The Economics of Collective Brands

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Abstract

We analyze the effect of a shared brand name, such as geographical names, on incentives of otherwise autonomous firms to establish a reputation for product quality. On the one hand, brand membership provides consumers with more information about past quality and therefore can motivate reputation building when the scale of production is too small to motivate reputation formation by stand alone firms. On the other hand, sharing a brand name may motivate free riding on the group's reputation, reducing investment in quality. We identify conditions under which collective branding delivers higher quality than is achievable by stand alone firms.

1 Introduction

Geographical names have been used to identify high quality products since ancient times. Corinthian wines, almonds from Naxos and Sicilian honey have been renowned for their quality since the 4th century BC (Bertozi, 1995). Other examples include Parma ham, California fruits, Jaffa oranges, and Washington apples. Some of these regional brands, such as spirits from Burgundy, Champagne, Chianti and Cognac are marketed individually by individual producers while others are marketed collectively, either by producer owned firms or by State Trading Enterprises (STEs). Two central features characterize these brands. First, their brand label are perceived as badges of superior quality by consumers who are willing to pay premium prices for them (e.g. Landon and Smith (1998) and Loureiro and McCluskey (2000, 2003)). Second, individual member - producers are generally autonomous firms, which make independent business decisions and retain their own profits, and only share a brand name.

The fact that collective brand labels are associated with superior quality suggests that firms which are members of these brands invest more to maintain brand quality than they would as stand alone firms (or at least are perceived to do so by consumers). This seems surprising. If consumers' perception of the collective brand label's quality is jointly determined by their experience with the qualities provided by different individual members, and if the provision of high quality requires costly investment, it would seem that each member has an incentive to free ride on the investments of fellow members. If so, why are these brand labels perceived as badges of quality?

It is true that in some cases, the perception of superior quality may be partly attributable to exogenous advantages such as climate, soil quality, access to superior inputs, technology and so on. However, even when such natural advantages are present the achievement of superior quality presumably also requires the requisite investment of effort and other resources. The free riding problem might also be mitigated to some extent by monitoring the efforts and investments of individual members to maintain quality standards. However, monitoring is costly and imperfect and is therefore unlikely to eliminate free riding altogether. Thus it would seem that producers have less of an incentive to invest in quality as members of a collective brand than they would as stand alone firms.

The purpose of this paper is to show that, despite the incentive to free ride, members of collective brands may nevertheless have a greater incentive to invest in quality than stand alone firms. Thus institutions like STEs, may increase welfare by providing consumers with better quality.

This has important implications for the ongoing public debate concerning antitrust policy in the agricultural sector. For example, demands to ban STE's and limit regional branding have been voiced during recent rounds of the World Trade Organization negotiations on the grounds that these institutions reduce welfare and market efficiency by endowing their members with market power. Our analysis suggests that these institutions, by facilitating collective branding, can have positive welfare effects by promoting more efficient investment in quality.[1]

The idea is the following. When product quality is difficult to observe before purchase and is revealed to consumers only after consuming the product ('experience goods'), their perception of quality and the amount they are willing to pay for the product is based on past experience with the product - its reputation. Thus the extent to which a firm is able to receive a good return on its investment in quality depends on how much information consumers have about its past performance. If firms are small, relative to the size of the market, consumers may have only little information about the past quality of any individual firm. In that case, an individual firm may be unable to effectively establish a robust reputation for quality on its own and consequently has little incentive to invest in quality. Here collective branding may come to the rescue and serve as a vehicle for reputation formation by increasing the relevant information available to consumers. Specifically, suppose small individual firms market their products under

[1] An alternative position expressed in defense of STE's is that they provide economies of scale in production and promotion.

a collective brand name, sharing a collective reputation, while otherwise retaining full autonomy. Since the collective brand name covers a larger share of the market than any individual member firm, consumers are better able to assess the reputation of the brand than of individual members. This in turn increases the value of a good brand reputation for each member, and may thus incentivize members to invest in quality when they would otherwise not do so. We call this effect of collective branding the 'reputation effect'.

But as noted above, branding may also have an opposing effect on investment incentives. Unless the brand is able to effectively monitor individual investment, sharing a collective reputation may encourage individual members to free ride on the efforts of other members. Therefore the full effect of collective branding on investment in quality is determined by the interaction of these two opposing factors - the fact that, on the one hand, a good collective reputation is more valuable than a stand alone reputation, against the incentive to free ride, on the other.

Accordingly, we analyze the effects of branding in two polar cases. First, as a benchmark, we consider the case in which the brand can deter free riding by perfectly monitoring members' investments and expelling members which don't invest. We show that in that case, since only the reputation effect is operative, a brand member's incentive to invest is always greater than that of a stand alone firm. Moreover, the incentive increases with brand size (the number of firms which are members of the brand) - the larger the brand, the greater the incentive of each member to invest and therefore the more profitable membership is.

We find that, for appropriate parameters this pro - investment effect of collective branding also applies when the brand is unable to monitor individual members' investment. Specifically, collective branding can facilitate investment if investment is a sufficiently important ingredient for the attainment of high quality - that is, if the difference between the expected product quality of a firm which invests in quality and one which doesn't is sufficiently large.

However, in contrast to perfect monitoring case, this is true only if brand size is not too large. If the brand is too large, the marginal contribution of an individual member's investment to the brand's reputation becomes too small to override free riding, reducing the brand's incentive to invest relative to stand alone firms.

In an econometric study of the determinants of reputation in the Italian wine industry, Castriota and Delmastro (2008) show that brand reputation is increasing in the number of bottles produced by the brand and decreasing in the number of individual producers in the brand. This is consistent with our analysis. Keeping output fixed, an increase in the number of individual producers has no reputation effect since the number of units whose quality consumers observe is unchanged. However, it does increase the incentive for free riding (which increases with the number of members), and hence lowers investment incentives and reduces the brand's reputation. Conversely, keeping the number of individual producers fixed, increasing output does not increase the incentive to free ride but does increase the reputation effect and hence increases incentives to invest.

