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AN EMPIRICAL ASSESSMENT OF THE PROXIMITY-CONCENTRATION TRADEOFF BETWEEN MULTINATIONAL SALES AND TRADE

S. Lael Brainard

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ABSTRACT

This paper empirically investigates the role of transport costs, trade and investment barriers, production scale economies, and firm-specific advantages in determining the use of overseas production relative to exports. The proximity-concentration hypothesis is robust in explaining the share of total sales accounted for by affiliate sales: this share is greater the higher are transport costs and trade barriers and the lower are plant scale economies and investment barriers. Although strictly speaking, the proximity-concentration hypothesis applies to the shares of affiliate sales and exports rather than the levels, the effects of trade and investment barriers on the levels are similar to their effects on the shares, controlling for simultaneity, and so is that of freight factors in the trade estimates. The elasticity of inward and outward net affiliate sales with respect to tariffs is around 0.45, and that with respect to NTBs is an additional 0.17. The elasticity of both imports and exports with respect to freight factors is -1. However, the effect of freight factors on the level of affiliate sales is not robust, and the probability of observing any affiliate sales is increasing in proximity.

The overall complementarity between trade and affiliate sales arises in part because relative income and intellectual property intensity increase both. In contrast, affiliate sales and trade move in opposite directions with increases in advertising intensity, suggesting that advertising-intensive products require a local presence.

S. Lael Brainard
Massachusetts Institute of Technology
Sloan School
Cambridge, MA 02142
and NBER

I. Introduction

Considering the dominance of multinational enterprises in international competition in a variety of important industries, the attention paid to them by empirical research in trade can only be described as neglect. Rugman (1988) estimates that the largest 500 multinationals control over one-half of global trade flows, and one-fifth of global GDP. For countries that have an extensive network of overseas affiliates, such as the US, UK, Netherlands, and Switzerland, affiliate sales tend to swamp export flows. In manufacturing and primary goods alone, local sales by US-owned affiliates are over four times the level of US exports to the UK, Germany, Norway, Brazil, and Spain. It is also striking that a large and growing share of multinational activity involves industrialized countries as both the source and destination markets, rather than flowing from North to South. Between 1961 and 1988, over half of all direct investment outflows generated by G-5 countries was absorbed by other G-5 countries; this share had risen to nearly 70 percent by 1988 (Julius, 1990). This suggests a large and growing amount of two-way activity across borders.

Despite their importance, empirical research on trade has largely ignored multinationals. And to a large degree, the empirical research that has focused on multinationals has done a poor job of explaining the location or scope of their activities. This is in part because much of it focused on the relationship between trade and FDI flows, which is a conceptual mismatch; the analogue to trade is multinational sales.[1] Moreover, these tests commonly focused on factor proportions hypotheses treating FDI as an international capital flow, with little success.[2]

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[1] With the notable exceptions of Swedenborg (1979), Blomstrom et. al. (1985), Lipsey and Weiss (1981) and Grubert and Mutti (1991), which are discussed further below.

[2] See Caves (1982) for a survey.

Broadly speaking, there are two competing explanations in trade theory for the location of multinational activities. The proximity-concentration hypothesis explains the choice of overseas production over exporting as motivated by proximity to customers or specialized suppliers at the expense of reduced scale, in markets characterized by oligopoly or monopolistic competition and differentiated products (Krugman, 1983; Horstman and Markusen, 1992; Brainard, 1992). This hypothesis predicts that multinationals will prevail over trade the greater are transport costs and trade barriers and the lower are investment barriers and the ratio of scale economies at the plant level relative to the corporate level. This is in contrast to the factor proportions hypothesis, which explains vertical expansion abroad in terms of factor proportions differences, using similar market structure assumptions (Markusen, 1984; Helpman, 1984; Helpman and Krugman, 1985; Ethier and Horn, 1990).

This paper empirically investigates the proximity-concentration hypothesis, using a variety of methods to avoid simultaneity between multinational sales and trade flows. Tests on the share of total foreign sales accounted for by affiliate sales provide strong support for the proximity-concentration hypothesis: affiliate sales comprise a greater share the higher are transport costs and trade barriers and the lower are plant scale economies and investment barriers. In addition, the effects of trade and investment barriers on the levels of trade and affiliate sales are similar to their effects on the shares, even though, strictly speaking, the hypothesis applies only to the shares. Similarly, transport costs have the predicted negative effect on the level of trade. However, the effect of transport costs on the level of affiliate sales is less robust, and the probability of observing any multinational sales in a market decreases with the distance between markets.

These findings contrast with past research, which has found that distance is insignificant in explaining multinational activities. The difference is attributable in part to a more accurate measure of transport costs. In addition, the tests avoid the simultaneity problems encountered by earlier work by using the share of overall sales as the dependent variable and by using a two stage least squares specification for the levels estimates.

Both the factor proportions and proximity-concentration hypotheses assume that firms in differentiated products (or oligopolistic) industries exploit their proprietary advantages internally and focus on the location decision. A third set of models (Ethier, 1986; Horstmann and Markusen, 1987; Ethier and Markusen, 1991; Raff, 1992) focuses instead on motivations for internalization, such as asymmetric information and control over quality or technology diffusion, taking as given the desirability of locating abroad. In tests that are more loosely related to theory, the paper finds support for the internalization hypothesis, in particular where internalization requires a local presence, as with brand advantages. It uses advertising intensity as a proxy for proprietary advantages, such as a brand reputation, that motivate internalization and a local presence, while R&D intensity is used as a proxy for advantages that do not require a local presence. The results suggest that high R&D intensity raises both outward sales and exports, while high advertising intensity raises only outward sales, consistent with models that focus on the reputation advantages of a local presence in industries where brand names are important. The positive relationship with intellectual property advantages, together with a strong positive response to income, partly explains the overall complementarity between trade flows and affiliate sales.

II. Theory

The managerial literature has developed a conceptual framework characterizing the decision to produce abroad as optimal in markets characterized by a conjuncture of internalization, ownership, and location advantages (Dunning, 1988). Trade theorists have formalized this framework and embedded it in general equilibrium models. Broadly, three types of models have emerged. One focuses on the decision between exporting and producing abroad motivated by considerations of market access, a second focuses on the same decision but is motivated by factor proportions differences, and the third focuses on the decision between producing abroad internally and licensing. I will review each briefly.

i. Proximity-Concentration Tradeoff

The proximity-concentration hypothesis explains horizontal expansion across borders motivated by considerations of access to the destination market (Krugman), at the expense of production scale economies (Horstmann, Markusen, 1992; Brainard, 1992). Consider a two-sector, two-country world, where firms in a differentiated products sector choose between exporting and cross-border expansion as alternative modes of foreign market penetration. Demand is identical and homothetic across classes of goods, and there is a constant elasticity of substitution, σ, among varieties of a good. The differentiated sector is characterized by increasing returns at the firm level due to some input, such as R&D, that can be spread among any number of production facilities with undiminished value, scale economies at the plant level, such that concentrating production lowers unit costs, and a variable transport cost that rises with distance. The decision whether to expand abroad via trade or via investment hinges on a trade-off between these proximity advantages and scale advantages from concentrating production in a single location.

