Export or Merge?
Proximity vs. Concentration in Product Space*

Marc-Andreas Muendler¶

University of California, San Diego, CESifo and NBER

December 8, 2013

Abstract

This paper proposes a proximity-concentration tradeoff in product space as a determinant of horizontal foreign direct investment (FDI). Firms that enter a foreign market by exporting are able to capture consumer surplus from introducing a differentiated product with characteristics that the incumbent cannot match. In relatively globalized product space, in contrast, consumers perceive an entrant's difference to existing products as less pronounced, so a consumer's virtual distance costs in product space are lower and a merger with an incumbent (horizontal FDI) offers pricing power that allows the entrant to extract consumer rent. Lower physical trade costs of shipping make Bertrand price competition fiercer in differentiated product space and can provide an additional incentive for a merger. A basic product space model with a linear Hotelling setup can therefore explain why FDI has become more frequent in recent periods in the presence of falling trade costs. Cross-border merger and acquisitions data support the model's prediction that horizontal FDI grows relatively faster than exports in differentiated goods industries, compared to homogeneous-goods industries.

*I thank Alan Spearot for generously sharing the sector-country-year aggregates of his global M&A transactions data. An early version of this manuscript circulated under the title "Market Access: Enter and Extract, or Merge and Match?" The author is also a member of CAGE. An Online Supplement at *http://econ.ucsd.edu/muendler/papers/abs/enter.html* documents equilibrium existence under parameter restrictions.

¶muendler@ucsd.edu (URL *econ.ucsd.edu/muendler*)

1 Introduction

Foreign direct investment (FDI) has far outpaced global trade and output over the past decades. Between 1980 and 2007, FDI flows rose from 49.7 billion U.S. dollars to 2.0 trillion U.S. dollars—a forty-fold increase.[1] Trade flows, in contrast, rose from 2.1 trillion U.S. dollars to only 17.0 trillion U.S. dollars over the same period 1980-2007—an increase by a factor of slightly more than 8, far below the factor of 40 for FDI.[2] Over the same period, trade costs and tariffs have fallen markedly. Hummels (2007) reports that air transportation costs have come down by 92 percent between 1955 and 2004 and that ocean shipping costs exhibit a steady, though considerably smaller, 20-year decline since the mid 1980s.

These empirical developments might pose a puzzle for the frequent explanation of foreign direct investment as horizontal, by which firms trade off the economies of scale from concentrating production in a single plant against market presence with a production site in the destination country to "jump" borders and avoid trade costs (e.g. Brainard 1997, Helpman, Melitz and Yeaple 2004, Ekholm, Forslid and Markusen 2007). All else equal, falling tariffs and trade costs would predict that firms favor exporting more often, rather than undertaking horizontal FDI, because now the advantages from plant-level economies of scale should outweigh the avoidance of trade costs more frequently. One explanation for the fast growth of foreign direct investment in the presence of falling trade costs may therefore be that recent foreign direct investment flows are more frequently than in earlier periods vertical in nature, whereby firms relocate stages of their production process to an affiliate in a host country that offers more favorable factor costs (e.g. Helpman 1984, Antràs 2003, Antràs and Helpman 2004).[3]

This paper outlines a different potential explanation. Much FDI arguably continues to be hori-

[1]The value for 1980 is the reported four-year average nominal total inward FDI flow (United Nations Center on Transnational Corporations 1991), and for 2007 it is the single year of nominal total inward FDI (United Nations Conference on Trade and Development 2013). Over the course of the Great Recession since 2008, world inward FDI dropped to 1.35 trillion U.S. dollars by 2012.

[2]World Development Indicators (*databank.worldbank.org/databank/download* accessed December 21, 2012).

[3]Of course, another explanation may be that not all else is equal. Plant-level economies of scale may have changed simultaneously, making concentration less attractive, or the firm-size distribution may have evolved, helping a larger fraction of firms overcome the fixed costs of horizontal FDI. Moreover, the distinction between vertical and horizontal FDI can be blurred (see, e.g., Feinberg and Keane 2006, Alfaro and Charlton 2009). Foreign affiliates may need to import intermediate inputs from their parent company, so that falling trade costs can propel vertical and horizontal FDI jointly. Moreover, foreign affiliates may need to source intermediate inputs from arm's length suppliers in the parent's home country, so that third-party vertical relationships and falling trade costs contribute to horizontal FDI.

zontal, consistent with evidence for recent decades (e.g. Carr, Markusen and Maskus 2001, Markusen and Maskus 2002). A possibility is that the proximity-concentration tradeoff that firms face is not geographic in nature. Instead, the proximity-concentration tradeoff arises in product space. This paper posits and explores two hypotheses related to globalization of product space: one hypothesis concerns a change in virtual distance costs for consumers in product space, and one hypothesis addresses a change in physical trade costs for firms and its consequences for competition in product space.

The first hypothesis is that globalization changes product space so that consumers perceive virtual distance between an additional entrant's product and existing varieties, including those from domestic incumbents, as less pronounced. Globalization homogenizes tastes. When firms, who had served their national markets almost exclusively, first expanded globally, they exported. Given their diverse origins, their product characteristics differed markedly across national markets. After export entry, the newly introduced foreign products met preferences of some consumers more closely than did the incumbents' varieties before, and the entrants were able to extract some of the consumer surplus that their differentiation generated. Export proliferation, however, gradually crowded the product space at the destination markets, changing tastes to become more alike so that consumers now view an entrant's difference to existing firms as less relevant. Entry through horizontal FDI, with a cross-border merger or acquisition of an incumbent, is therefore relatively more attractive in recent years.[4] The advantages of integrating two firms' operations through merger or acquisition may be numerous. A commonly referenced motive is "synergies" that help raise production or sales efficiencies. An important implication in the context of the first hypothesis is that such synergies tend to result in more homogeneous product characteristics and less diverse after-sales services. Mergers and acquisitions therefore do not tend to crowd product space further. A benefit for the merging companies is that the integrated firm can exert market power in pricing.

Concretely, this paper shows in a linear Hotelling model that, if the entrant's main product characteristics are sufficiently different from the local incumbent's product characteristics, then the early entrant is able to attract a consumer group whose tastes were not well served before. The newly captured demand, and some of the consumer surplus generated from matching the tastes more closely, contributes to the early entrant's profit. As globalization progresses and virtual distance costs decline

[4] As Barba Navaretti and Venables (2004, p. 9-10) state in their empirical summary of multinational firms, mergers and acquisitions account for the dominant share of FDI flows. From 1987 to 2004, between 44 and 76 percent of FDI flows in the world, and between 63 and 92 percent of FDI flows into industrialized countries, were cross-border mergers and acquisitions.

further, however, product space becomes more homogenized. When consumers become less sensitive to product differentiation in a Hotelling model, merging with the incumbent firm becomes more attractive than entry because the merged company can extract additional consumer rent through pricing power. A main result shows that, in markets with consumers who perceive differences between products as less relevant, a merger is relatively more attractive than entry.

The second hypothesis states that, as globalization reduces physical trade costs of shipping for export market entrants, oligopoly profits erode markedly. The reason is that high shipping costs serve as a commitment device of exporters to restrain the fierceness of Bertrand price competition in differentiated product space. As trade costs come down, profits from export entry erode and so do profits of the local incumbent, making a merger relatively more attractive. Even though the undifferentiated single product of a merged company generates lower consumer surplus than the distinct products of foreign exporters and local incumbents would generate, that loss in overall consumer surplus, which firms partly extract as profits, can weigh less heavily than profit erosion under fiercer price competition. In a linear Hotelling model a decline in trade costs can erode total duopoly profits of a foreign entrant and an incumbent faster than joining products into a single variety under a merger, so that horizontal FDI can become more attractive with declining physical trade costs.

An immediate implication of this proximity-concentration tradeoff in product space is that, in industries manufacturing differentiated goods, both falling virtual distance costs and falling physical trade costs should propel cross-border mergers and acquisitions (M&A) faster than exports. The reason is that, in industries with differentiated goods, both consumers can become less sensitive to differentiation in product space over time and price competition can vary in fierceness, whereas in industries that manufacture homogeneous goods product differentiation is of unchanged, and little, relevance. Consistent with this double prediction, evidence from comprehensive data on global cross-border M&A transactions for the period 1980-2006 by country and industry shows that growth in FDI activity in differentiated industries outpaces FDI growth in homogeneous industries, whereas export growth exhibits the converse relative change in the countries and industries for which M&A transactions are recorded.