An experimental study by Huck and Lűncer (2009) is also consistent with our analysis. They find that more sellers invest in quality when buyers are informed about the average past quality of all sellers - which corresponds to a collective brand in our model - than when they only know the record of the seller from whom they actually buy. However, as in our model, when the number of sellers increases, the average quality declines.

Online hiring markets also provide evidence for reputational effects of collective branding. Stanton and Thomas (2010) find that employers are willing to pay more to inexperienced online workers (which have yet to establish individual reputations) affiliated with groups of workers who share a common brand label than to inexperienced independent workers.

Finally, our analysis suggests that a collective brand may be viewed as an institution to regulate the brand size, keeping the number of producers large enough to enable successful reputation building but small enough to discourage individual free riding on the brand name. Thus one might speculate that a regional brand like Champagne wines owes its success not only to unique soil and climate but also to fortuitous natural boundaries which encompass "just the right" number of producers under its brand label.

1.1 Relationship to the Literature

Our emphasis on the centrality of a firms' reputation for quality for its success connects with the large and growing literature on firm reputation with a similar emphasis, e.g., Klein and Leffler (1981) Shapiro (1982), Kreps (1990), Tadelis (1999), Mailath and Samuelson (2001), Horner (2002). Banerjee and Duflo (2000) and Gorton (1996) provide empirical evidence that firms with reputation behave differently from firms without it. All of those papers are concerned with the reputation of individual firms. By contrast, our focus is on the collective reputation of otherwise autonomous firms.

More directly related are papers which explore the relationship between firm size and incentives for reputation formation. These include Andersson (2002), Cabral (2000, 2007), Choi (1997), Dana and Spier (2006), Hakenes and Peitz (2008), Miklos-Thal (2009) and Rotemberg (2010) who analyze the effect of expanding the firm's product line (umbrella branding) on its reputation and profit, Cai and Obara (2009), who analyze the effect of horizontal integration on the integrated firms' cost of maintaining its reputation, Rob and Fishman (2005), who show that a firm's investment in quality increases with size, Yacouel (2005) and Guttman and Yacouel (2006), who show that larger firms benefit more from a good reputation. All those papers are concerned with size effects on incentives of an individual firm governed by a centralized decision maker. By contrast, our concern is with the effect of changing the number of member firms of fixed size, each governed by a distinct and autonomous decision maker.

The most closely related research is the literature on collective reputation, beginning with Tirole (1996). He analyzes how group behavior affects individual incentive to invest (behave honestly). Evans and Guinnane (2007) analyze the conditions under which groups of heterogenous producers can create a common reputation and show that a common reputation can be created only if the members are not too different from each other and if marginal costs are declining. In these papers the group's size is fixed exogenously. By contrast, our focus is precisely on the role of the group size on individual incentives and, in particular, to compare a firm's incentives when standing alone with its incentives as a brand member.

There are also similarities between our approach and the common trait literature (for example Benabou and Gertner, 1993, Fishman 1996), in which observation of one agent's behavior reveals information about a common trait which she shares with other agents in the group. While in that literature the size of the group and the common trait itself are exogenously given, our focus is to understand how inferences about the common trait affect incentives to join the group, and motivate reputation formation.

2 Model - Stand Alone Firms

We consider a market for an experience good - consumers observe quality only after buying, but not at the time of purchase. There are two periods,[2] N risk neutral firms and we normalize the number of consumers per firm to be 1. There are two possible product quality levels, low (l) and high (h). Firms are of two types, H and L, which are distinguished by their technological ability to produce high quality. The probability with which a firm is able to produce high quality depends on its type and whether or not it invests in quality. Investment is "once and for all": Prior to period 1, each firm decides whether or not to invest and that investment determines the probability with which it produces high quality at every future period[3]. The cost of investment is fixed at e.[4] An L firm produces high quality with probability b at each period whether or not it

[2] It will be apparent that the qualitative properties of the model extend straightforwardly to any horizon length, an extension which would complicate algebra and notation without adding insight.

[3] This captures the idea that investment decisions are relatively inflexible in comparison to prices, which are easy to change.

[4] One could consider a richer model in which the probability of high quality is an increasing function of the amount invested. In that case, the intuition of our analysis suggests that whenever collective branding increases investment incentives, the brand invests more than stand alone firms and delivers

invests. An H firm produces high quality with probability b if it does not invest but if it invests, it produces high quality with probability g at each period, where $0 < b < g \leq 1$. In either case the realized quality at period 2 is independent of its realization at period 1. We denote by N_H and N_L the total number of H and L firms respectively, $N_L \geq N_H$. Let $r = \frac{N_H}{N_H+N_L}$ be the proportion of H firms in the market.

Each consumer is in the market for one period, has a demand for one (discrete) unit at the most and exits the market at the end of the period. Her utility from a unit of low quality is zero and her utility from a unit of high quality is 1. We assume that $g - b \geq e$, so that investment is efficient.

Consumers cannot directly observe a firm's type (whether it is H or L) and are also unable to observe if a firm has invested or not. At period 1, consumers only know r. At the beginning of period 2, consumers are informed (through interaction with consumers of the previous generation) about the realized quality of each firm at the preceding period.[5] This information is used to update her expectations about firm quality at the second period.

In order to focus on the reputational effects of collective branding on investment incentives in the most direct possible way, it is convenient (though inessential for our main results) to assume that firms have monopolistic market power; That is, if consumers' expected utility from a unit of firm i is v_i, the price of firm i is v_i.[6] Thus branding cannot affect firms' pricing power or market share, and can only affect firms' investment incentives via reputational considerations.

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higher expected quality.

[5] A more general formulation is that a consumer is informed about the first period quality of $\alpha \leq N$ randomly selected firms. This would complicate algebra without providing additional insight or qualitatively altering our main results.

[6] This could be because consumers have high transportation costs which effectively endows firms with local monopoly pricing power. Alternatively, consider a standard consumer sequential search market setup: A consumer knows only the price distribution but not which firm charges what price, is randomly and costlessly matched with one firm and can either buy from that firm or sequentially search for other firms, incurring a positive search cost at each search. As is well known, these assumptions imply that firms have monopoly pricing power (Diamond, 1971).