In the absence of factor proportions differences, the magnitude of variable transport costs and the size of scale economies at the plant level relative to the firm level will determine the location and configuration of production chosen by firms. Suppose there is a simple fixed cost associated with each plant of F, transport costs and trade barriers of e^{T+D} per unit, where transport costs are increasing in distance, D, and T captures tariff barriers, variable costs of

V(w,r) per unit that are declining in the amount of the firm-specific input, r, and increasing in local wages, w, and costs associated with production of the input C(w,r). Then, with n_m firms in each market, firms will adopt multinational configurations with plants in both markets if the increase in variable profits associated with producing close to consumers in both markets outweighs the additional plant fixed cost:[3]

(1) $$F(w) < \frac{\delta I}{\sigma}\left(\frac{1}{2n_m} - \frac{e^{(T+D)(1-\sigma)}}{(n_m-1)+e^{(T+D)(1-\sigma)}}\right)$$

Combining this condition with free entry yields the equilibrium condition:

(2) $$\frac{F(w)}{C^r(w,r)} < \frac{(1-e^{(T+D)(1-\sigma)})}{2e^{(T+D)(1-\sigma)}}$$

which simplifies by assuming that firms do not take into account the effect of their potential deviation on the market price index (which is increasingly accurate as the number of firms increases)[4]. Comparative statics establish that a multinational equilibrium, where all firms have production facilities in both markets, is more likely the higher are transport costs and trade barriers and the smaller is the fixed production cost relative to the corporate fixed cost. As the corporate cost goes to 0, an equilibrium with multi-plant firms is never sustainable. In addition, for a fixed number of firms, the dual-plant equilibrium is more likely to hold the larger is the foreign market. In such an equilibrium, multinational production completely supplants trade in final goods, there is trade only in "invisible" corporate services, and there is two-way multinational activity in the same industry.

An equilibrium characterized by single-plant, uninational firms arises

[3] The no-defection conditions reflect the additional costs that are required to open a production facility, holding fixed the level of R&D input.

[4] Brainard (1992) gives equilibrium conditions taking into account the effect on the market price index.

under reverse conditions. Firms will maintain a single-plant configuration as long as the increase in fixed costs to open a second plant in the foreign market outweighs the associated increase in variable profits. With free entry, the equilibrium conditions are characterized by the same expression as in equation (2), except with the inequality sign reversed. The single-plant equilibrium is more likely to prevail the higher is the fixed plant cost relative to the corporate fixed cost, and the lower are the transport cost and tariff barriers. In the limit, as the corporate cost goes to 0, a single-plant equilibrium always prevails. Here, there is two-way trade in final goods in the differentiated sector, and if factor proportions are equal, all trade is intraindustry, as would be predicted by a differentiated products model of trade.

In the intermediate range of parameter values, there is a third equilibrium, in which multinational firms coexist with national firms. In the mixed equilibrium, some fraction, α, of firms in each market has a single production facility and exports, and the remaining fraction has production facilities in both markets. The condition for the mixed equilibrium can be derived by combining no-defection conditions for both single-plant and dual-plant firms. Again, simplifying by assuming that firms do not take into account the effect on the market price index yields the no-defection condition:

$$\left(\frac{V(w,r_1)}{V(w,r_2)}\right)^{(1-\sigma)} = R < 1 \tag{3}$$

where r_i is the profit-maximizing level of R&D input for a firm with i plants. The variable production cost associated with the profit-maximizing R&D level for a single-plant configuration must exceed that for a two-plant configuration, and by an increasing amount the greater is the elasticity of substitution. When returns to the two configurations are equalized, the expression for the proportion of single-plant firms is:

where n_e is the number of firms in each market. For a given number of firms, the proportion with a single plant rises the smaller are transport costs and trade

(4)
$$\alpha = \frac{2}{2-R(1+e^{(T+D)(1-\sigma)})} - \frac{\delta I}{\sigma n_c\ (F(w)+C^r(w,r_2)-C^r(w,r_1))}$$

barriers, the greater is the fixed plant cost, the smaller are the savings in variable costs from additional R&D investment, the larger is the corporate cost for the two-plant configuration relative to the single-plant configuration, and the smaller is the size of each market.

In the mixed equilibrium, there is both two-way trade in final goods, and two-way multinational production. The share accounted for by multinationals rises with distance and trade barriers, and declines with greater production fixed costs. Further, given the share of single-plant firms, α, the share of total sales into the foreign market accounted for by exports is a simple function of transport costs and α:

(5)
$$\frac{X}{S+X} = \frac{\alpha e^{(T+D)(1-\sigma)}}{1-(1-\alpha)e^{(T+D)(1-\sigma)}}$$

Exports account for a greater share of sales the lower are transport costs and trade barriers, the greater is the fixed plant cost, the larger is the incremental R&D investment, and the smaller is the world market.

Thus, this model explains horizontal expansion across borders motivated by market access: multinational activity can arise in the absence of factor proportion differences and in two directions in the same industry, and is undertaken by multiplant firms.

The model can be elaborated in a variety of ways. It can be extended to multiple production stages, each of which is characterized by a different tradeoff between proximity and concentration advantages. When there are multiple production stages, the existence of multinational activities downstream generates intraindustry trade in intermediate goods. This complicates the interpretation of the results below, since at the level of disaggregation at which the multinational data is available, many of the industry categories include both intermediate and final goods.

Second, by changing the production function, firms may instead trade off increased marginal costs associated with operating in the foreign market, either due to increased coordination and communication costs, or different operating conditions, against increased transport costs, as in Krugman. Here, multinational sales would substitute for trade the lower are the variable production costs in the destination market relative to the combination of production costs in the source market and transport costs. Alternatively, in the presence of a concave cost function at the plant level, firms might both export from the headquarters market and produce in the destination market, dividing production between the two markets so as to equalize the marginal costs of production and transport. A similar outcome might obtain with convex costs of coordination across borders (Ethier and Horn).

Third, the size of the local market may affect the tradeoff. All else equal, if there are scale economies in production, a firm will be more profitable if it establishes production in the larger market and exports to the smaller market, thereby minimizing transport costs for the greater concentration of customers.

Fourth, taxes will distort the location decision. Corporate headquarters will migrate to the location with the lower profits tax, all else equal, and it will be more profitable to concentrate production in the low-tax location. Output taxes will affect only the production location choice, unless there are co-location advantages between corporate and production activities.

ii. Factor Proportions

Markusen[5], Helpman (1984), Helpman and Krugman, and Ethier and

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[5] In the Markusen model, factor endowments are symmetric, but sector-specific capital plays a key role in explaining multinational production.

Horn[6] similarly focus on the location decision, but explain vertical expansion across borders in terms of relative factor endowments and technological parameters. The Helpman, Krugman model incorporates multinationals into the same differentiated products framework, where one sector is characterized by product differentiation and multiple-stage production, and there are multiplant economies of scale associated with a firm-specific input which has a public goods character. However, the locational choice is motivated by access to lower cost supplies of factors. If headquarters and production activities have different factor-intensities, single-plant multinationals will arise to exploit potential factor cost differentials for sufficiently large factor proportions differences.

When factor endowments are sufficiently similar that factor price equalization obtains in the trade equilibrium, there is no incentive for cross-border investment, and there is two-way trade in differentiated products and one-way trade in homogeneous products motivated by factor proportion differences. Assume headquarters activities are relatively more capital-intensive. When factor prices are not equalized under trade, some of the firms in the differentiated sector locate their headquarters in the relatively capital-abundant economy, and production in the relatively labor-abundant economy and export back to the headquarters market. In general equilibrium, the ability to geographically separate firms' activities in the differentiated sector leads to an enlargement of the factor price equalization set. When cross-border investment is motivated solely by factor price differentials, multinational activities only arise in a single direction within an industry, in single-plant firms, and between economies with strong factor proportions differences. Thus, with a two-stage production process, the existence of multinationals generates interindustry trade

[6] Ethier and Horn are somewhat more concerned with organizational questions against the background of a factor proportions motivation for overseas production.

of final goods, and one would expect to see multinational sales arising between countries with different factor proportions and in a single direction. With additional stages of production, multinationals may generate interindustry trade of both final goods and intermediates, but again in one direction within an industry.