This paper's main model is based on a Hotelling linear city model, a main predecessor of horizontal differentiation models (Hotelling 1929). Several families of models in the literature share its main feature that each individual consumer's decision is binary, purchasing the product from a given producer if tastes are sufficiently close to the product characteristics or price sufficiently low, and not purchasing otherwise. Consumer tastes are continuously distributed so that demand is continuous in ranges, and discontinuous at points when consumers choose not to buy. There are important recent extensions of the Hotelling model, among other generalizations for example those to multiple product characteristics (Irmen and Thisse 1998), multiple product purchases (Kim and Serfes 2006) and consumer switching over time (Sajeesh and Raju 2010). To establish the conceptual tradeoff between proximity and concentration, this paper returns to the basic Hotelling setup. A second family of differentiated taste models is based on Salop's (1979) circular city model, which is typically implemented under the assumption that an additional entrant leads to a relocation of all incumbents along the circle so that the distances between all active firms are equal around the circle. This modelling device facilitates demand derivations but is less attractive in the context of this paper where product characteristics are considered to be producer specific and lasting so that entry should not result in relocations of incumbents. Third, there are families of models in richer taste spaces, including for instance a Chamberlinian model by Helpman (1981), in which a consumer has a most preferred product type on a circle of varieties, and non-linear space based on network methods (see e.g. Hadjinicola, Charalambous and Muller 2013).[5]

Several key determinants for mergers or acquisitions have been stressed in the literature. As mentioned above, efficiency-related reasons such as unit cost reductions, the joint use of complementary assets or research and development compatibility, economies of scale, or other synergies can cause mergers and prominently inform anti-trust policy (e.g. Teece 1980, Bloch 1995, Farrell and Shapiro 2001, Davidson and Ferrett 2007). Mergers can attempt to create market power by forming monopolies or oligopolies (e.g. d'Aspremont and Gabszewicz 1986, Kamien and Zang 1990, Gowrisankaran 1999). Mergers may generate opportunities for diversification and reduce cost or demand uncertainty (e.g. Zhou 2008). Mergers have also been shown to provide market discipline if they change inefficient management at the target firm or to counteract market discipline if they allow the acquirer management to over-expand (Andrade, Mitchell and Stafford 2001). This paper sets aside issues of uncertainty and is instead closely related to the first two reasons for mergers: synergies and market power. Andrade et al. (2001) present systematic evidence that mergers improve the newly forged

[5]A fourth and separate family of models considers competition with non-homogeneous substitutes, partly to study incentives for information sharing (e.g. Raith 1996). Related demand systems with non-homogeneous substitutes do not endogenize the choice of product differentiation as consumers demand all substitutes in a given ratio that depends on relative prices.

firm's operating performance relative to industry peers.

In an influential paper, Mitchell and Mulherin (1996) consider merger activity over the last century and emphasize two main facts: Mergers occur in waves and, within a wave, mergers cluster by industry. These findings are typically interpreted as evidence that mergers occur as a reaction to unexpected shocks to industry structure. Andrade et al. (2001) argue that deregulation has become a dominant factor for national mergers, accounting for nearly half of the domestic merger activity since the late 1980s. This paper takes a cross-border perspective and emphasizes falling physical trade costs and a global homogenization in tastes as other potential sources of shocks. A number of recent papers build on real-options theories of irreversible mergers to show that acquirers might make their bids in merger waves because postponing an acquisition, which may provide gains from more favorable future market conditions, is more costly at times of strong merger activity when each firm is at higher risk of being preempted by a rival (Toxvaerd 2008). This paper sets aside such dynamic considerations but nevertheless produces predictions that are consistent with empirical insights emphasized in that literature (Bernile, Lyandres and Zhdanov 2012, Hackbarth and Miao 2012). The frequency of horizontal mergers should be higher in relatively more concentrated industries (in this paper interpreted as industries with consumers who are less sensitive to differentiation) and higher in industries that generate stronger synergies (in this paper by standardizing products). To my knowledge, the literature on mergers has not directly explored the idea that cost or sales synergies can also result in a limitation of available product characteristics.This paper highlights that a merged company foregoes the opportunity to extract consumer surplus because of its concentration of product characteristics in product space. In contrast, export entry generates a closer proximity of products to consumer tastes but results in reduced pricing power for the firms, especially if physical trade costs fall in addition to a homogenization of virtual distance costs. As product markets globalize, this tradeoff between concentration under a merger and proximity under entry shifts. Horizontal FDI becomes relatively more profitable than export entry when globalization homogenizes tastes and when physical trade costs erode.

The remainder of this paper proceeds as follows. Starting with the symmetric case of no physical trade costs and firms with identical unit costs, Section 2 derives the effects of product entry for a duopoly in differentiated product space. Section 3 turns to the opposite case of a cross-border merger in differentiated product space. Section 4 then analyzes the market conditions, and virtual distance costs in product space in particular, under which one entry mode dominates the other. Section 5 introduces physical trade costs, shows that price competition becomes fiercer with the reduction of physical trade costs, and analyzes which entry mode dominates the other under varying market conditions. Section 6 subjects the model's main prediction to empirical evidence. Section 7 concludes.

2 Foreign Entry

Consider Hotelling's linear city model. A continuum of consumers is uniformly distributed along a real line of length one. Individual consumer k is at position $x_k \in [0, 1]$ and has utility

$$U_k = \bar{s} - p_i - (\ell_i - x_k)^2 \cdot t, \tag{1}$$

where $\bar{s}$ denotes utility from consuming one unit of the good. In this model, all consumers have unit demands and purchase either one or no variety of the good. There are two components of disutility. First, a consumer has to pay a price p_i to firm i from which she purchases. Second, firm i is located somewhere along the unit line at $\ell_i \in [0, 1]$ and consumer k has to cover a distance $\|\ell_i - x_k\|$ in product space when consuming firm i's variety. The disutility of covering that virtual distance in product space is $(\ell_i - x_k)^2 \cdot t$.

This section analyzes the strategic interaction between two firms: an incumbent in the domestic market and an entrant from abroad. In this two-firm model, the virtual distance parameter t reflects the consumers' perception of differentiation in product space. When t is low, consumers are relatively insensitive to the producers' locations in product space and view an entrant's differentiation from the existing firm's product as less relevant or less pronounced. As globalization progresses, and tastes across the world become more homogeneous, the virtual distance parameter t falls and consumers perceive the difference between the most recent foreign entrant and an incumbent as minor. When t is high, in contrast, consumers suffer a strong disutility from the virtual distance to their preferred variety. A high t therefore corresponds to the notion of a relatively under-served product space in this framework and little globalization. If no entry occurs, each consumer can only buy from the incumbent or choose to not make any purchase. If entry occurs, each consumer can choose between two firms, and to buy or not. The relevant case to explain is that of an incumbent with product characteristics that appeal to a consumer segment different from the consumer segment most attracted to the foreign entrant's product. To make product space concrete, and without loss of generality, this paper considers an incumbent located in the lower half of the unit interval with product characteristic $\ell_I = \lambda_I \leq .5$ and an entrant located in the upper half with product characteristic $\ell_E = 1 - \lambda_E > .5$. The parameter λ_E is the entrant's distance from point 1 on the unit line, and λ_I is the incumbent's distance from point 0. The incumbent being in the lower half and the entrant in the upper half of the unit interval implies that $1 - \lambda_E > \lambda_I$.

There are two key parameter relations in this setup. A first key parameter is the degree of differentiation between the two firms. The *degree of differentiation* Λ can by measured by the difference $(1 - \lambda_E) - \lambda_I$:

$$\Lambda \equiv (1 - \lambda_E) - \lambda_I.$$

We will consider this degree of differentiation as determined by the firms' past pattern of product development, when they used to target mostly their local customers, and therefore as given when the incumbent and entrant set their optimal pricing strategies.

A second fundamental of the model regulates the firms' rents. The rents crucially depend on the ratio between potential consumer surplus $\bar{s} - c$ and the disutility from virtual distance to the offered product characteristic t. The consumer valuation of the good is $\bar{s}$. The unit cost of the good is its production cost c. The difference between surplus $\bar{s}$ and unit cost c is the potential consumer surplus. For now we consider the symmetric case where both firms have the same unit cost c. The resulting *surplus-disutility ratio* σ,

$$\sigma \equiv \frac{\bar{s} - c}{t},$$

captures the market's attractiveness and the potential rents from a firm's perspective. In the entry game version that we consider in this section, all consumers will be reached and choose to buy the good from one or the other firm given equilibrium prices. The surplus-disutility ratio therefore does not play a role for reaching additional consumers. However, the surplus-disutility ratio regulates the magnitude of the available rent for a merger. If the product differentiation disutility parameter t is low (after globalization has made tastes more similar), then offering only a single variety after a merger does not reduce demand much. As a consequence for later sections, falling virtual distance costs t can make a merger relatively more attractive than foreign entry.

After entry, consumer k purchases from the incumbent if and only if

$$p_I + (\lambda_I - x_k)^2 t \leq p_E + (1 - \lambda_E - x_k)^2 t.$$

Consumers to the left of some critical consumer at X therefore purchase from the incumbent, and consumers to the right of the critical point buy the entrant's variety. The critical consumer's position is implicitly given by the indifference condition

$$p_I + [X^* - \lambda_I]^2 t = p_E + [1 - \lambda_E - X^*]^2 t,$$

or equivalently

$$X^* = \frac{\lambda_I + (1 - \lambda_E)}{2} + \frac{p_E - p_I}{2\Lambda t}. \tag{2}$$

The critical consumer is half way between the two firms (the first term) unless the two firms' prices differ. When prices differ, then a larger share of consumers buys from the lower-priced firm so the critical consumer is further away from the lower-priced firm (by the second term). The critical consumer's position in equilibrium is therefore a function of the entrant's and incumbent's equilibrium prices, $X^* = X(p_I, p_E)$.

