Global and local players in a model of spatial competition

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Abstract

We analyze equilibrium configurations of Hotelling location games where some players compete on several markets with the *same* product. Such *global players* tend to lower product diversity across markets. The model is consistent with recent empirical findings on preference externalities.

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1 Introduction

This note provides an explanation for product homogeneity arising across heterogenous markets, which is based on the observation that these markets are often served by two types of firms: *Global players* who compete in several, heterogenous markets, and *local players* who are active in a single market only. The decisive feature is that global players cannot tailor their product to each individual market in which they operate. Media markets are natural examples: Major newspapers such as the New York Times compete in many different (regional) markets, which are heterogenous with respect to consumer preferences, importance and competitive structure.[1] [2]

We analyze a simple location game à la Hotelling where one global player competes with the same product in two heterogenous markets with one local competitor, respectively. In equilibrium, product homogeneity emerges across heterogenous markets.

Clearly, product homogeneity is not necessarily a desirable feature when markets are heterogenous, as for example documented in public complaints on program uniformity.[3] In our framework, the desirability of product diversity arises from the minimization of consumer preference costs and, interestingly, market configurations with global players induce higher preference costs.

We compare our explanation of product homogeneity emerging from

[1] Similar examples also exists in other segments such as radio and TV. Similarly, in politics major parties often compete on several levels (local, regional and federal). While districts tend to be highly heterogenous (with respect to average income, for example), parties are typically unable to fully customize their announced policy platforms to individuals districts. Moreover, in Germany for example, they also face competition from smaller parties and other political groups which compete in a subset of jurisdictions only.

[2] Our use of the term "market" is not restricted to a geographic connotation and also applies to other attributes such as gender, age, ethnical background or education level.

[3] See, e.g., **?** and **?** for the case of Swiss radio broadcasting and newspapers, respectively.

global players to an alternative, demand-side-driven explanation based on consumer mobility. Finally, we show that our theory is consistent with a recent empirical literature on preference externalities in media markets (George and Waldfogel, 2003 and Waldfogel, 2003).

2 Model

Consider a Hotelling model of spatial competition in two markets $k = A, B$, where a global player G competes *with the same product* in both markets against one local competitor, L_A and L_B, respectively.

Each market $k = A, B$ has a unit mass of consumers distributed on $[0, 1]$ according to distributions F_k with a strictly positive density f_k everywhere. The median of F_k is denoted m_k, where $m_A > m_B$ without loss of generality. Each consumer has unit demand and patronizes the closest firm, thereby incurring linear preference costs normalized to 1 per distance unit.

Markets also differ with respect to size and importance measured by a parameter s_k. If, say, $s_A > s_B$ then a customer in market A is more valuable than in market B. In media markets, for example, s_k will typically depend on market size and average income since these factors affect the advertisement value of a firm's product. Each firm's revenue in market k is then simply its market share times s_k.

Location choices occur sequentially, with the global player moving first. This particular timing assumption captures the idea that by competing in several markets, a global player like the New York Times is generally much less flexible in responding to *each* of its many local competitors compared to a *single* local newspaper whose primary competitor is the New York Times.[4]

[4]The literature has so far considered sequential moves primarily to analyze the issue of entry deterrence, see Prescott and Visscher (1977), **?**, Neven (1987), Anderson and Engers (2001) and Callander (2005).

Furthermore, once a location choice has been made, it is prohibitively costly to change it ex post.[5]

Throughout, we abstract from price competition. Since our main focus is on media markets, we believe there is fair justification for this assumption. First, price competition can safely be neglected when consumer prices are zero, which is e.g. the case for on-air TV and radio broadcasting. Second, even when prices are positive, they typically exhibit very little variation. For example, 75% of general interest newspapers in the US were sold at 50 cent per copy in the year 2000 (see George and Waldfogel, 2000). When price competition is important, one would expect uniform prices across markets only when these markets are homogenous. However, empirical evidence strongly points in the opposite direction, supporting the view that preferences across different media markets are heterogenous (see e.g. Waldfogel, 2003). Thus, price competition seems to be of minor importance in media markets, and firms mainly compete in product space.[6]

3 Analysis

3.1 Benchmark: Separated Hotelling markets

As a natural benchmark we consider the case of separated markets with two local players competing in each market by locating sequentially. For this case, Prescott and Visscher (1977, pp. 381) have shown that the subgame perfect equilibrium coincides with the well-known result by Hotelling (1929):

Proposition 1. *On each market $k = A, B$, in the unique subgame perfect equilibrium outcome both firms cluster at m_k.*

[5]For example, Prescott and Visscher (1977) mention pure physical re-location costs, and advertisement costs to change customers' perception of a firm. From a technical point of view, these assumptions also ensure the existence of pure strategy equilibria.

