Entry for Merger with Flexible Manufacturing: Implications for Competition Policy*

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Abstract

This paper studies a model of product variety with flexible manufacturers when, contrary to prior work, atomistic entry occurs prior to horizontal integration. In this model, more lax antitrust laws that allow for fewer and more concentrated merged firms lead to a greater extent of excess entry. Optimal policy permits no horizontal mergers when demand is perfectly inelastic, but may permit some horizontal integration when demand is price responsive.

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Flexible manufacturing systems that customize products for a wide range of consumer preferences are increasingly prevalent in a number of industries, including electronics, construction equipment, machine tools, construction materials, clothing, automobiles, furniture, computers, software, and aerospace (Norman and Thisse, 1999). In a small and growing literature, economists have studied implications of these systems for market structure, beginning with the initial work of MacLeod, Norman and Thisse (1988) and Lederer and Hurter (1986).[1] How do these systems affect equilibrium entry? And what are the attendant implications for economic welfare and antitrust policy?

To address these questions, scholars study market settings characterized by either exogenous pure competition (the "interlaced stores" of Brander and Eaton (1984) and Norman and Thisse (1999)) or an incumbent firm (or firms) that has the first opportunity to proliferate products before any other firm can enter the market. The purpose of this paper is to study the entry and welfare effects of flexible manufacturing when there is a different ordering of who enters when. Specifically, we envision first a phase of differentiated product development wherein many firms work to identify local niches in product space; this entry phase is then followed by opportunities for horizontal mergers, subject to antitrust constraints. We thus assume that entry occurs *first*, before horizontal concentration takes place. Concentration occurs by horizontal merger, rather than by initial monopolization of the market.

There is reason to think that concentration by merger, as modeled here, is very relevant in certain markets. For example, food markets often fit the description for flexible production. Large numbers of differentiated food products are tailored to consumer tastes, with conventional U.S. supermarkets today selling between fifteen and

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[1]For related work on flexible manufacturing systems, see Norman and Thisse (1996), Roller and Thombak (1990), Eaton and Schmitt (1994), Reitzes and Levy (1995), Anderson and Engers (2001). Other work studies flexibility in production quantities, rather than product attributes (e.g., Boyer and Moreaux, 1997).

twenty thousand items.[2] Moreover, in these markets, new product introductions are made both by dominant firms and proportionately more by a large number of much smaller firms. In 1993, the ten largest U.S. food companies accounted for less than seven percent of all new food product introductions, but over fifty percent of total U.S. market share (among all publicly traded food companies).[3] The smaller food companies that are responsible for the vast majority of new product introductions may ultimately anticipate future mergers with other producers.[4] These firms are precisely the sorts of apriori entrants that we model in this paper.

Another relevant example is the paint and coatings industry.[5] This industry offers a large array of different products, often tailored to specific customer needs using flexible production technologies.[6] New products are constantly being introduced by new and incumbent firms,[7] and mergers are constantly absorbing smaller firms into bigger ones.[8] Hence, as in food markets, entrants can anticipate future mergers with other producers.

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[2]See www.fmi.org and Progressive Grocer (60th Annual Report of the Grocery Industry, 72:104, April 1993).

[3]These statistics are derived from COMPUSTAT sales data for companies in the food industry's two digit SIC class 20 (food and kindred products) for 1988-1995 and data on new product introductions reported in Prepared Foods (162:24, November 1993).

[4]Between 1997 and 2002, for instance, there was an annual average of 646 mergers in the food industry and 294 mergers in food processing, production and wholesaling businesses alone (The Food Institute Report, January 20, 2003). Prominent recent examples of food company mergers include acquisitions of Snapple by Cadbury (a leading soft drink producer) in 2000, Celestial Seasonings by the Hain Group (a leading natural foods producer) in 2000, and Earth's Best baby foods by Heinz (a leading baby food producer) in 1996.

[5]I am indebted to the Editor, Josh Gans, for suggesting this example.

[6]An industry organization (see www.paint.org) writes: "Many of the industrial and special purpose coatings are formulated in close consultation with the end-user, to achieve optimum product characteristics that conform to the applier's specifications, as well as to the available means of application." The range of products and the range of product applications is vast in this industry. For example, paints and coatings include enamels, primers, undercoats, stains, varnishes, clears, powders, UV cures, and aerosols, among others. Applications range from homes and buildings to aircrafts, automobiles, and ships to machinery and appliances to bridges and factories.

[7]For example, in one month (September 2006), a paint and coatings industry magazine (www.pcimag.com) identifies the introduction of five new materials (including a new colorant system, a new specialty coating, a new waterborne UV resin, and anew urethane dispersant), as well as new scratch-resistant coatings (using alumina and silica nanoparticle additives), reformulated paints that are less toxic to the environment, new acrylic and waterborne UV interior coatings, longer-lived ceramic coatings, and new advances in color technology (that more efficiently match colors, determine formulae, and design color schemes).

[8]For example, in one month, the industry magazine (www.pcimag.com) identifies fifteen key new industry mergers.

The ordering of entry has quite sharp implications for antitrust policy. In a model of flexible manufacturing wherein an incumbent monopolist can saturate the product space before any outside entry occurs, the monopolist preempts all subsequent entry (Eaton and Schmitt, 1994; Norman and Thisse, 1999). Moreover, when demands are perfectly inelastic (a standard premise in spatial models), Eaton and Schmitt (1994) show that the incumbent monopoly outcome is cost-benefit optimal and, hence, a laissez faire antitrust policy maximizes economic welfare.

In our analysis, in contrast, monopoly outcomes are always welfare dominated by those in which more than one firm is required to compete. Indeed, when demands are completely inelastic, an optimal antitrust policy minimizes the extent of excess entry by allowing no horizontal integration at all -- the extreme opposite of laissez faire. When demands are price responsive, however, *some* horizontal integration can be desirable. All else the same mergers raise prices; however, they also spur more entry and can spur firms to locate their products close to the borders of their market areas, both of which lower prices. We find that the latter (pro-competitive) effects of small mergers can dominate the former (anti-competitive) effects – perhaps our most surprising result.

Like the present paper, but for different reasons, Norman and Thisse (1999) argue that a monopoly market structure will often give rise to excessive product variety, contrary to Eaton and Schmitt (1994). The reason is that a monopolist will optimally respond to entry by relocating its base products, which raises entrant profit; entry deterrence thus requires more product introductions – that is, excessive variety. However, this cost of monopoly need not vitiate the Eaton and Schmitt (1994) motive for a laissez faire antitrust policy; for example, when product "reanchoring" costs are zero, Norman and Thisse (1999, Corollary 1) conclude that monopoly and competitive / interlaced market structures produce the same number of products and, hence, the same level of economic welfare. Our conclusions are thus quite different in both their source (the ordering of entry) and their implications.

Our arguments also relate to a rather large literature on horizontal concentration and entry with "inflexible" technologies. In this literature, debate has centered on the effects of industry concentration on *subsequent* entry. The spatial preemption literature, for example, studies whether and how incumbent firms can preempt future entry.[9] The horizontal merger literature studies whether horizontal mergers in Cournot-Nash markets will, by reducing competition, spur subsequent entry that thereby mitigates or eliminates the adverse consequences of mergers for consumer welfare (e.g., Werden and Froeb, 1998; Spector, 2003; Cabral, 2003).[10] We focus instead on how the anticipation of the ability to merge, as dictated by antitrust law, affects entry apriori.[11] Subsequent (post-merger) entry is endogenously preempted and, hence, not at issue.

