

# Multi-market Competition in Packaged Goods: Sustaining Large Local Market Advantages with Little Product Differentiation

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## Abstract

Local outputs for nationally available brands of packaged goods tend to be spatially concentrated, i.e., the same brand has high outputs in some regions, and low outputs in others. Curiously, such spatial concentration is very persistent despite direct competition between brands and a notable lack of product differentiation. It is shown that the stability of spatial concentration can be explained from two realities of competing in packaged goods, namely multi-market contact of national brand manufacturers and high local positioning cost (e.g., advertising costs or retailer incentives). These explanations gain more weight as the differentiation between brands diminishes. Indeed, a main result of the paper is that when two products are undifferentiated, their observed local outputs are more likely to be asymmetric. A surprising implication of the analysis is that multi-market profits can be higher with high positioning cost than without such cost. This happens when manufacturers have some strong and some weak markets and when positioning costs are a deterrent to seeking a “fair” share in each local market. Positioning costs are more effective in this deterring role when products are again undifferentiated. Another implication of the main result is that firms selling undifferentiated goods should focus on defending their strong markets and stay away from attacking in markets where a competitor leads.

JEL Classification: L11, L15, L22, L66, M30, R12

# 1 Introduction

Consumer goods in the United States often lack meaningful product differentiation on attributes other than brand labels (Carpenter, Glazer, and Nakamoto 1994; Trout and Rivkin 2000). If two products are physically identical, except perhaps for brand labels, utility maximizing consumers should be relatively indifferent between them. All else equal, therefore, demand for such brands should be similar –or at least not systematically different– within and across geographical markets.

However, the same national brand of repeat purchase goods often has very different market shares across different local markets, even after controlling for the influence of regional or local brands. Consider Figure 1, which shows market shares for the two largest manufacturers of brands of Mexican salsa, Campbell and Frito-Lay. These manufacturers market the Pace and Tostitos brands, respectively. Both brands originate in Texas and offer very similar products. Within and across markets, the two firms have very different shares and seem to divide the domestic U.S. market in two territories, one for each firm.<sup>1</sup> Tostitos dominates along the East Coast, whereas Pace leads west of the Mississippi. While market-shares are clearly not constant across *markets*, they are in fact constant across *time*.<sup>2</sup> Given any one market, and given the similarity of the two brands, the question in this paper is: How is it possible that in direct competition, these firms sustain such diverse yet persistent market divisions? Put differently, why can large local market advantages persist in the face of little product differentiation?

I present two explanations for this puzzle. First, reciprocal local market advantages, e.g., where all competitors have some strong –and accept some weak– markets, can be sustained as the outcome of multi-market competition. Second, when it is costly to position as the market leader in communication– or distribution channels, it is still possible for two physically identical products to end up in an asymmetric equilibrium, even in a single market (i.e., without reciprocity).

With both arguments, the key contingency in this paper is that with less product differentiation, asymmetries in competitive equilibria occur more often and – if they rely on orientation toward future profits – are more easily sustained.

Traditionally, geographic concentration of outputs and prices has been linked to geographic cost

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<sup>1</sup>The pattern in Figure 1 is not exceptional. Equally concentrated patterns are observed for categories such as ground coffee, margarines, and mayonnaise.

<sup>2</sup>This fact is illustrated by the fact that Figure 1 represents the annual averages of market shares for 1996, suggesting that the differences in share are not simply due to temporary local marketing programs.

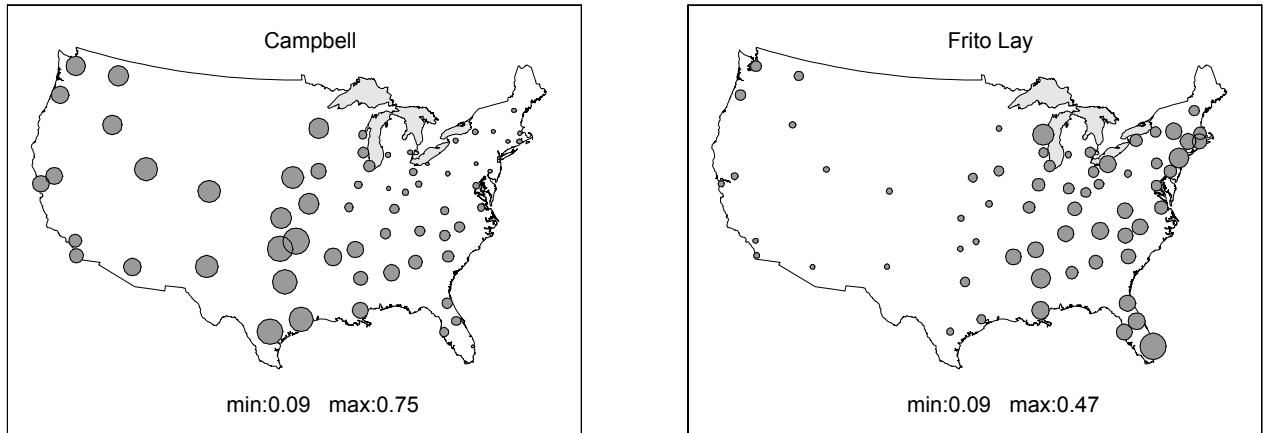


Figure 1: Market shares of two leading manufacturers of Mexican salsa

differences (see e.g., Greenhut 1981). For instance, prices can be affected by the location of firms through transportation cost (Anderson and de Palma 1992; Fujita, Krugman, and Venables 1999). Thus, locating oneself closer to consumers creates a cost advantage which may impact observed outputs. In this research tradition, it is the transportation cost of *firms* that drives the spatial distribution of prices and outputs.

However, the location of the manufacturers whose outputs are represented in Figure 1 was initially similar and therefore transportation cost of firms does not seem to explain the observed data well. Rather than focusing on the transportation cost of firms, I focus on (1) the transportation cost of *consumers* and (2) that firms compete in *multiple geographic markets*.

Geographic markets are defined in this paper as areas without consumers overlap and without consumer arbitrage. In other words, I use as a defining characteristic of a geographic market that consumers do not travel from one market to the next to benefit from price differences across markets. This definition is particularly applicable in the domestic US with its discrete population centers (metropolitan areas) separated by sparsely populated space. In the context of packaged goods, consumer transportation cost across such markets is often high compared to the potential gains from traveling. Although almost entirely omitted from theoretical analysis, the “no consumer arbitrage” property of local markets is important to understanding multi-market conduct of firms. At a minimum, the opposite assumption, i.e., that firms would not seek to benefit from the *de facto* immobility of consumers across markets, seems lacking as a theoretical point of departure.

Allowing firms to set different prices in different markets, I show that firms have an incentive to maintain advantages that may have grown historically in some markets and accept historical disadvantages in other markets. This incentive increases as the differentiation between products diminishes and may lead to implicit coordination by firms across markets. Therefore, even without transportation cost arguments and even with the same types of consumers across markets, large market advantages can be sustained, especially in the face of little product differentiation.

This paper aims to contribute to a growing literature in economics and marketing about the role of geography and space. In this context, the “New Economic Geography” (Fujita, Venables, and Krugman 1999) focuses on providing answers to two fundamental questions about economic activity. These are (1) when does spatial symmetry of economic activity break, and (2) why do spatial asymmetries in economic activity persist. Because of the empirical observation of *existing* spatial concentration in packaged goods categories, I focus in this paper on the second question.

The paper is organized as follows. The next section reviews research that suggest consumers take non-product attributes such as advertising and distribution as perceptual cues for product quality. Section 3 discusses the demand model with local quality perceptions. Section 4 sets up firm competition and establishes the basic relation between profits, perceived quality and prices in a single market framework. Section 5 analyses when asymmetries can be sustained in a multi-market economy even when it is costless to locally reposition from low to high perceived quality. Section 6 shows how the asymmetries can be sustained when there are significant costs to locally positioning as a high quality firm. It also focuses on the role of retailers in sustaining spatial concentration of outputs. Section 7 discusses and interprets the main results in the context of packaged goods. Section 8 concludes.

## **2 Local determinants of consumer quality perceptions, mind– and shelf-space.**

Consumers form brand perceptions from environmental cues other than the product itself. As Keller (1993) puts it “*although the judicious choice of brand identities can contribute significantly to customer-based brand equity, the primary input comes from [...] the various product, price, advertising, promotion, and distribution decisions.*”

Obviously, an important impetus to quality perceptions remains the physical product itself.

However, as the quote above seems to imply, perceptual advantages for packaged goods also originate in differences in brand awareness and brand support in the distribution channel. Corstjens and Corstjens (1995) note that brand awareness and distribution support are frequently zero-sum “assets” to firms because of limits on consumer information processing and on retailer shelf-space. The premise of this paper is that brand awareness and distribution support such as shelf-space are used by consumers as quality cues.

For instance, Kirmani and Wright (1989) find a positive relation between advertising and expectations about product quality. It is therefore not surprising that brand awareness is often a determinant of choice, especially for low involvement decisions (Bettman and Park 1980; Hoyer and Brown 1990; Park and Lessig 1981).

Simonson (1993) concludes that consumers construct preferences at the point of purchase. For packaged goods this means that preferences for different brands are often formed at the supermarket shelf. Shelf space allocations then affect choices in at least two ways. First, consumers may take large shelf space allocations of packaged goods as cues that those brands are popular in a given local market. Thus, if consumers do not acquire brand information themselves (Dickson and Sawyer 1990, Hoyer 1984), they may rely on (what they believe are) the preferences of others. Second, the spatial arrangement of products including shelf-space allocations raise brand awareness at point of purchase (Fazio, Powell, and Williams, 1989).

In sum, while consumers from different markets may face the same physical product, perceptions about the quality of these products are co-determined by local advertising and distribution strategies of firms. It is exactly the point of this paper that even if such influences on quality perceptions are small they can be of substantial consequence in multi-market competition.

I consider two types of perceived quality. In section 4 and 5, I use a concept of perceived quality that is an endowment from the past. Its cost is sunk. An example is order-of-entry effects on top-of-mind awareness for brands or on favorable treatment by retailers (Bowman and Gatignon 1990; Robinson and Fornell 1985). In section 6, perceived quality is costly.