Of course, the two models are not mutually exclusive. When factor proportion differences and a proximity-concentration tradeoff are combined, firms make the decision whether to produce abroad based on the relative importance of the two considerations (Brainard, 1992). This implies that vertical single-plant multinationals will emerge for sufficient factor proportions differences, when strong concentration advantages relative to proximity advantages would lead to single-plant exporters in the absence of factor differences. Single-plant vertical multinationals may also emerge for sufficiently strong factor proportions differences, even when proximity advantages are sufficiently strong that horizontal multinationals would form in the absence of factor differences. Thus, the addition of factor proportions differences increases the likelihood of concentrating production in a single location, leading to single-plant multinationals rather than multi-plant multinationals or single-plant national firms. With a two-stage production process, multinationals arise in a single direction between countries and generate inter industry trade when factor proportions considerations dominate, while multinational sales supplant two-way trade in final goods of unequal magnitudes and may generate intraindustry trade in intermediates when considerations of proximity dominate.

iii. Internalization

The third strand of literature focuses on the choice between licensing and investing across borders. It models internalization as an endogenous response to a market failure that prevents firms from fully realizing the value of their proprietary advantages by selling them. Ethier incorporates the internalization decision into a general equilibrium trade model based on specific factor endowments with a differentiated manufacturing sector. The internalization decision of the firm is a response to imperfections in contracting under uncertainty. Ethier and Markusen similarly focus on the internalization decision. The decision between overseas production via licensing or investment depends on the potential loss of monopoly profits from disseminating proprietary designs to a licensee as against savings in fixed costs. Horstman and Markusen focus on the internalization decision in a partial equilibrium framework, where production in the destination market may be chosen over licensing in order to maintain a reputation for quality. These models are largely complementary to the location models. Loosely, they predict that firms choose direct investment or exporting over licensing when the advantages of exploiting proprietary advantages internally outweigh the costs, and direct investment over exporting when a local presence is required due to reputational or informational considerations.

III. Related Literature

The empirical research on multinationals has focused mainly on foreign direct investment flows, and much of it has been preoccupied with responses to differentials in corporate income taxation. Much of the older research on non-tax determinants has focused on hypotheses based on factor proportion differences, where foreign direct investment is conceived in terms of physical capital. These empirical efforts have not been successful at explaining the location of multinational activity.

This literature has missed two critical characteristics of multinational activity. First, the comparison between foreign direct investment and trade flows is a conceptual mismatch. When multinational activities are considered as a substitute for trade in the presence of trade barriers, for instance, the relevant comparison should be between trade flows and multinational sales rather than investment. Although trade and investment are connected through the current account, and this is an interesting connection from a macroeconomic perspective, it is not relevant to the analysis of the extent and location of overseas production. Second, this literature does not address the substitutability or complementarity between exporting and producing abroad as modes of foreign market penetration.

There are, however, a few important exceptions. Horst (1972) uses data on production by US affiliates in Canada, and finds that affiliate production is increasing in tariffs, and that both affiliate sales and exports are increasing in R&D intensity. Using cross-section, firm-level data for Swedish multinationals, Swedenborg finds that multinational sales and exports are complements at the level of the firm, but the tests do not address proximity considerations. Blomstrom et. al. similarly find evidence of complementarity using industry data on US and Swedish multinationals; they exclude distance as an explanatory variable after concluding it is insignificant. In equations that use affiliate sales as a dependent variable, Lipsey and Weiss find that distance is insignificant in explaining exports. Grubert and Mutti find that both exports and net affiliate sales are an increasing function of distance, but neither is significantly affected by tariffs, and only exports to affiliates are affected by tax differences.

There is a large body of empirical research on the determinants of trade flows that is related to the tests formulated below, but none of it distinguishes trade mediated by multinationals from arms-length trade. The most robust empirical regularity in international trade is the negative relationship between trade flows and distance embodied in the gravity equation. Following its initial formulation by Linneman in 1966, the gravity equation was established as a solid empirical relationship in search of a model. Since that time, it has been given theoretical underpinnings in a model in which products are differentiated by country of origin, demand is characterized by constant elasticity of substitution (CES) among varieties of a differentiated good and homothetic preferences over classes of goods, and prices reflect transport costs, which increase with distance (Anderson, 1979; Bergstrand, 1984). Imports of differentiated products are decreasing in transport costs because they raise the delivered price to consumers, who optimally consume less of the more expensive varieties. By this reasoning, trade barriers should function similarly to transport costs, and indeed trade flows are found to be decreasing in tariff levels (Harrigan, 1993) and in NTBs after controlling for political economy factors (Treffler, 1993).

The theory has since been elaborated to include the Linder (1961) hypothesis, according to which consumers with similar per capita incomes have similar consumption bundles (Thursby, 1987; Bergstrand, 1988 and 1990). Using per capita income as a proxy for the distribution of types of consumers, the empirical results confirm that bilateral trade flows are higher the more similar are the per capita incomes of the trading partners. Per capita income has also been used as a proxy for capital-labor ratios: a positive relationship between trade and per capita income differences is taken as evidence of interindustry trade motivated by factor proportions, while a negative relationship suggests intraindustry, differentiated products trade (Bergstrand, 1988 and 1990).

The work below differs from previous research in a variety of ways. Compared to the research on trade flows using gravity equations, it uses much more disaggregated data. It also uses a direct industry and country-specific measure of transport costs, rather than a measure of physical distance or an approximation from OECD reporting discrepancies, as well as disaggregated data on tariff and nontariff barriers. It is the first to include variables measuring concentration advantages as well as proximity advantages. And it compares estimated equations for trade with similar equations for affiliate sales. Compared to the research on multinationals, it controls for simultaneity between trade flows and affiliate sales both by using instrumental variables techniques in the level equations and by using SUR techniques to predict shares.

IV. Data

As is well known in the field of empirical trade, limitations due to incomparability of trade data across countries are daunting. Limitations on multinational sales data are even worse. The US Bureau of Economic Analysis (BEA) compiles the most complete set of data disaggregated by industry, but it covers only bilateral activity between the US and its trading partners. In order to fully exploit this data set, the analysis below is confined to two-way bilateral relationships. One set of analyses focuses on outward activity - which includes sales by foreign affiliates of US multinationals and US exports - and another focuses on inward activity - which includes sales by US affiliates of foreign-owned multinationals and US imports. Ideally, of course, a single equation would be used to test a full set of multilateral relationships.

The analysis focuses on a cross-section of industry-country pairs for 1989. Ideally, the analysis would use a panel to control for fixed effects. However, some of the series, such as tariffs and NTBs, change only at long intervals, while data for other variables (R&D and advertising intensities) is only available for a small number of years. The use of shares as the dependent variable should alleviate some of the concern about fixed effects.

i. Trade flows and affiliate sales

The data includes trade and multinational sales for 27 countries in total. The countries were selected to maximize diversity in geographical coverage, income, and production structure, and minimize missing data. They include: Argentina, Australia, Austria, Belgium, Brazil, Canada, Columbia, Denmark, France, Germany, Hong Kong, Ireland, Italy, Japan, Mexico, Netherlands, New Zealand, Norway, Philippines, Singapore, South Korea, Spain, Sweden, Switzerland, Taiwan, United Kingdom, and Venezuela. Data on both bilateral imports and exports at the 3-digit SIC level was obtained from the Census Bureau. Data on affiliate sales was compiled at the lowest level of aggregation available, which is between the 3-digit and 2-digit SIC levels. Industries for which over 50 percent of revenues are accounted for by services, including finance and utilities, were excluded, along with wholesale and retail trade, because the "nontradeable" nature of these activities requires a local presence. Matching the two sets of classifications yielded data on 64 industries, covering manufacturing and primary industries (BEA categories 150 and 292 were dropped because I did not have matching trade data). Ideally, the full set of industries would be included, with the extent of "tradeability" reflected in the freight factor. In practice, however, data on freight factors and trade barriers is only available for industries in which there is trade. The data on multinational sales in manufacturing probably understates the true values because some proportion is allocated to wholesale. The data includes all US affiliates on the inward side but only majority-owned foreign affiliates on the outward side. Variables that are used to instrument for multinational sales, such as employment and net assets of affiliates, come from the same BEA database.