I. The Model

We consider a Hotelling (1929) address model wherein each differentiated good is described by a point x on the unit interval [0,1]. To avoid endpoint problems, it is convenient to assume that this interval is the circumference of a circle (as in Salop, 1979). Consumers buy only one type of good (one x) and are also characterized by an address on the circle, $x^* \in [0,1]$. A consumer's address represents the most preferred good; in particular, if a consumer buys an $x \neq x^*$, then she bears a per-unit cost that is proportional to the product's distance from the most-preferred x^*. Formally, an x^*

[9]See, for example, Eaton and Lipsey (1979), Judd (1985), Hadfield (1991), Reitzes and Levy (1995).
[10]The general conclusion from these studies is that, anticipating entry effects, firms will merge only if the merger nevertheless raises prices and thereby raises profits and harms consumers. Gowrisankaran (1999) comes to a similar conclusion when studying a general dynamic Cournot-Nash model wherein firms merge, entry occurs, and the process repeats. In Gowrisankaran (1999), unlike other work, entry can occur in anticipation of possible future mergers; however, unlike the apriori entry of the present paper, entry does not stem from unexploited gains from mergers, but rather from potential rents created by prior mergers and random entry costs, draws from which can be low. Other related work studies how mergers in spatial markets affect apriori location decisions, but not entry (e.g., Heywood, et al., 2001), effects of vertical foreclosure by an upstream monopolist in a downstream horizontally differentiated market (Kuhn and Vives, 1999), and entry deterrence effects of non-horizontal mergers (Innes, 2006).
[11]Our arguments are related to Rasmussen's (1988) classic "entry for buyout" in the sense that entry occurs in anticipation of future rents. However, our analysis is substantially different. In Rasmussen, a firm enters even when entry is otherwise unprofitable because the entrant can "hold up" an incumbent firm for ransom. In this paper, we explicitly rule out such "hold up" problems (see Section I below) and focus instead on how the merger process -- and hence, the antitrust treatment of mergers -- affects entry incentives.

consumer buying product x at price p(x) obtains the indirect utility, $U(p(x)+t|x-x^*|)+y$, where y is consumer income and $t>0$. The consumer attribute x^* is uniformly distributed on [0,1] with unit density.

An unmerged firm, or "store," is defined by a base product, $X\in[0,1]$. The cost of establishing a single base product production capability is $k>0$. Given a base product location X, firms can adapt the good to mimic attributes of other differentiated goods -- other x's. Unit costs of adaptation are proportional to the distance from the base product. Specifically, a store located at X can produce good x at constant marginal cost,

$$C(x) = c + r|x-X|,$$

where $r>0$. For simplicity, we assume that the unit "base" production cost, c, is zero. More importantly, we assume that product adaptation to consumer preferences is less costly than consumer "adaptation" to product specifications; that is, $r<t$. Hence, firms supply consumers with their most-preferred products.

In prior work, an incumbent firm (or firms) establishes whichever base products that it likes, both number and location, and then subsequently faces potential entry and possible reanchoring opportunities (Norman and Thisse, 1999). We instead consider a contestable process of entry, with the game proceeding in four stages. First (Stage 1), each of a large number of potential producers enters (or not) by establishing at most one base product at an initial location X. The number of entering firms will be denoted by N. Firms are assumed to be risk neutral. Second (Stage 2), the entered "stores" can horizontally merge subject to the constraints imposed by antitrust laws. At the time that mergers take place, we assume that antitrust law requires that no more than n stores can merge, where $n=N/\underline{N}$. $\underline{N}$ ($\leq N$) is chosen by the government apriori and is the minimum number of allowed horizontally merged firms. For example, if $\underline{N}$ equals one -- the least restrictive antitrust policy -- then monopoly is allowed; conversely, if $\underline{N}=N$, then no horizontal mergers are allowed. Third (Stage 3), as in Norman and Thisse (1999), a firm can relocate / reanchor any of its stores. For simplicity, we assume that a one-time relocation is costless within a relevant neighborhood of the initial location. (See below for elaboration on the motivation for this relocation process.) And fourth (Stage 4), product pricing, production, and trade occur.

In a game such as this, there can be many subgame perfect equilibria.[12] We focus on the simplest – and arguably most plausible – of these equilibria. First, for simplicity, we assume that the number of (Stage 1) entering firms, N, is sufficiently large that it can be treated as approximately continuous and integer-divisible by $\underline{N}$.[13] Second, as in related prior work, we focus on equilibria that are symmetric (in a sense that will become precise in a moment). And third, we posit a merger process that is efficient in that the most profitable mergers are made, subject to antitrust constraints.

To be more specific, let us consider each of the four stages, proceeding by backward induction. Stage 4 gives rise to firm profits for the pre-determined configuration of store locations and ownership. There are two well-known properties of these profits (each of which is easily verified as we proceed): (1) adding a contiguous store to a merged firm increases the joint (merged firm plus added store) profit; and (2) serving a contiguous / continuous market area of given size is more profitable than serving a non-contiguous / non-continuous market area of the same size. Hence, efficient mergers will contain contiguous (rather than non-contiguous) stores, will serve a continuous market area, and will be as large as possible, subject to antitrust constraints.

In Stage 3, costless relocation opportunities imply that each merged firm will locally relocate its stores to maximize its profits. We focus on Stage 3 equilibria that are symmetric in the sense that merged firms with the same number of stores serve market areas of the same size. However, stores need not be symmetrically located within a firm's market area, as asymmetric locations can be profit-maximizing.

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[12]See Kamien and Zang (1990) and Gowrisankaran (1999).

[13]We thus abstract from the integer and remainder issues studied in Anderson and Engers (2001).

In Stage 2, we envision a merger process by non-cooperative bargaining that achieves Pareto efficient outcomes for participants in each merger agreement (as in Rubinstein, 1982; Shaked, 1986; and many others). We assume that nature randomly assigns an order of play (as in Menezes and Pitchford, 2003), so that firms are symmetric at the time of entry (Stage 1). Specifically, let us suppose that at the start of Stage 2, nature randomly selects a point on the market circle, with each point having an equal probability of selection; proceeding clockwise from this point, firms are indexed from one to N. Firm 1 is the first mover and, subject to the antitrust constraint ($n^* \leq n$), selects both the number of neighboring firms, (n^*-1), and which (n^*-1) neighboring firms, with whom to bargain. The selected n^* firms play a unanimity bargaining game wherein the order of play is determined by the order of firms' indeces (see, for example, Chatterjee and Sabourian, 2000).[14] Exempting all firms tagged for participation in the first merger game, the store with the next highest index becomes the first mover in the next bargaining game, first selecting the neighboring firms with whom to bargain (excluding those participating in the first game) and then playing a unanimity bargaining game with these players. This process continues until all firms have participated. It is well known (Shaked, 1986) that a unique stationary subgame perfect equilibrium (SSPE) to a unanimity bargaining game with pie of size one and n^{**} players yields no delay and the allocation, ($1/Q$, δ/Q ,...,
$\delta^{n^{**}-1}/Q$), where $Q=1+\delta+...+\delta^{n^{**}-1}$, and δ=discount factor between bargaining rounds. Here, the first mover in each game chooses her bargaining partners to maximize the "size of the pie" (the net gains to merger) subject to antitrust constraints; this is done by selecting $n^*=n$ contiguous stores.

[14]In this game, firm 1 offers an allocation of the joint gains from merger (vs. no merger) and the (n^*-1) other firms sequentially accept or reject the offer; any rejection defeats the bargain and inaugurates a second round wherein the second player in line offers an allocation, and so on. If no agreement is reached, then no merger takes place and all firms are left with their no-merger profits.

As of Stage 1, when the indexing of play is unknown, each entrant expects an equi-proportionate share of the gains from an n-store contiguous merger – that is, an equal probability (1/n) of being the ith player (1=1,…,n) in a bargaining game with n contiguous players, and obtaining the corresponding share of merger profits (δ^{i-1}/Q).