### 3 A duopoly model of demand

*Utility* I use an address model of consumer demand. In this model, consumers  $h$  are characterized by a position  $\mathbf{z}_h$  in a  $K$ -dimensional attribute space in  $\mathbb{R}^K$ . Whereas the consumer’s ideal point  $\mathbf{z}_h$

is unobserved, its distribution across  $h$  is known. Products  $i = 1, 2$  are defined by a known address  $\mathbf{z}_i \in \mathbb{R}^K$  in the attribute space. Consumers  $h$  have a quadratic disutility for distance between ideal points  $\mathbf{z}_h$  and the location of products  $\mathbf{z}_i$  (d'Aspremont, Gabszewicz, and Thisse 1979). Utility for brand  $i$  by household  $h = 1, \dots, N_m$  in market  $m$  is given by

$$V_i(h, m) = Y_h + a_{im} - p_{im} - \frac{\mu}{2} \sum_{k=1}^K (z_h^k - z_i^k)^2, \quad (1)$$

where  $Y_h$  is income of household  $h$ , and  $a_{im}$  is the perceived quality of a firm in given market. The local quality attribute  $a_{im}$  is common to all households in market  $m$ ;  $p_{im}$  is the price of the product in market  $m$ . The scalar  $\mu$  measures the consumer's disutility of products being far away from his ideal point. The utility model (1) thus acknowledges the presence of household, market, and brand specific components.

*Quality perceptions* As discussed previously, quality perceptions can either reflect historical advantages, such as order of entry effects, selective consumer learning, etc., or can be influenced by shelf-space allocations by retailers in local markets or local advertising of the brand. Alternatively, the quality perceptions  $a_{im}$  can capture versions of the same product. For instance, services in the airline industry are spatially versioned, with individual firms offering more travel flexibility in some regions than in others (see e.g., Karnani and Wernerfelt 1985). However, we focus on the first two interpretations, i.e., market reach or historical advantages.

*Product positions in the physical attribute space* I assume that there is one physical attribute  $z_i^k$  ( $K = 1$ ), in addition to the quality perceptions  $a_{im}$ . This attribute is common to all consumers and markets. To rule out a consumer-focused explanation of asymmetries, I initially assume that the location of products and consumers is symmetric around zero. Owing to the presence of the multiplier  $\mu$ , it can be assumed without loss in generality that the position of product 1 is given by  $-\frac{1}{2}$  and of product 2 by  $+\frac{1}{2}$ . The difference in positions of the two products introduces horizontal differentiation in the model.

*Location of consumers in the physical attribute space* The consumer ideal points  $z_h \in \mathbb{R}$  represent the idiosyncratic component of utility. I assume the logistic density for the location of consumers

$$g(z) = \frac{\exp -z}{(1 + \exp -z)^2}, z \in \mathbb{R}^1. \quad (2)$$

*Expected demand* Consumers choose that alternative that maximizes their utility. Expected

demand of product  $i$  for  $N_m$  consumers in market  $m$  is thus obtained by integrating of the utility equation (1) over the support of product  $i$  using the consumer density of equation (2). Given the formulation of the utility function the components  $Y_h$  and  $z_h^2$ , do not affect choice (they are common to both alternatives). Given the symmetric positions, the utility component  $z_i^2$  ( $i = 1, 2$ ) also drops out of the utility comparisons. What remains is the interaction  $z_h z_i$  of the location of consumers and products. Thus the location of the consumers enters the utility comparison as a linear term, and hence demand is given by a logit model.

$$\begin{aligned}
s_{im} &= N_m \Pr(V_i(h, m) \geq V_j(h, m)) \\
&= N_m \Pr\left(z_h \leq \frac{(a_{im} - p_{im}) - (a_{jm} - p_{jm})}{\mu}\right) \\
&= N_m \frac{\exp[(a_{im} - p_{im})/\mu]}{\sum_{j=1,2} \exp[(a_{jm} - p_{jm})/\mu]}, i, j = 1, 2
\end{aligned} \tag{3}$$

In this formulation, the effective degree of horizontal differentiation manifests itself as the disutility for quadratic distance between product  $i$  and the consumer's ideal point scale parameter of the logit,  $\mu$ . For convenience and because its role turns out to be largely passive, I arbitrarily scale  $N_m = 1$ .

The logit demand formulation has broad appeal in both theoretical (e.g., Anderson, de Palma, and Thisse 1992), as well as empirical work (e.g., Berry, Levinsohn, and Pakes 1995). It is noted that with a uniform distribution for  $g(z)$ , a version of the Hotelling model obtains that is a duopoly version of the Mussa-Rosen model. This does not change basic results in this paper.

Because I initially wish to separate multi-market contact effects from demand expansion, the standard model used here does not account for an outside good. This may be justified by realizing that for mature categories such as coffee, Mexican salsas, and alike, demand expansion is small (Nijs et al 2002). Nonetheless, it is desirable to explore the robustness of the main results to the introduction of an outside good. Hence, after establishing several results with the standard model, these results will be shown to generalize to the case of demand with an outside good.

## 4 Perceived quality, prices and profits

### 4.1 A basic relation

Of initial interest is how perceived quality  $a_{im}$ , affects prices  $p_{im}$ , and profits  $\pi_{im}$ . Firms compete by first simultaneously setting  $a_{im}$ . Conditional on product positioning, firms next simultaneously



set prices.<sup>3</sup> Marginal cost  $c_{im}$  and fixed cost  $K_{im}$  are initially quality-independent and fixed. Thus, for now, firms can increase perceived quality at no additional cost. This assumption gives a strong result. If firms do not wish to increase perceived quality to the highest attainable level in each market even when it is costless to do so, they will not do so when attacking is expensive.<sup>4</sup>

In a two-product case, demands are give by

$$s_{1m} = \frac{\exp [(a_{1m} - p_{1m})/\mu]}{\exp [(a_{1m} - p_{1m})/\mu] + \exp [(a_{2m} - p_{2m})/\mu]}, \quad (4)$$

with  $s_{2m} = 1 - s_{1m}$  in the absence of an outside good. The profit function for firm  $i$  is  $\pi_{im} = (p_{im} - c_{im}) \cdot s_{im} - K_{im}$ .

Given the sequence of decisions, prices are solved first. Caplin and Nalebuff (1991) have shown that a unique Bertrand-Nash equilibrium in prices exists for the demand system in equation (4). Rearranging the f.o.c. for firm  $i$

$$\frac{d\pi_{im}}{dp_{im}} = (p_{im} - c_{im}) \cdot s'_{im} + s_{im} = 0, \quad (5)$$

an implicit equation for the prices of interest is obtained

$$p_{im}^* - c_{im} = \frac{\mu}{1 - s_{im}}, \quad i = 1, 2. \quad (6)$$

These price equations are implicit because the right-hand side of the expression for the markup contains all prices, and positioning information (through  $s_{im}$ ). Using the last equation to solve for  $s_{im}$  and substituting in the profit function gives that at optimal prices

$$\pi_{im}^* = p_{im}^* - c_{im} - \mu - K_{im}. \quad (7)$$

Define the local positioning difference as  $a_m \equiv a_{1m} - a_{2m}$ . Two useful dependencies of local prices (and profits, given the last equation) on the positioning differential are given in the first proposition.

**Proposition 1 (Optimal Prices)**

1. *The price of firm 1's product is increasing in  $a_m$ , and the price of firm 2's product is decreasing in  $a_m$ .*
2. *The price increase (decrease) is never larger than the increase in the positioning differential, i.e.,*

$$0 < \frac{dp_{1m}^*}{da_m} < 1, \quad \text{and} \quad -1 < \frac{dp_{2m}^*}{da_m} < 0$$

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<sup>3</sup>Currently these prices are to be interpreted as market prices. Later when the case of retailers is considered, the manufacturers will set whole sale prices.

<sup>4</sup>I later consider cases where costs depend on  $a_{im}$ .

**Proof:** see appendix A

This result states that prices for firm 1 increase as its positioning advantage over firm 2 widens. However, if one firm improves its positioning, its equilibrium price does not rise in equal measure. Consumers get at least part of the utility stemming from positioning improvement. For a related result, see Anderson, de Palma and Thisse (1992), and Anderson and de Palma (2001).

**Proposition 2 (Convexity)** *The optimal prices of both products,  $p_{1m}^*$  and  $p_{2m}^*$  are convex in their positioning difference,  $a_m$ .*

**Proof:** see appendix A

This result states that with a widening positioning gap between the two products, the marginal effect of  $a_m = a_{1m} - a_{2m}$ ,  $m = 1, \dots, M$ , on prices increases. Given equation (7) this result also applies to profits.

What does this result imply for multi-market profits? First, firms can set  $a_{im}$  in each market. The convexity result then implies that both firms, competing on  $M$  markets, would prefer to have a distribution of uneven market-specific positions  $a_m$  over an even set of product positions of  $\bar{a} = \frac{1}{M} \sum a_m$  in each market.

In practical terms, the result therefore suggests that each firm is better off having some strong markets paired with some weak markets rather than having many “average” markets. Both firms therefore have an incentive to sustain uneven market-division as long as each firm has a sufficient number of “strong” markets: a condition to be explored more fully in the coming sections. I now present a benchmark result in a single market.

## 4.2 The case of a single market

Suppose firms can choose among two levels of perceived quality  $a_h$  and  $a_\ell$ , with  $a_h > a_\ell$ . Firms first set perceived quality  $a_{im}$  simultaneously and subsequently choose prices. The following proposition conveys that, in a single market, both firms will end up positioning at  $a_h$ .

**Proposition 3 (Single Market)** *In the single market equilibrium both firms position at  $a_h$  and charge a price of  $c + 2\mu$ . Profits are equal to  $\mu - K$ .*

**Proof:** see appendix A

That is to say, given proposition 1 both firms choose to set perceived quality high. This will give both players equal shares in the market and give the optimal prices in the market. As expected,

profits and prices rise in the degree of horizontal differentiation.<sup>5</sup> In other words, if horizontal differentiation is effectively absent, price competition will drive profits to zero.

I now consider how the above result can be avoided as a function of a key reality of firm competition in packaged goods, namely that firms meet in multiple markets that are characterized by absence of consumer arbitrage.