Because the multinational data is less familiar than the trade data, I will describe it in some detail here. For the industries included in the analysis, which will be termed "tradeables", gross trade flows are positively correlated with gross affiliate sales in both directions, but the correlation is much stronger for outward sales and exports (60 percent) than for inward sales and imports (20 percent). Table 1A describes affiliate sales and trade flows on aggregate and by country and Table 1B describes the same data by industry. Descriptions of the BEA industry codes are listed in the appendix. The level of outward sales is $ 542 billion, well above that for inward sales of $ 393 billion. The reverse is true of trade flows: imports total $ 380 billion, exceeding exports totalling $269 billion. While the ratio of outward sales to exports is thus nearly twice that of inward sales to imports, the share of both imports and exports accounted for by intra-firm transfers is roughly equal at one quarter.[7] [8] When imports and exports to and from unrelated parties are included as well as those to and from affiliated parties, the ratio of trade attributable to affiliates is 32 percent on the import side, and 37 percent on the export side. On average, $1 of sales by foreign affiliates owned by US parents generates $0.13 of US exports, and $0.15 of US imports, while $1 of sales by foreign-owned affiliates in the US generates $0.08 of US exports and $0.11 of US imports. The share of imports accounted for by intrafirm transfers is particularly high in tobacco, grain mill products, chemicals, drugs, and other paper. The share of exports accounted for by intrafirm transfers is similar on average, with shares particularly high in cars, iron ore, drugs, photographic equipment, and rubber products. These comparisons must be taken as rough approximations, however, as the BEA data on firm trade is classified by the industry of affiliate sales, while the trade data are classified by the actual product.

Comparing countries, 22 percent of outward sales are to Canada, with the UK, Germany, France, and the Netherlands accounting for an additional 43 percent of the total. Canada similarly accounts for 21 percent of exports, with

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[7] The ratios of intrafirm transfers and of transfers mediated by affiliates to exports and imports here include transfers both between US affiliates and their foreign parents and between foreign affiliates and their US parents, while those listed in Tables 1A and 1B include only transfers mediated by US-owned foreign affiliates on the outward side and by foreign-owned US affiliates on the inward side. There may be some double counting in the two-way estimates, since some US affiliates are classified both as US parents and foreign-owned affiliates, but for intra-firm trade it should be very small.

[8] Estimates of the share of trade mediated by multinationals seem to vary widely. The estimates cited here do not include trade between US parents and foreigners other than affiliates, or between foreign parents and unaffiliated parties in the US. For 1989, the ratio of merchandise exports shipped by US parents to foreigners other than affiliates (excluded) to exports shipped to foreign affiliates (included) is 1.3; the analogous ratio for imports is 1.1.

Japan a close second at 16 percent, and Mexico, the UK, and Germany together accounting for an additional 22 percent. The relatively modest level of affiliate sales to Mexico and Japan relative to their importance as export markets have been noted in recent negotiations over bilateral investment. On the inward side, the UK accounts for 25 percent of affiliate sales, Canada accounts for 14 percent, and Germany, Japan, and the Netherlands together account for an additional 33 percent. The order is somewhat different for imports - with Japan accounting for 24 percent, Canada accounting for 22 percent, and Mexico, Taiwan, and Germany accounting for 12 percent.

The ratio of outward sales to exports exceeds 1 for 19 of the 27 countries, while the ratio of inward sales to imports exceeds 1 for only 10 of the 27 countries. In the 64 industries covered, transfers internal to foreign multinationals account for over 40 percent of imports from Switzerland, the Netherlands, Canada, Singapore, UK, and Ireland, and for less than 5 percent for Taiwan, Venezuela, Columbia, and South Korea. Internal transfers account for over 29 percent of exports to Canada, Ireland, Spain, Germany, and the UK, and less than 5 percent for South Korea, Denmark, New Zealand, Norway, and Taiwan. Internal transfers appear somewhat higher for trade with industrialized countries.

The share of affiliate sales destined for sale in the local market exceeds three quarters for 6 countries, including 4 Latin American countries, Japan, and New Zealand. This may reflect a history of high trade barriers in the 4 Latin American countries and Japan, and high transport costs for New Zealand and Japan. Overseas affiliate production destined for exports, and in particular to the parent country, is the category of activity most likely to be associated exclusively with vertical integration across borders. The share of foreign affiliate production destined for export back to the US from foreign affiliates is highest for Singapore, Hong Kong, Canada, South Korea, Taiwan, and Mexico - exceeding 29 percent. On the inward side, the share of production in the US by foreign-owned affiliates that is destined for export back to the parent is highest for affiliates owned by Brazilian, New Zealand, and Taiwanese parents, ranging between 18 and 30 percent.

Comparing industries, motor vehicles and equipment account for over 20 percent of outward sales, and, together with computers and office equipment, industrial chemicals, integrated petroleum refining and extraction (291) and drugs, these 5 industries account for 49 percent of total sales by US-owned affiliates abroad. Exporting is slightly more diversified: other transportation equipment is the largest industry, accounting for 10 percent of sales, and the top 5 - which include motor vehicles, computers and office equipment, industrial chemicals, and crops - account for 40 percent of the total. The gross level of outward affiliate sales exceeds exports in 60 percent of the industries. Affiliate sales account for a particularly large share of total outward sales in petroleum extraction (133), bakery products, soap, cleaners, and toiletries, beverages, and other paper products (265), and a particularly low share in forestry, fishing, crops, livestock, coal, and other transportation equipment.

On the inward side, industrial chemicals generates the greatest amount of affiliate sales, accounting for 15 percent of the total, and the top 5 industries - including integrated petroleum refining, drugs, household audio and video, and primary nonferrous metal products - account for 38 percent of the total. Imports are similarly concentrated. The biggest import industry is automobiles, with 20 percent of the total - and, together with computers and office equipment, household audio and video, electronic components and assemblies, and petroleum extraction (133), these 5 industries account for 39 percent of the total. The activities of foreign-owned affiliates in the US are much less extensive relative to importers than are US-owned affiliates abroad relative to exporters: inward sales exceed imports in only 47 percent of the industries, and the share of inward sales in total sales is well below one-half in one-third of the industries. The ratio of inward sales to imports is particularly high in tobacco, newspapers, grain mill products, and metallic ores (102).

ii. Barriers

Two types of variables have been used to proxy freight factors in past research. Most of the work on gravity equations uses measurements of physical land and sea distances between national "economic centers" as proxies (Bergstrand), following the procedure outlined in Linneman (1966). At the industry level, a more accurate measure of transport costs should reflect specific product characteristics, as well as geographical factors. Harrigan approximates variations in freight factors by product, by using the ratio between OECD import values reported on a cif basis by the importing country, and the associated value reported on a fob basis by the exporting country. The results are disappointing, however, with freight factors for some industries exceeding 500 percent, which Harrigan attributes in part to inconsistent reporting procedures.