This structure gives rise to a monopolistically competitive equilibrium with three properties:[15] (1) there are $\underline{N}$ merged firms, each with $n=N/\underline{N}$ neighboring stores that serve a continuous market area of size $1/\underline{N}$; (2) given (equilibrium) rival store locations, the n stores are located so as to maximize the merged firm profit; and (3) each Stage 1 entrant anticipates an equi-proportionate share of the n-store merged firm profit, and entry occurs until this profit equals the entry cost k, so that further entry is unprofitable.

Some elaborations on this structure are in order. First, why do we have the store relocation stage of the game? As observed by Norman and Thisse (1999), the posited ability of flexible manufacturers to locally reanchor their base products, at little or no cost, is a natural by-product of flexible technologies that enable low-cost local customization. Moreover, beyond the realism of relocation opportunities, their absence may motivate a firm to select a Stage 1 location that enhances its bargaining payoff in the merger game, even when this choice reduces merged firm profit. This strategic location incentive could lead to inefficiencies driven purely by the merger process.[16] Clearly, such inefficiencies do not arise if no mergers are allowed. Stage 3 relocation

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[15] See Kuhn and Vives (1999) for another model of monopolistic competition in a contestable market. In a model with fixed initial locations and no mergers, Eaton and Wooders (1985) have a continuum of possible simultaneous-move symmetric Nash entry equilibria, including the monopolistically competitive outcome (see also MacLeod, et al., 1988). However, as in Anderson and Engers (2001), the unique sequential-entry equilibrium in their model is different: entry occurs until a firm located midpoint between any two of N symmetrically located firms is no longer profitable, thus making positive profits possible for the prior entrants (the "spatially noncontestable" outcomes of Norman and Thisse, 1996). When mergers are possible in our analysis (because antitrust law does not preclude them), the prospective "midpoint entrant" that is deterred in the Eaton and Wooders (1985) sequential equilibrium nevertheless anticipates benefits of merger and, hence, enters. We model these merger profit anticipations in the simplest possible way by allowing for plausible post-entry relocation possibilities that ensure a Pareto optimal post-merger configuration of stores. Restricting attention to symmetric equilibria thus yields the monopolistically competitive outcomes characterized in this paper. See Section IV below for comparison to inflexible technologies and entry preemption games that can give rise to spatially noncontestable equilibria.

[16] For example, see Heywood, et al. (2001) for a study of these location inefficiencies.

opportunities avoid handicapping mergers by such location inefficiencies and thereby focus our attention on the entry implications of antitrust policy.

Second, the game could be repeated ad infinitum. A key insight of prior work (e.g., Eaton and Schmitt (1994), Reitzes and Levy (1995), Norman and Thisse (1999)) is that merged firms will deter further entry. This observation holds here as well and implies that there will be no action in a repeated game, absent exogenous changes in the market. However, this conclusion relies upon the implicit premise that there is no hold-up by future entrants, or firms that refuse to merge. Even when the entry and operation of another store is not profitable, entry and operation of a one-store firm would reduce the profits of neighboring merged firms; anticipating bargaining with these neighbors, and obtaining a share of the avoided losses, a potential future store may find entry profitable. Like others, we rule out such "hold-ups" -- Rasmussen's (1988) classic "entry for buyout." One way to do so endogenously is to have merger agreements stipulate that, if there is any future entry in the merged firm's territory, then the merger agreement is terminated and a new merger bargaining process ensues. Similarly, hold-up by firms that refuse to merge is avoided if any merger agreement is terminated when any store targeted for merger fails to join; this is true in the unanimity bargaining game described above.

II. Completely Inelastic Demands

Consider first the case of completely inelastic demands, where

(1) $$U() = U^*(x,p(x)) = V - p(x) - t\,|x-x^*|$$

and each consumer demands one unit of the good x that maximizes $U^*(x,p(x))$, provided this maximal $U^*()$ value is positive; if the maximum is negative, then no good is purchased. For simplicity, to ensure that all consumers are served in this market, we assume the following:

Assumption 1: $V \geq r/2$.

Assumption 1 implies that the maximum willingness to pay, V, is at least as high as the maximum unit cost of supplying each consumer with her most-preferred product, r/2.

A. Pricing (Stage 4). Given inelastic demands and r<t, a Stage 4 monopoly firm will supply each consumer with her most-preferred (x*) product at the choke price, V. Pricing policies when there are multiple merged (or unmerged) firms (with $\underline{N} \geq 2$) are only slightly more complicated. With r<t, firms again supply consumers with their most-preferred products. Moreover, to maximize profits, tailored products are priced at the maximum of (i) the firm's minimum unit cost of supply (the cost from the firm's closest store) and (ii) the minimum unit cost of all rival producers. Figure 1 illustrates this pricing policy for any given merged firm facing the proximate rival stores $\underline{X}$ and $\overline{X}$.

B. Profit Maximizing Store Locations (Stage 3). The following is easily shown (see Appendix):

> Lemma 1. When demand is perfectly inelastic, a profit maximizing merged firm locates its stores equi-distant from one another and from proximate rival stores. Hence, in equilibrium, stores are symmetrically spaced in the unit circle.

C. Mergers (Stage 2). Merging of proximate stores is always profitable because it permits higher prices to be charged without altering costs of supply. Hence (given Lemma 1), an equilibrium will yield $\underline{N}$ merged firms that each have $n=N/\underline{N}$ equally spaced stores servicing an equal share of the consumer market. For $\underline{N} \geq 2$, merged firm profit can thus be defined as:

$$(2)\quad \pi(N,\underline{N}) = 2r \left\{ \int_0^{(2\underline{N})^{-1}} [(2\underline{N})^{-1}+(2N)^{-1}-x]\, dx - (N/\underline{N}) \int_0^{(2N)^{-1}} x\, dx \right\} = r\, \{(4\underline{N}^2)^{-1}+(4N\underline{N})^{-1}\},$$

where the first term (in the first right-hand expression) gives the firm's revenues over its market area (of length $(\underline{N})^{-1}$) with proximate rival stores located the distance $(2N)^{-1}$ from the edges of this market area; the second term gives the firm's costs, with stores each located the distance $(N)^{-1}$ from one another. Similarly, for a monopoly ($\underline{N}=1$), we have:

$$(3)\qquad \pi(N,1) = V - 2Nr \int_0^{(2N)^{-1}} x\, dx = V - r(4N)^{-1}.$$

Let us further define joint industry profit as:

(4) $$\pi^*(N,\underline{N}) = \underline{N}\ \pi(N,\underline{N}).$$

Equations (2)-(4) directly imply:

<u>Lemma 2</u>. With inelastic demands, joint industry profit falls with tighter antitrust restrictions (higher $\underline{N}$, provided $\underline{N}<N$).

Proof. From equations (2)-(4), we have, for $\underline{N}\geq 2$,

(5) $$\partial\pi^*(N,\underline{N})/\partial\underline{N} = -\ (r/4)\underline{N}^{-2} < 0,$$

and, for $N\geq 2$,

(6) $$\pi^*(N,1)-\pi^*(N,2) = V - \frac{3r}{8N} - \frac{r}{16} \geq \frac{7r}{16} - \frac{3r}{8N} > 0,$$

where the first inequality in (6) is due to Assumption 1. QED.