## 5 Sustaining historical asymmetries through multi-market contact

### 5.1 Spatial concentration and horizontal product differentiation

The base-scenario analyzed in this section contains two firms, two markets, and two levels of perceived quality: high ( $a_h$ ) and low ( $a_\ell$ ). For the moment, firms can increase perceived quality from low to high at no cost. Firms each maximize multi-market profits by choosing positioning  $a_{im}$  first, and setting prices  $p_{im}$  next. In addition, in a multi-market context, it is unnecessarily restrictive to limit the analysis to one-period games. Therefore, firms are allowed to interact repeatedly in an infinite horizon game (Bernheim and Whinston 1990).<sup>6</sup>

Consistent with empirical observation, e.g., Figure 1, it is assumed that there is an existing degree of spatial concentration in outputs. In the modeling framework, this translates in each firm being endowed with one market in which it is the sole provider of a high perceived quality product and one market in which it is the sole provider of a lower perceived quality product. This pre-existing condition is exogenous to the analysis and its origins are therefore left general. The analysis therefore applies to the persistence of any type of local advantages, even those whose origins are fleeting.

Arbitrarily let firm 1 be positioned at  $a_h$  in market 1 while firm 2 is positioned at  $a_\ell$ . In market 2 the opposite happens. Denote the ratio of output of product 1 to that of product 2 at optimal prices in market 1 by  $\Phi \equiv s_{11}^*/s_{21}^*$ . Further, denote the equilibrium profits of firm  $i$  by  $\pi_i^* \equiv \sum_m \pi_{im}^* = \pi_{i1}^* + \pi_{i2}^*$ . Given equal cost, the prices of products mirror each other across markets, i.e.  $p_{11}^* = p_{22}^*$ , and  $p_{12}^* = p_{21}^*$ . From the definition of the ratio of outputs, it is therefore obvious that in market 2,  $s_{12}^*/s_{22}^* = \Phi^{-1}$ . By proposition 1,  $\Phi > 1$ , i.e., in market 1, firm 1 is the product with the higher

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<sup>5</sup>Soberman (2002) shows however that in a single market, if consumers differ with respect to their awareness of products, the monotonicity of profits in differentiation may not hold.

<sup>6</sup>Comparisons to the single period single market game in the previous section are thus not immediate. However, unless consumers accept the idea of each firm taking periodic turns at being the “high-quality” player, a single market repeated game will result in the same equilibrium as the single period game.

perceived quality, prices, and demand. Equations (6) and (7) give that

$$\pi_{im}^* = \frac{s_{im}}{1 - s_{im}} \cdot \mu - K \quad (8)$$

Therefore, with asymmetric positioning, multi-market profits are

$$\pi_i^* = \sum_m \pi_{im}^* = (\Phi + \Phi^{-1}) \mu - 2K, \quad i = 1, 2. \quad (9)$$

If quality positioning is free, firm 1 is tempted in the short run to reposition from  $a_\ell$  to  $a_h$  in market 2. Because both products are then positioned at  $a_h$  in market 2, the ratio of their outputs is 1. Thus, the one-time payoff of deviation for firm 1 is  $\pi_1^d = (\Phi + 1) \mu - 2K$ . Given this deviation, it is easy to show that firm 2 now optimally repositions in market 1 from  $a_\ell$  to  $a_h$ . The payoff for both firms is now equal to  $\pi_i^0 = 2\mu - 2K$ . Subsequently, there is no profitable deviation for either firm. The following proposition now holds:

**Proposition 4 (base result)**

1. *There is always a mutual profit incentive to sustain spatial concentration.*
2. *The minimum discount factor that sustains spatial concentration is equal to the ratio of each firm's smaller and larger output, i.e.,  $\delta^* = \Phi^{-1}$*
3. *The motivation to sustain spatial concentration decreases monotonically with the degree of product differentiation.*

**Proof:** see appendix A

The first part of the proposition states that  $\pi_i^* > \pi_i^0$ , i.e., that there is always a profit incentive to sustain spatial concentration. This result is implied by proposition 2. Indeed, with asymmetric positioning the positioning difference in market 1 is  $a_1 = a_h - a_\ell$ , whereas in market 2 it is  $-a_1$ . The positioning difference when both competitors position at  $a_h$  is equal to 0 in both markets. It follows from the proposition that  $\pi(a_1) + \pi(-a_1) > 2\pi(0)$ .

The second part of the proposition implies that existing spatial concentration is sustainable –even when breaking it is free– as long as firms value future profits sufficiently. Specifically, firm 1 does not reposition if a periodic profit of  $\pi_i^*$ , is valued higher than a one time profit of  $\pi_i^d$  followed by a periodic profit of  $\pi_i^0$ . This valuation is met for all discount rates  $\delta$  that satisfy

$$\pi_i^*(1 + \delta + \delta^2 + \dots) > \pi_i^d + \pi_i^0(\delta + \delta^2 + \delta^3 \dots). \quad (10)$$

Hence, when

$$\delta > \delta^* \equiv \frac{\pi_i^d - \pi_i^*}{\pi_i^d - \pi_i^0} = \frac{1}{\Phi} \quad (11)$$

firm 1 does not reposition. By symmetry, the same holds for firm 2. Given that  $\Phi > 1$  by construction,  $0 < \delta^* < 1$ . As a matter of interpretation, the more asymmetric existing outputs are, the less forward looking managers need to be to sustain them.

The third part of the proposition is based on the result that  $\partial\delta^*/\partial\mu > 0$ . This result implies that as markets are less and less differentiated, even myopic managers will sustain spatial concentration. This is for two reasons. First, the profit gains from improving one's position in the weak market is not large when there is no product differentiation. That is, the short-term incentive to deviate is less. Second, the post-deviation drop in profits from competing head-to-head looms larger in absence product differentiation. Indeed, as the horizontal differentiation of the products diminishes, the value of  $\delta^*$  tends to zero.

## 5.2 Duopoly with outside good

The previous analysis generated an unconditional result because it isolated one specific aspect of multi-market competition, namely, that spatial concentration creates local market power for both firms. However, it is likely that breaking the spatial concentration by positioning both products at  $a_h$  raises category-demand. To investigate which of these effects (market power vs. demand expansion) dominates, I investigate positioning and pricing decisions in the presence of an outside good. Demand is now given by

$$s_{im} = N_m \cdot \frac{\exp[(a_{im} - p_{im})/\mu]}{\exp[(a_{1m} - p_{1m})/\mu] + \exp[(a_{2m} - p_{2m})/\mu] + \exp[V_0/\mu]}, i = 1, 2, m = 1, 2,$$

where  $V_0$  is the value of the outside good. As before, set  $N_m = 1$  in both markets.<sup>7</sup>

Equation (6) still describes optimal prices given positioning. To facilitate discussion of the results in the presence of an outside good, some additional notation is helpful. Let  $T$  stand for the combined share of the inside goods (at optimal prices) when both are positioned at  $a_h$ .  $S$  is the combined share of the inside goods (again at optimal prices) when one is positioned at  $a_h$  and the other at  $a_\ell$ . Finally, among the inside goods,  $R$  is the share of the product positioned at  $a_h$  if the other product is positioned at  $a_\ell$ , i.e.,  $R = s_1/(s_1 + s_2)$ , if product 1 is positioned at  $a_h$  and product 2 at  $a_\ell$ . Applying these definitions,  $s_1 = SR$  if product 1 is positioned at  $a_h$  and product 2 at  $a_\ell$ , whereas  $s_1 = 0.5T$  if both products are positioned at  $a_h$ . The following result holds.

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<sup>7</sup>A more general result can be obtained using a nested logit model with separate nests for the inside and outside goods and different scale parameters for the choice among nests and the choice among the inside goods. The results for this model are analytically very cumbersome without adding much insight. These results are available upon request.

**Proposition 5 (Outside good)**

1. *There is a mutual profit incentive to sustain spatial concentration as long as the demand expansion effects is not too large. More formally,*

$$T - S < \frac{S^2(1 - 2R)^2}{(2 - S)}.$$

2. *If the above inequality holds, the minimum discount factor that sustains spatial concentration equals,*

$$\delta^* = \frac{1}{\Phi} \frac{T\Phi - S(2 - T)}{S(2 - T)\Phi - T}$$

where  $\Phi = R/(1 - R)$

**Proof:** see appendix A

The interpretation of the first part of the proposition is as follows. The right hand side of the inequality is always positive. Hence as long as  $T - S \leq 0$ , the presence of a pay-off incentive to sustain any existing asymmetries is guaranteed. However, the more interesting case is  $T - S > 0$  (demand expansion from both positioning at  $a_h$ ). The proposition states that as long as demand expansion from both products positioning at  $a_h$  is not too large, there is a profit incentive to maintain a reciprocal form of asymmetric positioning. Because previous research (e.g., Nijs 2002) suggests that expansion effects (at least those of price) are small in mature categories, this condition seems met in practice. In addition,  $T - S$  is likely to be small for undifferentiated products. If the products are the same, then increasing the perceived quality of one of them while the other is already of high quality should not affect their cumulative demand appreciably. This is not the case for differentiated goods where increases in perceived quality draw demand that is unique to each product.

The second part of the proposition shows  $\delta^*$  to be a rather complex function of  $S, T$ , and  $\Phi$ . It is noted that when the outside good gets smaller (and  $S$  and  $T$  tend to 1) the same expression as in proposition 4 will obtain.

In order to illustrate when spatial concentration is more profitable than symmetric positioning even in the presence of an outside good, I use an example of profits under spatial concentration vs. symmetric positioning as a function of  $\mu$ . Figure 2 shows the multi-market profits at optimal prices when  $a_h = 1$ ,  $a_\ell = 0$ , and  $V_0 = -1$  as a function of  $\mu$ . As is clear from the graph, for small degrees of horizontal differentiation, the profit incentive to sustain asymmetries is present and given sufficient valuation of future profits asymmetric positioning is an equilibrium.