An equilibrium specifies for each firm whether or not it invests and its price at each period, possibly as a function of previous quality realizations. Trivially, there always exists an equilibrium in which no firm invests[7].

The more interesting possibility is the existence of an 'investment equilibrium' (IE) in which H firms invest (L firms obviously don't invest in any equilibrium since investment has no effect on their quality). Suppose there is such an equilibrium. At the first period no firm has any history. Therefore, given that H firms invest, the expected utility from the product of any firm is $rg + (1-r)b$ which is therefore the equilibrium price of each firm. At the second period consumers update their beliefs on the basis of the firms' realized quality at the preceding period (recall that consumers observe the first period quality realization of each firm).

Let $\Pr(H \mid h)$ be the posterior belief at period 2 that a firm is type H given that it produced high quality at period 1 and let $\Pr(H \mid l)$ be the posterior belief at period 2 that a firm is type H given that it produced low quality at period 1. Then by Bayes' Rule,

$$\Pr(H \mid h) = \frac{g\ r}{gn + b(1-\ r)}.$$

$$\Pr(H \mid l) = \frac{(1-g)\ r}{(1-g)\ r + (1-b)(1-\ r)}.$$

Thus the second period price of a firm which produced high quality at the first period, p_h, is

$$\begin{aligned} p_h &= g\Pr(H \mid h) + b\Pr(L \mid h) = g\Pr(H \mid h) + b(1-\Pr(H \mid h)) \\ &= b + (g-b)\Pr(H \mid h) = b + \frac{(g-b)gr}{gr + b(1-r)}. \end{aligned} \tag{1}$$

The second period price of a firm which produced l at the first period, p_l, is

$$\begin{aligned} p_l &= g\Pr(H \mid l) + b\Pr(L \mid l) = g\Pr(H \mid l) + b(1-\Pr(H \mid l)) \\ &= b + (g-b)\Pr(H \mid l) = b + \frac{(g-b)(1-g)r}{(1-g)r + (1-b)(1-r)}. \end{aligned} \tag{2}$$

[7] In this equilibrium consumers believe that no firm invests, which makes it optimal for firms not to invest.

Let R be the expected second period revenues of an H firm that invests and R_{-1} the expected second period revenues of an H firm that doesn't invest. Then, since its probability of producing high quality is g if it invests and b if it doesn't,

$$R = gp_h + (1-g)p_l$$

and

$$R_{-1} = bp_h + (1-b)p_l.$$

An H firm's expected gain from investment is $e_1 \equiv R - R_{-1}$. By (1) and (2):

$$e_1 = (g-b)^2 \left[\frac{gr}{gr + b(1-r)} - \frac{(1-g)r}{(1-g)r + (1-b)(1-r)} \right]. \tag{3}$$

Thus, when firms stand alone an *IE* exists only if $e \leq e_1$.

A stand - alone firm has only a limited opportunity to establish a reputation for quality, since at period 2 consumers have only limited information about its past quality - one observation in our formulation. Hence if $e > e_1$ an *IE* does not exist because the cost of investment exceeds the individual firm's expected return from maintaining a good reputation.

We proceed to show below that collective branding can lead to higher quality by increasing the incentive to invest and thus expanding the range of investment costs for which an *IE* exists. That is, if two or more firms sell their product under a common brand name, an *IE* may exist even when it does not exist if firms stand alone.

3 Collective Branding

We define a *collective brand* (henceforth '*brand*') as two or more firms which market their products under a common brand name, while retaining full autonomy with respect to all business decisions and retaining their own profits. In particular, members of the brand decide individually whether or not to invest in quality. We denote by m the brand size (the number of firms which are members of the brand).

We model the process of brand formation as follows. One H firm is randomly selected to be a *brand entrepreneur*. The entrepreneur's objective is to maximize her own profit. The entrepreneur makes offers to $m-1$ other firms to join her brand (where m is at the discretion of the entrepreneur). Entrepreneurs can discern a firm's type - whether it is type H or L. Each firm which receives an offer can either accept and join the brand or reject and then stand alone or join a different brand. Joining the brand means that the firm markets its product under the brand label. Once the brand is closed (the entrepreneur doesn't admit any new members), if there are any remaining firms which have not yet joined any brand, one of them is randomly selected to be a brand entrepreneur and the procedure is repeated until all firms have either joined a brand or stand alone.

In our formulation, the defining characteristic of a collective brand is that consumers evaluate a firm's quality not on the basis of its individual past performance, but on the basis of the overall performance of the brand to which it belongs. More precisely, denote by $k \leq m$ the total number of high quality units produced by the members of a brand of size m at period 1. Consumers can't discern brand members' types but observe k and m. Consider a firm which is a member of a brand of size m with k high quality units at the first period. Our key assumption is that the probability with which a consumer believes that a unit produced by this firm at period 2 depends only on m and k (and not on that firm's individual past performance). Thus a brand member's reputation depends not only on its own investment but also on the investments of all other brand members.

Definition 1 *A Brand IE (BIE) is an equilibrium in which at least some H firms invest.*

A *symmetric BIE* is a *BIE* in which all brands are the same size. In the rest of the paper we shall restrict attention to symmetric equilibria.

Since our goal is to determine whether collective branding can lead to investment when stand alone firms do not invest, we assume that $e > e_1$ so that stand alone firms do not invest.

Assumption 1: $e > e_1$.

We also define a H *brand* as a brand all of whose members are type H, an L *brand* as a brand all of whose members are type L, and a *hybrid brand* as a brand which includes both H and L firms.