Below I use an alternative formulation of freight factors, based on data on freight and insurance charges reported by importers to the US Census Bureau. The freight factors are calculated as the ratio of charges to import values. Since no comparable data is available from exporters, and there is no reason to expect systematic differences in charges for transporting the same goods between the same locations based on the direction of transport, these values are used in the outward equations for all industry/country pairs for which there is intraindustry trade (95 percent of all industry-country pairs), as well as in the inward equations for all industries. The resulting series appears more accurate than either of its two predecessors, yielding values uniformly between 0 and 100 percent in 99.8 percent of the industry-country pairs for which freight factors are reported, with a mean of 8 percent, as compared with a mean ranging between 140 and 270 percent for different methods of correcting the OECD-based series. The series also seems reasonable, with high average values for countries such as Philippines and Singapore and for industries such as iron ore and concrete, asbestos, and cut stone, and low average values for countries such as Canada and Mexico, and for industries such as electronic components and scientific instruments.

The measures of both tariff and nontariff barriers (NTBs) are necessarily crude. As is well known, establishing a common metric for different types of barriers is a research project in its own right. Measures of tariff barriers come from a database compiled in 1988/9 by GATT, courtesy of the USTR. Ad valorem tariff rates for industries categorized by 10-digit harmonized codes were aggregated into 3-digit SIC categories using a concordance provided by the Census Bureau, both using simple averages and using trade weights, with all the attendant flaws such aggregation encounters. Results were similar for both series, so I report results only for the unweighted tariff series below. Data on NTBs for the US comes from a World Bank database for 1989. As is common with most recent work using NTBs, I rely on coverage ratios, which specify the percentage of imports covered by some form of NTB and unfortunately are not broken down by source country.

Since no comparable data on NTBs was available for the trading partners, an alternative measure which employs survey data was used. The World Competitiveness Report asks international managers to rank different countries on a variety of measures, including barriers to imports. I include the resulting index - which is increasing in the degree of openness - as a rough measure of barriers not captured by the tariffs. There is a negative correlation of 37 percent between the openness index and country average tariff rates, suggesting that the openness index is capturing some barriers not reflected in tariffs. While Brazil is judged least open in the survey data, followed at some distance by Japan, Switzerland, and South Korea, average tariff rates are highest for Mexico and Brazil.

The tests also include a measure of barriers to foreign direct investment, which should have the reverse effect to trade barriers in the choice between local production and exports. Survey data in the World Competitiveness Report is the basis for the index of openness to foreign direct investment that is included in both the share and level equations. The index seems sensible; Japan and South Korea are reported to be relatively closed to direct investment, while Hong Kong, Ireland, and the UK are gauged among the most open. Barriers to FDI into the US are imposed on a case-by-case basis according to the criteria in the Exon-Florio legislation, so there is no measure comparable to the FDI openness index for the US.

iii. Other data

Data on national income, per capita income, exchange rates, export unit values, import unit values, and inflation are taken from the IMF Financial Statistics. Indices for US export and import prices for a subset of 3-digit SIC industries are supplied by the Bureau of Labor Statistics, and are used to instrument for exports and imports.

Data on average effective tax rates is taken from Price, Waterhouse for 1989. There is an extensive literature on the responsiveness of FDI and reported profits to effective marginal tax rates. The formulation I use here ignores many of the complicated issues associated with the US tax treatment of foreign source income for practical reasons, but the results should be less sensitive due to the use of sales rather than FDI or profits.

The theory distinguishes between scale economies at the corporate and plant levels. Distinguishing these empirically is quite difficult. Ideally, the shape of the production function would be estimated. Unfortunately, the data on multinationals is gathered at the enterprise level and is insufficiently detailed to estimate production functions. Instead, I use variables taken from the structure-conduct-performance empirical literature in industrial organization as proxies (Schmalensee, 1989). I use industry averages of advertising intensity and R&D intensity based on expenditures-to-sales ratios as proxies for corporate scale, as well as for internalization advantages. The data is taken from a detailed FTC survey on a line-of-business basis in 1978, and is converted to the BEA industry categories using the FTC concordance for SIC codes and sales weights. Plant-level scale economies are measured as the number of production employees in the median plant in each industry (ranked in terms of value added), using data from the Census Annual Survey of Manufactures. This measure was selected from several possible candidates as the one that is least correlated with the firm-level costs captured in R&D and advertising.[9]

V. Gravity Equations for Overseas Sales Shares

The proximity-concentration hypothesis addresses the choice between trade and overseas production as alternative modes of foreign market penetration. A direct test of this hypothesis should estimate the share of each mode in total sales to a destination market, rather than the levels. The equation that is tested explains the share of total outward sales accounted for by affiliate sales:

$$OUTSH_i^j = \alpha_0 + \alpha_1 FF_i^j + \alpha_2 FAT^j + \alpha_3 PCY_i + \alpha_4 EXR_i + \alpha_5 TAX_i + \alpha_6 TOPN_i + \alpha_7 FOPN \quad (6)$$

where all variables are in logs. The dependent variable, $OUTSH^j_i$, is the share of total US sales of good j in country i accounted for by US-owned affiliates located in country i. FF^j_i is the freight factor for good j transported between the

[9] There is a strong correlation between the two 1978 intensity measures and several variables based on 1989 data from the Annual Survey of Manufacturers. A variable measuring the number of nonproduction workers per plant averaged over the largest plants that account for 50 percent of industry value-added has a correlation of 87 percent with the R&D intensity index and -3 percent with the advertising index. Value-added per plant averaged over the same firms has a correlation of 29 percent with the advertising index, and 49 percent with the R&D index.

US and country i, FAT^j_i is the foreign average tariff on imports of good j in country i, PCY_i is the per capita income in i, EXR_i is an index measuring the appreciation of the nominal exchange rate in country i relative to the dollar, TAX_i is the average effective corporate income tax rate in country i, $TOPN_i$ is the survey measure of openness to trade, $FOPN_i$ is the survey measure of openness to FDI, and $PSCL^j$ measures plant-level scale economies.

Equation (6) differs from traditional gravity equations in using the share of multinational sales as the dependent variable, in the inclusion of plant scale, and in the interpretation of several of the explanatory variables. The central hypothesized relationship is that between the share of multinational sales in total sales and the resistance variables. The coefficients on the freight factor, FF, and on tariffs, FAT, should be positive if the substitution of subsidiary production for exports increases with increasing transport costs and trade barriers. Similarly, the absence of NTBs and other trade barriers, which is captured very roughly in $TOPN_i$, should make exporting relatively attractive,[10] while the absence of barriers to investment, $FOPN_i$, should have the reverse effect. The theory further predicts that multinational sales are more likely to be used as the vehicle for market penetration, the smaller are scale economies at the plant level relative to the corporate level. Since it is difficult to measure this ratio directly, I simply include a measure of scale economies at the plant level, $PSCL^j$.

The inclusion of the level of per capita income in the foreign market, PCY_i, parallels the gravity approach. The absolute value of the differential in source and destination market per capita incomes has been used in gravity tests of trade to proxy for differences either in preferences or in capital/labor ratios.

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[10] The burgeoning strategic trade policy literature suggests that there are a variety of effects from different barriers, such as, for instance, quality upgrading and strategic effects, but in general the share of exports in total foreign sales should decline with increases in barriers.

Here, I include the level of per capita income in the destination market, since the source country is the US in all cases, which has among the highest per capita income levels. Trade in differentiated products should be positively related to the trade partner's per capita income (negatively related to the per capita income differential), if either the income elasticity of demand for differentiated goods is higher than for homogeneous goods as would be predicted by the Linder hypothesis, or the differentiated sector is relatively more capital-intensive. Similarly, both the Linder and proximity-concentration hypotheses predict a positive relationship between affiliate sales and the trading partner's per capita income, while the factor proportions hypothesis predicts a negative coefficient.