Two aspects of the profit curves are noteworthy. Profits *decrease* in the degree of horizontal differentiation,  $\mu$ , for  $\mu$  small enough. Thus, spatially concentrated industries with “intermediate”

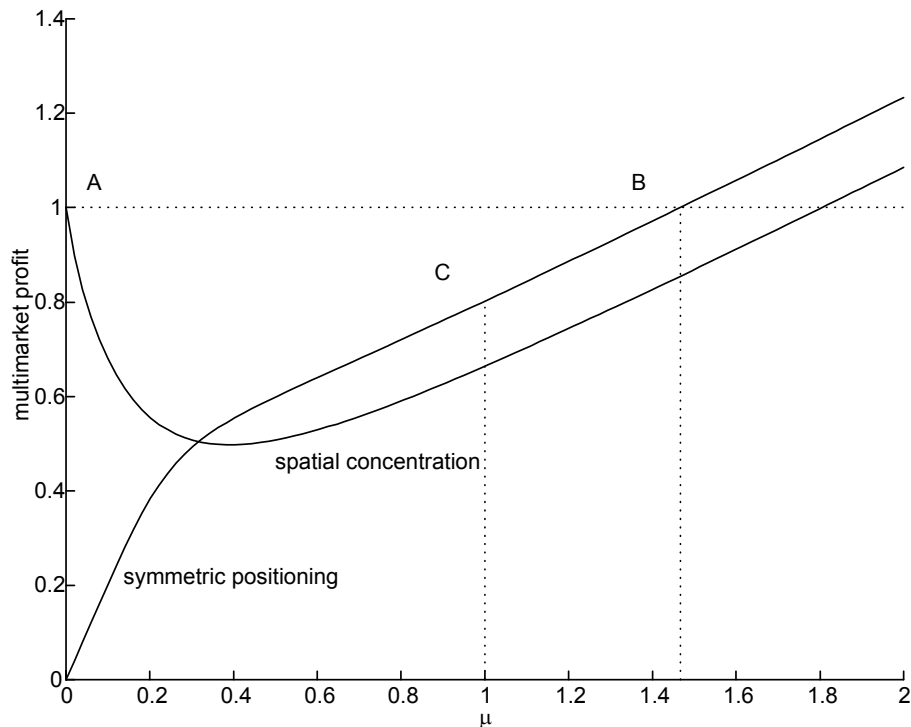


Figure 2: Multimarket profits with symmetric and with asymmetric positioning

levels of product differentiation are less profitable than industries without product differentiation (see also Klemperer 1992 who raises a similar point). Point *A* in Figure 2 shows that profits from spatial concentration are 1 when there is no horizontal differentiation, i.e.,  $\mu = 0$ . Not until a relatively high degree of horizontal differentiation,  $\mu = 1.47$ , is there a multi-market policy with equal profits (point *B*). The intuition of the negative impact of  $\mu$  on profits is that differentiation on perceived quality is more effective when there is no actual horizontal differentiation between the products. The demand effect of positioning  $a_{im}$  is amplified (dampened) by absence (presence) of horizontal differentiation.<sup>8</sup>

Second, in the presence of an outside good, the two profit curves intersect (this is the conditionality in the first part of proposition 5). Hence, beyond a certain degree of horizontal differentiation firms are more profitable when they both position as high quality players.

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<sup>8</sup>While our main results so far are insensitive to the choice of a logit vs. linear demand system, the decrease in profits with increased differentiation is specific to the logit demand system and does not hold with a linear demand system.

### 5.3 The case of $M$ markets

For spatial concentration to be sustained, it was so far assumed that the firms are “balanced” across markets, i.e., that firms are globally equally well off. This section investigates how imbalance across markets still leaves ample possibility for local asymmetries to persist, *even when the smaller firm could obtain substantial demand expansion at the expense of the larger firm at no cost*. I analyze  $M$  markets, two firms, without an outside good. As before, existing positioning on perceived quality is asymmetric. For historical reasons, firm 1 leads in  $L < M$  markets. Firm 2 leads in  $M - L$  markets. Again, without much consequence,  $N_m = 1$  for all markets. Once more,  $a_{im}$  can assume two values:  $a_h$  and  $a_\ell$ . To simplify the analysis  $a_{1m} = a_h$ ,  $a_{2m} = a_\ell$  for markets  $1, \dots, L$  and vice versa for markets  $L + 1, \dots, M$ . Denote the high share that is associated with positioning at  $a_h$  when the competitor positions at  $a_\ell$  by  $R$  ( $R > 0.5$ ).

The following proposition is proven in the appendix.

**Proposition 6** ( $M$  markets)

1. *There is a mutual profit incentive to sustain spatial concentration as long as within-market dominance,  $R$ , is larger than across-market share of weak markets, i.e.,  $(M - L)/M$  for firm 1, and  $L/M$  for firm 2.*
2. *This incentive condition becomes more easily met as the degree of horizontal differentiation diminishes.*
3. *The critical discount factor that sustains spatial concentration as an equilibrium is equal to*  

$$\delta^* = \frac{1}{\Phi} \max \left( \frac{M-L}{L}, \frac{L}{M-L} \right)$$

**Proof:** see appendix A

The first part of the proposition gives a surprisingly simple condition under which both firms are better off with local asymmetries than with local symmetries: within-market share in the strong markets, needs to be larger than across-market share of weak markets. This condition is guaranteed for the firm with the lesser amount of weak markets, but it poses a boundary condition on the presence of a profit incentive for the other firm. The firm with the smaller number of “strong” markets therefore has a profit incentive only if the asymmetries are strong enough. Indeed, even with only one strong market ( $L = 1$ ) a firm may be motivated to maintain spatial concentration. However, small asymmetries (those with  $R$  close to 0.5) will not be sustainable if competing firms do not share an equal number of “strong” and “weak” markets.



The second part of the proposition states that, in the case of  $M$  markets, as was the case for a 2 market duopoly, the profit incentive to sustain asymmetries is more generally present when firms are less horizontally differentiated. Technically, the smaller  $\mu$ , the larger  $R$ .

The third part of the proposition focuses on the critical discount factor that sustains the scenario of this section as an equilibrium in which one firm has  $L$  strong markets and one firm has  $M - L$  strong markets. Mathematically, the discount factor is equal to the relative within-market share  $(1 - R)/R$  in weak markets (at optimal prices) times the relative across-market share of weak markets  $(M - L)/L$ . Given that this result only holds if there is a principle reason to sustain asymmetric positions, this discount rate is guaranteed to be less than 1. The max operator in the third part of the proposition expresses the condition that the firm with the lesser number of strong markets is more easily tempted to attack in its weak markets. The result in proposition 4 that  $d\Phi/d\mu < 0$ , implies that –as before– even relatively impatient managers will resist the short term temptation to attack and increase their demand in “weak” markets when product differentiation diminishes.

## 6 The role of positioning cost: the case of retailers

### 6.1 A simple representation of retailers

To discuss the role of local positioning cost on sustaining multi-market spatial concentration, I use a contextual example. This example interprets positioning costs as retailer fees paid by competing firms in order to obtain “premium” shelf space. Admittedly, other interpretations of such costs, e.g., advertising costs, are equally judicious in the context of consumer packaged goods. To allow for some generality in interpretation, positioning costs are modeled using two simple modifications to the model.

First, slotting fees,<sup>9</sup> promotion allowances, and alike are modeled as a (periodic) fixed cost,  $K$ , that does not depend on quantity sold. It is assumed that retailer support for firm  $i$  in market  $m$  enhances the quality perceptions of consumers  $a_{im}$ . The fixed cost  $K(a)$  increases in  $a$  and is assumed to be low enough for two manufacturing firms to enter in any given market. The latter accords with the empirical fact that all local markets are entered by multiple manufacturers.

The second modification is the introduction of a fixed retailer mark-up. Prices are modeled as

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<sup>9</sup>Slotting fees are meant here to capture “pay-to-stay” fees. Such fees are charged by retailers to manufacturers in return for special treatment at the supermarket shelf. See e.g., Federal Trade Commission (2001).

$p_{im} = w_{im} + u_{im}$ , where  $u_{im}$  is the markup set by all retailers in market  $m$  and  $w_{im}$  is the wholesale price that is set by the firm. I use constant retailer mark-ups  $u_{im} = u$ , because these retailer mark-ups reflect intra-market competitive phenomena (e.g., competition between retailers) that do not likely give rise to spatial concentration at the national level (for a similar simplification, see Vilcassim, Kadiyali, and Chintagunta 1999).

Exogenous slotting fees and markups are a useful approximation of the reality that retailers face many different product categories and therefore use heuristic approaches to setting margins and slotting fees. Even with passive retailers, the model is informative about how the presence of costly retailers might sustain spatial concentration.

## 6.2 Single market competition

Consider a single market (drop the subscript  $m$  momentarily), logit demand, no outside good, two manufacturing firms, and the presence of retailers with slotting fees  $K(a_i)$ , and markup  $u$ . Manufacturers first set positioning simultaneously, and then simultaneously decide on prices. I again assume that there are two possible levels of quality perceptions  $a_h$  and  $a_\ell$ . Demand for good  $i$  is equal to

$$s_i = \frac{\exp((a_i - p_i)/\mu)}{\exp((a_1 - p_1)/\mu) + \exp((a_2 - p_2)/\mu)} \quad (12)$$

with  $p_i = w_i + u$ . In a single market context, profit for each of the manufacturing firms is equal to

$$\pi_i = s_i (w_i - c) - K(a_i) \quad (13)$$

From the first-order conditions, wholesale prices are equal to

$$w_i = c + \frac{\mu}{1 - s_i}. \quad (14)$$

Note that these prices are not the same as before. That is to say, the retailer mark-up is represented in the shelf price, which in turn impacts  $s_i$ . Profits at these wholesale prices are equal to

$$\pi_i^* = \frac{\mu s_i}{1 - s_i} - K(a_i). \quad (15)$$

Of initial interest is whether an asymmetric equilibrium in which one firm's positions at  $a_h$  and the other at  $a_\ell$  can emerge because of slotting fees  $K(a)$ .

*Asymmetric positioning* Consider first the case where product 1 is positioned at  $a_h$  while product 2 is positioned at  $a_\ell$ . Profit for firm 1 is equal to  $\pi_1^* = \mu\Phi - K(a_h)$ , with  $\Phi = s_1/(1 - s_1) > 1$ .

Suppose firm 1 considers repositioning to  $a_\ell$ . If so, it splits the market evenly with firm 2 (which is also positioned at  $a_\ell$ ) and its profits would equal  $\mu - K(a_\ell)$ . Thus, firm 1 will not reposition to  $a_\ell$  as long as  $\mu\Phi - K(a_h) > \mu - K(a_\ell)$ , with  $K(a_h) > K(a_\ell)$  because  $a_h > a_\ell$ .

Firm 2, positioned “low,” will not reposition if the payoff of sustaining  $a_\ell$  is larger than that of repositioning to  $a_h$ . This implies that  $\mu\Phi^{-1} - K(a_\ell) > \mu - K(a_h)$ . By combining these results, neither firm has an incentive to deviate from asymmetric positioning as long as

$$\mu(1 - \Phi^{-1}) < \Delta K < \mu(\Phi - 1), \quad (16)$$

with  $\Delta K \equiv K(a_h) - K(a_\ell)$ . Note that  $\mu(1 - \Phi^{-1}) < \mu(\Phi - 1)$  iff  $\Phi > 1$ , i.e. as long as the product with the highest perceived quality obtains the highest market share (which is true given our assumptions). Thus, there always exist slotting fees  $[K(a_h), K(a_\ell)]$  that make asymmetric positioning an equilibrium.