Since a member's reputation depends on the investments of all other members, an H firm which is a member of a brand with more than one H firm may be motivated to free ride on other members' investment. Therefore we shall consider separately two alternative regimes. In the first regime, termed '*perfect monitoring'*, the brand is able to monitor individual members' investment and prevent firms which do not invest from using the brand label. In that case, free riding is not an option and so incentives to invest are driven only by the reputation effect. More specifically, in the perfect monitoring regime we assume that the entrepreneur can choose whether or not to enforce investment. If she chooses to enforce investment, each member - including the entrepreneur - must invest or leave the brand. If she chooses not to enforce investment, no member invests. In the second regime, termed '*no monitoring*', the brand is unable to monitor its members' investments.

The following formulations and definitions will be useful in constructing equilibria below. Suppose there are n_H type H brands of size m, n_L type L brands of size m, all members of the H brands invest, all other firms stand alone and don't invest, and all this is known by consumers. Let $f = \frac{n_H}{n_H+n_L}$ be the proportion of H brands in the market. Let $\Pr(H \mid k, m)$ be the probability with which a consumer believes that a brand of size m with k high quality units at the first period is type H. Then by Bayes rule:

$$\Pr(H \mid k, m) = \frac{g^k(1-g)^{m-k}f}{g^k(1-g)^{m-k}f + b^k(1-b)^{m-k}(1-f)} \tag{4}$$

Then the price consumers are willing to pay at the second period to a member of an m brand which produced k high quality units and $m-k$ low quality units at the first period is given by p_k^m :

$$\begin{aligned} p_k^m &= g\Pr(H \mid k, m) + b(1 - \Pr(H \mid k, m)) \\ &= b + (g-b)\Pr(H \mid k, m) \end{aligned} \tag{5}$$

Thus the expected revenues of each member of an H brand at period 2, R^m, is:

$$R^m = \sum_{k=0}^{m} \binom{m}{k} g^k (1-g)^{m-k}\ p_k^m \tag{6}$$

and the expected revenues of each member of an L brand at period 2, R_-^m, is:

$$R_-^m = \sum_{k=0}^{m} \binom{m}{k} b^k (1-b)^{m-k}\ p_k^m. \tag{7}$$

Also, since stand alone firms don't invest, $\Pr(H \mid k, 1) = 0$ and so by (5) $p_k^1 = b$.

Finally, let e_m be the difference between the expected revenue of a member of an H brand and that of a member of an L brand. That is,

$$e_m \equiv R^m - R_-^m \tag{8}$$

Lemma 1 *R^m and e_m are strictly increasing in m.*

3.1 Perfect Monitoring

Proposition 1 below establishes that under perfect monitoring, if $e \leq e_{N_H}$, where e_{N_H} is defined by (8) for $m = N_H$, then there is an equilibrium in which all H firms belong to the same homogenous brand of size n_H. By Lemma 1, $e_{N_H} > e_1$. Thus collective branding leads to investment in cases where stand alone firms don't invest.

Proposition 1 *Under perfect monitoring, there is a BIE in which all H firms belong to the same brand if $e \leq e_{N_H}$.*

Proof of proposition: We construct the equilibrium. Let n_L be the largest integer $\leq \frac{N_L}{N_H}$, $n_L \geq 1$. Let there be one H brand all its members invest, n_L type L brands, all of size N_H , and $N_L - n_L N_H$ stand alone L firms. Then $\Pr(H \mid k, N_H)$ is given by (4) and $p_k^{N_H}$ is given by (5). Let consumers (out of equilibrium) beliefs be that if a brand is of size $m \neq N_H$, then all its members are type L. Then for $m \neq N_H$, $\Pr(H \mid k, m) = 0$ and by (5) $p_k^m = b$.

Consider an L entrepreneur. Given that all H firms join the H brand, it can only form a L brand. If it forms a brand which is not size N_H, then, given consumers' beliefs its revenue is b while if it forms a L brand of size N_H its expected profit is $R_{-}^{N_H} > b$ where the inequality follows from (5) and (7). For the same reason it is more profitable for an L firm to join an L brand than to stand alone.

Consider the H entrepreneur. If it establishes a brand of size $m \neq N_H$, then by the above consumer beliefs, the revenue of each member is only b. If it establishes a H brand of size N_H and enforces investment, then by (6) the profit of each member, including the entrepreneur, is $R^{N_H} - e$. If it admits any type L firms into the brand, the profit of each member is strictly less than $R^{N_H} - e$ since an L firm produces a high quality unit with smaller probability than an H firm which invests. If the entrepreneur does not enforce investment then its profit is $R_{-}^{N_H}$. Since $e \leq e_{N_H} = R^{N_H} - R_{-}^{N_H}$ it follows that $R^{N_H} - e \geq R_{-}^{N_H} > b$. Thus it is optimal to establish a H brand of size N_H and enforce investment.

Consider an H firm. It can either join the H brand and invest, join an L brand and not invest or stand alone. The same argument used above for the H entrepreneur implies that it is optimal for it to join the H brand.

Since the number of stand alone firms is $< N_H$, they can not form a brand of size N_H, therefore cannot earn revenue greater than b by forming or joining a brand, and therefore optimally stand alone. ■

Thus, under the assumption of perfect monitoring, collective branding can support investment when investment by stand alone firms is unsustainable. The equilibrium derived in the preceding proposition has the extreme characteristic that all H firms are in the same brand. However, this is not a necessary feature. As we shall now show, depending on the investment cost, there also exist other BIE which sustain investment in which the brand size is smaller than N_H and there is more than one H brand which invests. To fully characterize these equilibria, it is convenient to make the following assumption in the rest of the paper:

Assumption 2: Only H brands invest. That is, if there are any hybrid brands, none of its members invest.

We now construct BIE in which brand size is smaller than N_H under this assumption and then go back and verify conditions under which it is justified.

Proposition 2 *Suppose that $e \leq e_{m'}$ for $m' < N_H$. Then a BIE exists for any m, $m' \leq m \leq N_H$.*

Proof of proposition: Let m' satisfy $e \leq e_{m'}$, $m' \leq N_H$. We construct the equilibrium for any $N_H \geq m \geq m'$. Let n_H be the largest integer $\leq \frac{N_H}{m}$ and n_L the largest integer $\leq \frac{N_L}{m}$. There are n_H type H brands all of whose members invest and n_L type L brands, all of size m. If $N_L - n_L m + N_H - n_H m \geq m$, there is one hybrid brand (by Assumption 2 none of whose members invest) and all remaining firms stand alone and don't invest. Otherwise there are $N_L - n_L m + N_H - n_H m$ stand alone firms which don't invest.