[6]Consistent with that view, Lewis (1995) finds that the demand for newspapers is very price inelastic; see also George and Waldfogel (2003).

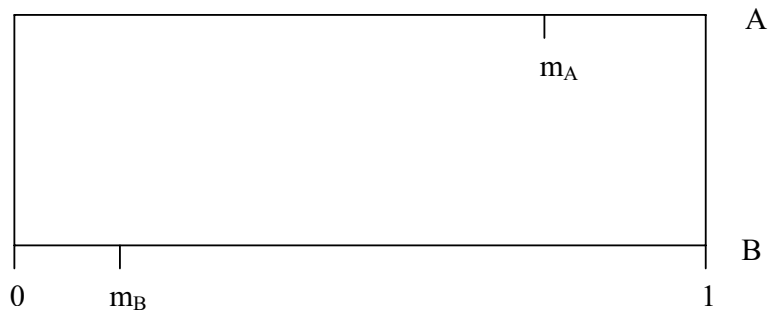

Figure 1: Equilibrium in the benchmark.

Intuitively, given the first firm's location, the second firm will always locate adjacently towards the "long side" of the market. Thus, the first firm's optimal location is at the median position where the remaining "short side" is maximized.

3.2 Product Homogeneity in Heterogenous Markets

We now show that the introduction of global players will in equilibrium induce clustering even across markets, although markets are heterogenous. Solving the game backwards, for any given location g of firm G, the best response of each local competitor L_k is

$$l_k^*(g) = \begin{cases} g^- & \text{if } g > m_k \\ g & \text{if } g = m_k \\ g^+ & \text{if } g < m_k \end{cases} \tag{1}$$

where $g^- := g - \varepsilon$, $g^+ := g + \varepsilon$ and $\varepsilon > 0$.

For G's optimal location g^*, we then have:

Lemma 1. *On each market $k = A, B$, $g^* < m_k$ only if $m_{-k} < m_k$. Thus, in any subgame perfect equilibrium $m_B \leq g^* \leq m_A$ holds.*

Proof. With only market k to consider, G would locate at m_k (Proposition 1). Thus, he is willing to depart from m_k only if this increases his profit in

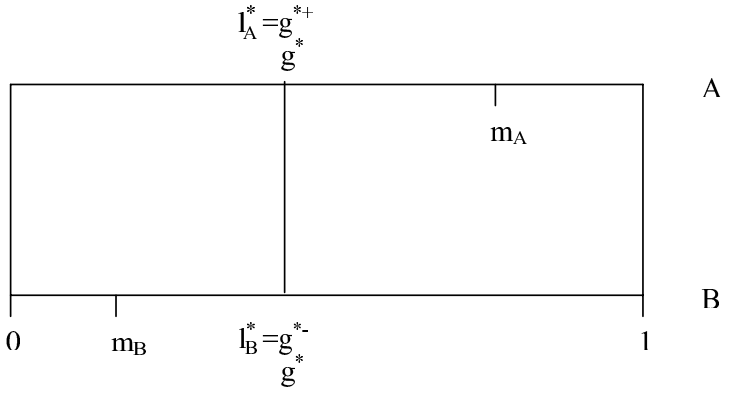

Figure 2: Product homogeneity in heterogenous markets

market $-k$. Given the best responses of his local competitors, this is only possible by moving towards m_{-k}. □

Using Lemma 1, the local competitors' relevant best responses are $l_A^* = g^{*+}$ and $l_B^* = g^{*-}$ $\forall g \in (m_B, m_A)$ and $l_k^* = g^*$ for $g^* = m_k$. Therefore, for G's optimal location:

$$g^* \in \arg\max_g s_A \cdot F_A(g) + s_B \cdot (1 - F_B(g)) \qquad \forall g \in [m_B, m_A] \qquad (2)$$

Firm G captures all customers to the left (right) of his competitor in market A (B).

Proposition 2. *In the unique subgame perfect equilibrium outcome, there is clustering at g^*.*

Depending on F_k and s_k, g^* can either be interior (as depicted in figure 2) or at one of the corners m_A or m_B. In either case, there is clustering in equilibrium but, in contrast to the benchmark, not at the median positions. Instead, both markets are "tied" together and *product homogeneity across heterogenous markets* results.

4 Diversity

We have shown how global players tend to increase product homogeneity. A natural question is whether this is socially desirable. As shown next, the answer is no, because minimization of consumer preference costs requires product diversity:

Lemma 2. *i) In each market k, clustering does not lead to minimization of preference costs.*
ii) Given that clustering occurs in market k, preference costs are lowest if firms cluster at m_k.