*Symmetric positioning* With symmetric positioning at  $a_\ell$ , the profits for both firms are  $\pi_i^* = \mu - K(a_\ell)$ . If either firm repositions to  $a_h$ , profits of that firm will be  $\mu\Phi - K(a_h)$ . Thus, if  $\Delta K > \mu(\Phi - 1)$ , then repositioning will not occur and a symmetric equilibrium with both firms positioned at  $a_\ell$  holds. Following similar logic, a symmetric equilibrium at  $a_h$  is obtained when it is not profitable for either firm to reposition to  $a_\ell$ . This happens when  $\Delta K < \mu(1 - \Phi^{-1})$ . In words, if it is cheap enough to position at  $a_h$ , all firms will do so.

The following proposition summarizes these results

**Proposition 7 (Retailer – single market)**

1. (a) Both firms position their products symmetrically at  $a_h$ , if  $\Delta K < \mu(1 - \Phi^{-1})$ .  
(b) The firms position their products asymmetrically with one at  $a_h$  and the other at  $a_\ell$ , if  $\mu(1 - \Phi^{-1}) \leq \Delta K \leq \mu(\Phi - 1)$ .  
(c) Both firms position their products symmetrically at  $a_\ell$  if  $\Delta K > \mu(\Phi - 1)$ .
2. The cost differential  $\Delta K$  over which asymmetric positioning is the only equilibrium has the following limiting bounds

- (a)  $\lim_{\mu \downarrow 0} \{\mu(1 - \Phi^{-1}), \mu(\Phi - 1)\} = \{0, a_h - a_\ell\}$
- (b)  $\lim_{\mu \rightarrow \infty} \{\mu(1 - \Phi^{-1}), \mu(\Phi - 1)\} = \{(a_h - a_\ell)/3, (a_h - a_\ell)/3\}$

**Proof:** see appendix A

The slotting fees  $K(a)$  can sustain an asymmetric equilibrium between firms in a *single* market. Therefore this outcome can not be due to multi-market contact. Rather, in this case, the asymmetry

is due to the inherent non-linearity in demand.<sup>10</sup> The first two parts of this proposition were discussed above.

The second part of the proposition merits further discussion and interpretation. When product differentiation is low, i.e., when  $\mu \downarrow 0$ , the difference in gross profits (before positioning cost) between the two firms in the unit-sized market tends to  $a_h - a_\ell$ . This statement echoes proposition 1 which showed that price (and profit) increases are never larger than the increases in positioning. Therefore, the upper limit of the difference in slotting fees  $\Delta K$  that supports an asymmetric equilibrium is equal to  $a_h - a_\ell$ .

Conversely, when the category becomes more differentiated –as  $\mu$  increases– positioning has less influence on profitability. In the limiting case of ever increasing  $\mu$ , there can only be an asymmetric equilibrium if  $(a_h - a_\ell)/3 \leq \Delta K \leq (a_h - a_\ell)/3$ . In other words as the products are more horizontally differentiated, no slotting fees (except in the limit  $K(a) = K_0 + \frac{1}{3}a$ ) will support an asymmetric equilibrium.

The width of the interval  $\left\{ \mu \left( 1 - (\Phi_1)^{-1} \right), \mu (\Phi_1 - 1) \right\}$  can be loosely interpreted as the generality with which an arbitrary cost function  $K(a)$ ,  $a > 0$ , obeys  $\mu (1 - \Phi^{-1}) \leq \Delta K \leq \mu (\Phi - 1)$ . If the interval is wide, any cost differential will support an asymmetric market outcome as the only equilibrium outcome. Conversely, if the interval is very narrow, only very small cost-differences will support an asymmetric market outcome. Hence, again, asymmetric outcomes happen under more general conditions when goods are undifferentiated. The intuition behind this result is that when goods are undifferentiated, there is only “room” for one high quality player in the market. If two products try to both be high quality players, neither of them will make enough profits to make up for the increased positioning costs.

### 6.3 Multi-market competition in the presence of retailers

I now consider the case of two markets instead of one. Retailers are again passive players, with a fixed mark-up and slotting fees,  $K(a)$ , that depend on the level of support,  $a$ , given to the manufacturer’s products. As before, I use a repeated interaction framework with infinite horizon to explore the multi-market nature of competition. In each period, firms position their products first (either at  $a_h$

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<sup>10</sup>Yarrow (1989) considers the specific case that  $K(a) = \exp(a)$ . Not unlike this paper, he finds that asymmetric equilibria are possible in a single market. For another instance of the latter result see also Moorthy (1988), who makes the additional argument that the asymmetric equilibrium may be interpreted as a possible advantage of the first entrant. Both papers focus on asymmetric equilibria in a single market.

or  $a_\ell$ ) and then set prices.

Four possible positioning cases need to be considered. These cases are listed below.

CASE 1	firm 1	firm 2	CASE 2	firm 1	firm 2
market 1	$a_\ell$	$a_\ell$	market 1	$a_h$	$a_h$
market 2	$a_\ell$	$a_\ell$	market 2	$a_\ell$	$a_\ell$

CASE 3	firm 1	firm 2	CASE 4	firm 1	firm 2
market 1	$a_h$	$a_\ell$	market 1	$a_h$	$a_h$
market 2	$a_\ell$	$a_h$	market 2	$a_h$	$a_h$

All other possible combinations merely involve label switching of firms or markets and are therefore redundant. Case 1 (positioning low by all firms in all markets) falls under the previous proposition. If it is too expensive to position at  $a_h$  in one market, it is also too expensive to position at  $a_h$  in multiple markets.

Case 2 can not be a multi-market equilibrium because it can not be the case (given  $\mu$  and  $K(a)$ ) that both firms position at  $a_h$  in one market and at  $a_\ell$  in the other. If positioning is cheap enough for both firms to select  $a_h$  in market 1, there is a profitable deviation from both playing  $a_\ell$  in market 2. Conversely, if advertising is expensive enough for both firms to choose  $a_\ell$  in market 1, there is a profitable deviation from both selecting  $a_h$  in market 2.

This leaves cases 3 and 4. For logical reasons, I focus first on case 3. Firm 1 leads firm 2 in market 1 and vice versa in market 2. At optimal prices the ratio of shares of the larger over the smaller product is denoted by  $\Phi$ , as before. If case 3 is an equilibrium, both firms have a profit of

$$\pi_i^* = (\Phi + \Phi^{-1}) \mu - (K(a_h) + K(a_\ell)). \quad (17)$$

A possible deviation for a given firm is to reposition to  $a_\ell$  in the market where it was positioned at  $a_h$ . This deviation is attractive when positioning cost is high enough. However, if it is optimal for one firm to reposition from  $a_h$  to  $a_\ell$  it is optimal for the other firm to do the same in the other market. The optimality of this repositioning is therefore considered in case 1 and is covered by proposition 7.

Another deviation is to reposition to  $a_h$  in the market in which it was positioned at  $a_\ell$ . If so, it ends up with one market in which it positions at  $a_h$  against  $a_\ell$  by its competitor, and one market where both firms position at  $a_h$ . This repositioning will give to the firm that repositions the following profits

$$\pi_i^d = (\Phi + 1) \mu - 2K(a_h). \quad (18)$$

This deviation is attractive in the short run to the firm that repositions if the cost of positioning at  $a_h$  is small enough. Specifically, comparison of profits gives that if  $\Delta K < \mu(1 - \Phi^{-1})$ , then  $\pi_i^* < \pi_i^d$  and firm  $i$  has a short term incentive to deviate. If this condition is met for one firm in one market, it logically also meets for the other firm in the other market. Assume that other firm will then also position at  $a_h$  (I now obtain case 4). Upon this retaliation from the second firm, the profits for either firm will forever equal

$$\pi_i^0 = 2\mu - 2K(a_h), \quad (19)$$

which is less than  $\pi_i^*$ . Using the same arguments as those preceding proposition 4, case 4 will not occur if firms value future profits enough. These results are formally stated in the following proposition

**Proposition 8 (Retailer – two markets)**

1. Wholesale prices are  $w_{im}^* = \mu / (1 - s_{im}) + c$ ,  $i = 1, 2$
2. When firms meet in multiple markets the following equilibria exist in the presence of a retailer
  - (a) If  $\Delta K > \mu(\Phi - 1)$  then both products position symmetrically at  $a_\ell$  in all markets.
  - (b) If  $\mu(1 - \Phi^{-1}) \leq \Delta K \leq \mu(\Phi - 1)$  then one product positions at  $a_h$  and one product positions at  $a_\ell$  in each market.
  - (c) If  $\Delta K < \mu(1 - \Phi^{-1})$  then
    - i. if the value of future profits exceeds  $\delta^*$  times the value of today's profits both firms will sustain spatial concentration.
    - ii. if the firms are myopic, both products position symmetrically at  $a_h$  in each market.
3. The minimum current value of future profits that sustains an asymmetric multi-market equilibrium is equal to

$$\delta^* = \frac{1}{\Phi} \left( 1 - \frac{\Delta K}{\mu(1 - \Phi^{-1})} \right) < \frac{1}{\Phi}$$

**Proof:** see appendix A

The third part of the proposition implies that the presence of costly retailers generalizes the existence of a spatially concentrated equilibrium. Namely, comparing propositions 4 and 8,  $\delta^*$  is smaller in the presence of positioning cost than without it. Indeed, retailer fees make attacking expensive and effectively discourage myopic behavior by firms that would break spatial concentration without positioning cost.