In addition, the equation includes the depreciation of the dollar vis-a-vis the destination currency between 1985 and 1989, EXR_i, to proxy for changes in relative production costs in the two markets associated with macroeconomic factors. With CES subutility, consumers allocate expenditures among varieties in inverse relationship to their relative prices (and with a monopolistic competition model, currency appreciation is partially passed through by exporters), so that consumers allocate an increasing share to locally produced varieties the greater is the depreciation of the local currency vis-a-vis the source market currency. Multinational sales should behave much like domestic production compared to foreign imports, so that the share of multinational sales in total foreign sales should fall as the dollar depreciates vis-a-vis the currency in the destination market (an increase in EXR).

And finally, the tax rate in the destination market, TAX_i, is included for obvious reasons. Firms should prefer exporting as the mode of penetration the greater is the tax rate in the destination market relative to the US. Since the US tax system credits foreign tax payments against US tax liabilities, there might be some discontinuity in the relationship above and below the level of US taxes. I experimented with various formulations of the tax variable to take this into account, and found the basic results are robust.

Strictly speaking, the proximity-concentration hypothesis should be tested on variables measuring the share of affiliate sales and exports in total sales to a destination market, rather than on levels. However, to make the results comparable with past research, I also report equations testing the levels of multinational sales and of trade flows against the barrier variables, cost variables, and income variables. Past research suggests that these tests are problematic, due to apparent complementarity between trade flows and affiliate sales. The suspected complementarity is suggested by a glance at the correlation between affiliate sales and trade flows. Table 2 reports correlations between inward affiliate sales (IN) and imports (IM), and between outward sales (OUT) and exports (EX). Both are positive, and the correlation is particularly strong on the outward side. The levels estimates attempt to avoid simultaneity problems by using instrumental variables techniques for gross flows, and by using net flows as the dependent variable. Since, as explained above, the BEA data classifies flows by the industry of affiliate sales, it is likely that some part of the trade mediated by affiliates is comprised of products from other industries. Thus, netting out internal trade is an imperfect control at best. The correlations in Table 2 fall, and in some cases become negative, when multinational imports and exports are netted out. NEX and NOUT are exports and outward sales net of US exports to foreign affiliates, and NIM and NIN are exports and inward sales net of sales to foreign-owned affiliates in the US from their foreign parents.[11] Finally, NEX2 nets out all exports that are internal to

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[11] The higher correlation between NIM and IM relative to that between NEX and EX reflects the narrower classification of trade flows that are netted out. On the outward side, BEA data for 1989 isolates all exports to affiliates originating in the US. BEA data records the source country for imports by foreign affiliates only in benchmark years such as 1987. Since the BEA data for 1989 does not record the source country for imports by foreign affiliates, only imports purchased from the foreign parent group can be included. Unfortunately, this series includes some imports that are not from the country of the ultimate

multinationals, including both exports to US-owned affiliates abroad and exports by foreign-owned affiliates in the US, and similarly for NIM2 (see footnote 7).

Outward Activity

i. Outward Shares (Table 3)

Equation (6) is estimated both for the share of affiliate sales, OUTSH, and for the share of exports, EXSH. Both equations are estimated as a gauge of the robustness of the results. Differences arise with the log formulation because there are a number of industries in which exports are positive while affiliate sales are zero (the reverse problem is virtually eliminated due to the choice of industries described above). The two equations are first tested separately in an OLS specification, and are then tested jointly using a SUR procedure. I also report results for a generalized tobit, to control for this sample selection problem.[12]

Table 3A reports results for equation (6) for the share of affiliate sales and the share of exports. Column 1 reports the OLS estimates excluding the scale variable for the affiliate sales share, and column 2 reports the corresponding equation for the export share. Columns 3 and 4 report similar OLS estimates, with the set of independent variables expanded to include PSCL. The coefficients on the barrier variables have the expected sign in all 4 equations, and, with the exception of the trade openness measure in the outward share equations, all are significant. The coefficient on the exchange rate has the predicted sign in all 4 equations, but is significant only in the outward share

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beneficial owner.

[12] I also estimated a tobit specification. The results on the resistance variables are generally robust, but the fit of the equation varies. The tobit specification improves the fit of the inward equations, while the log formulation results in more precise estimates for the outward equations.

equations. The coefficient on the tax variable consistently diverges from the predicted sign, and is significant. The coefficient on per capita income is close to zero in the export share equations, while it is significantly positive in the affiliate sales share equations, consistent with a Linder hypothesis or an intraindustry interpretation. The coefficient on plant scale has the predicted sign and is significant in the affiliate sales share equations, but is insignificantly negative in the export share equations. Its inclusion raises the fit of both equations considerably.

Columns 1 and 2 of Table 3B reestimate the base equation reported in columns 1 and 2 of Table 3A using SUR estimation, and columns 3 and 4 similarly correspond to those in Table 3A. The fit of the affiliate sales share equations improves only moderately, while the fit of the export share equations improves substantially. The improved fit is attributable at least in part to the restriction to interior observations implied by the SUR formulation.

This sample selection bias is addressed by performing a generalized tobit estimation procedure, combining a probit on the likelihood of observing any affiliate sales, with an equation explaining the share of total sales accounted for by affiliates in those cases where affiliate sales are observed. The probit equation replaces the dependent variable by a dummy indicating the presence of affiliate sales, $OUTD_i^j$, and adds the R&D intensity, RD^j, destination market GDP_i, and geographical distance, $DIST_i$, to the group of independent variables, on the premise that these variables are likely to be important determinants of the presence of multinational activities but not of their share. Columns 1 and 2 of Table 3C report joint estimates of the probit and affiliate sales share equations respectively associated with the equation in column 1 of Tables 3A and 3B, and columns 3 and 4 expand the set of independent variables to include PSCL, similar to column 3 of Tables 3A and 3B. The likelihood of observing multinational activities is inversely related to physical distance, unaffected by freight factors and per capita income, weakly positively related to tariffs, and positively correlated with the level of income in the destination market and the R&D intensity of the industry. In other respects, the presence of affiliate sales is similar to the share of affiliate sales. And the share equations in columns 2 and 4 yield results similar to the OLS and SUR specifications, after controlling for the sample selection bias.

ii. Outward Affiliate Sales - Levels (Table 4)

Next I report estimates for similar equations explaining the levels of outward affiliate sales and exports as a check on the share estimates, and to make the results comparable with previous research. As discussed above, there is likely to be a simultaneity problem linking exports to affiliate sales, either because they serve as alternative modes of serving a foreign market or because third factors affect both. The level regressions control for the simultaneity between exports and affiliate sales in two ways. First, affiliate sales net of exports, NOUT, are used as the dependent variable in an equation which is a variant of equation (6):

$$NOUT_i^j = \alpha_0+\alpha_1 FF_i^j+\alpha_2 FAT_i^j+\alpha_3 GDP_i+\alpha_4 PCY_i+\alpha_5 EXR_i+\alpha_6 TAX_i+\alpha_7 TOPN_i+\epsilon \quad (7)$$

The income of the destination country, GDP_i, is added to control for market size effects. An alternative attempt to control for simultaneity estimates gross affiliate sales, OUT_i^j, using 2SLS techniques. I experimented with two sets of instruments for exports: one uses industry export price series compiled by the BLS and import unit values compiled by the IMF, and the second uses exports net of all transactions mediated by both foreign and US affiliates, NEX2. I report only the second below, since both yield similar results, and the incomplete coverage of the export price series reduces the number of observations. The instrument has a 96 percent correlation with total exports (in logs), and 33 percent correlation with total outward sales.