Proof. Starting with part ii), with clustering at some point $y \in [0,1]$, preference costs in market k have to be minimized with respect to y:

$$\min_y \int_0^y (y-x) f_k(x) dx + \int_y^1 (x-y) f_k(x) dx$$

The first order condition implies

$$\int_0^y f_k(x) dx = \int_y^1 f_k(x) dx$$

and thus the solution is at $y = m_k$. Moreover, the second order condition $2f_k(y) > 0$ is satisfied for all y.

Part i): Suppose preference costs are minimized when firms cluster at m_k. Since $f_k(\cdot)$ is positive everywhere, this yields a contradiction: Let one of the two firms move to any other location $y' \neq m_k$, then there always exists a subset of customers with positive measure for which preference costs are now strictly lower when patronizing the firm at y'. Those customers for which this is not true can still patronize the other firm at m_k so that total preference costs decrease strictly. □

Given that clustering occurs in equilibrium, from a preference cost minimizing point of view, firms should cluster at the median. However, preference costs could be further decreased by inducing some diversity in each market. The result is useful because it allows to compare equilibrium outcomes where clustering occurs at different locations:

Corollary 1. *Compared to the benchmark with local players only, total equilibrium preference costs are strictly higher in the framework with a global player.*

5 Discussion

5.1 Demand-driven product homogeneity

Our theory that global players are a driving force behind product homogeneity rests on supply-side arguments. An alternative, demand-side explanation based on consumer mobility also leads to product homogeneity, but has somewhat different implications.

To disentangle demand- from supply-driven product homogeneity, we now abstract from global players and go back to the benchmark case with two local players in each market. After firms have chosen their locations, consumers are mobile in the following sense: With probability α, each individual in market $k = A, B$ will move to market $-k$, thereby keeping her location in the $[0, 1]$-interval unchanged, while with probability $(1 - \alpha)$, she will stay in market k. These probabilities are independent across individuals. Clearly, $\alpha = 0$ corresponds to our previous model without mobility, while with $\alpha = \frac{1}{2}$, mobility is maximum.

Let $\tilde{F}_k(\cdot)$ denote the effective distribution of consumers in market k accounting for mobility, i.e.

$$\tilde{F}_k(\cdot) = \alpha F_{-k}(\cdot) + (1 - \alpha) F_k(\cdot) \tag{3}$$

and denote by $\tilde{m}_k(\alpha)$ the corresponding median.

Then it immediately follows from Proposition 1 that in equilibrium, both firms in market $k = A, B$ cluster at $\tilde{m}_k(\alpha)$. Furthermore, it is easily shown that as consumer mobility increases, products become more homogeneous. Full product homogeneity emerges when consumer mobility is maximum, since $\tilde{m}_A(\frac{1}{2}) = \tilde{m}_B(\frac{1}{2})$. These latter results are simply due to the fact that increased consumer mobility makes markets more homogenous, which is also reflected in firms' equilibrium locations. In contrast, according to our theory based on global players, product homogeneity arises even in heterogenous markets.

Using Corollary 1, the two different forces for inducing product homogeneity can also be compared with respect to equilibrium preference costs: Since with consumer mobility, clustering occurs at the median position, preference costs are strictly lower than in the framework with global players and heterogenous markets (and immobile consumers) where there is also clustering, but not at the median position.

5.2 Preference externalities

Our framework is also consistent with a recent empirical literature on preference externalities in media markets (George and Waldfogel, 2003 and Waldfogel, 2003), where individuals impose *positive* externalities on others with similar preferences because firms will cater their products in favor of this group. As a result, individuals in this group (market) consume more. Analogously, individuals in other groups suffer from a *negative* externality and consume less because products are less catered toward their preferences.

Consider the case where g^* (see (2)) is interior and therefore implicitly

given by:

$$s_A \cdot f_A(g^*) = s_B \cdot f_B(g^*) \tag{4}$$

i.e., the marginal gain from moving closer towards m_A and attracting more customers there, must equal the marginal loss from moving further away from m_B, thereby losing customers there.

Applying the implicit function theorem, it is then straightforward to show that $\frac{dg^*}{ds_A} > 0$ and $\frac{dg^*}{ds_B} < 0$: As market A, say, becomes more important, equilibrium locations move towards m_A (Proposition 2). We abstract from abstention in our model, so that the number of consumers in each market is unaffected by the increase in s_A. By Lemma 2 however, this increase induces lower (higher) preference costs in market A (B). In the spirit of George and Waldfogel (2003) and Waldfogel (2003), consumers in market A benefit on average from the change as their market is catered more, while consumers in market B suffer. The case with abstention would then be a natural extension to analyze, thereby making the number of consumers in each market endogenous.

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