Figure 3 helps to interpret the proposition further. It outlines the equilibria that exist for an arbitrary cost function  $K(a)$  (subject to the constraint that the profits for both firms needs to be non-negative) and degree of horizontal differentiation  $\mu$ . This figure was generated, using a numerical

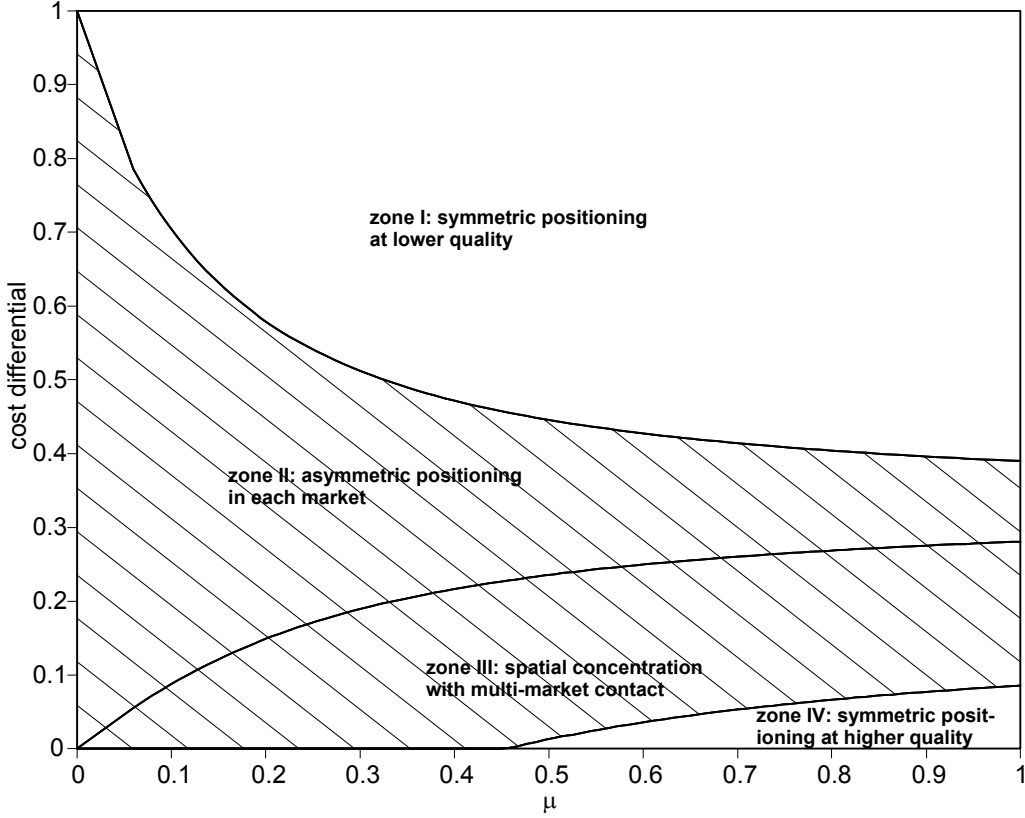


Figure 3: Equilibria for product differentiation  $\mu$ , and cost differential  $\Delta K$ .

solver, for the scenario in which  $a_h = 1$ , and  $a_\ell = 0$ . Zone I outlines the cases where the cost difference between positioning high and low is so large that both products position low in all markets. Zone II represents the cases where a single-market asymmetric equilibrium exists. In this zone, a firm may lead in both markets, in one, or in none. In none of these cases is there an incentive to deviate in any single market. Consequently, deviations in multiple markets are also unprofitable. Zone III identifies when asymmetric equilibria are sustainable in two markets but not in a single market. Here the cost difference between positioning high or low is so small that in a single market case, all products would position at  $a_h$ . However, in a two-market context, firms prefer to sustain spatial concentration if they value the future enough. Figure 3 was created with  $\delta = 0.75$ . Thus even if firms only value next period's profits at 75% of current profits, the area over which spatial concentration is sustainable increases very substantially. Finally, zone IV contains all cases where firms position at  $a_h$  in all markets. As the firm's value for future profits increases, the fourth zone will diminish (as an example if  $\delta = 0.90$ , zone IV is no longer visible in Figure 3).

Zones II and III combined give all cases where a spatially concentrated market equilibrium may occur. The narrowing of these zones as a function of horizontal differentiation once more implies that sustained spatial concentration as in Figure 1 is more likely to happen with undifferentiated than with differentiated goods.

Without further discussion it is noted that the introduction of an outside good does not affect Figure 3 substantively, as long as the outside good is not too large (see also proposition 5).

#### 6.4 Do slotting fees harm firms' profits?

The previous proposition claimed that without positioning costs, spatial concentration can not be sustained by firms whose discount rates satisfy

$$\frac{1}{\Phi} - \frac{\Delta K}{\mu(\Phi - 1)} < \delta < \frac{1}{\Phi}. \quad (20)$$

In a retailing context, an interesting question now is whether profits of such firms are harmed by retailer cost such as slotting fees? Interestingly, the answer to this question is not always yes. Specifically, for the cases identified by equation (20), firms do better *with* costly retailers than *without*, if the profit from the combination of spatial concentration and the presence of retailer fees is higher than the profit from the combination of symmetric positioning and no retailer fees, i.e., if

$$(\Phi + \Phi^{-1})\mu - (K(a_h) + K(a_\ell)) > 2\mu - 0, \quad (21)$$

which alternatively can be rewritten as

$$K(a_h) + K(a_\ell) < (\Phi - 1)(1 - \Phi^{-1})\mu \quad (22)$$

It is clear that there exist  $\delta$  and slotting fees  $K(a)$  that obey the conditions (20) and (22). For instance, to obey (20) slotting fees should discriminate across different levels of  $a$ . To meet (22) slotting fees should not be too high, i.e., firms' profitability will be ultimately harmed by ever increasing slotting allowances. The following proposition formalizes the conditions under which firms may benefit from the presence of retailers, and illustrates the dependence of these conditions on horizontal differentiation.

#### Proposition 9 (retailers and incumbents)

1. For moderately myopic firms, i.e.,  $\frac{1}{\Phi} - \frac{\Delta K}{\mu(\Phi - 1)} < \delta < \frac{1}{\Phi}$ , spatial concentration is sustained only by positioning costs.



2. *For such firms, equilibrium profits in the presence of positive positioning cost can be higher than equilibrium profits without positioning cost. This happens especially when products are undifferentiated, but not when products are horizontally differentiated.*

**Proof:** see appendix A

The first part of proposition 9 was addressed above. The last part states that as the horizontal differentiation between products increases, the firms are better off with retailers only when these retailers are free. Yet when products are very close substitutes, it is more profitable to have costly retailers –who sustain spatial concentration– as long as they are not too expensive, i.e., as long as  $K(a_h) + K(a_\ell) < (a_h - a_\ell)$  (see the Appendix). An interesting link emerges to work by McGuire and Staelin (1983) who found that as products become closer substitutes, firms prefer to shield themselves from competition by selling through a retailer. In contrast to their single-market framework, the result here relies on the fact that firms meet in multiple markets.

## 6.5 An alternative interpretation for advertising

The previous section analyzed the role of positioning cost in the context of shelf space allocations or other retailer-support. Keller (1993) and Kirmani and Wright (1989) have argued that inferences about product quality are alternatively affected by advertising investments. Therefore, a short discussion of the previous results in the context of advertising is appropriate.

In an advertising interpretation, positioning at  $a_h$  ( $a_\ell$ ) translates into advertising at a high (low) level. The cost difference  $\Delta K$  is the marginal cost of advertising. The previous section suggests there are three advertising cases to consider.

First, if advertising costs are sufficiently high, nobody will advertise at  $a_h$ . This is equivalent to the case in proposition 7 where  $\Delta K$  is large. Second, for intermediate values of  $\Delta K$  an asymmetric advertising equilibrium exists. In such an equilibrium, there is only “room” for one player to advertise at a high level. The other player will realize that it is impossible to mimic the success of the first player given that this player occupies the  $a_h$  position. It is therefore natural to think in this context of a defensible first mover advantage (see also Moorthy 1988). Finally, for really low values of  $\Delta K$  both firms will advertise if the decision makers are strongly myopic.

Advertising expenditures can increase firm profits even if it does not increase demand, especially for undifferentiated goods. In proposition 9 it was shown that profits with costly positioning can be higher than profits without costly positioning, even when advertising fails to generate primary

demand. In an advertising interpretation, the profitability of advertising comes from the monopoly power it creates especially in packaged goods industries where goal functions of product managers are moderately short term oriented (compare equation 20) and where products are undifferentiated.

## 7 Discussion

The main result of this paper is that spatial concentration may persist especially for products of undifferentiated consumer goods. This idea was motivated by illustrating the surprising degree of spatial concentration of weakly differentiated categories such as Mexican salsas. It was noted that the same degree of spatial concentration holds for products such as ground coffee and mayonnaise. However, a second result was that opportunities and/or incentives to sustain spatial concentration are less strong when products are more clearly differentiated.

If the argument about differentiation is empirically important, local differences should not persist to the same extent in categories with differentiated goods. An example of such a category is breakfast cereals. That is, consumers will in general have little difficulty distinguishing between say Kellogg's Corn Flakes and General Mills Cheerios. More broadly, the product portfolios of the top manufacturers contain few if any products that are physically indistinguishable. Indeed, as Nevo (2001) observes, the top manufacturers of breakfast cereals do not imitate each other's products. Therefore, it is not unreasonable to claim that breakfast cereals are more horizontally differentiated than brands of Mexican salsas.

Figure 4 shows the 1992 local shares of Kellogg and General Mills in the breakfast cereal market. Compared to figure 1, the striking contrast between the salsa data and the cereal data is the absence of spatial concentration. That is, whereas there are differences in market shares for each product across markets they are only modest compared to the example of salsas.

This empirical example suggests that (lack of) product differentiation may impact the observed degree of spatial concentration of an industry. It is not claimed that differentiation is the only important factor. Specifically, cost efficiencies of spatial concentration or the presence of actors whose decisions have spatial footprints (such as retailers or distributors) could well contribute to spatial concentration. However, if the striking difference between figure 4 and 1 is any indication, the degree of product differentiation does seem to play a role in the occurrence of spatial concentration of firm outputs.