The incumbent and the entrant strategically set prices under Bertrand competition. Both firms face the same constant unit cost of production c. (See Section 5 for the case with asymmetric unit costs.) Given a conjectured price choice p_E of the entrant, the incumbent maximizes profit

$$\pi_I(p_E) = \max_{p_I} (p_I - c) \cdot X^*$$

and, given a conjectured incumbent price p_I, the entrant maximizes profit

$$\pi_E(p_I) = \max_{p_E} (p_E - c) \cdot [1 - X^*].$$

The two firms' first-order conditions for profit maximizing prices are equivalent to[6]

$$p_I^* = \frac{1}{2}\left[p_E + c + \left((1 - \lambda_E)^2 - \lambda_I^2\right) t\right] \quad \text{and} \quad p_E^* = \frac{1}{2}\left[p_I + c + \left((1 - \lambda_I)^2 - \lambda_E^2\right) t\right].$$

[6]The second-order conditions are satisfied, with the second derivative of the profit functions equal to $-1/(t\Lambda) < 0$.

In Nash equilibrium, the two first-order conditions are jointly satisfied and result in prices

$$p_I^* = c + \frac{\Lambda}{3}\left[3 + (\lambda_I - \lambda_E)\right]t \quad \text{and} \quad p_E^* = c + \frac{\Lambda}{3}\left[3 - (\lambda_I - \lambda_E)\right]t, \tag{3}$$

with associated profits

$$\pi_I^*(\lambda_I, \lambda_E) = \frac{\Lambda}{18}\left[3 + (\lambda_I - \lambda_E)\right]^2 t \quad \text{and} \quad \pi_E^*(\lambda_I, \lambda_E) = \frac{\Lambda}{18}\left[3 - (\lambda_I - \lambda_E)\right]^2 t, \tag{4}$$

assuming that all consumers purchase one of the two firms' products in equilibrium.

Adding the two firms' profits yields total duopoly profit:

$$\pi_I^*(\lambda_I, \Lambda) + \pi_E^*(\lambda_I, \Lambda) = \Lambda\left[1 + \left(\frac{2\lambda_I - (1-\Lambda)}{3}\right)^2\right]t \tag{5}$$

after replacing $\lambda_E = (1-\Lambda) - \lambda_I$. For a given incumbent location λ_I, a higher degree of product differentiation Λ between entrant and incumbent strictly raises total duopoly profit. Under the maintained assumption that all consumers on the unit interval buy the good in equilibrium, total duopoly profit does not depend on the surplus-disutility ratio σ.

The necessary and sufficient condition that every consumer in the lower half of the unit interval buys in equilibrium is that $\bar{s} - p_I^* - (\lambda_I)^2 t \geq 0$, and the necessary and sufficient condition that every consumer in the upper half of the unit intervals buys in equilibrium is that $\bar{s} - p_E^* - (\lambda_E)^2 t \geq 0$. Note that if $\lambda_I \geq \lambda_E$ then, whenever the consumer at $\ell_k = 0$ buys the good from the incumbent in the lower half of the unit interval, then the consumer at $\ell_k = 1$ also buys the good from the entrant in the upper half of the unit interval. Similarly, if $\lambda_I < \lambda_E$ then, whenever the consumer at $\ell_k = 1$ buys the good from the entrant in the upper half of the unit interval, then the consumer at $\ell_k = 0$ also buys the good from the incumbent in the lower half of the unit interval. As a consequence, one condition implies the other, and we can state equivalently

$$\sigma \geq \begin{cases} \frac{\Lambda}{3}\big(3 + [2\lambda_I - (1-\Lambda)]\big) + (\lambda_I)^2 & \text{if } \lambda_I \geq \lambda_E \\ \frac{\Lambda}{3}\big(3 - [2\lambda_I - (1-\Lambda)]\big) + [\lambda_I - (1-\Lambda)]^2 & \text{if } \lambda_I < \lambda_E \end{cases} \tag{6}$$

after replacing $\lambda_E = (1-\Lambda) - \lambda_I$. Under these conditions consumers at both extremes of the unit interval buy the good in equilibrium.

In addition, all consumers between the two firms' locations λ_I and $(1-\lambda_E)$ must buy the good in equilibrium. Suppose the incumbent is closer to the middle with $\lambda_I \geq \lambda_E$ and condition (6) holds. Then all consumers with a location $\ell_k \leq \lambda_I$ buy the good. Moreover, all consumers in the interval $\ell_k \in [\lambda_I, X^*]$ also buy the good if $\lambda_I \geq X^* - \lambda_I$, and all consumers in the interval $[X^*, (1-\lambda_E)]$ buy the good if $\lambda_E \geq (1-\lambda_E) - X^*$. Note that the latter restriction is equivalent to $2\lambda_E \geq 1 - X^*$ and implies the former restriction for $\lambda_I \geq \lambda_E$. Conversely, consumers between the two firms' locations buy the good when $\lambda_I < \lambda_E$ under the former restriction, which is equivalent to $2\lambda_I \geq X^*$. Plugging (2) in for X^* and simplifying those restrictions yields the following combined condition. All consumers on the unit interval buy the good in equilibrium under the joint sufficient conditions[7]

$$\sigma \geq \begin{cases} \dfrac{\Lambda}{3}\big(3 + [2\lambda_I - (1-\Lambda)]\big) + (\lambda_I)^2 & \wedge \quad 11(1-\Lambda) - 10\lambda_I \geq 3 \quad \text{if } \lambda_I \geq \lambda_E \\ \dfrac{\Lambda}{3}\big(3 - [2\lambda_I - (1-\Lambda)]\big) + [\lambda_I - (1-\Lambda)]^2 & \wedge \quad 10\lambda_I + (1-\Lambda) \geq 3 \quad \text{if } \lambda_I < \lambda_E. \end{cases} \tag{7}$$

The following proposition states the duopoly results.

Lemma 1 *If condition* (7) *is satisfied so that all consumers on the unit interval buy the good in duopoly equilibrium, then total duopoly profit* (5) *is independent of the surplus-disutility ratio* σ *and strictly increases in the degree of differentiation* Λ.

Duopoly profit (5) increases in the degree of differentiation Λ because price competition is less fierce when the two firms are further apart in product space. Concretely, the mutually optimal price equations (3) imply that p_I^* increases in Λ for given λ_I and p_E^* increases in Λ for given λ_E. Duopoly profit (5) is independent of the surplus-disutility ratio σ under the assumption that σ exceeds a threshold level so that all consumers buy the good from one firm in equilibrium (6). The intuitive reason is that Bertrand price competition dissipates the rent.

If total duopoly profit exceeds the total profit from merger, to be derived below, then the two firms can agree on side payments that will make entry preferable to merger for both firms.

[7]Condition (7) is a sufficient condition. It is also the necessary condition for the plausible case when $\lambda_I, \lambda_E > 1/4$ (a country's incumbent monopolist caters to the middle consumer so λ_I is closer to $1/2$ than to 0, see Section 3). In this case, consumers between the two firms buy the good whenever consumers at both extremes buy ($11(1-\Lambda) - 10\lambda_I \geq 3$ and $10\lambda_I + (1-\Lambda) \geq 3$ are satisfied for $\lambda_I, \lambda_E > 1/4$). In general, the necessary condition for all consumers buying in equilibrium is weaker than the stated sufficient condition.

3 Cross-border Merger

After a merger, the monopolist's price choice in the linear city model is complicated by the fact that demand drops discontinuously when price surpasses a certain threshold level because then some consumers choose not to buy at all.

Consider a monopoly with product characteristics λ_M. A consumer k chooses to buy from the monopolist if $\bar{s} - p_M - (\lambda_M - x_k)^2 t \geq 0$. Given a monopoly price p_M, the left-most consumer who is indifferent between buying or not is located at

$$\underline{x} = \max\left[0, \lambda_M - \sqrt{\frac{\bar{s} - p_M}{t}}\right]$$

in product space and the right-most consumer who is indifferent between buying or not is at

$$\bar{x} = \min\left[\lambda_M + \sqrt{\frac{\bar{s} - p_M}{t}}, 1\right].$$

For a uniform distribution of consumers over the unit line, the monopolist will attract a total demand X_M of

$$X_M = \min\left[\lambda_M + \sqrt{\frac{\bar{s} - p_M}{t}}, 1\right] - \max\left[0, \lambda_M - \sqrt{\frac{\bar{s} - p_M}{t}}\right]. \tag{8}$$

As a consequence, revenues and profit are not continuously differentiable in monopoly price.

For sufficiently low prices, the monopolist will attract all consumers on the unit line ($X_M = 1$). For an intermediate range of prices, the monopolist will lose consumers on one side of the unit interval but not on the other side (e.g. in the upper half of the interval if $\lambda_M < .5$ so that $X_M = \lambda_M + \sqrt{(\bar{s} - p_M)/t}$). For a range of high prices, the monopolist will lose consumers on both sides of the unit interval ($X_M = 2\sqrt{(\bar{s} - p_M)/t}$). Only if the monopolist is located at the midpoint of the unit interval ($\lambda_M = .5$) will the monopolist lose an equal mass of consumers on both sides of the unit interval.