Then $\Pr(H \mid k, m)$ is given by (4), where $f = \frac{n_H}{n_H + n_L}$ if $N_L - n_L m + N_H - n_H m < m$, and, abusing notation, $f = \frac{n_H}{n_H + n_L + 1}$ otherwise, and p_k^m is given by (5). Let consumers (out of equilibrium) beliefs be that if a brand is of size different than m, then none of its members invest. Then by (5) for a brand of size different than m, $p_k^m = b$.

Given these consumer beliefs, the analysis of the incentives of entrepreneurs and members of brands is analogous to those in the construction of proposition 1. And given that the hybrid brand (if there is one) doesn't invest, the entrepreneur's and member's incentives are identical to those of a L brand entrepreneur. Finally, since the number of stand alone firms is smaller than m, they cannot earn more than b whether they stand alone or form a brand and whether or not they invest. ■

Combined with Lemma 1 this implies:

Corollary 1 *The maximum value of e for which a BIE exists is strictly increasing in the brand size, m.*

Proposition 2 implies that there are generally multiple equilibria (multiple brand sizes which support a *BIE*). In the equilibria, as constructed in the proof of the proposition, all the investing firms belong to H brands and therefore by equation (6) each member's revenue is R^m. Since by Lemma 1, R^m is increasing in m, these equilibria can be ranked in terms of H - firms' profitability : the larger the equilibrium brand size, m, the greater the H firms' profit. In this sense, under perfect monitoring, "bigger is better". The reason for this is that, when perfect monitoring eliminates incentives to free ride and ensures that each member invests, then the larger the brand, the more information consumers have about the brand type. Hence, since H firms produce high quality with greater probability than L firms, the larger the brand, the more consumers are willing to pay, on average, and the larger the brand's profits[8]. The same logic implies that the reverse is true for L firms; the larger the equilibrium brand size, the lower the L firms' expected profits.[9]

Although profits increase with m, this does not necessarily imply that we should expect to observe a 'mega brand' including all the H firms in reality. This is because our construction ignores managerial and administrative limitations which, realistically, would restrict the brand size which may be effectively monitored and managed.

Now we go back to see when Assumption 2 is justified in equilibrium. In the equilibria constructed in the proof of proposition 2 there are at most $N_H - n_H m$ type H firms that do not belong to an H brand. Assumption 2 is of course satisfied if $N_H - n_H m = 0$ (i.e., $\frac{N_H}{m}$ is an integer). If $N_H - n_H m > 0$, then it is optimal for these firms to join with some L firms to form a hybrid brand of size m (since by doing so their

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[8] As described in the proof of the proposition, the equilibria in which brand size is $m < n_H$ are supported by consumers' out of equilibrium belief that a brand size greater than m is type L. This belief seems somewhat unreasonable. Since a larger brand size provides more information about the brand's performance, providing consumers with more information is in the interest of H firms but works against the interest of L firms, who would like to conceal information about their type and thus prefer the brand to be as small as possible. Thus, a larger brand size should, if anything, *increase* the prior that the brand is H, not decrease it. This logic suggests that, under perfect monitoring, the most reasonable equilibrium brand size is the largest possible one, n_H.

[9] The profits of members L brand memebers is $\sum_{k=0}^{m} \binom{m}{k} b^k (1-b)^{m-k}\ p_k^m$. In the proof of the lemma it is shown that the last expression declines with m.

profit is at least as great as that of a pure L brand of the same size while by standing alone their profit is only b). If $e_{N_H - n_H m} < e \leq e_m$ then our previous analysis implies that it is more profitable for an H firm to stand alone than to invest as a member of the hybrid brand. Thus if $N_H - n_H m > 0$, Assumption 2 is satisfied for $e_{N_H - n_H m} < e \leq e_m$. If Assumption 2 is not satisfied, the analysis will be more complicated since consumers' updating would account for investment behavior of both H brands and the hybrid brand. We believe that our results would still hold for this case though the math would be more complicated.

3.2 No Monitoring

The more realistic and interesting case is the one in which the brand is unable to perfectly enforce investment by individual members. Therefore, we now consider the other extreme case, in which each brand member decides on its own whether or not to invest and that decision is undetectable by other brand members.

Define R_{-1}^m as:

$$R_{-1}^m = \sum_{k=0}^{m-1} \binom{m-1}{k} g^k (1-g)^{m-1-k} \left[(1-b)p_k^m + bp_{k+1}^m\right] \tag{9}$$

In analogy to R^m, R_{-1}^m is the expected revenues at period 2 of each member of an H brand of size m when all members but one invest, consumers' willingness to pay is given by p_k^m and $\Pr(H \mid k, m)$ is given by (4).[10] Let $\widetilde{e}_m \equiv R^m - R_{-1}^m$ where R^m is defined by (6). Under the same assumptions, $\widetilde{e}_m$ is the increase in the revenue of a member of an H brand of size m from investing when all other members invest. While in the perfect monitoring regime, the entrepreneur determines whether to invest, here each brand member decides individually. Therefore in the no monitoring context, $\widetilde{e}_m$ assumes the role played by e_m in the perfect monitoring context.[11] The following lemma shows that a similar result to

[10] $\sum_{k=0}^{m-1} \binom{m-1}{k} g^k (1-g)^{m-1-k}$ is the expected number of high quality units given that are produced by the $m-1$ investing firms. With probability $1-b$ the firm which doesn't invest produces low quality and with probability b high quality. Hence the price is p_k^m and p_{k+1}^m in the first and second case, respectively.

[11] Note that $\widetilde{e}_1 = e_1$.

lemma 1 applies under no monitoring in the special case $g = 1$.