Column 1 of Table 4 reports results for equation (7) for net outward affiliate sales, NOUT. The coefficients on the policy variables are significant and have the predicted signs, except for the trade openness index, which is insignificant. The per capita income variable is positive, consistent with the Linder hypothesis, or an intraindustry interpretation. Destination market income is significant and positive as predicted. Exchange rate depreciation is negative as predicted, while the tax variable is negative, contrary to tax minimization, but insignificantly so. Column 2 reports analogous results for 2SLS estimates of the gross level of outward affiliate sales, OUT. The signs and significance of the coefficients are similar, but the fit is better. In both cases, the main difference from the share results reported above is the negative sign of the coefficient on the freight factor. The proximity hypothesis would predict a zero coefficient in a pure multinational equilibrium and a positive coefficient in a mixed equilibrium (since the relative price of imported varieties reflects the transport costs).

iii. Exports - Levels (Table 4)

Columns 3 and 4 of Table 4 report the analogous equations for the levels of net exports and gross exports instrumenting for affiliate sales. In the estimate of net exports, NEX, in column 3, the results for all of the barrier variables are consistent with the proximity hypotheses, except the coefficient on the tariff is insignificant. The coefficient on total income is positive as predicted. Similar to the results in the share equation, and contrary to the model, the coefficient on the tax rate is negative and significant. The coefficients on exchange rate depreciation and per capita income are insignificantly different from zero. The 2SLS estimate of gross exports, EX, uses affiliate employment and assets to instrument for affiliate sales. The instruments have a correlation of 76-9 percent with total outward sales, and a correlation of 27-35 percent with total exports (in logs). The results are very similar to those for net exports, except that the coefficient on tariffs becomes significant, with the predicted sign. In both cases, the elasticity of exports with respect to freight factors is twice that of affiliate sales.

Inward Activity

I check these results against tests on trade flows and multinational sales in the reverse direction. It is important to note that the inward equations are not fully symmetric to the outward equations, however,. which affects the interpretation of several of the independent variables. In particular, the outward equations analyze which *characteristics of the destination market* and industry determine the choice of exporting versus production abroad and which variables determine *the choice of destination, given that the firm's home is the US*. The inward equations analyses which *characteristics of the home market* and industry determine the choice of exporting versus production abroad and which variables *favor one home base over another, given that the destination market is the US.*

This difference changes the interpretation of several of the independent variables, and especially the tax variable. In the inward equations, a positive correlation between the excess of the source country tax rate over the US tax rate and the share of affiliate sales would imply that a high home market tax rate makes production in the US more profitable than exporting as a means of penetrating the US market, all else equal. Further, differences among countries in the treatment of foreign source income may affect the results. Following the international tax literature, I included a control in the inward equations to distinguish between "exemption" countries, which exempt income earned abroad from taxation, and "foreign tax credit countries", which credit foreign tax payments against tax liabilities in the parent's home country[13]. The variable distinguishing between exemption and foreign tax credit countries takes the right

[13] See Hines (1993) and Slemrod (1990) for empirical estimates of the importance of this distinction.

sign in both share equations, and is significant in the import equation. However, its inclusion does not change the size or significance of the other coefficients or the fit of the equations markedly, so I do not report these results below.

iv. Inward Shares (Table 5)

The inward affiliate sales and import share equations are specified symmetrically to equation (6), with the exception that US average tariffs, $USAT^j$, replace foreign average tariffs, and an explicit measure of nontariff barriers, NTB^j, replaces the trade openness measure. Given the simultaneity problems linking NTBs to import penetration through the political process, I report results for the inward equations both including and excluding the NTB series.

Column 1 of Table 5A reports OLS estimates of the share of inward sales accounted for by affiliate sales, INSH, for equation (6), excluding the plant scale variable, and column 2 reports results for the corresponding estimates of import shares, IMSH. All of the coefficients in the affiliate sales share equation have the predicted signs, and all are significant at the 1 percent level, with the exception of the exchange rate. The coefficient on the per capita income variable is consistent with the Linder hypothesis or an intraindustry interpretation. The import share equation performs more poorly, and the tariff variable is insignificantly different from zero. However, the signs of the coefficients are as predicted for the freight factors, exchange rate, and tax rate, and all but the exchange rate are significant. The coefficient on the per capita income variable is consistent with a factor proportions hypothesis. Columns 3 and 4 add the NTB variable. The NTB variable interacts with the tariff variable, rendering it insignificant in the affiliate sales share equation, and changing its sign in the import share equation. In both cases, the NTB variable is insignificant. The results are not inconsistent with a simultaneity problem between NTBs and imports. Columns 5 and 6 add the plant scale variable, PSCL, to the set of independent variables. The scale variable is negative as predicted in the affiliate sales share equation, but its inclusion improves the fit of the equation only marginally, and the coefficient on tariffs loses significance. The coefficient on the scale variable is positive as predicted in the import share equation, and the other variables are robust to its inclusion.

Columns 1 to 6 in Table 5B report results for the same equations estimated using SUR techniques; the use of SUR improves the fit of the equations and the precision of the estimates.

As with the outward equations, the affiliate sales share equations may reflect a sample selection bias, and possibly to a greater extent, since inward affiliate sales are observed in fewer than half of the industry-country pairs. Table 5C reports generalized tobit estimates of equations corresponding to columns 1, 3, and 5 of Tables 5A and 5B in columns 2, 4, and 6, and the associated probit equations in columns 1, 3, and 5. As above, the probit equations predicting the probability of observing any affiliate sales add GDP, R&D, and distance to the set of explanatory variables. The probability of observing inward affiliate sales increases in the level of income in the home market, the R&D intensity of the industry, and in per capita income. The first two findings are consistent with the existence of firm-level scale economies, and the third is consistent with both the Linder hypothesis and an intraindustry interpretation of affiliate sales. The coefficients on the tax rate and the exchange rate are positive, but are only marginally significant. In all three probit equations, the coefficient on the distance variable is significantly negative, but the coefficient on freight factors varies in sign and is significant only in the last equation. Similarly, the level of tariffs is not a robust predictor of the existence of foreign affiliates in an industry. The coefficients in the associated share equations in columns 2, 4, and 6 closely parallel those in the OLS equations. Taken together, these findings suggest even more strongly than the outward equations that the establishment of a local presence is more likely the nearer is the destination market, but given a local presence, the share of total sales accounted for by local affiliates is an increasing function of natural and policy barriers to trade.

v. Inward Affiliate Sales - Levels (Table 6)

Next I turn to level equations for inward affiliate sales. Again, the equations attempt to control for simultaneity both by using affiliate sales net of internal imports as the independent variable, and by using 2SLS to estimate the gross flows. And similar to the outward equations, the 2SLS equations use imports net of all imports mediated by both US-owned and foreign-owned affiliates to instrument for total imports; similar results are obtained when industry import price and export unit value indices are used as instruments instead. The instrument has a correlation of 15 percent with affiliate sales (in logs) and of 98 percent with total imports. As such, it is not a great improvement, but the simultaneity problem appears less severe than on the outward side.