Without loss of generality, suppose that the monopolist is located at $\lambda_M \leq .5$ for the following derivations. The monopolist sets price p_M to maximize profit

$$\pi_M(p_M) = \max_{p_M} (p_M - c)X_M.$$

In the highest price range (C) some consumers in both the upper and lower half of the unit interval are not buying the good. In this case, a monopolist with $\lambda_M \leq .5$ faces demand $X_M = 2\sqrt{(\bar{s} - p_M)/t}$ and maximizes profit $\pi_M(p_M)$. This demand is independent of the firm's location in product space because some consumers at both ends of the unit interval do not buy, and the "radius" of consumers that do buy is $\sqrt{(\bar{s} - p_M)/t}$. Taking the first derivative of profit in this price range, setting it zero, and solving out for price yields the optimal monopoly price in this range[8]

$$p_M^{*C} = \bar{s} - \frac{\sigma}{3}t \tag{9}$$

with associated profit

$$\pi_M^{*C} = 4\left(\frac{\sigma}{3}\right)^{\frac{3}{2}} t. \tag{10}$$

If consumers in the lower half of the unit interval are not buying, then consumers in the upper half of the unit interval are also not buying because $\lambda_M \leq .5$. A sufficient condition on parameters that ensures that consumers on both sides of the unit interval are not buying is therefore that consumers in the lower half of the unit interval are not buying: $\bar{s} - p_M - (\lambda_M)^2 t < 0$ or equivalently $p_M > \bar{s} - (\lambda_M)^2 t$. Therefore p_M^{*C} in the highest range (C) satisfies the constraint that consumers in the lower half of the unit interval are not buying if and only if

$$p_M^{*C} > \bar{s} - (\lambda_M)^2 t \qquad \Leftrightarrow \qquad \sigma < 3(\lambda_M)^2.$$

In other words, a monopolist only chooses prices in the highest range (C) when facing a tough market with a low surplus-disutility ratio, where rents are hard to extract.

In the intermediate price range (B), where some consumers in the upper half of the unit interval do not buy the good but all consumers in the lower half do buy, a monopolist with $\lambda_M < .5$ faces demand $X_M = \lambda_M + \sqrt{(\bar{s} - p_M)/t}$ and maximizes profit $\pi_M(p_M)$. In the intermediate price range, consumers in the lower half of the unit interval must buy the good: $\bar{s} - p_M - (\lambda_M)^2 t \geq 0$ or equivalently $p_M \leq \bar{s} - (\lambda_M)^2 t$. This latter constraint on price may or may not be binding, so there are two subcases to consider in the intermediate price range (B). If the constraint is binding, then price at the constraint

[8] The second-order condition $-3(\bar{s} + \sigma t - p_M)\sqrt{(\bar{s} - p_M)/t}\Big/[4(\bar{s} - p_M)^3] < 0$ is satisfied if $p_M < \bar{s}$.

is simply

$$p_M^{*B2} = \bar{s} - (\lambda_M)^2 t \tag{11}$$

with associated profit

$$\pi_M^{*B2} = 2\lambda_M[\sigma - (\lambda_M)^2]t. \tag{12}$$

If the constraint, by which consumers in the lower half of the unit interval do buy, is not binding, then the optimal unconstrained price in intermediate price range (B) is[9]

$$p_M^{*B1} = \bar{s} - \left[\frac{\sigma}{3} + \frac{2\lambda_M}{9}\left(\lambda_M + \sqrt{3\sigma + (\lambda_M)^2}\right)\right] t \tag{13}$$

with associated profit

$$\pi_M^{*B1} = \frac{2}{27}\left(3\sigma - (\lambda_M)^2 - \lambda_M\sqrt{3\sigma + (\lambda_M)^2}\right)\left(3\lambda_M + \sqrt{3\sigma + 2(\lambda_M)^2 + 2\lambda_M\sqrt{3\sigma + (\lambda_M)^2}}\right) t. \tag{14}$$

In this intermediate price range (B), the constrained price (11) exceeds the unconstrained price (13), and therefore the constrained profit (12) exceeds the unconstrained profit (14), if and only if[10]

$$p_M^{*B2} > p_M^{*B1} \qquad \Leftrightarrow \qquad \sigma < 5(\lambda_M)^2.$$

As the market becomes friendlier, with an increasing surplus-disutility ratio so that rents are easier to extract, a monopolist chooses prices in lower ranges.

In the lowest price range (A), when all consumers on the unit line buy the good, a monopolist with $\lambda_M \leq .5$ satisfies the condition that all consumers in the upper half of the unit interval buy the good (and therefore also all consumers in the lower half) if $\bar{s} - p_M - (1-\lambda_M)^2 t \geq 0$ or, equivalently, if $p_M \leq \bar{s} - (1-\lambda_M)^2 t$. For demand $X_M = 1$ profit strictly increases in price, so the monopolist will pick the maximum permissible price in this range

$$p_M^{*A} = \bar{s} - (1-\lambda_M)^2 t \tag{15}$$

[9]The second-order condition $-3(\bar{s} + \sigma t/3 - p_M)\sqrt{(\bar{s} - p_M)/t}\Big/[4(\bar{s} - p_M)^2] < 0$ is satisfied if $p_M < \bar{s}$. The solution to the monopolist's first-order condition has two roots. The root reported in equation (13) is the only root that satisfies $p_M^{*B1} < p_M^{*C}$. A derivation of the two roots is available as a Mathematica 9 notebook file at *http://econ.ucsd.edu/muendler/papers/abs/enter.html*.

[10]The derivation is available in a Mathematica 9 notebook file at *http://econ.ucsd.edu/muendler/papers/abs/enter.html*.

with associated profit

$$\pi_M^{*A} = [\sigma - (1-\lambda_M)^2]t. \tag{16}$$

The price p_M^{*A} in (15) is strictly below the price p_M^{*B1} from the next higher range (13) if and only if[11]

$$p_M^{*B1} > p_M^{*A} \qquad \Leftrightarrow \qquad \sigma < (1-\lambda_M)(3-\lambda_M).$$

Table 1 summarizes these results. As the market becomes friendlier with an increasing surplus-disutility ratio σ, the monopolist switches from high-price to low-price regimes in steps. In the toughest market in the upper-most row of Table 1 (C), the monopolist accepts the loss of a mass of consumers at both sides of the unit interval. As the market becomes friendlier in the next two rows (B2 and B1), the monopolist sets a less extreme price so that consumers only at the more distant side of the unit interval do not buy the product. In the friendliest market (row A), the monopolist sets a price just low enough so that every consumer on the unit interval buys the good.

All results in Table 1 are based on a given monopoly location λ_M in product space. A merger is made up of two companies which, at the merger time, need to decide the merger's location in product space. In the lowest range of σ, where the market is toughest, the monopolist loses consumers on both sides of the unit interval irrespective of location, so profit does not depend on λ_M. In range B of σ, demand $X_M = \lambda_M + \sqrt{(\bar{s} - p_M)/t}$ strictly increases in λ_M. More consumers in the upper half of the unit interval buy the good as the monopoly locates closer to them. In range A of σ, optimal merger profit $\pi_M^*(\lambda_M; \sigma)$ also strictly increases in λ_M (as differentiation of profit in the third column of Table 1 with respect to λ_M shows). A central location allows the monopoly to extract additional consumer rent because fewer consumers suffer a disutility from the distance in product space. As a consequence, merger profit is maximal when the monopoly is located at the center of the unit interval with $\lambda_M = .5$.

Suppose a merger has three choices: to pick the incumbent's location λ_I in product space, to select a linear combination of the incumbent's and the entrant's location $\alpha\lambda_I + (1-\alpha)\lambda_E$ for some $\alpha \in (0, 1)$, or to pick the entrant's location λ_E. Since profit strictly increases with the location, the merger will pick an extreme and select either λ_I or λ_E. The optimal location choice for the merger can therefore

[11] The derivation is available in a Mathematica 9 notebook file at *http://econ.ucsd.edu/muendler/papers/abs/enter.html*.

Table 1: **Price Choice and Optimal Profit of a Merger**

Range	$\sigma \in$	Price p_M	Profit $\pi^*_M(\lambda;\sigma)$	Profit $\pi^*_M(\lambda;\sigma) \in$
C	$\left(0, 3\lambda^2\right]$	$\bar{s} - \dfrac{\sigma}{3}t$	$4\left(\dfrac{\sigma}{3}\right)^{\frac{3}{2}} t$	$\left(0, 4\lambda^3 t\right]$
B2	$\left(3\lambda^2, 5\lambda^2\right]$	$\bar{s} - \lambda^2 t$	$2\lambda(\sigma - \lambda^2)t$	$\left(4\lambda^3 t, 8\lambda^3 t\right]$
B1	$\left(5\lambda^2, (1-\lambda)(3-\lambda)\right]$	$\bar{s} - \left[\frac{\sigma}{3} + \frac{2\lambda}{9}\left(\lambda + \sqrt{3\sigma + \lambda^2}\right)\right] t$	$\frac{2}{27}\left(3\sigma - \lambda(\lambda + \sqrt{3\sigma + \lambda^2})\right) \times \left(3\lambda + \sqrt{3\sigma + 2\lambda(\lambda + \sqrt{3\sigma + \lambda^2}}\right) t$	$\left(8\lambda^3 t, \frac{2}{27}(3-\lambda) \times (3+2\lambda)(3-4\lambda)t\right]$
A	$\left((1-\lambda)(3-\lambda), \infty\right)$	$\bar{s} - (1-\lambda)^2 t$	$[\sigma - (1-\lambda)^2]t$	$\left(2(1-\lambda)t, \infty\right)$

Notes: The monopoly's product characteristic is $\ell_M = \lambda \leq .5$. Profit at the upper bound $\bar{\sigma}^{B1} = (1-\lambda)(3-\lambda)$ of range B1 is strictly less than profit at the lower bound $\underline{\sigma}^A = (1-\lambda)(3-\lambda)$ of range A: $\pi^*_M(\lambda;\bar{\sigma}^{B1}) = (2/27)(3-\lambda)(3+2\lambda)(3-4\lambda)t\big] < 2(1-\lambda)t = \pi^*_M(\lambda;\underline{\sigma}^A)$ for $\lambda > 0$.

be written as

$$\lambda_M^* = \max[\lambda_I, (1-\Lambda) - \lambda_I],$$

after replacing $\lambda_E = (1-\Lambda) - \lambda_I$. As a result, the merger profit is independent of the degree of differentiation Λ if $\lambda_I \geq \lambda_E$, whereas λ_M^* strictly decreases in Λ otherwise; then merger profit strictly declines in Λ. This establishes the value of profit $\pi_M^*(\lambda_M^*;\sigma)$ of the merged firm.