Lemma 2 *Under the no monitoring regime, if $g = 1$, $\widetilde{e}_m$ is increasing in m for $m \geq 1$.*

Based on this lemma, the following proposition shows that an analogue of proposition 2 exists for the no monitoring regime if $g = 1$.

Proposition 3 *Suppose that $g = 1$ and $e \leq \tilde{e}_{m'}$ for $m' \leq N_H$. Then a BIE exists for any m, $m' \leq m \leq N_H$.*

P roof. The proof uses a similar construction to that used in the proof of proposition 2. The difference between the two cases is that under perfect monitoring the brand entrepreneur decides whether the brand should invest whereas here brand members individually decide whether to invest and hence the relevant criterion is that $e \leq \widetilde{e}_m$. ■

Thus, when $g = 1$ it continues to be true that the larger the brand size, the greater the range of investment costs for which a BIE exists. The intuition behind this Proposition is that $R^m - R^m_{-1}$ reflects the adverse effect of a single low quality observation on the brand's reputation. If $g = 1$, consumers believe that the brand is type L if it produces even a single low quality unit, regardless of how many other high quality units it produces. Therefore the incentive to free ride does not increase with the brand size. On the other hand, if all members invest, the consumers' posterior probability that the brand is type H, and hence the price they are willing to pay, increases with brand size, just as under perfect monitoring. Thus when $g = 1$, an individual brand member's loss from not investing, and hence its incentive to invest, increases with m.

However, if $g < 1$, it is no longer the case that bigger is better. In fact, the following lemma shows that for sufficiently large m, a *BIE* does not exist under no monitoring.

Lemma 3 *Under the no monitoring regime, if $g < 1$ and m is sufficiently large, no BIE exists.*

Proof: In the Appendix.

If $g < 1$, even when all brand members invest, some of the brand's units are low quality with positive probability, a probability which increases with the brand size. Therefore, when $g < 1$, the adverse effect of an additional low quality unit decreases with the brand's size. Therefore if m is sufficiently large, the free riding effect dominates the reputation effect. Thus if $g < 1$,branding does not necessarily enable more investment than stand alone firms. However, the following proposition shows that nevertheless, as long as g is not too small, or b is not too large, branding can facilitate investment when stand alone firms do not invest.

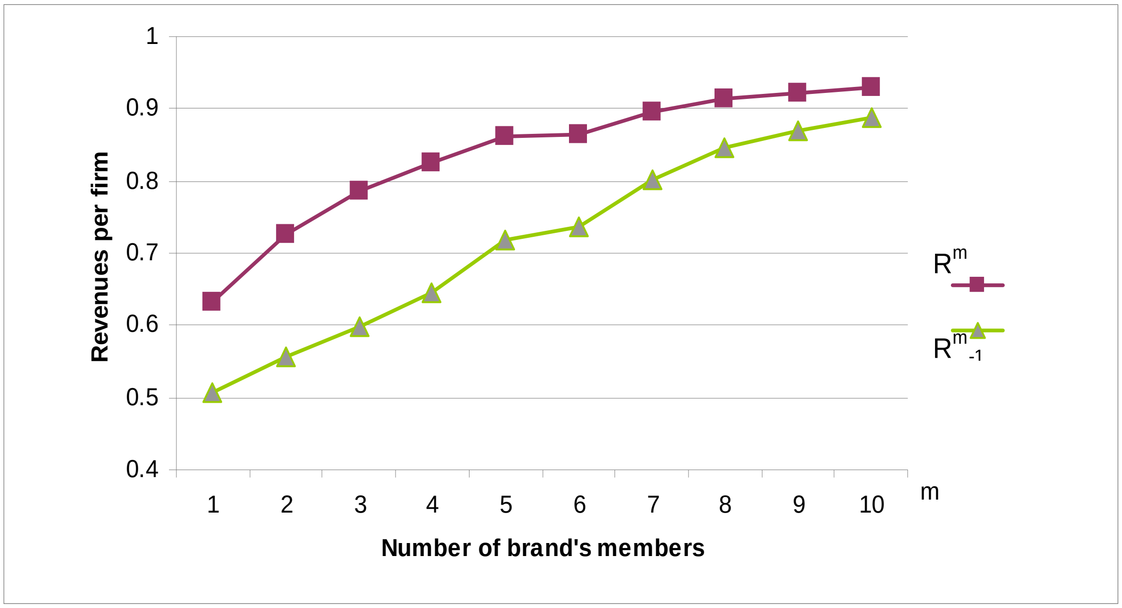
Proposition 4 *(i) Given b, there is $g^* < 1$ such that if $1 \geq g \geq g^*$, a BIE exists for some $e > e_1$.*

(ii) Given g, there is b^* such that if $b < b^*$, a BIE exists for some $e > e_1$.

Generally, even if $g < 1$, a BIE exists under no monitoring if a single success has enough of an impact on consumers' posterior to overcome free riding. The preceding proposition provides two such cases. The intuition for part (i) is that even if $g < 1$ (but large enough), a low quality observation is expected with low probability if the brand is not too large. In that case, a single low quality observation still has enough of a negative effect on the consumers' posterior to discourage free riding. By contrast, if g is small, consumers expect a low quality unit with relatively high probability even if the brand is small, hence the marginal negative effect of free riding on consumers' posterior, and consequently the incentive to invest, is small. The intuition behind part (ii) is that if b is small, every high quality observation has relatively large effect on the posterior that the firm belongs to an H brand and therefore has a large effect on the brand's price.

The proposition is illustrated in the figure, where R^m and R^m_{-1} are sketched for the parameters $b = 0.4$, $g = 0.95$, $N_H = 10$, $N_L = 30$ and $e = 0.14$. $\widetilde{e}_m$ is represented by the distance between R^m and R^m_{-1}.

For these parameters, $e_1 = 0.12$ (represented in the figure by the vertical distance between R and R_{-1} at $m = 1$) but $\widetilde{e}_m > 0.14$ for $2 \leq m \leq 5$. Thus a stand alone firm



would not invest but BIE exist for $2 \leq m \leq 5$.