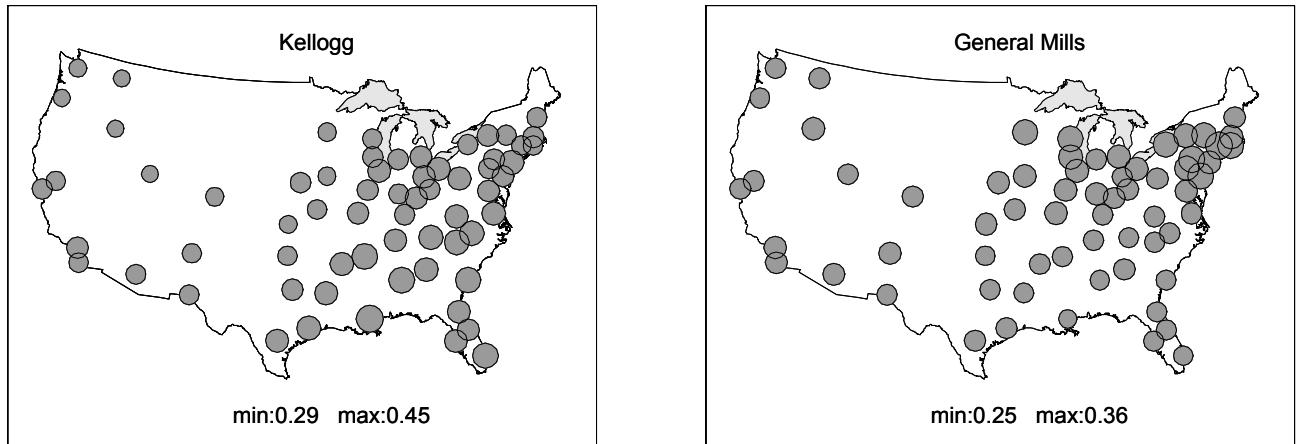


Figure 4: Local market share of two leading manufacturers in cereals

## 8 Conclusion

There are many reasons why competing firms of undifferentiated goods face different initial conditions in a given markets, e.g., order-of-entry effects, pre-emption of mind-space (e.g., selective learning by consumers) and shelf-space (e.g., selective availability of facings), etc. These phenomena can lead to initial differences in market shares and profitability. This paper has argued that even after the original reasons for the asymmetries that arise from such initial conditions vanish, spatial concentration of prices and outputs can be sustained despite immediate competition between goods. Two different explanations for this fact were presented.

The first explanation is that multi-market contact provides a mechanism to sustain an implicit geographical segmentation. As long as each firm has a large enough number of strong markets, or as long as local domination is strong enough even in a small number of markets, there are no incentives to compete for “fair share” in each local market once competitive response is taken into account.

The second explanation focuses on the possibility that firms can create a local form of vertical differentiation through costly positioning of their products through costly agreements with retailers or costly advertising. It was found that for a variety of positioning cost, there is “room for only one high quality player in each market.” Thus spatial concentration in multiple markets can be sustained if local positioning is costly. It is also shown that costly intermediaries such as retailers, may help to sustain asymmetries by making it expensive for lagging firms to compete for “fair” market share.

The contingency that spans both explanations is that sustenance of spatial concentration should be expected *especially* when goods are physically similar, i.e., when demand side arguments for spatial concentration are *a priori* weak. Surprisingly, if goods are the same, initial market conditions may cast very long shadows, whereas if products are differentiated, these initial market conditions will not be sustainable. Indeed, in the latter case, all competitors tend to compete for a “fair share” in all local markets. Thus in undifferentiated categories, “initial conditions,” i.e., launch strategies, are very important and may initiate a market division that will resist change.

Provided that spatial concentration leaves both firms with at least some strong markets, this paper further suggested that profitability of packaged-goods categories does not need to rely exclusively on horizontal product differentiation. Local asymmetries in product positioning on perceived quality may suffice as a source of differentiation.

Finally, situations wherein category demand is high but market share is low, are oft seen as a business opportunity (see e.g., Kotler 2003; Schultz, Martin and Brown, 1984). The results in this paper are cautionary with respect to attacking in such markets. Specifically, in cases of spatial concentration a firm has to consider what will happen in one’s own high-share markets as a consequence. The results in this paper suggest that spatial concentration may dissolve and all firms will be worse off ever after. This is especially true in mature categories with a low degree of product differentiation, i.e., for many packaged goods categories.

There are several limitations to this paper. First, I have analyzed duopolies in markets of equal size. Whereas the consideration of oligopolies or markets of varying size will have some impact on the results, such impact is small and perhaps of limited theoretical interest. Second, I have focused mainly on *sustenance* of existing asymmetries. In future research, it is desirable to address the *emergence* of concentrations in market shares. Indeed, given the opportunity of sustenance of asymmetries especially when there is little product differentiation, the question of what causes these asymmetries takes on some urgency. Third, empirically –and Figure 1 nicely illustrates this– the patterns of share concentration are highly spatial. Given the regularity of the patterns, and the degree of spatial variability of market shares, it seems important to study the origins of this phenomenon.

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## A Proofs

**Proof of proposition 1** For convenience, drop all subscripts  $m$ . Recall that

$$s_1 = \frac{\exp[(a - p_1)/\mu]}{\exp[(a - p_1)/\mu] + \exp[(-p_2)/\mu]}, a = a_1 - a_2 \quad (\text{A.1})$$

Some useful relations are  $\frac{ds_1}{dp_1} = -\frac{1}{\mu}s_1(1 - s_1)$ ,  $\frac{ds_1}{dp_2} = \frac{1}{\mu}s_1s_2$ ,  $\frac{ds_1}{da} = \frac{1}{\mu}s_1(1 - s_1)$ . Taking the first order condition for firm 1 gives,

$$F(p_1, p_2, a) \equiv p_1 - c_1 - \frac{\mu}{1 - s_1} = 0 \quad (\text{A.2})$$

The total differential of this function is  $F_{p_1}dp_1 + F_{p_2}dp_2 + F_a da = 0$ . Writing  $\Phi \equiv s_1/s_2$ , it is easy to show that

$$F_{p_1} = 1 - \frac{\mu \cdot d(1 - s_1)^{-1}}{dp_1} = 1 - \mu(1 - s_1)^{-2} \frac{ds_1}{dp_1} = 1 + \Phi \quad (\text{A.3})$$

It can further be shown that  $F_{p_2}$  and  $F_a$  are both equal to  $-\Phi$ . Substitution in the total differential for  $F$  gives

$$(1 + \Phi)dp_1 - \Phi dp_2 - \Phi da = 0 \quad (\text{A.4})$$

Now, totally differentiate the first order condition for firm 2.

$$G(p_1, p_2, a) \equiv p_2 - c_2 - \frac{\mu}{s_1} = 0 \quad (\text{A.5})$$

The total differential of this function is  $G_{p_1}dp_1 + G_{p_2}dp_2 + G_a da = 0$ . Once more it is easy to show that

$$G_{p_1} = -\frac{1}{\Phi}, \quad G_{p_2} = 1 + \frac{1}{\Phi}, \quad G_a = \frac{1}{\Phi} \quad (\text{A.6})$$

Substitution in the total differential of  $G$  gives

$$-\frac{1}{\Phi}dp_1 + \left(1 + \frac{1}{\Phi}\right)dp_2 + \frac{1}{\Phi}da = 0 \quad (\text{A.7})$$

Finally, combining (A.4) and (A.7), gives that

$$\frac{dp_1^*}{da} = \frac{\Phi^2}{1 + \Phi + \Phi^2} > 0, \quad \frac{dp_2^*}{da} = \frac{-1}{1 + \Phi + \Phi^2} < 0. \quad (\text{A.8})$$

This proves proposition 1. The result states further that changes in  $a$  are never priced by the firm to the market completely. Indeed, it may be noted from the definition of  $\Phi$  that the sensitivity of  $p_1$  to changes in  $a$  is always between 0 and 1. ■

**Proof of proposition 2** Once again, the subscript  $m$  is dropped from the notation. It needs to be shown that the profits of both firms are convex in  $a$ . Thus, the second order derivative of profits with respect to  $a$  needs to be evaluated at the equilibrium prices. It is sufficient that

$$\frac{d\left(\frac{d\pi_i^*}{dq}\right)}{da} = \frac{d^2\pi_i^*}{da^2} = \frac{d^2p_i^*}{da^2} > 0, \quad i = 1, 2 \quad (\text{A.9})$$



To simplify the derivation, I can use the expressions in (A.8) and take the derivative of both expressions with respect to  $a$ . For both firms it is possible to write

$$\frac{d^2 p_i}{da^2} = \frac{df_i(\Phi)}{d\Phi} \frac{d\Phi}{da} \quad (\text{A.10})$$

with  $f_i(\Phi)$  given by equation (A.8). It can be shown that

$$\frac{df_1(\Phi)}{d\Phi} = \frac{(2 + \Phi) \Phi}{(1 + \Phi + \Phi^2)^2} > 0 \quad \text{and} \quad \frac{df_2(\Phi)}{d\Phi} = \frac{(2 + \Phi)}{(1 + \Phi + \Phi^2)^2} > 0 \quad (\text{A.11})$$

Recalling that  $\Phi = \exp [(-p_1 + p_2 + a) / \mu]$ , the derivative  $d\Phi/da$  of the ratio of outputs with respect to  $a$  is

$$\begin{aligned} \frac{d\Phi}{da} &= \frac{d(\exp [(-p_1^* + p_2^* + a) / \mu])}{da} \\ &= \exp [(-p_1^* + p_2^* + a) / \mu] \cdot \frac{d((-p_1^* + p_2^* + a) / \mu)}{da} \\ &= \Phi \cdot \frac{1}{\mu} \left( -\frac{dp_1^*}{da} + \frac{dp_2^*}{da} + 1 \right) \\ &= \frac{1}{\mu} \frac{\Phi^2}{1 + \Phi + \Phi^2} > 0. \end{aligned} \quad (\text{A.12})$$

Substitution of (A.11) and (A.12) into (A.10) proves that the profits of both firms are convex in  $a$ . ■

**Proof of proposition 3** This result is implied by proposition 1. If both firms have high perceived quality they both set prices of  $c + 2\mu$ . These prices stem from  $p_i^* = c_i + \mu/(1 - s_i)$ , and from the obvious result that if both have the same positioning  $s_i = 1/2$ . It is easily verified that there are no unilateral deviations from this proposed equilibrium. ■

#### Proof of proposition 4

1. The presence of the profit incentive is easily derived from the comparison of total profit across the two markets under asymmetric market positions vs. symmetric positioning.

$$\mu\Phi + \mu\Phi^{-1} - 2K \geq 2\mu - 2K. \quad (\text{A.13})$$

The LHS is minimized for  $\Phi = 1$ , which is the case of symmetry. Hence, the above inequality always holds.