These results allow us to state the following proposition.

Lemma 2 *Total merger profit* $\pi_M^*(\lambda_M^*;\sigma)$

- *strictly increases in the surplus-disutility ratio* σ*;*
- *is independent of the degree of differentiation* Λ *if* $2\lambda_I \geq (1-\Lambda)$ *or* $\sigma \leq 3(\lambda_M^*)^2$*,*
- *and strictly falls in the degree of differentiation* Λ *otherwise.*

Proof. See Appendix A. ■

4 Proximity-Concentration Trade-off in Product Space

Whenever total duopoly profit, that is the sum of the incumbent's and the entrant's profit after entry, exceeds the total profit from a merger, then the two firms can agree on side payments that will make entry preferable to merger for both firms. Entry, and not a merger, will therefore occur if and only if

$$\pi_I^*(\lambda_I, \Lambda) + \pi_E^*(\lambda_I, \Lambda) \geq \pi_M^*(\lambda_M^*;\sigma),$$

where total duopoly profit is given by (5) and the merger profit depends on the four relevant ranges of the surplus-disutility ratio σ as given by (10), (12), (14) and (16) above (see also the third column of Table 1).[12]

There are two relevant cases to consider. First, the incumbent may be closer to the midpoint of the unit interval and $\lambda_I \geq \lambda_E$. Then we can substitute λ_I for λ_M^* and restate the condition for entry to be

[12] The question arises whether the parameter restrictions on the foreign entry game (6), by which all consumers buy in equilibrium, may preclude ranges of the possible monopoly outcomes from A to C in Table 1. Online Supplement II at *http://econ.ucsd.edu/muendler/papers/abs/enter.html* presents numerical checks at the extremes of the permissible parameter range to document that the analysis can proceed considering the full range of possibilities in Table 1.

more profitable than merger as

$$\frac{\Lambda\left[1+\left(\frac{2\lambda_I-(1-\Lambda)}{3}\right)^2\right]t}{\pi_M^*(\lambda_I;\sigma)} \geq 1.$$

The numerator strictly increases in the degree of differentiation Λ (Lemma 1), whereas the denominator is constant. Therefore, if $\lambda_I \geq \lambda_E$ the incentive for entry, rather than merger, becomes stronger as the degree of differentiation between entrant and incumbent increases. The denominator strictly increases in the surplus-disutility ratio σ (Lemma 2), while the denominator does not depend on σ if condition (7) holds (Lemma 1). Therefore, if $\lambda_I \geq \lambda_E$ the incentive for merger, rather than entry, becomes stronger as globalization homogenizes consumer tastes and product differentiation becomes less relevant (lower t) from a consumer perspective.

Second, the incumbent may be farther from the midpoint of the unit interval and $\lambda_I < \lambda_E$. Then we must substitute $(1-\Lambda)-\lambda_I$ for λ_M^* and restate the condition for entry to be more profitable than merger as

$$\frac{\Lambda\left[1+\left(\frac{2\lambda_I-(1-\Lambda)}{3}\right)^2\right]t}{\pi_M^*((1-\Lambda)-\lambda_I;\sigma)} \geq 1.$$

The numerator strictly increases in the degree of differentiation Λ (Lemma 1), and the denominator strictly falls in Λ if $\sigma > 3(\lambda_M^*)^2$. Therefore, if $\lambda_I < \lambda_E$ the incentive for entry, rather than merger, becomes stronger as the degree of differentiation between entrant and incumbent increases (and at an even faster rate than in the case with $\lambda_I \geq \lambda_E$ before because now the denominator also drops). As before, the denominator strictly increases in the surplus-disutility ratio σ (Lemma 2), while the denominator does not depend on σ if condition (7) holds (Lemma 1). Therefore, also if $\lambda_I < \lambda_E$, the incentive for merger, rather than entry, becomes stronger as the market becomes friendlier for undifferentiated firms.

Proposition 1 *The ratio of total profit after entry and the profit after a merger is* $[\pi_I^*(\lambda_I,\Lambda)+\pi_E^*(\lambda_I,\Lambda)]/\pi_M^*(\lambda_M^*;\sigma)$. *The ratio strictly falls in the surplus-disutility ratio* σ *and strictly increases in the degree of differentiation between entrant and incumbent* Λ.

This proposition summarizes the proximity-concentration tradeoff in product space under the premise that globalization homogenizes consumer tastes and reduces the disutility from virtual distance. When the surplus-disutility ratio σ is low because consumers suffer a high disutility t from virtual distance to their preferred variety, then entry is relatively more attractive. In other words, a duopoly's proximity to individual consumers is relatively more profitable when consumers are highly sensitive to matching their preferred variety. Conversely, when the surplus-disutility ratio σ is high because consumers do not value strongly closeness to their preferred variety, then merger is relatively more attractive. In other words, a merger's concentration of product offerings at a single point in product space is relatively more profitable when globalization makes consumers insensitive to virtual distance from their preferred variety so that they perceive an additional entrant's variety differentiation as little relevant.

5 Physical Trade Costs

Globalization can also be thought of as a process of falling physical trade costs.[13]

Physical trade costs have non-trivial implications in differentiated product space. On the one hand, a drop of variable trade costs makes export entry more profitable, and more likely, simply because cross-border shipping becomes less expensive. On the other hand, a high unit cost per good can serve as a commitment device in differentiated product space and make price competition less fierce. As a result of heightening price competition, a drop in variable trade costs may therefore erode equilibrium profits, rather than raise them, and thus render export entry less likely than a cross-border merger.

To model physical shipping costs, suppose both firms continue to face the same constant unit production cost c, but the foreign entrant also incurs a trade cost τ for shipping across a country border. Given a conjectured incumbent price p_I the entrant now maximizes profit

$$\pi_E(p_I) = \max_{p_E} (p_E - c - \tau) \cdot [1 - X^*],$$

while the incumbent's profit maximization problem is unchanged. The two firms' first-order conditions for profit maximizing prices are then equivalent to

$$p_I^* = \frac{1}{2}\left[p_E + c + \left((1-\lambda_E)^2 - \lambda_I^2\right) t\right] \quad \text{and} \quad p_E^* = \frac{1}{2}\left[p_I + c + \tau + \left((1-\lambda_I)^2 - \lambda_E^2\right) t\right].$$

[13]The case of falling fixed entry costs can be accommodated readily and with unsurprising results. The findings are reported in Online Supplement I. Falling fixed costs of mergers trivially make mergers more likely.

In equilibrium, the two first-order conditions are jointly satisfied and result in prices

$$p_I^* = c + \frac{\tau}{3} + \frac{\Lambda}{3}\left[3 + (\lambda_I - \lambda_E)\right] t \quad \text{and} \quad p_E^* = c + \frac{2\tau}{3} + \frac{\Lambda}{3}\left[3 - (\lambda_I - \lambda_E)\right] t, \tag{17}$$

assuming again that all consumers purchase one of the two firms' products in equilibrium. As before, a more central location in product space (a higher λ_I for the incumbent or a higher λ_E for the entrant) awards a firm with more pricing power. In equilibrium, a higher trade cost leads to a higher price for both firms, because the trade cost allows the entrant to commit to less fierce price competition (raising both p_E and p_I by $\tau/3$), and to a higher price of the entrant who passes through a part of the trade cost to consumers (raising p_E by another $\tau/3$).

The associated profits are

$$\pi_I^*(\lambda_I, \Lambda, \tau) = \frac{\Lambda}{18}\left[3 + (\lambda_I - \lambda_E) - \frac{\tau}{\Lambda t}\right]^2 t \quad \text{and} \quad \pi_E^*(\lambda_I, \Lambda, \tau) = \frac{\Lambda}{18}\left[3 - (\lambda_I - \lambda_E) - \frac{\tau}{\Lambda t}\right]^2 t. \tag{18}$$

In Bertrand equilibrium, incumbent and entrant bear the incidence of the foreign entrant's trade cost symmetrically by (18) even though only the entrant incurs the trade cost. Importantly, a higher trade cost may raise profits in Bertrand equilibrium because a high τ serves as a commitment device for the entrant to maintain a higher price. The foreign entrant's equilibrium profit $\pi_E^*(\lambda_I, \Lambda, \tau)$ strictly increases in the cross-border trade cost (that is $\partial \pi_E^*(\lambda_I, \Lambda, \tau)/\partial \tau > 0$) if and only if

$$\tau > \Lambda(4 - 2\lambda_I - \Lambda)t > 0.$$

For an initially high level of the trade cost, the entrant's profit therefore drops as cross-border shipping costs come down with globalization. The reason is that a lower trade cost makes Bertrand price competition between entrant and incumbent fiercer in this parameter range, and the entrant's profit initially declines as the commitment role of trade cost erodes.