<u>D. Entry (Stage 1)</u>. Entry occurs until it is no longer profitable, given that entrants anticipate an equal share of prospective merged firm profit:

(7) $$[\pi^*(N,\underline{N})/N] - k = 0 \Leftrightarrow N^e(\underline{N}).$$

From Lemma 2 and equation (7), tighter antitrust restrictions (higher $\underline{N}$) reduce prospective merged firm profits and thereby reduce entry incentives: $\partial N^e/\partial\underline{N}<0$. In the extreme, when no horizontal mergers are allowed at all (so that $\underline{N}=N$), the fewest possible number of entrants is obtained:

(8) $$\pi(N,N) - k = 0 \Rightarrow N^e(\underline{N}^{max}) = \underline{N}^{max} = (r/2k)^{.5}.$$

Let us compare this minimum number of entrants to its welfare-maximizing (cost-minimizing) counterpart (MacLeod, Norman and Thisse, 1988),

(9) $$N^* = \text{argmin}\ 2Nr \int_0^{(2N)^{-1}} x\,dx + kN \Rightarrow N^* = (r/4k)^{.5}.$$

Equations (7)-(9) imply that, for $\underline{N}<\underline{N}^{max}$,

(10) $$N^e(\underline{N}) > N^e(\underline{N}^{max}) > N^*.$$

Even the minimum possible number of entrants is excessive because firms enter to obtain rents from consumers, rents that are irrelevant to the social (cost minimization) calculus. Hence, to get as close as possible to the optimal number of stores, we have:

<u>Proposition 1</u>. When demand is completely inelastic, a constrained optimal antitrust policy minimizes excess entry by allowing no horizontal mergers (n=1).

For the case of inelastic demand, Eaton and Schmitt (1994) show that an incumbent monopolist, when allowed to establish a profit-maximizing set of stores before other firms can enter, preempts all entry and achieves cost-benefit optimality, $N=N^*$. With completely inelastic demands, all that matters for efficiency is that the number and location of products, or "stores," minimize total costs; as an incumbent monopolist faces all costs, it structures its production efficiently. In addition, an antitrust policy that requires multiple incumbent firms to operate (rather than a single monopolist) will, while also preempting further entry, lead to an excessive number of stores, $N>N^*$.[17] Hence, with inelastic demands and entry preemption, an optimal antitrust policy is no policy at all -- unfettered monopolization. With contestable entry, this conclusion is completely reversed (Proposition 1); increased concentration leads to more entry, not less, and is socially disadvantageous.

The intuition is straightforward. Here, entry occurs in response to profits anticipated from subsequent mergers. In the initial entry phase, monopolistic competition yields entry until anticipated profits (net of entry costs) are zero. As in Reitzes and Levy (1995) and others, locally merged firms can charge higher prices to consumers in their market area, vis-a-vis unmerged firms that must compete for these

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[17] Although Eaton and Schmitt (1994) do not show this, it is a natural by-product of their analysis. Specifically, suppose that each of $\underline{N} \geq 2$ firms (rather than one) are allowed to establish stores before further entry can take place. To characterize the symmetric equilibrium number of stores, consider the choice problem of one of the $\underline{N}$ firms, given a distance Δ between proximate rival stores. (Δ represents the potential market area for the firm of interest.) If the firm operates n stores, optimally equally spaced, then its profit will be

$$\pi = 2 \int_{(2n)^{-1}}^{\Delta/2} rx\, dx \; - \; 2n \int_{0}^{(\Delta - n^{-1})/2n} rx\, dx \; - \; kn.$$

Maximizing profit by choice of n and substituting (by symmetry) for $\Delta=\underline{N}^{-1}+n^{-1}$ and $n=N/\underline{N}$ gives the first order condition that implicitly defines the equilibrium number of stores (N),

$$(r/2)(\underline{N}/N)^3(1-\underline{N}^{-1}) + (r/4)N^{-2} - k = 0.$$

Evaluated at N^*, the left-hand-side of this condition reduces to the first term, $(r/2)(\underline{N}/N)^3(1-\underline{N}^{-1})>0$, implying that the equilibrium N is higher than N^*.

customers; as a result, a greater degree of merger, for a given set of differentiated products, yields higher profit per product and, hence, more entry. When monopoly is allowed by antitrust laws -- so that an industry-profit-maximizing merger process leads to a monopoly outcome -- the highest possible amount of entry occurs as firms seek a share of the monopoly rents. Conversely, when no horizontal integration is allowed, the minimum possible amount of entry is obtained. When demands are completely inelastic, the latter "competitive" amount of entry is higher than optimal because firms enter in pursuit of revenues that are irrelevant to the economic welfare calculus. The best that can be done is to minimize the extent of excess entry by allowing no horizontal integration at all.

III. Responsive Demands

Let us now suppose that consumer demand is price responsive,

$$D(p) = -U_p(p), \quad D' < 0. \tag{11}$$

For this general demand, we will consider two extreme cases: (1) *monopoly*, with no antitrust regulation, and (2) *pure competition*, under which no horizontal merger of any stores is allowed.

A. Pricing. For the first case, define the monopoly price $P^m(z)$ as the solution to the maximization,

$$J(z) = \max_p \, (p-z) \quad D(p). \tag{12}$$

For simplicity -- and because it is generally realistic -- we will assume that monopoly pricing does not vitiate consumers' incentives to purchase their most-preferred product:

Assumption 2. $dP^m(z)/dz \leq (t/r)$ for $z \in [0,r/2]$.[18]

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[18]Assumption 2 implies that, with monopoly pricing, consumer x obtains a lower unit purchase cost at x ($P^m(rx)$) than at $x_o<x$ ($P^m(rx_o)+t(x-x_o)$); because $dP^m/dz>0$, consumer x also obtains a lower cost at x than at $x_o>x$. Sufficient conditions for this assumption to hold include: (1) demand is weakly price inelastic in a relevant region, and there is a fixed consumer choke price V; or (2) at $p=P^m(z)$ (relevant z),

$$D'(p)(2-\varpi)-(D(p)D''(p)/D'(p)) \leq 0 \quad , \quad \varpi=(r/t)\in(0,1);$$

or, more specifically, (3) demand is linear; or (4) demand is log linear, $D(p)=a-b\ln p$, with $D(p)\leq b(2-\varpi)$ for relevant p; or (5) demand has constant elasticity ε, with $\varepsilon \leq -(1-\varpi)^{-1}$.

Hence, a monopolist prices at $P^m(c(x))$, where c(x) is the unit cost of supplying the tailored product x from the nearest store. Purely competitive firms likewise tailor their products to consumer preferences and charge a price equal to the maximum of their own unit cost of supply and the minimum rival cost of supply.

B. Store Locations. The following can be shown to hold (see Appendix):

Lemma 3. A profit maximizing monopoly locates its stores equi-distant from one another. Under pure competition, profit maximizing firms may not locate their stores equi-distant from one another, but will do so if demand is weakly price inelastic in a relevant region.

Even when a purely competitive firm's store is a different distance from its two proximate neighbors, the equilibrium is symmetric in the sense that the total distance between each store's proximate neighbors is the same, as are the market areas served and the two (different) distances from proximate neighbors. Symmetric equilibrium per-store profits, given N, are thus:

$$\pi(N,N) = \max_{\delta\leq\Delta} \; r \left\{ \int_{\delta/2}^{\delta} [2x-\delta]\, D(rx)\, dx + \int_{\delta}^{\Delta} \delta\, D(rx)\, dx + \int_{\Delta-(\delta/2)}^{\Delta} [2x-(2\Delta-\delta)]\, D(rx)\, dx \right\}, \tag{13}$$

where $\Delta=N^{-1}$ = equilibrium firm market area and δ = distance to closest proximate rival.

C. Entry and Welfare. Under pure competition, entry occurs until the symmetric per-store profit of equation (13) equals the set-up cost k:

$$N^c = N: \pi(N,N)=k. \tag{14}$$

Likewise under monopoly, entry occurs until the per-store monopoly profit, $\pi(N,1)/N$, equals k.