The brand member's profit increases with the brand size as long as the brand is small enough to deter free riding. Thus the brand size which maximizes H firm's profits is the largest size which still deters free riding, which in the example is $m = 5$. Of course, the opposite is true for L firms; for them the most profitable brand size is the smallest brand which is still large enough to sustain investment of the H brands - $m = 2$ in this example.

With regard to efficiency, brands of size 2 to 5 are equally efficient because all sustain investment. An alternative notion is that the socially optimal brand size is the one which supports investment in the widest range of circumstances; that is, m for which $\widetilde{e}_m$ is maximized. In the example, the brand size which is optimal in this sense is 3 where $\tilde{e}_3 = 0.19$.

4 Concluding Remarks

Collective Brands and State Trading Enterprises are often perceived as a means of fostering collusion and therefore as an obstacle to efficient markets. On these grounds, they have been targeted by free market advocates in recent WTO rounds. Here we take a contrasting view, arguing that by affecting reputational incentives, these institutions can increase efficiency and welfare by enabling higher product quality than would be attainable in their absence. In a richer setting, the socially optimal brand size would have to balance the positive effect of branding on reputation building against its negative effect on firms' market power.

There are interesting parallels between our characterization of collective brands as vehicles of reputation formation and franchisees of chain stores and restaurants. Like a member of a collective brand, a franchisee is affected by and affects the reputation of the entire chain. Therefore it may be motivated to free ride on the chain's reputation and for this reason is closely regulated by chain ownership. Indeed, Jin and Leslie (2008) present evidence, that chain-affiliation is indeed a source of reputational incentives which may drive chain restaurants to have better hygiene than independent restaurants. They also find that franchisees invest less in hygiene than company owned restaurants of the same chain, which they interpret as evidence of free riding by franchisees on the chain reputation.

In contrast to franchises, the collective brand has no centralized ownership or control and each member is an autonomous firm. What we have shown is that despite incentives for free riding, collective branding can create greater reputational incentives than is possible with stand alone firms, even in the absence of a centralized ownership and even in the complete absence of any regulation or monitoring.

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5 Appendix

5.1 Proof of Lemma 1

By equations (4) - (6)

$$\begin{aligned} R^m &= b + (g-b)\sum_{k=0}^{m}\binom{m}{k}g^k(1-g)^{m-k}\frac{g^k(1-g)^{m-k}f}{g^k(1-g)^{m-k}f + b^k(1-b)^{m-k}(1-f)} \\ &= b + (g-b)\sum_{k=0}^{m}\binom{m}{k}g^k(1-g)^{m-k}\frac{f}{f+(1-f)x_k^m} \\ &= b + (g-b)\sum_{k=0}^{m}\binom{m}{k}g^k(1-g)^{m-k}s_k^m \end{aligned}$$

where

$$x_k^m \equiv \frac{b^k(1-b)^{m-k}}{g^k(1-g)^{m-k}} \quad \text{and } s_k^m \equiv \frac{f}{f+(1-f)x_k^m}$$

Let K be a binomial random variable with the parameters (m, g). Let

$$X^m \equiv \frac{b^K(1-b)^{m-K}}{g^K(1-g)^{m-K}} \quad \text{and } S^m \equiv \frac{f}{f+(1-f)X^m}$$

Note that

$$E(X^{m+1} \mid X^m) = g\frac{b^{K+1}(1-b)^{m-K}}{g^{K+1}(1-g)^{m-K}} + (1-g)\frac{b^K(1-b)^{m+1-K}}{g^K(1-g)^{m+1-K}} = bX^m + (1-b)X^m = X^m$$

implying that $X^1, X^2, X^3, ...$ is a martingale. Since $X^m \geq 0$, S^m is a strictly convex function of X^m, then by Jensen's Inequality, $ES^{m+1} > ES^m$. Hence,

$$R^{m+1} = b+(g-b)\sum_{k=0}^{m+1}\binom{m+1}{k}g^k(1-g)^{m+1-k}s_k^{m+1} > b+(g-b)\sum_{k=0}^{m}\binom{m}{k}g^k(1-g)^{m-k}s_k^m = R^m$$

which proves that R^m is increasing with m.

To show that e_m is increasing in m substitute eqautions (4) and (5) into (7) yielding

$$\begin{aligned} R_-^m &= b+(g-b)\sum_{k=0}^{m}\binom{m}{k}b^k(1-b)^{m-k}\frac{g^k(1-g)^{m-k}f}{g^k(1-g)^{m-k}f + b^k(1-b)^{m-k}(1-f)} \\ &= b+(g-b)\sum_{k=0}^{m}\binom{m}{k}g^k(1-g)^{m-k}\frac{fx_k^m}{fx_k^m + (1-f)} \end{aligned}$$

Since $\frac{fX^m}{fX^m+1-f}$ is a concave function of X^m, by Jensen's Inequality

$$E\frac{fX^{m+1}}{fX^{m+1}+1-f} < E\frac{fX^m}{fX^m+1-f}$$

implying

$$\begin{aligned} R_-^{m+1} &= b+(g-b)\sum_{k=0}^{m+1}\binom{m+1}{k}g^k(1-g)^{m+1-k}\frac{fx_k^{m+1}}{fx_k^{m+1}+1-f} \\ &< b+(g-b)\sum_{k=0}^{m}\binom{m}{k}g^k(1-g)^{m-k}\frac{fx_k^m}{fx_k^m+1-f} = R_-^m \end{aligned}$$

and it follows that

$$e_{m+1} = R^{m+1} - R_-^{m+1} > R^m - R_-^m = e_m$$

completing the proof. ■

5.2 Proof of Lemma 2

Proof: When $g = 1$, the $m-1$ investing firms produce high quality with certainty. If the the mth firm doesn't invest it produces high quality with probability b, in which case its revenues (and that of every other member of the brand) are R^m. With probability $1-b$ it produces low quality in which case $k = m-1$ and, by equations (4) and (5) $\Pr(H \mid k, m) = 0$ and $p_k^m = b$. Hence,

$$R_{-1}^m = bR^m + (1-b)b.$$

It follows that

$$\widetilde{e}_m = R^m - R_{-1}^m = (1-b)(R^m - b).$$

Since by Lemma 1 R^m is increasing with m, it follows that $\widetilde{e}_m$ is increasing with m. ■

5.3 Proof of Lemma 3

The proof is using the following Claim.