The incentives for a merger, however, depend on the two firms' total profit. Adding the two firms' profits yields total duopoly profit:

$$\pi_I^*(\lambda_I, \Lambda, \tau) + \pi_E^*(\lambda_I, \Lambda, \tau) = \Lambda\left[1 + \left(\frac{2\lambda_I - (1 - \Lambda)}{3}\right)^2\right] t + \frac{\tau}{18}\left[2\lambda_I - (1 - \Lambda) + \frac{\tau}{2\Lambda t}\right] \tag{19}$$

after replacing $\lambda_E = (1-\Lambda) - \lambda_I$. Total duopoly profit $\pi_I^*(\lambda_I, \Lambda, \tau) + \pi_E^*(\lambda_I, \Lambda, \tau)$ strictly increases in the cross-border trade cost (that is $\partial[\pi_I^*(\lambda_I, \Lambda, \tau) + \pi_E^*(\lambda_I, \Lambda, \tau)]/\partial\tau > 0$) if and only if

$$\tau > \Lambda[2\lambda_I - (1-\Lambda)]t.$$

The term on the right-hand side of the inequality is strictly negative if and only if $\lambda_I < \lambda_E$. This means that, if the entrant's product location is closer to the center than the incumbent's, then a reduction in trade costs strictly reduces duopoly profits (the eroding commitment role of trade costs for price competition outweighs the shipping cost savings). If the incumbent's product location is closer to the center than the entrant's, then there is a range of sufficiently high trade cost τ so that a reduction of the trade cost strictly reduces duopoly profits.

Similar to the case with no trade cost before, total duopoly profit does not depend on the surplus-disutility ratio σ under the assumption that all consumers on the unit interval buy the good in equilibrium. The necessary and sufficient condition that every consumer in the lower half of the unit intervals buys in equilibrium is that $\bar{s} - p_I^* - (\lambda_I)^2 t \geq 0$, and the necessary and sufficient condition that every consumer in the upper half of the unit intervals buys in equilibrium is that $\bar{s} - p_E^* - (\lambda_E)^2 t \geq 0$. The incumbent prices one-third of the entrant's trade cost into its price p_I^* by (17), whereas the entrant passes two-thirds of the trade cost onto the consumers in its price p_E^*. We can therefore infer that, if $\lambda_I \geq \lambda_E$ then, whenever the consumer at $\ell_k = 0$ buys the good from the incumbent in the lower half of the unit interval for a price that hypothetically includes $2\tau/3$, then the consumer at $\ell_k = 1$ also buys the good from the entrant in the upper half of the unit interval.

As a consequence, we can augment condition (6) and state a sufficient condition for all consumers to buy the good at the extremes of the unit interval as

$$\sigma \geq \begin{cases} \dfrac{2\tau}{3} + \dfrac{\Lambda}{3}\big(3 + [2\lambda_I - (1-\Lambda)]\big) + (\lambda_I)^2 & \text{if } \lambda_I \geq \lambda_E \\ \dfrac{2\tau}{3} + \dfrac{\Lambda}{3}\big(3 - [2\lambda_I - (1-\Lambda)]\big) + [\lambda_I - (1-\Lambda)]^2 & \text{if } \lambda_I < \lambda_E \end{cases}$$

after replacing $\lambda_E = (1-\Lambda) - \lambda_I$.

In addition, we need a sufficient condition so that all consumers between the two firms' locations λ_I and $(1-\lambda_E)$ buy the good in equilibrium. Suppose $\lambda_I \geq \lambda_E$ and the above condition holds so that all consumers with a location $\ell_k \leq \lambda_I$ buy the good. Then, just as in the symmetric case with no physical trade costs, all consumers in the interval $\ell_k \in [\lambda_I, X^*]$ also buy the good if $\lambda_I \geq X^* - \lambda_I$, and all consumers in the interval $[X^*, (1-\lambda_E)]$ buy the good if $\lambda_E \geq (1-\lambda_E) - X^*$. The latter restriction is equivalent to $2\lambda_E \geq 1 - X^*$ and implies the former restriction for $\lambda_I \geq \lambda_E$. Conversely, consumers between the two firms' locations buy the good when $\lambda_I < \lambda_E$ under the former restriction, which is equivalent to $2\lambda_I \geq X^*$. Plugging (2) in for X^* and simplifying those restrictions yields the following combined condition. All consumers on the unit interval buy the good in equilibrium if

$$\sigma \geq \begin{cases} \dfrac{2\tau}{3} + \dfrac{\Lambda}{3}\big(3 + [2\lambda_I - (1-\Lambda)]\big) + (\lambda_I)^2 & \wedge \quad 11(1-\Lambda) - 10\lambda_I \geq 3 \quad \text{if } \lambda_I \geq \lambda_E \\ \dfrac{\Lambda}{3}\big(3 - [2\lambda_I - (1-\Lambda)]\big)\dfrac{2\tau}{3} + + [\lambda_I - (1-\Lambda)]^2 & \wedge \quad 10\lambda_I + (1-\Lambda) \geq 3 \quad \text{if } \lambda_I < \lambda_E. \end{cases} \tag{20}$$

The following lemma summarizes the duopoly results in the presence of a cross-border trade cost.

Lemma 3 *If condition* (20) *is satisfied so that all consumers on the unit interval buy the good in duopoly equilibrium, then total duopoly profit* (19) *is independent of the surplus-disutility ratio σ and strictly increases with trade cost τ if and only if*

$$\tau > \Lambda[2\lambda_I - (1-\Lambda)]t. \tag{21}$$

Under condition (21) a falling physical trade cost erodes duopoly profit because the resulting fiercer Bertrand price competition outweighs the benefits from lower shipping costs. Entry, and not a merger, will occur if and only if

$$\frac{\pi_I^*(\lambda_I, \Lambda, \tau) + \pi_E^*(\lambda_I, \Lambda, \tau)}{\pi_M^*(\lambda_M^*; \sigma)} \geq 1,$$

where total duopoly profit is now given by (19) and the merger profit depends on the four relevant ranges of the surplus-disutility ratio σ (Table 1). Merger profit does not depend on the physical transportation cost τ because a merger serves consumers from its local production site. To analyze a decline in physical transportation cost we therefore only need to consider the numerator. Conversely, it is only the denominator that depends on the virtual distance cost t in product space because t is inversely related to the surplus-disutility ratio σ.

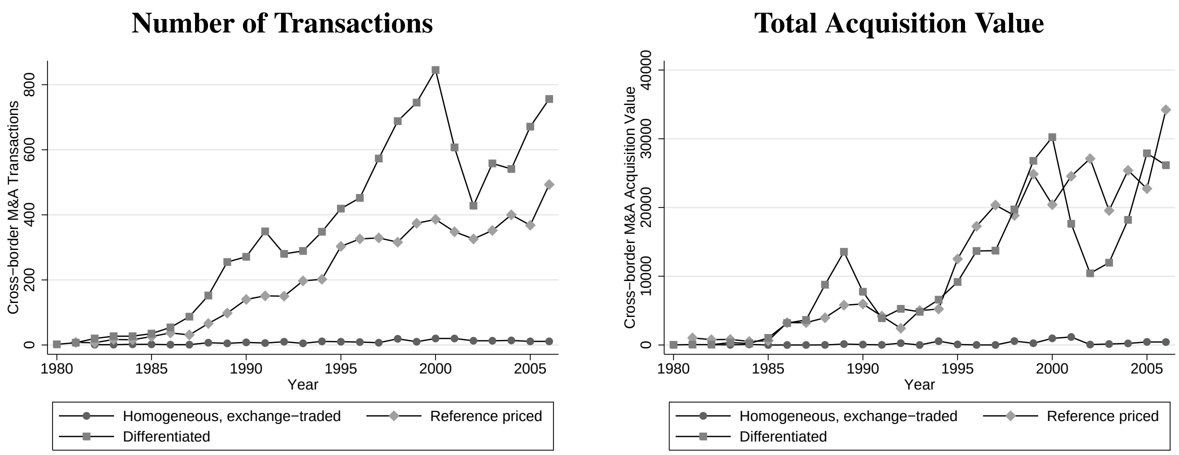
To investigate the effect of physical trade cost on the relative incentives for entry and merger, we need to discern two cases. If the entrant's location in product space is closer to the center than the incumbent's so that $\lambda_I < \lambda_E$, then condition (21) is always satisfied (because the right-hand side is negative) and the ratio of total duopoly profit to merger profit strictly falls in τ so that, after τ has fallen enough, merger profit strictly exceeds total duopoly profit. If the entrant's location in product space is further away from the center than the incumbent's so that $\lambda_I \geq \lambda_E$, then condition (21) is satisfied as long as the ratio of physical and virtual trade cost τ/t is sufficiently large. Consequently, for any level of physical trade costs τ, we can always find a level of virtual trade costs t low enough so that condition (21) is satisfied also when the incumbent is closer to the center in product space. In other words, if the incumbent's location is better geared to capture many consumers in the local market, then eroding physical transportation costs keep driving total duopoly profit down and ultimately below the monopoly profit if globalization keeps reducing t as well as τ so that condition (21) remains satisfied. We know from Lemma 2 that merger profit itself strictly increases as the virtual distance cost t falls (and σ rises). Progressing globalization therefore implies again that the two firms cannot agree on side payments that would make entry preferable to a merger for both firms, and globalization will propel horizontal FDI. We summarize this set of results in a proposition.