Social welfare is the sum of total consumer surplus in the industry and net industry profit after set-up costs,

$$W = CS + N[\pi(N,\underline{N})-k] = CS, \tag{15}$$

where the second equality follows from entry; and

$$CS = \text{consumer surplus} = \int_0^1 \int_{p(x)}^{\infty} D(z)\, dz\, dx.$$

Because the entry process erodes away all firm rents, social welfare reduces to consumer surplus. In view of this reduction, a plausible and simple condition ensures that monopoly outcomes will be welfare-dominated by those of pure competition:

Assumption 3. $P^m(0) \geq r/N^c$ (where N^c is defined in equation (14)).

Assumption 3 states that the minimum monopoly price (when there are no costs of tailoring a product to consumer preferences) is at least as high as the maximum price charged under pure competition. For example, Assumption 3 will hold if demand is weakly price inelastic over the interval $[0, r/N^c]$. Assumption 3 implies that consumer surplus is necessarily higher under pure competition.

Proposition 2. If demand is price responsive and Assumption 3 holds, then an antitrust policy that prohibits any horizontal merger (requiring pure competition) is cost-benefit optimal relative to a policy that allows unfettered mergers (monopoly).

D. Can Some Horizontal Integration Be Optimal? From the foregoing, one might suspect that allowing any horizontal integration -- even if requiring more than one firm to operate -- will lead to higher consumer prices and thereby lower social welfare. This is not the case in general. The reason is that, although horizontal integration leads to higher prices for a given set of stores, it also induces entry that sharpens competition at the borders of merged firms' territories and thereby leads to some lowering of prices.

To document that some horizontal integration can be desirable, we now consider the example of a unit elastic demand subject to the choke price V:[19]

$$D(p) = \begin{matrix} (1/p) & \text{if } p{=}V \\ 0 & \text{otherwise} \end{matrix} \tag{16}$$

[19]Eaton and Schmitt (1994) use this example to investigate welfare effects of monopoly preemption with responsive demands.

Furthermore, we will compare two possible policies: (1) pure competition (no horizontal mergers), and (2) an antitrust rule allowing the merger of any two stores, but no more than two. We will show that welfare is higher under the second policy.

By Lemma 3 (equal spacing when demand is weakly inelastic), pure competition gives rise to the following consumer surplus and welfare:

$$(17)\qquad W^c = CS^c = 2N^c \int_0^{(2N^c)^{-1}} \int_{r[(N^c)^{-1}-x]}^{V} (1/z)\ dz\ dx.$$

Solving for N^c (of equations (13)-(14)) for the demand in equation (16) gives:

$$(18)\qquad N^c = (2/k)[1-\ln(2)] = \text{number of stores under pure competition.}$$

Substituting (18) into (17) yields:

$$(17')\qquad W^c = CS^c = 1 - \ln(k) + \ln(V) - \ln(r) + \ln(1-\ln(2)).$$

The case of two-store mergers is more complicated. For this case, symmetric spacing of stores is not profit-maximizing. Rather, merged firms locate their stores closer to the borders of their territories because prices are lower toward the borders, and demands are greater; firms thus want to keep costs of supplying the borders lower by locating more closely.[20] Formally, if $\Delta = |\bar{X} - \underline{X}|$ is the distance between proximate rival stores and δ is the distance of a two-store firm's stores from these proximate rivals (Figure 2), then firm profits are:

$$(19)\qquad \pi = 2\left\{ \int_0^{(\Delta/2)-\delta} r\delta\, D(r((\Delta/2)-x))\,dx + \int_{(\Delta/2)-\delta}^{(\Delta-\delta)/2} [2r((\Delta/2)-x)-r\delta]\, D(r((\Delta/2)-x))\,dx \right\}.$$

Differentiating (using the Leibnitz Rule),

$$(20)\qquad \partial\pi/\partial\delta = 2r\left\{ \int_0^{(\Delta/2)-\delta} D(r((\Delta/2)-x))\,dx - \int_{(\Delta/2)-\delta}^{(\Delta-\delta)/2} D(r((\Delta/2)-x))\,dx \right\}.$$

Setting (20) to zero (and verifying second order conditions) for our equation (16) demand gives:

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[20]By locating nearer to borders, a firm can also steal customers from its rivals. However, because net profits from serving border customers are zero, these customer-stealing benefits vanish in the firm's location calculus.

(21) $$\delta^{*}=\Delta/4.$$

Substituting for δ from (21), $\Delta=(2/N)+\delta=8/(3N)$,[21] and D() from (16) into equation (19) yields the equilibrium per-store profit,

(22) $$\pi/2 = \frac{2}{3N}\ .$$

Entry occurs until this per-store profit is equated with the set-up cost k,

(23) $$N^{I} = \frac{2}{3k} \text{ = number of stores with two-store mergers.}$$

Consumer surplus can now be written as follows:

(24) $$W^{I} = CS^{I} = N^{I} \int_{0}^{(N^{I})^{-1}} \int_{r[(N^{I})^{-1}+(\delta/2)-x]}^{V} (1/z)\ dz\, dx = 1 - \ln(k) + \ln(V) - \ln(r) - (5/3)\ln(2),$$

where the second equality is obtained by substituting for N^{I} from (23) and $\delta=2(3N^{I})^{-1}=k$.

Subtracting (17') from (24),

(25) $$W^{I}-W^{c} = -(5/3)\ln(2) - \ln(1-\ln(2)) > 0.$$

Equation (25) implies:

Proposition 3. An antitrust policy that allows some horizontal integration (n=2) can be cost-benefit optimal.

IV. Discussion and Generalization[22]

A. Interpretations of Antitrust Policy. We have modeled antitrust policy as the choice of the maximum number of "stores" that can merge (n) and the related minimum number of allowed horizontally merged firms ($\underline{N}$). However, in the context of our model, antitrust policy can be interpreted in ways more closely related to observed practice. For example, in this paper, there is no reason to restrict mergers between stores/firms that are not contiguous, because non-contiguous mergers have no effect on pricing, profits or welfare. Hence, the key criterion suggested for the attention of antitrust authorities is the spatial proximity of the merger and the extent of uncontested (contiguous) market that a merger will yield. In the case of inelastic demands, the prescription is to allow no

[21]With symmetric two-store firms, each merged firm's market area equals (2/N). From the definition of Δ (see Figure 2), we have that $\Delta = (2/N)+\delta$.

[22]I am indebted to the Referee for raising the issues that are discussed in this Section.

mergers of contiguous firms, but any mergers of non-contiguous firms. In the case of elastic demands, the prescription is potentially to allow some limited contiguous mergers (and again any non-contiguous mergers), but to restrain the extent of contiguous merging. Antitrust restraints or remedies may thus take the form of requiring divestitures of some assets in order for some mergers to proceed, with the divestitures designed to avoid spatial dominance by denying the merged firm with contiguous markets.

In judging the need for antitrust restraint, our analysis thus suggests that market share per se is a poor indicator. Two firms may entirely dominate a market, but operate entirely interlaced "stores" (with neither firm owning any two neighboring outlets); in this case, market shares are high, but purely competitive outcomes nonetheless prevail. Rather, it is the extent of spatial dominance that should spur antitrust action.

B. Large vs. Small Product Innovations. This analysis can be criticized for posing a pure model of entry-for-merger wherein all potential market participants are atomistic apriori. Clearly, in practice, product innovators come in many forms, both large and small. In our defense, this analysis is offered as a counterpoint to standard modeling wherein an initial incumbent (or incumbents) has the first opportunity to proliferate products and thereby preempt entry; this work rules out any small innovator/entrants, just as we rule out any large ones.