Claim

$$R^m = \sum_{k=0}^{m-1} \binom{m-1}{k} g^k (1-g)^{m-1-k} \left[g p_{k+1}^m + (1-g) p_k^m \right] \tag{10}$$

Proof of the Claim: Let k' be the number of high quality units produced by any given group of $m-1$ members of an H brand of size m. Since the mth firm invests, it produces high quality with probability g and low quality with probability $1-g$. Hence, the brand produces $k'+1$ high quality units and receives a price of $p_{k'+1}^m$ with probability g and produces k' high quality units and receives a price of $p_{k'}^m$ with probability $1-g$. Since the probability that $m-1$ members produce k' high quality units is $\binom{m-1}{k'} g^{k'} (1-g)^{m-1-k'}$ it follows that

$$R^m = \sum_{k=0}^{m-1} \binom{m-1}{k} g^k (1-g)^{m-1-k} \left[g p_{k+1}^m + (1-g) p_k^m \right]$$

which proves the Claim.

Using equations (9) and (10)

$$\widetilde{e}_m = R^m - R^m_{-1} = (g-b)\sum_{k=0}^{m-1}\binom{m-1}{k} g^k(1-g)^{m-1-k}\left[p^m_{k+1} - p^m_k\right]$$

Substituting for p^m_k from equations (4) and (5) and recalling from the proof of Lemma 1 that $x^m_k \equiv \frac{b^k(1-b)^{m-k}}{g^k(1-g)^{m-k}}$:

$$\begin{aligned}\widetilde{e}_m &= (g-b)^2\sum_{k=0}^{m-1}\binom{m-1}{k} g^k(1-g)^{m-1-k}\left[\frac{f}{f+(1-f)x^m_{k+1}} - \frac{f}{f+(1-f)x^m_k}\right] \\ &= (g-b)^2\sum_{k=0}^{m-1}\binom{m-1}{k} g^k(1-g)^{m-1-k}\frac{f(1-f)(x^m_k - x^m_{k+1})}{\left[f+(1-f)x^m_{k+1}\right]\left[f+(1-f)x^m_k\right]}. \quad (11)\end{aligned}$$

Since

$$x^m_k - x^m_{k+1} = \frac{b^k(1-b)^{m-k}}{g^k(1-g)^{m-k}} - \frac{b^{k+1}(1-b)^{m-k-1}}{g^{k+1}(1-g)^{m-k-1}} = \frac{b^k(1-b)^{m-k-1}}{g^k(1-g)^{m-k-1}}\left(\frac{1-b}{1-g} - \frac{b}{g}\right)$$

it follows that

$$\widetilde{e}_m = (g-b)^2\sum_{k=0}^{m-1}\binom{m-1}{k} b^k(1-b)^{m-k-1}\frac{f(1-f)\left(\frac{1-b}{1-g} - \frac{b}{g}\right)}{\left[f+(1-f)x^m_{k+1}\right]\left[f+(1-f)x^m_k\right]}.$$

Hence, and since $\lim_{m\to\infty} x^m_k = \infty$ and $\sum_{k=0}^{m-1}\binom{m-1}{k} b^k(1-b)^{m-k-1} = 1$ it follows that

$$\lim_{m\to\infty}\widetilde{e}_m = 0$$

completing the proof of the lemma. ■

5.4 Proof of Proposition 4

By equation (11) $\widetilde{e}_m$ is continuos in g. Part (i) of the proposition follows immediately from this and since by Lemma 2 $\widetilde{e}_m > \widetilde{e}_1$ for $g = 1$.

To prove part (ii) we will show that it holds for $m = 2$. Setting $m = 1$ and $m = 2$ in equation (11),

$$\frac{\widetilde{e}_1}{(g-b)^2} = \frac{f}{f+(1-f)x^1_1} - \frac{f}{f+(1-f)x^1_0}$$

$$\frac{\widetilde{e}_2}{(g-b)^2} = (1-g)\left(\frac{f}{f+(1-f)x_1^2} - \frac{f}{f+(1-f)x_0^2}\right) + g\left(\frac{f}{f+(1-f)x_2^2} - \frac{f}{f+(1-f)x_1^2}\right)$$

When $b \to 0$, x_1^1, x_1^2, x_2^2 and x_1^2 converge to zero and therefore,

$$\begin{aligned}
\lim_{b\to 0}(\widetilde{e}_2 - \widetilde{e}_1) &= g^2 \lim_{b\to 0}\left[(1-g)\left(1 - \frac{f}{f+(1-f)x_0^2}\right) + \frac{f}{f+(1-f)x_0^1} - 1\right] \\
&= g^2 \lim_{b\to 0}\left[(1-g)\frac{(1-f)x_0^2}{f+(1-f)x_0^2} - \frac{(1-f)x_0^1}{f+(1-f)x_0^1}\right]
\end{aligned}$$

Since by definition $x_0^2 = \frac{1-b}{1-g}x_0^1$, the last equality can be written as:

$$\begin{aligned}
\lim_{b\to 0}(\widetilde{e}_2 - \widetilde{e}_1) &= g^2 \lim_{b\to 0}\left[(1-g)\frac{(1-f)\frac{1}{1-g}x_0^1}{f+(1-f)\frac{1}{1-g}x_0^1} - \frac{(1-f)x_0^1}{f+(1-f)x_0^1}\right] \\
&= g^2 \lim_{b\to 0}\left[\frac{(1-f)x_0^1}{f+(1-f)\frac{1}{1-g}x_0^1} - \frac{(1-f)x_0^1}{f+(1-f)x_0^1}\right] > 0
\end{aligned}$$

which proves Part (ii). ■