Proposition 2 *The ratio of total profit after entry and the profit after a merger is* $[\pi_I^*(\lambda_I, \Lambda, \tau) + \pi_E^*(\lambda_I, \Lambda, \tau)]/\pi_M^*(\lambda_M^*; \sigma)$. *If the entrant is closer to the center of product space,* $\lambda_I < \lambda_E$, *then the ratio strictly falls in physical transportation cost* τ. *If the incumbent is closer to the center of product space,* $\lambda_I \geq \lambda_E$, *then, for any physical transportation cost level* τ, *there is a level of virtual distance cost* t *low enough so that the ratio strictly falls in* τ.

In summary, as globalization diminishes virtual distance costs by homogenizing tastes in product space and reduces physical transportation costs, it also erodes the incentives for export entry and favors horizontal FDI.

6 Evidence

An implication of the proximity-concentration tradeoff in product space is that falling virtual distance cost and falling physical trade costs should propel cross-border mergers and acquisitions faster than exports in industries that manufacture differentiated (or reference-priced) goods. The reason is that only in industries with differentiated (or reference-priced) goods can the consumers' perception of



Source: Thomson SDC Platinum, global M&A activity 1980-2006 by country pair and SIC 1987 industry pair (courtesy of Spearot 2007).
Notes: Data are restricted to M&A transactions with acquiring and target firms in the same SIC 1987 4-digit industry but in different countries. Classification of industries into those with goods traded on organized exchanges (homogeneous goods), reference priced goods and differentiated products following Rauch (1999, conservative classification, revised 2007), based on a crosswalk from SIC 1987 4-digit industries to SITC (rev. 2) 4-digit sectors using concordances by the U.S. Census and the United Nations from SIC to ISIC (rev. 3.1) and from SITC to ISIC by Arkolakis and Muendler (2011).

Figure 1: **Cross-border Horizontal M&A Activity by Industry Type**

varieties in product space change over time and especially in industries with differentiated goods will the reduction in physical transportation cost alter price competition, so that merger becomes preferable. In industries that manufacture homogeneous goods, in contrast, perfect competition is akin to an unchanged perception of variety differentiation in product space and does not alter the fierceness of competition.

Figure 1 is based on data from Thomson SDC Platinum, a comprehensive global data set that records national and international M&A activity for the period 1980-2006 by country and industry (courtesy of Spearot 2007).[14] Industries are classified into product types following Rauch (1999). So as to restrict the data to horizontal foreign direct investments, the graphs use only those transaction records where the acquiring firm is in the same industry as the target firm. The left panel of the figure depicts the number of cross-border M&A transactions by industry and shows that this number rose by far the fastest in differentiated product industries, where consumers arguably become less sensitive to variety differentiation as globalization progresses, and the slowest in homogeneous goods industries.

[14]The M&A sample in the Thomson SDC Platinum data likely over-represents mergers and acquisitions between publicly traded companies, with private firm activity harder to observe. Di Giovanni (2005) and Díez and Spearot (2013) discuss data properties and present in-depth empirical analysis.

Table 2: Cross-border Horizontal M&A Activity and Trade Flows by Industry Type

	Gross Change between 1985-1994 and 1995-2004			
Industry Type	# Transactions	Acquisition Value	Target Firm Sales	Exports
Differentiated goods	2.64	3.06	8.27	3.05
Reference priced goods	3.51	6.35	4.01	3.08
Homogeneous goods	2.02	2.18	.90	3.30

Sources: Thomson SDC Platinum, global M&A activity 1985-2005 by home-host country pair and SIC 1987 industry pair (courtesy of Spearot 2007); World Trade Flows by coinciding source-destination country pair from Hanson et al. (2013), based on Feenstra et al. (2005, revision 2).
Notes: M&A data are restricted to transactions with acquiring and target firms in the same SIC 1987 4-digit industry but in different countries. Classification of industries in M&A data into conservative Rauch (1999, revised 2007) categories based on a crosswalk from SIC 1987 4-digit industries to SITC (rev. 2) 4-digit sectors using concordances by the U.S. Census and the United Nations from SIC to ISIC (rev. 3.1) and from SITC to ISIC by Arkolakis and Muendler (2011). Classification of industries in World Trade Flow data into conservative Rauch (1999, revised 2007) categories based on the mode within time consistent SITC 3-digit or 2-digit sectors from Hanson et al. (2013).

Reference-priced goods industries exhibit an intermediate evolution between the two extremes in terms of transaction numbers.

The right panel depicts the FDI transaction value in current U.S. dollars. Similar to the evidence on transaction counts in the left panel, the total acquisition values rose the fastest in differentiated product industries and the slowest in homogeneous goods industries. In terms of acquisition values, FDI in industries with reference-priced goods changes in similar ways as FDI in differentiated goods industries. In short, consistent with the implications of the model, FDI in differentiated goods industries grew faster than FDI on average. Figure 1 documents the growth differential of FDI between differentiated and homogeneous goods industries.

For a comparison to a similar growth differential of trade, I use time consistent global trade flow data from Hanson, Lind and Muendler (2013) for the years 1985 through 2005, which are in turn based on world trade flow data by Feenstra, Lipsey, Deng, Ma and Mo (2005, revision 2). I restrict both the M&A and trade data to country pairs for which the M&A data record a home-host country pair and the trade data the same source-destination pair. To smooth out sketchy reporting of transactions and transaction values, I pool the data into an early decade from 1985 to 1994 and a late decade from 1995 to 2004.

Table 2 shows the gross change between the early decade 1985-1994 and the late decade 1995-2004 in the number of horizontal M&A transactions between countries, the average acquisition value of the target firm, the average sales of the target firm as well as the total exports flowing from the acquiring firm's home country to the target firm's host country in the same period. Exports in the source-destination country pairs grow fastest in homogeneous goods industries (by a factor of 3.3) and slowest in differentiated goods industries (a factor of 3.1) between the two periods. In contrast, M&A transactions, acquisition values and target firm sales all grow faster in differentiated goods industries (with factors between 2.6 and 8.3) than in homogeneous goods industries (factors between .9 and 2.2). Interestingly, transactions and acquisition values grow even faster in industries with reference-priced goods. But in terms of target firm sales, which are arguably most closely comparable to export sales, the ranking is monotonic: horizontal FDI in homogeneous goods industries is associated with the lowest target firm sales (a reduction factor of .9), in reference-priced goods industries it is associated with an intermediate growth factor (of 4.0) and in differentiated goods industries with the largest growth factor (8.3).

Given the reverse growth factor ranking in exports, this evidence supports the idea that horizontal FDI increasingly substitutes exports in differentiated goods industries, where consumers view additional differentiation in product space as less relevant when exports grow.

7 Conclusion

This paper has formalized a conjecture: Given their product characteristics, firms will choose to enter and compete whenever their products are strongly differentiated, and to merge whenever consumers are insensitive to variety differentiation. The paper has presented two alternative underlying rationales. The common tenet for both underlying rationales is that a merger unifies the product characteristics in some respect as it exploits synergies in production, sales or R&D. A merger's resulting concentration of product characteristics in product space matches some consumers' preferences less closely than an entrant with a differentiated product would match those tastes. The difference between the two underlying rationales is that one rationale considers the consumers' disutility from virtual distance to their preferred variety in product space and the other rationale considers the producers' shipping cost from physical distance to the destination market. First, as globalization homogenizes tastes and diminishes virtual distance costs, a merger becomes relatively more profitable than entry because consumers are relatively insensitive to the foregone benefits from a close match to their product preferences. Entry with a differentiated product offers proximity to consumers in product space.

Concentration under horizontal foreign direct investment is therefore relatively more profitable than the taste proximity from a differentiated product if consumers are not sensitive to product characteristics, in a market that is highly globalized. Second, as globalization erodes barriers to trade and reduces physical trade costs, a merger becomes relatively more profitable than entry because entrants gradually lose the commitment device of transportation cost to keep prices high. Concentration under horizontal foreign direct investment is therefore relatively more profitable than the duopoly, whose products' proximity in product space makes price competition fierce, in a market that is highly globalized.

An implication of this double hypothesis is that cross-border mergers become more frequent over time as globalization progresses. Evidence from two decades of cross-border M&A transaction records confirms that horizontal FDI increasingly substitutes exports in differentiated goods industries, compared to homogeneous-goods industries. Another testable implication of this hypothesis is that entry would occur in young markets where product space is still relatively uncovered, so that consumers value variety differentiation highly and price competition is less fierce, whereas mergers would occur in older markets with consumers who are relatively insensitive to differentiation in product space.