However, the logic of our analysis can be extended to allow for the presence of both large (incumbent) innovators and atomistic (new) innovators. Of course, antitrust policy will limit the ability of incumbent firms to dominate markets with product introductions just as it limits merger opportunities after products have been established. For example, laissez faire permits a single incumbent to proliferate products without limit. Conversely, the strongest possible antitrust restriction will prevent any one organization from introducing any two contiguous products.

Let us consider these two extremes in our model of inelastic demands. In the case of tight antitrust policy, entry incentives are exactly as described in Section II above (for the "competitive" case of $\underline{N}=\underline{N}^{max}$). In the case of an incumbent monopolist, however, there are differences. Unlike "entry preemption" models (Eaton and Schmitt, 1994; Norman and Thisse (NT), 1999), an atomistic entrant here can anticipate merger with the incumbent monopolist. Unlike our prior (Section II) analysis, the merger process will be one of bilateral bargaining. Bilateral bargaining will split gains from merger according to a parameter $\alpha \in [0,1]$, where α represents the share of gain obtained by the entrant. For example, if $\alpha=0$, then the entrant obtains his no-merger payoff (as in NT, 1999); and if $\alpha>0$, the entrant obtains a higher payoff.

With this structure, there are two benefits of entry that are absent in the pure entry preemption model of Eaton and Schmitt (1994). First, due to costless reanchoring, an incumbent monopolist accommodates entry by optimally adjusting the locations of its base products; this reanchoring increases the entrant's profits absent merger and, in turn therefore, enhances the entrant's bargained payoff under merger. Entry deterrence thus requires greater monopoly product proliferation. This is the key insight of Norman and Thisse (NT, 1999). Second is the central observation of the present paper. Contrary to prior analyses, entrants can anticipate obtaining a share of gains from post-entry merger, which also raises entry incentives. Together, these benefits of entry imply that a monopoly market structure will yield more entry than a competitive one.

To see this, note that entry (without merger) will spur the incumbent to relocate to a new symmetric distribution of stores (NT, 1999). Hence, if $\alpha=0$, the entrant's anticipated payoff is the same as with atomistic competition and equilibrium entry will also be the same ($N=\underline{N}^{max}$). However, if the entrant obtains any positive gain from bargaining ($\alpha>0$), equilibrium entry will be higher under monopoly than under competition. In summary:

Proposition 4. If demands are inelastic, an incumbent firm can proliferate products, and atomistic entrants can anticipate post-entry merger (with $\alpha>0$), then equilibrium entry (N) will be higher than under pure competition ($\underline{N}^{max}$). Hence, an antitrust policy that prohibits any horizontal concentration is cost-benefit optimal relative to a policy that allows monopoly.

Whether negotiating in a bargaining game with other atomistic entrants, or engaging in bilateral bargaining with a "large" incumbent, an entrant can anticipate gains from mergers that rise with post-merger concentration. Hence, entry incentives rise with concentration and a regulator who is trying to minimize the extent of excess entry will therefore want to limit concentration.

C. Alternative Modes of Competition. We have so far considered a model of price competition with flexible production. Are our qualitative results robust to alternative models of spatially differentiated markets? Let us consider two alternatives.

First, suppose we have the more standard model of inflexible production and price competition for consumers with unit demands uniformily distributed on the unit circle (as in Salop (1979) and many others). In this model, consumers "travel" to stores (rather than vice versa) at a cost of t per unit distance and a "store" can be established at a cost k, with relocation economically infeasible. An optimum is achieved with $N^*=(t/4k)^{.5}$ symmetrically distributed stores. As shown by Norman and Thisse (NT, 1996), pure competition (with atomistic entry) can yield a range of possible symmetric equilibria, with two extremes in this range: (1) "spatially contestable" (SC) outcomes wherein entry bids away all producer rents and (2) "spatially noncontestable" (SNC) outcomes; SNC yields the minimum number of producers / stores such that a prospective midpoint entrant will obtain non-positive profit. In the first (SC) case, entry yields the zero-profit equilibrium (Salop, 1979): $N_{SC}=(t/k)^{.5}$. In the second (NSC) case, the equilibrium number of entrants is (see NT, 1996):

$$N_{NSC} = (t/k)^{.5}\{3/[2(2+3^{.5})]\}^{.5} \leftrightarrow N_{SC} > N_{NSC} > N^*.$$

In sum, with pure competition and no mergers, there is excess entry in any symmetric equilibrium. By tempering price competition, mergers of neighboring "stores" enhance profits, with the enhancement greater when the merger is larger. Hence, the anticipation of mergers – with some sharing of the gains to merger – increases entry incentives, thereby worsening the extent of excess entry in either SC or NSC equilibria. As in the foregoing analysis, the extent of excess entry can be optimally minimized by an antitrust policy that allows no contiguous horizontal mergers at all.

The second alternative is more complicated. Consider Matsushima's (2001) model of flexible production with spatial quantity (vs. price) competition for consumers with identical linear (elastic) demands and producer transport costs of consumer delivery equal to r per unit distance (as in this paper). In this model, in striking contrast to the setting studied above, Matsushima (2001) shows that "side-by-side" mergers are unprofitable; however, sequential (two store) mergers can be profitable and can arise in equilibrium. For purposes of the present paper, two questions are germane. First, do mergers promote entry? And second, considering their entry effects, do mergers promote or deplete economic welfare?

The answer to the first question is straightforward. If they occur, mergers are profitable; hence, to the extent that gains from merger are shared by the partnering firms, incentives for entry rise with the anticipation of gains from subsequent merger. That is, mergers – if they occur – promote ex-ante entry.

The second question, perhaps not surprisingly, has no simple answer. On one hand, drawing on Matsushima's (2001) analysis, it can be seen that "pure competition" (with no mergers) can give rise to a zero-profit entry equilibrium in which entry is excessive (i.e., higher than would maximize social welfare).[23] When this is so, it would

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[23] In a flexible production model where "reanchoring" is likely to be inexpensive or free, zero-profit (spatially contestable) entry equilibria are arguably the most plausible. To see that these equilibria can yield more entry than maximizes social welfare, it suffices to evaluate the marginal social benefit of an entrant at the zero-profit level of entry (N^e); using Matsushima's (2001) calculations of per-firm profit and social welfare with an even number of firms; this marginal benefit is negative, indicating excess entry:

$$\partial SW/\partial N \,\big|_{N^e} - k = - \{[(48a^2-24ar)\,2N + 6Nr^2]/[96(1+N)^3 b]\} < 0,$$

seem that mergers, by stimulating entry, would tend to deplete economic welfare. On the other hand, however, there are additional effects of mergers on social welfare. Most notably, in Matsushima's (2001) model, independent firms sell to all consumers. A key economy of mergers is that merged firms deliver from their lowest-cost "store," so that each store serves only a subset of the consumer market (that which it can supply at lower cost than all of the other merged firm stores). The welfare benefit of these cost savings from mergers is offset to some extent by the tempering of competition that results from a more concentrated market. These effects suggest that interlaced mergers are likely to be salutary, for example allowing only two firms to have equal market share but no contiguous "stores" (so that the two firms' outlets are all interlaced). Such a structure simultaneously permits cost economy and competition, much as in the present paper. Allowing more (side-by-side) mergers may well deplete welfare both by inhibiting competition and promoting entry. However, these last speculations merit a full analysis.

D. Non-Uniform Distribution of Consumers. We have assumed that consumers are uniformily distributed on the unit circle. Suppose instead that consumer density at location x is f(x) (and cumulative density from zero to x is F(x)). The non-uniform distribution of consumers will affect the spatial distribution of stores, with outlets more concentrated in locations of high demand. While a complete analysis of these locational (and resulting entry) equilibria cannot be performed here, a few observations suggest that our results are often robust to this generalization.