2. Proved in the text.

3. I need to show that  $\frac{d\delta^*}{d\mu} > 0$  or equivalently that  $\frac{d\Phi}{d\mu} < 0$  as long as  $\Phi > 1$ . Define  $a = a_h - a_\ell$ , and rearrange the definition of  $\Phi$  at optimal prices to obtain the implicit equation that

$$\Phi = \exp ((a - p_1^* + p_2^*) / \mu) \quad (\text{A.14})$$

with  $p_1^* - c = \mu/(1 - s_1) = \mu(1 + \Phi)$ ,  $p_2^* - c = \mu/(1 - s_2) = \mu(1 + \Phi^{-1})$ . Thus, at optimal prices the following relation exists,

$$\Phi = \exp\left(\frac{a}{\mu} - \Phi + \frac{1}{\Phi}\right) \quad (\text{A.15})$$

which is larger than 1 if  $a > 0$  (see proposition 1). From this equation, take the derivative to obtain that

$$\begin{aligned} \frac{d\Phi}{d\mu} &= -\exp\left(\frac{a}{\mu} - \Phi + \frac{1}{\Phi}\right) \left(\frac{a}{\mu^2} + \frac{d\Phi}{d\mu} + \frac{1}{\Phi^2} \frac{d\Phi}{d\mu}\right) \\ \frac{d\Phi}{d\mu} &= -\Phi \left(\frac{a}{\mu^2} + \frac{d\Phi}{d\mu} + \frac{1}{\Phi^2} \frac{d\Phi}{d\mu}\right). \end{aligned} \quad (\text{A.16})$$

Rearranging gives that

$$\frac{d\Phi}{d\mu} = -\frac{a}{\mu^2} \frac{\Phi^2}{(1 + \Phi + \Phi^2)}, \quad (\text{A.17})$$

which is strictly negative as long as  $a > 0$  (which is always true). ■

### Proof of proposition 5:

1. I use the symbols  $S$ ,  $T$ , and  $R$  as they are defined in the text. Optimal prices are given by  $\frac{\mu}{1-s}$ , where  $s = SR$  in one market and  $s = S(1-R)$  in the other. At optimal prices, the profit that a firm will get from asymmetric positioning is equal to

$$\pi^* = \frac{SR\mu}{1-SR} + \frac{S(1-R)\mu}{1-S(1-R)} - 2K, \quad (\text{A.18})$$

whereas the profit (at optimal prices) a firm will get if all firms position at  $a_h$  in all markets is equal to

$$\pi^0 = \frac{T\mu}{1-0.5T} - 2K. \quad (\text{A.19})$$

Manipulating the inequality  $\pi^* - \pi^0 > 0$  gives the result that

$$(T - S) < \frac{S^2(1 - 2R)^2}{(2 - S)} \quad (\text{A.20})$$

2. Suppose the incentive condition holds and that both firms are positioning asymmetrically. Arbitrarily taking  $R > 0.5$ , the profit a player would enjoy if it deviated from the asymmetric positioning is

$$\pi^d = \frac{RS\mu}{1-RS} + \frac{0.5T\mu}{1-0.5T} - 2K, \quad (\text{A.21})$$

which is always more than  $\pi^*$ . Using that

$$\delta^* = \frac{\pi^d - \pi^*}{\pi^d - \pi^0} \quad (\text{A.22})$$

gives the result ■

**Proof of proposition 6:**

1. Say  $R > 0.5$  in markets 1 through  $L$ . Then the profit incentive condition follows from the following comparison. If the firm stays in asymmetric equilibria it gets high profits in market 1 through  $L$  and lower profits in all other markets. If the firm is in symmetric equilibrium, then it gets the symmetric duopoly profits in each market. Formally, with spatial concentration profits are equal to

$$\pi_1 = L \left( \frac{\mu R}{1-R} - K \right) + (M-L) \left( \frac{\mu(1-R)}{R} - K \right), \quad (\text{A.23})$$

whereas in the symmetric case ( $R = 0.5$ ), they are equal to

$$\pi_1 = M(\mu - K). \quad (\text{A.24})$$

Solving for the superiority of the payoffs under spatial concentration, for firm 1 the following condition holds

$$L \frac{R}{1-R} + (M-L) \frac{(1-R)}{R} - M > 0, \quad (\text{A.25})$$

which solves to

$$\frac{M-L}{M} < R \quad (\text{A.26})$$

Using the same reasoning, for firm 2 spatial concentration is better if

$$\frac{L}{M} < R \quad (\text{A.27})$$

This condition is guaranteed for the firm that leads in the majority of markets. For the other firm there is a boundary condition.

2. The derivative of  $R$  with respect to  $\mu$ . At optimal prices,

$$R = \frac{\exp((a - p_1^* + p_2^*)/\mu)}{\exp((a - p_1^* + p_2^*)/\mu) + 1} \quad (\text{A.28})$$

from which it follows that

$$R = \frac{\exp(a/\mu - 1/(1-R) + 1/R)}{\exp(a/\mu - 1/(1-R) + 1/R) + 1} = \frac{f(\mu)}{f(\mu) + 1}, \quad (\text{A.29})$$

with  $f(\mu) > 0$ . Taking derivatives implies that

$$R' = \frac{f'(\mu)}{f(\mu) + 1} - \frac{f'(\mu)f(\mu)}{(f(\mu) + 1)^2} = \frac{f'(\mu)}{(f(\mu) + 1)^2}. \quad (\text{A.30})$$

Next, develop

$$f'(\mu) = f(\mu) \left( -\frac{a}{\mu^2} - \frac{R'}{(1-R)^2} - \frac{R'}{R^2} \right). \quad (\text{A.31})$$

Combining the last two equations gives the following result.

$$R' = -\frac{a}{\mu^2} \frac{(1-R)^2 R^2}{((1-R)^2 + R)} \quad (\text{A.32})$$

thus if  $a > 0$  then  $R' < 0$ . This means that if firm 1 is positioned advantageously, its share will become larger as horizontal differentiation is further diminished (as  $\mu$  goes down).

3. What holds for the minimal discount rate  $\delta^*$  in this case? A necessary condition is that the profit incentive to sustain the local asymmetries must hold. Therefore,

$$\frac{M-L}{M} < R \text{ and } 1-R < \frac{L}{M} \quad (\text{A.33})$$

so that when there is a profit incentive to sustain the asymmetries, the following inequality is guaranteed.

$$\frac{R}{1-R} > \frac{M-L}{L} \quad (\text{A.34})$$

The profit from a one time deviation from mutual asymmetric positioning for firm 1 is equal to

$$\pi^d = \mu \left( L \frac{R}{1-R} + (M-L) \right) - MK. \quad (\text{A.35})$$

Thus,

$$\delta^* = \frac{\pi^d - \pi^*}{\pi^d - \pi^0} = \frac{1}{\Phi} \frac{M-L}{L}. \quad (\text{A.36})$$

For firm 2, it is easy to show that

$$\delta^* = \frac{\pi^d - \pi^*}{\pi^d - \pi^0} = \frac{1}{\Phi} \frac{L}{M-L}. \quad (\text{A.37})$$

■

### Proof of proposition 7:

1. Proof is the same as that given in the text preceding proposition 1
2. These statements are directly proven in the text

- (a) It is obvious that  $\lim_{\mu \downarrow 0} \mu (1 - \Phi^{-1}) = 0$ . Applying l'Hopital's rule to  $\lim_{\mu \downarrow 0} \mu (\Phi - 1)$ , I get

$$\lim_{\mu \downarrow 0} \mu (\Phi - 1) = \lim_{\mu \downarrow 0} -\frac{\Phi'}{1/\mu^2} = \lim_{\mu \downarrow 0} \frac{(a_h - a_\ell) \Phi^2}{(1 + \Phi + \Phi^2)} = (a_h - a_\ell) \quad (\text{A.38})$$

- (b) Again, applying l'Hopital's rule,

$$\lim_{\mu \rightarrow \infty} \mu (\Phi - 1) = \lim_{\mu \rightarrow \infty} -\frac{\Phi'}{1/\mu^{-2}} = \lim_{\mu \rightarrow \infty} \frac{(a_h - a_\ell) \Phi^2}{(1 + \Phi + \Phi^2)} = \frac{(a_h - a_\ell)}{3}. \quad (\text{A.39})$$

Further,

$$\lim_{\mu \rightarrow \infty} \mu (1 - \Phi^{-1}) = \lim_{\mu \rightarrow \infty} -\frac{\Phi'}{\Phi^2/\mu^{-2}} = \lim_{\mu \rightarrow \infty} \frac{(a_h - a_\ell)}{(1 + \Phi + \Phi^2)} = \frac{(a_h - a_\ell)}{3}. \quad (\text{A.40})$$

This completes the proof. ■

### Proof of proposition 8

1. Proof is the same as that given in the text preceding proposition 1
2. These statements are directly proven in the text. The only comment worth making is that if

$$\mu (1 - \Phi^{-1}) \leq \Delta K \leq \mu (\Phi - 1)$$

one firm will position at  $a_h$  while the other firm will position at  $a_\ell$ . Because this result holds in a single market, it will necessarily also hold for two markets given the lack of arbitrage across markets. In simple terms, consumer demand is independent across markets, and therefore if there is no profitable deviation for the leader or the lagger in a single market, there is no profitable deviation in  $M$  markets, regardless of who leads and who lags or where.

3. This result can be obtained from

$$\delta^* = \frac{\pi_i^d - \pi_i^*}{\pi_i^d - \pi_i^0}, \quad (\text{A.41})$$

where the exact expressions for  $\pi_i^d$ ,  $\pi_i^*$  and  $\pi_i^0$  are given in the text preceding this proposition. ■

### Proof of proposition 9

1. These results are derived in the text.
2. Applying l'Hôpital's rule to equation (22),

$$\begin{aligned} \lim_{\mu \downarrow 0} \mu (\Phi - 1) (1 - \Phi^{-1}) &= \lim_{\mu \downarrow 0} \mu \frac{\Phi + \Phi^{-1} - 2}{1/\mu} = \\ \lim_{\mu \downarrow 0} -\frac{\Phi' (1 - 1/\Phi^2)}{1/\mu^2} &= \lim_{\mu \downarrow 0} (a_h - a_\ell) \frac{\Phi^2 (1 - 1/\Phi^2)}{(1 + \Phi + \Phi^2)} = \\ \lim_{\mu \downarrow 0} (a_h - a_\ell) \frac{(\Phi^2 - 1)}{(1 + \Phi + \Phi^2)} &= (a_h - a_\ell) \end{aligned} \quad (\text{A.42})$$

Following the same steps it is easy to show that  $\lim_{\mu \rightarrow \infty} \mu (\Phi - 1) (1 - \Phi^{-1}) = 0$ . ■