Appendix

A Proof of Proposition 1

Consider the relationship between $\pi^*_M(\lambda^*_M;\sigma)$ and σ. Inspection of (10), (12) and (16) (also see the third column of Table 1) shows that profit $\pi^*_M(\lambda;\sigma)$ strictly increases in the surplus-disutility ratio σ in ranges C, B2, and A. In range B1, the first derivative of profit (14) with respect to σ is

$$\frac{\partial \pi^{*B1}_M(\lambda;\sigma)}{\partial\sigma} = \frac{\sigma}{\sqrt{3\sigma+2\lambda(\lambda+\sqrt{3\sigma+\lambda^2})}} + \frac{\lambda}{3}\left(2+\frac{\frac{3\sigma}{\sqrt{3\sigma+2\lambda(\lambda+\sqrt{3\sigma+\lambda^2})}}-\lambda}{\sqrt{3\sigma+\lambda^2}}\right) > 0.$$

The derivative is strictly positive because $2\sqrt{3\sigma+\lambda^2} > \lambda$ so that the last term is strictly positive. This establishes the first statement of the proposition.

Duopoly profit (4) strictly increases in Λ. Now consider the relationship between $\pi^*_M(\lambda^*_M;\sigma)$ and λ^*_M. In range C where $\sigma \in (0, 3(\lambda^*_M)^2]$ merger profit (10) is independent of λ^*_M. If $2\lambda_I \geq (1-\Lambda)$ so that $\lambda_I \geq \lambda_E$, then the merger locates at $\lambda^*_M = \lambda_I$, independent of Λ. This establishes the second statement.

Otherwise, the merger locates at $\lambda^*_M = (1-\Lambda)-\lambda_I$. Note that λ^*_M strictly decreases in Λ in that case. Profit, in turn, strictly increases in λ_M in range A by (16) and in ranges B1 and B2 because demand $X_M = \lambda_M + \sqrt{(\bar{s}-p_M)/t}$ strictly increases in λ_M. Therefore monopoly profit strictly decreases in Λ, establishing the third statement.

References

Alfaro, Laura and Andrew Charlton, "Intra-Industry Foreign Direct Investment," *American Economic Review*, December 2009, *99* (5), 2096–2119.

Andrade, Gregor, Mark Mitchell, and Erik Stafford, "New Evidence and Perspectives on Mergers," *Journal of Economic Perspectives*, Spring 2001, *15* (2), 103–20.

Antràs, Pol, "Firms, Contracts, and Trade Structure," *Quarterly Journal of Economics*, November 2003, *118* (4), 1375–1418.

_ **and Elhanan Helpman**, "Global Sourcing," *Journal of Political Economy*, June 2004, *112* (3), 552–580.

Arkolakis, Costas and Marc-Andreas Muendler, "The Extensive Margin of Exporting Products: A Firm-level Analysis," August 2011. University of California, San Diego, unpublished manuscript.

Barba Navaretti, Giorgio and Anthony J. Venables, *Multinational firms in the world economy* With Frank G. Barry et al., Princeton and Oxford: Princeton University Press, 2004.

Bernard, Andrew B., J. Bradford Jensen, and Peter K. Schott, "Importers, Exporters, and Multinationals: A Portrait of Firms in the U.S. that Trade Goods," in Timothy Dunne, J. Bradford Jensen, and Mark J. Roberts, eds., *Producer Dynamics: New Evidence from Micro Data*, Vol. 68 of *Studies in Income and Wealth*, Chicago: University of Chicago Press, May 2009, chapter 14, pp. 513–552.

Bernile, Gennaro, Evgeny Lyandres, and Alexei Zhdanov, "A Theory of Strategic Mergers," *Review of Finance*, April 2012, *16* (2), 517–75.

Bloch, Francis, "Endogenous Structures of Association in Oligopolies," *Rand Journal of Economics*, Autumn 1995, *26* (3), 537–56.

Brainard, S. Lael, "An Empirical Assessment of the Proximity-Concentration Trade-off between Multinational Sales and Trade," *American Economic Review*, September 1997, *87* (4), 520–544.

Carr, David L., James R. Markusen, and Keith E. Maskus, "Estimating the Knowledge-Capital Model of the Multinational Enterprise," *American Economic Review*, June 2001, *91* (3), 693–708.

d'Aspremont, Claude and Jean-Jaskold Gabszewicz, "On the Stability of Collusion," in Joseph E. Stiglitz and G. Frank Mathewson, eds., *New Developments in the Analysis of Market Structure*, Cambridge, Massachusetts: MIT Press, 1986, pp. 243–61. Proceedings of a conference held by the International Economic Association in Ottawa, Canada.

Davidson, Carl and Ben Ferrett, "Mergers in Multidimensional Competition," *Economica*, November 2007, *74* (296), 695–712.

Di Giovanni, Julian, "What Drives Capital Flows? The Case of Cross-Border M," *Journal of International Economics*, January 2005, *65* (1), 127–49.

Díez, Federico J. and Alan C. Spearot, "Core Competencies, Matching, and the Structure of Foreign Direct Investment," August 2013. University of California, Santa Cruz, unpublished manuscript.

Ekholm, Karolina, Rikard Forslid, and James R. Markusen, "Export-Platform Foreign Direct Investment," *Journal of the European Economic Association*, June 2007, *5* (4), 776–795.

Farrell, Joseph and Carl Shapiro, "Scale Economies and Synergies in Horizontal Merger Analysis," *Antitrust Law Journal*, 2001, *68* (3), 685–710.

Feenstra, Robert C., Robert E. Lipsey, Haiyan Deng, Alyson C. Ma, and Hengyong Mo, "World Trade Flows: 1962-2000," *NBER Working Paper*, January 2005, *11040.*

Feinberg, Susan E. and Michael P. Keane, "Accounting for the Growth of MNC-Based Trade Using a Structural Model of US MNCs," *American Economic Review*, December 2006, *96* (5), 1515–1558.

Gowrisankaran, Gautam, "A Dynamic Model of Endogenous Horizontal Mergers," *Rand Journal of Economics*, Spring 1999, *30* (1), 56–83.

Hackbarth, Dirk and Jianjun Miao, "The Dynamics of Mergers and Acquisitions in Oligopolistic Industries," *Journal of Economic Dynamics and Control*, April 2012, *36* (4), 585–609.

Hadjinicola, George C., Christakis Charalambous, and Eitan Muller, "Product Positioning Using a Self-Organizing Map and the Rings of Influence," *Decision Sciences*, June 2013, *44* (3), 431–461.

Hanson, Gordon, Nelson Lind, and Marc-Andreas Muendler, "The Empirical Dynamics of Comparative Advantage," October 2013. UC San Diego, unpublished manuscript.

Helpman, Elhanan, "International Trade in the Presence of Product Differentiation, Economies of Scale and Monopolistic Competition: A Chamberlin-Heckscher-Ohlin Approach," *Journal of International Economics*, August 1981, *11* (3), 305–40.

—, "A Simple Theory of International Trade with Multinational Corporations," *Journal of Political Economy*, June 1984, *92* (3), 451–471.

—, Marc J. Melitz, and Stephen R. Yeaple, "Export versus FDI with Heterogeneous Firms," *American Economic Review*, March 2004, *94* (1), 300–316.

Hotelling, Harold, "Stability in Competition," *Economic Journal*, 1929, *39*, 41–57.

Hummels, David, "Transportation Costs and International Trade in the Second Era of Globalization," *Journal of Economic Perspectives*, Summer 2007, *21* (3), 131–54.

Irmen, Andreas and Jacques-François Thisse, "Competition in Multi-characteristics Spaces: Hotelling was Almost Right," *Journal of Economic Theory*, 1998, *78*, 76–102.

Kamien, Morton I. and Israel Zang, "The Limits of Monopolization through Acquisition," *Quarterly Journal of Economics*, 1990, *105*, 465–99.

Kim, Hyunho and Konstantinos Serfes, "A Location Model with Preference for Variety," *Journal of Industrial Economics*, December 2006, *54* (4), 569–95.

Markusen, James R. and Keith E. Maskus, "Discriminating among Alternative Theories of the Multinational Enterprise," *Review of International Economics*, November 2002, *10* (4), 694–707.

Mitchell, Mark L. and J. Harold Mulherin, "The Impact of Industry Shocks on Takeover and Restructuring Activity," *Journal of Financial Economics*, June 1996, *41* (2), 193–229.

Raith, Michael, "A General Model of Information Sharing in Oligopoly," *Journal of Economic Theory*, October 1996, *71* (1), 260–88.

Rauch, James E., "Networks versus Markets in International Trade," *Journal of International Economics*, June 1999, *48* (1), 7–35.

Sajeesh, S. and Jagmohan S. Raju, "Positioning and Pricing in a Variety Seeking Market," *Management Science*, June 2010, *56* (6), 949–961.

Salop, Steven C., "Monopolistic Competition with Outside Goods," *Bell Journal of Economics*, September 1979, *10* (1), 141–56.

Spearot, Alan C., "Domestic and Foreign Mergers and Acquisitions: Theory and Evidence." PhD dissertation, University of Wisconsin–Madison, Madison, Wisconsin 2007.

Teece, David J., "Economics of Scope and the Scope of the Enterprise," *Journal of Economic Behavior and Organization*, 1980, *1*, 223–47.

Toxvaerd, Flavio, "Strategic Merger Waves: A Theory of Musical Chairs," *Journal of Economic Theory*, May 2008, *140* (1), 1–26.

United Nations Center on Transnational Corporations, *World Investment Report 1991*, New York: United Nations, 1991.

United Nations Conference on Trade and Development, *World Investment Report 2013*, New York and Geneva: United Nations, 2013.

Zhou, Wen, "Large Is Beautiful: Horizontal Mergers for Better Exploitation of Production Shocks," *Journal of Industrial Economics*, March 2008, *56* (1), 68–93.