Consider the case of inelastic demands. For the post-entry location equilibrium, we can show:

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where SW is the social welfare described in Matsushima's (2001) equation (10), k=entry cost = per firm profit (from Matsushima's (2001) equation (9)), N= number of symmetric firms/stores, (a,b) are parameters of consumer demand (P=a-bQ), and the inequality follows from a>r/2 (p. 265, Matsushima, 2001).

Lemma 4. With inelastic demands and non-uniformily distributed consumers, an optimal location of a given number of stores is also a post-entry equilibrium location for either a monopolist or independent retailers.

For exactly the same reasons as before, mergers increase per-store profit and thereby increase entry incentives. Hence, if there is excess entry with independent retailers – when no horizontal integration is allowed – mergers decrease efficiency by promoting entry. Unfortunately, with a non-uniform consumer density, the lack of symmetry in entrant locations and profits make general statements about the efficiency of competitive (no merger) entry equilibria difficult. However, let us consider the case of triangular consumer densities, with $f(x)=\alpha x$ for $x\in[0,1/2]$ and $f(x)=\alpha(1-x)$ for $x\in(1/2,1]$.[24] In this case, when N=2, 3, or 4, optimal store locations yield the total costs (excluding entry),

$$C_2 = r\alpha\,(.024406), \quad C_3 = r\alpha\,(.0167356), \quad C_4 = r\alpha\,(.0129726).$$

Now let us suppose that the entry cost is $k = .005\, r\alpha$, so that

$$C_2 - C_3 > k > C_3 - C_4,$$

and hence, $N^*=3$ is optimal. Even with no mergers allowed, entry to N=4 will occur if the resulting minimum store profit is greater than the entry cost k. Now note that, in the efficient post-entry (N=4) equilibrium (appealing to Lemma 4), two stores are located symmetrically in the low demand regions (at x=.23095 and x=.76905) and two are located symmetrically in the high demand regions (at x=.42229 and x=.57771). "Low demand" (L) and "high demand" (H) stores earn the respective profits:

$$\pi_L = r\alpha\,(.0072166) > \pi_H = r\alpha\,(.0061455) > k.$$

[24] This example can be directly extended to allow for multiple (triangular) peaks in consumer density.

Because per-store profit in the four firm equilibrium exceeds the entry cost, entry occurs at least to N=4, despite the efficiency of N*=3 and despite the absence of any mergers.[25] In sum, in this example, allowing mergers increases the extent of excess entry and, hence, reduces economic welfare, as in Section II above.

IV. Conclusion

Spatial models of product variety often imply that free entry produces excess entry and that market concentration, by reducing entry, can yield efficiency dividends (Lancaster, 1990; Salop, 1979). In the context of a spatial model of flexible production, this paper explores the robustness of such conclusions to an entry process in which concentration occurs by merger, after product proliferation by atomistic entrants. The main message imparted by this alternative model of entry is very simple: Because more concentrated markets are more profitable, and because prospective entrants can anticipate obtaining a share of profits from post-entry mergers, concentration tends to spur more entry, not less. Hence, the problem of excess entry is exacerbated, not mitigated, by allowing more market concentration.

As noted in the introduction, food markets fit the description for flexible production quite well. Beyond heuristic evidence that new food products are predominantly launched by small (atomistic) firms – as accords with our model of entry-for-merger – there is also empirical evidence that the positive predictions of this model are borne out in these markets. Specifically, recent work by Roder, Herrmann and Connor (2000) and Bhattacharya and Innes (2006) documents that higher levels of

[25] In fact, for any k such that N*=3 is optimal, $(k/r\alpha)\in(.003763, .0076704)$, the competitive entry equilibrium yields at least three entrants. When $(k/r\alpha)<.0061455$, competitive entry yields $N\geq 4$ by the logic above. When $(k/r\alpha)\in(.0061455, .0076704)$, competitive entry yields N=3, with the three firms earning the following profits (before entry costs) in the optimal location equilibrium: $\pi_1=\pi_3=r\alpha\,(.0119316)>\pi_2=r\alpha\,(.0118664)>k$ at locations $x_1=.27345$, $x_2=.5$, and $x_3=.72655$.

market concentration are associated with significantly higher numbers of new food product introductions.[26]

This paper also identifies a more subtle implication of entry-for-merger games. Despite the adverse entry promotion and price-raising effects of mergers, some horizontal integration can increase economic welfare when demands are price responsive. The reason is that there are price-cutting effects of integrated firms' product location choices. Hence, to the extent that it applies in practice, our model argues against an antitrust policy that allows for substantial monopolization of a market, but may also argue for some horizontal concentration, despite an absence of scale economies in production.

Of course, as with any model, we have made a number of stylizations to develop our argument, focusing (for example) on flexible technologies with identical producers, uniformily distributed consumers, and atomistic entrants. It is likely, however, that our qualitative conclusions are robust to a variety of generalizations, some of which we discuss in Section IV above. For example, allowing for a non-uniform distribution of consumers will affect the spatial distribution of stores, with outlets more concentrated in locations of high demand. Nevertheless, for exactly the same reasons as in our simpler model, competition is still likely to spur excess entry. And mergers of contiguous outlets are still likely to worsen the extent of excess entry by rewarding each entrant with a share of gains to merger.

[26]Although new product introductions (NPIs) are likely to include both new base products and new "customizations" of existing base products, there is almost certainly a monotonic relationship between total NPIs and base NPIs. Hence, this empirical evidence supports the positive links between concentration and base NPIs predicted by this paper's model.

Appendix

Proof of Lemma 1. Consider first interior stores (those that do not have a rival store as a proximate neighbor) and suppose (toward a contradiction) that one store is not equi-distant from its two proximate neighbors, with distance δ_L from its leftward neighbor (X_L) and δ_R from its rightward neighbor (X_R). Then costs of supplying customers in the interval $[X_L,X_R]$ are

$$2r\left\{ \int_0^{(\delta_L/2)} x\,dx + \int_0^{(\delta_R/2)} x\,dx \right\} = (r/4)\left\{ \delta_L^2 + \delta_R^2 \right\}.$$

Minimizing these costs (by choice of δ_L and δ_R, subject to $\delta_L+\delta_R=|X_R-X_L|$) yields $\delta_L=\delta_R$, the desired contradiction.

Consider next the edge stores (those that have a rival store as a proximate neighbor, like X_1 and X_3 in Figure 1). Again, suppose (toward a contradiction) that an edge store (X_1) is not equi-distant from its proximate neighbors, with distance δ_R from its rival neighbor (X_R) and δ_F from its "own firm neighbor" (X_F). Net profits from serving firm customers in the $[X_R,X_F]$ interval are:

$$\text{Revenues} = \int_{(\delta_R/2)}^{\delta_R+\delta_F} rx\,dx\ ,\ \ \text{Costs} = 2r \int_0^{(\delta_F/2)} x\,dx + r \int_0^{(\delta_R/2)} x\,dx$$

$$\Rightarrow \text{Profit} = r\{ (\delta_R^2/4)+(\delta_F^2/4) + \delta_R\delta_F\}$$

Maximizing this profit (by choice of δ_F and δ_R, subject to $\delta_F+\delta_R=|X_F-X_R|$) yields $\delta_F=\delta_R$, the desired contradiction. Finally, the last statement in Lemma 1 now follows because neighboring firms cannot simultaneously have equi-distant stores and different between-store distances. QED.

