frac{k+\text{INT}[(a+1)/k]}{2k+a}$$

Let b = INT[$(a+1)/k$]. Then (13) can be rewritten as:

(14) $$\frac{1}{2} \geq \frac{k+b}{2k+a}$$

and (14) holds iff:

(15) $$a \geq 2b$$

or:

(16) $$a \geq 2\text{INT}[(a+1)/k]$$

and, in particular, (16) holds if:

(17) $$a \geq 2(a+1)/k$$

or

(18) $$k \geq 2(a+1)/a$$

If $k = 3$, it can be verified that (16) is satisfied for $a = 1$, and that (18) is satisfied for every positive integer a, $a > 1$. If $k \geq 4$, (18) is satisfied for every positive integer a. Hence, for $n \geq 2k$, $k \geq 3$, the majority of existing firms always approve entry of a new inferior firm. We have thus proved that the industry is decaying. ■

Proof of Proposition 3:

When $n = rk$ or $n = (rk\text{-}1)$, by (1), the sale probability of a firm of quality r is the same and equal to $\frac{(n-r)!(n-k)!k}{(n-r-k+1)!n!}=\frac{(rk-r)!(rk-k)!k}{(rk-r-k+1)!(rk)!}$.

The sale probability of a firm with quality r when there are $(rk+1)$ firms is smaller than the sale probability when there are (rk) firms. By induction, it can be verified that the sale probability of a firm with quality r when there are $(rk+a+1)$ firms is smaller than the sale probability when there are $(rk+a)$ firms. The sale probability of a firm with quality r when there are $(rk\text{-}2)$ firms is smaller than the sale probability when there are $(rk\text{-}1)$ firms. By induction, it can be verified that the sale probability of a firm with quality r when there are (rk-a-2) firms is smaller than the sale probability when there are (rk-a-1) firms. Hence, the maximal sale probability of a firm ranked r is obtained when there are (rk) or (rk-1) firms, which completes the proof. ■

Proof of Corollary 2:

By Proposition 3, $n_1 = k$, and since, by assumption, $k \leq n$, the top-quality firm votes against entry of any number of firms. By definition then, under hierarchy the chosen industry size is n. ■

Proof of Corollary 3:

By Proposition 3, $n_r = kr$ is the most preferred industry size of a firm ranked r. The distribution of these most preferred sizes satisfies the single-peakedness property (see proof of Proposition 3). Hence, by the median voter theorem, the most preferred industry size of the median voter $k(n+1)/2$ is the equilibrium industry size under simple majority rule (the proposal $k(n+1)/2$ is a Condorcet winner: a proposal that defeats any other alternative industry size by a simple majority). ■

Proof of Corollary 4:

By Proposition 3, $n_r = kr$ is the most preferred industry size of a firm ranked r. The distribution of these most preferred sizes satisfies the single-peakedness property (see proof of Proposition 3). It is straightforward to verify that in such a case, the game associated with the polyarchy rule possesses the unique Nash equilibrium $(e_1^*,...,e_n^*) =$ (0,0,…,(k-1)n), hence, $e_1^* + e_2^* + ... + e_n^* = (k-1)n$. That is, the (Nash) equilibrium industry size is nk ■

Proof of Proposition 4:

The probability that a consumer purchases from firm x when k firms are sampled is given in (1). The expected ranking of the firm from which the consumer purchases is therefore equal to:

$$\text{(19)} \qquad \sum_{r=1}^{n-k+1} r(1) = \sum_{r=1}^{n-k+1} \frac{r(n-r)!(n-k)!k}{(n-r-k+1)!n!} = \frac{n+1}{k+1}$$

When a new firm enters the market there is a (1-k/n) probability that it is not sampled, so the expected quality of the firm from which the consumer purchases is unchanged. There is a (k/n) probability that the new firm is sampled. In this case, clearly, a new firm of equal or lower quality (equal or higher ranking) than the initial expected quality decreases or does not change this expected quality, while a new firm of higher quality than the initial expected quality increases this expected quality.■

Proof of Corollary 5:

By Proposition 4, the expected ranking of the firm from which the consumer purchases is $\frac{n+1}{k+1}$. When an inferior firm enters the market, the expected ranking of the firm from which the consumer purchases is:

$$\frac{n+2}{k+1} = \frac{n+1}{k+1} + \frac{1}{k+1} \tag{20}$$

Hence, a new inferior firm that enters the market decreases the expected ranking of the firm from which the consumer purchases by $\frac{1}{k+1}$. ■

Proof of Proposition 5:

By Proposition 4, the consumer can benefit only if the entrant's ranking is lower than $\frac{n+1}{k+1}$. By Proposition 1, if a prospective entrant is of such quality, then all the firms of higher quality; firms whose ranking is lower than or equal to $\frac{n+1}{k}$, vote against entry and, in particular, all the firms of ranking smaller than $\frac{n+1}{k+1}$, which is smaller than $\frac{n+1}{k}$, vote against it. By Proposition 1, all the firms of quality lower than that of the entrant vote against it. Since all the existing firms vote against entry, there is no democratic voting rule that can benefit the consumer. ■

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