Proof of Lemma 3. (1) Monopoly. Suppose (toward a contradiction) that one store is not equi-distant from its two proximate neighbors, with distances δ_L and δ_R from leftward (X_L) and rightward (X_R) neighbors respectively. Then net profits from supplying customers in the interval $[X_L,X_R]$ are:

$$2\left\{ \int_0^{\delta_L/2} [P^m(rx)-rx]\, D(P^m(rx))\, dx + \int_0^{\delta_R/2} [P^m(rx)-rx]\, D(P^m(rx))\, dx \right\}.$$

Maximizing (by choice of δ_L, with $\delta_R=|X_R-X_L|-\delta_L$) yields the first order condition derivative, $J(\delta_L/2)-J(\delta_R/2)$ (where J is as defined in equation (12)). By revealed preference, J is a decreasing function; hence, profits are maximized when $\delta_L=\delta_R$, the desired contradiction.

(2) Competition. Suppose that a store is to be located between two proximate neighbors that are the total distance, 2Δ, from one another. Further suppose that the store locates a distance $\delta\leq\Delta$ from one neighbor (and $2\Delta-\delta$ from the other). Then store profit is as described by the maximand in equation (13), which we will denote by $J^*(\delta,\Delta)$. Differentiating gives:

$$\partial J^*/\partial\delta = r\left\{ -\int_{(\delta/2)}^{\delta} D(rx)\, dx + \int_{\delta}^{\Delta} D(rx)\, dx + \int_{\Delta-(\delta/2)}^{\Delta} D(rx)\, dx \right\}.$$

Clearly, $\partial J^*/\partial\delta=0$ at $\delta=\Delta$ and $\partial J^*/\partial\delta>0$ at $\delta=0$. Hence, to show that $\delta^*=\Delta$, it suffices to show that $\partial^2 J^*/\partial\delta^2\leq(<)0$ for $\delta\leq(<)\Delta$; conversely, to show that $\delta^*\in(0,\Delta)$, it suffices to show that $\partial^2 J^*/\partial\delta^2>0$ at $\delta=\Delta$. Differentiating,

$$\partial^2 J^*/\partial\delta^2 = r\left\{ (1/2)[D(r\delta/2)+D(r(\Delta-(\delta/2)))] - 2D(r\delta)\right\} \leq r\left\{D(r\delta/2)-2D(r\delta)\right\}$$
$$= -2r \int_{1/2}^{1} \{d[\alpha D(\alpha r\delta)]/d\alpha\}d\alpha = -2r \int_{1/2}^{1} D(\alpha r\delta)(1+\varepsilon^D(\alpha r\delta))d\alpha,$$

where $\varepsilon^D(p)=d\ln D(P)/d\ln p$ is the price elasticity of demand; and the first inequality (i) follows from $\Delta-(\delta/2)\geq \delta/2$ (with $\delta\leq\Delta$) and $D'<0$, (ii) holds with equality when $\delta=\Delta$, and (iii) holds with strict inequality when $\delta<\Delta$. When demand is weakly price inelastic in a relevant region, so that $\varepsilon^D(p)\geq-1$, then $\partial^2 J^*/\partial\delta^2\leq(<)0$ for $\delta\leq(<)\Delta$; hence, $\delta^*=\Delta$. Conversely, if demand is price elastic in a relevant region, so that $\varepsilon^D(p)<-1$, then $\partial^2 J^*/\partial\delta^2>0$ at $\delta=\Delta$; hence, $\delta^*<\Delta$. QED.

Proof of Lemma 4. An optimal location of stores minimizes total costs of product delivery, as does a monopolist's location of stores. Necessary for a post-entry location of stores to be optimal is that any one store, A, be located at the point between its two neighboring stores, B and C, so as to minimize total costs of product delivery to all consumers between stores B and C. Let Δ denote the distance between B and C, δ denote the (endogenous) distance of store A from B, and x=0 denote the location of store B. Then the following condition for choice of δ is necessary for optimality:

(B1) $$[F(\delta)-F(\delta/2)] - [F((\Delta+\delta)/2)-F(\delta)]=0.$$

For obvious reasons, we assume that an optimum exists so that second order (sufficient) conditions are satisfied.

Now consider the choice of location δ for an independent retailer A situated between stores B and C. This choice maximizes profit,

(B2) $$\pi_A = \int_a^c rx\, f(x)\, dx + \int_c^d r(\Delta-x)\, f(x)\, dx - \int_a^b r(\delta-x)\, f(x)\, dx - \int_b^d (x-\delta)\, f(x)\, dx,$$

where $a=\delta/2$, $b=\delta$, $c=\Delta/2$, and $d=(\delta+\Delta)/2$; the first two terms represent revenues; and the second two terms represent costs. The first order condition for maximizing π_A in (B2) is (B1), with the second order condition satisfied by assumption. Hence, given that all stores other than A are optimally located, retailer A will *choose* to optimally locate. The Lemma now follows by induction. QED.

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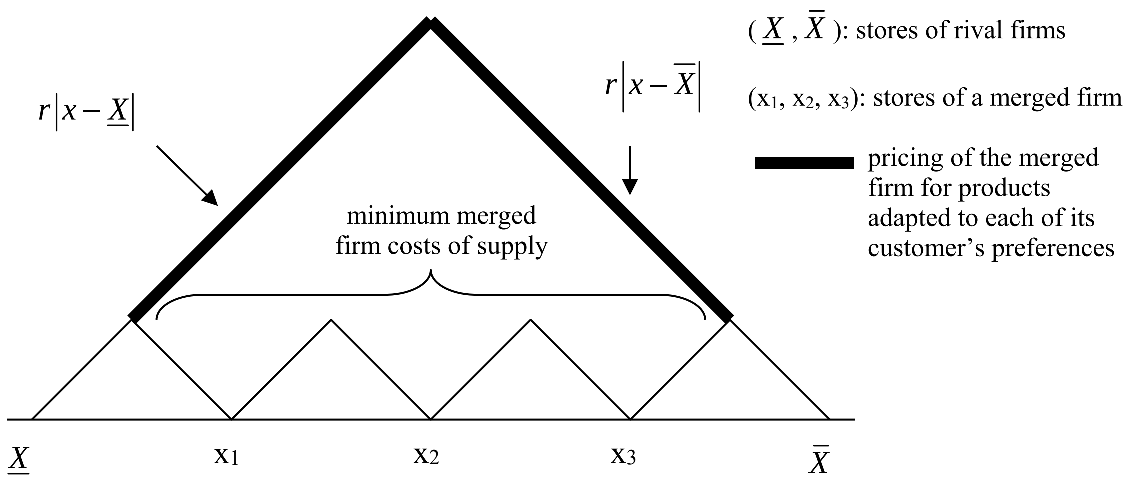

Figure 1: Pricing and Costs with Flexible Production

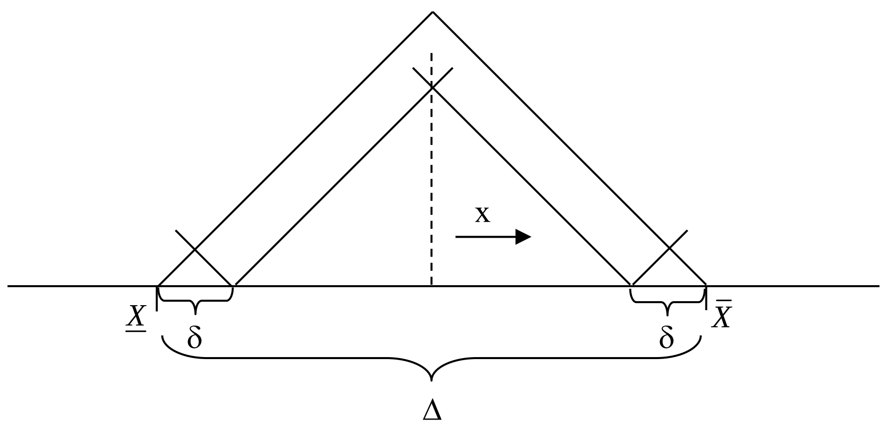

Figure 2: Two-Store Mergers