The first column of Table 6 reports the OLS estimate of the level of net inward affiliate sales, NIN, for the base equation. The results for tariffs, per capita and total income, and the exchange rate and tax variables are consistent with the hypotheses, but the per capita income and tax variables are only marginally significant. The coefficient on freight factors is negative but insignificant. Column 2 reports 2SLS estimates of the same equation for gross affiliate sales, IN, instrumenting for imports. The results are similar to the net sales equations, except that the coefficient on the tax variable becomes significant, and that on the freight factor becomes positive, although only at a 17 percent level of significance. Adding NTBs to the net affilite sales equation in column 3 improves the fit of the equation and raises the significance of the tax and per capita income variables, and the coefficients on both policy barrier variables have the predicted signs. However, the coefficient on freight factors becomes negative and significant at the 10 percent level. Adding NTBs to the 2SLS estimate in column 4 has a similar effect, although here the coefficient on the freight factor remains positive and simply loses significance.

vi. Imports - Levels (Table 6)

The corresponding equations for net imports and gross imports are reported in columns 5 through 8 of Table 6. Similar to the outward equations, assets and employment are used to instrument affiliate sales in the 2SLS equation. The instruments have a correlation of 92 percent with the independent variable and a correlation of 25-9 with the dependent variable. In general, the variables explain a significantly greater share of the variation in imports than of affiliate sales, and this is especially true for the 2SLS estimates. In the base equations for net imports, NIM, in column 5, the coefficient on the freight factor is significant and has the predicted sign, but the coefficient on the tariff variable is positive, contrary to the theory, and significant at the 10 percent level. The coefficients on the remaining variables have the predicted signs, although that on per capita income and the exchange rate are insignificant. A significantly better fit is obtained in the 2SLS estimate of gross imports, IM, where the per capita income, exchange rate, and tariff variables gain significance. The coefficient on the per capita income variable is consistent with an interindustry factor proportions explanation. Adding NTBs in equations 7 and 8 improves the fit of both equations significantly. The coefficient on the NTB variable is significantly positive, however, suggesting a simultaneity problem, and it interacts with the tariff variable in both equations.

Summary

Taken together, the two sets of equations provide qualified support for the proximity-concentration tradeoff as an explanation for the importance of overseas production relative to exporting as alternative modes of market penetration. Affiliate sales account for a greater proportion of total foreign sales the greater are natural barriers associated with transport costs and policy barriers to trade and the lower are policy barriers to investment and scale economies at the plant level. These results are somewhat stronger for the outward equations than for the inward equations. Similar relationships govern the determination of the levels of affiliate sales and of trade, controlling for simultaneity, with the exception of the freight factors, whose role in determining the level of affiliate sales is somewhat weak. And probably related to this, the sample selection tests establish that the probability of observing affiliate sales is greater the more proximate is the destination market.

In addition, the results suggest that multinational sales substitute for exports in response to persistent depreciation of the destination market currency vis-a-vis the source market currency. This result is stronger for the outward than the inward equations, possibly because the stock of overseas capacity is relatively greater for US multinationals abroad than for foreign multinationals operating in the US on average across countries. And, both the share and level of affiliate sales are greater, the more similar are the per capita incomes of the source and destination markets, consistent with either the Linder hypothesis or an intraindustry explanation of affiliate sales. The reverse is true of trade, consistent with a factor proportions explanation, but this result is less robust in explaining the level than the share.

VI. Internalization Advantages

As discussed above, the existence of multinationals hinges on proprietary advantages whose full value is realized through internal exploitation. Proprietary advantages whose full value is unlikely to be realized through sale on the market, due to problems of asymmetric information and externalities, include intellectual property and brand advantages. Internalization hypotheses predict that sales in industries where proprietary advantages are high are more likely to be internalized than arms-length. Further, differentiated products models of trade predict that two-way sales should arise in industries with firm-specific advantages. The two hypotheses together suggest that the level of internal sales across borders should be increasing in proprietary advantages, such as R&D intensity, but does not predict how those sales will be divided between affiliate sales and exports. Recall in the model above, the firm-specific input, r, is produced by both single-plant and dual-plant firms. The internalization hypothesis is thus more appropriately tested in a level specification. However, to the extent that the advantages associated with a brand name require a local presence in addition to internalization, for instance to maintain a reputation, brand advantages should be associated with an increase in affiliate sales relative to exports. In this case, controlling for the importance of such advantages would be appropriate both in the share equation above and in a level equation.

Following research in industrial organization, I use advertising and R&D intensities to proxy proprietary advantages in equations explaining affiliate sales, and compare these to analogous estimates for trade flows. To the extent that multinational sales only arise in industries that are characterized by proprietary advantages, while trade flows may reflect both proprietary advantages and factor proportions, one might expect the two intensity series to be at least as important as determinants of affiliate sales. And to the extent that brand advantages associated with advertising intensity require a local presence for control, the advertising intensity variable should raise affiliate sales but not exports.

i. Outward Affiliate Sales and Exports (Table 7A)

Table 7A reports estimates of the levels of outward affiliate sales and exports including the intensity variables. Similar to Table 4, the equations control for simultaneity by netting out trade flows mediated by affiliates in OLS estimation, and by using a 2SLS framework to estimate gross flows. Column 1 adds R&D intensity, RD^j, and advertising intensity, $ADVT^j$, to equation (7) for net outward affiliate sales, NOUT, and Column 2 does the same for the 2SLS estimate of gross affiliate sales, OUT. In both cases, the inclusion of the intensity variables improves the fit of the equations considerably, and the coefficients on both variables are significantly positive, consistent with a firm-specific advantage hypothesis.

The two intensity variables are added to the base equation explaining net exports, NEX, in column 3, and to the 2SLS equation explaining gross exports, EX, in column 4. Their inclusion raises the explanatory power of the equations considerably. The coefficient on the R&D intensity variable is significant, positive, and somewhat larger than that for outward sales in both equations, which suggests that differentiated products industries account for a significant share of US exports. However, exports are decreasing in advertising intensity, suggesting that the brand advantages associated with high advertising intensity require a local presence.

ii. Inward Affiliate Sales and Imports (Table 7B)

Columns 1 and 2 of Table 7B report the corresponding equations for inward affiliate sales and imports. Interestingly, the strong results on both intensity variables are not supported by the inward equations. The two intensity variables are added to the base equation for net inward affiliate sales, NIN, in column 1 and to the 2SLS estimation of gross affiliate sales, IN, in column 2. The fit of the equation is largely unchanged, the coefficients on both intensity variables are insignificantly different from zero, and the coefficients on the other variables are largely unaffected. This clearly contradicts the internalization hypothesis. A possible explanation is that industry advertising and R&D intensities vary across countries, so that the negative coefficient suggests firm-specific advantages of US firms that constitute entry barriers to foreign competitors. This suggests a model where countries specialize in different industries rather than in different varieties of the same industries.

Analogous results for imports are reported in columns 3 and 4. The inclusion of the two intensity variables improves the fit of both import equations moderately. The coefficient on advertising intensity is significant and negative in both equations, consistent with either an interpretation that brand advantages require a local presence or an entry barriers interpretation. The coefficient on R&D intensity is insignificant in the net imports equation, but it is significantly positive in the gross imports equation, which would be consistent with a differentiated products model.

iii. <u>Share Equations</u> (Table 8)

Table 8 uses the share specification to investigate the role of advertising intensity further. Columns 1 and 2 add $ADVT^j$ to the list of explanatory variables for the outward affiliate sales share and export share equations respectively. Advertising intensity has a significantly positive effect on the share accounted for by affiliate sales, and a significantly negative effect on the share of exports, and improves the fit of both equations markedly. These results support the hypothesis that a local presence may be motivated by considerations of reputation.

Analogous equations are reported for the inward affiliate sales share and import share in columns 3 and 4. The advertising variable is negative in the affiliate sales share equation but insignificant and adds no explanatory power. In contrast, the coefficient on advertising intensity is significantly negative in the import share equation, consistent with the prediction, but it improves the fit of the equation only marginally. Given the robustness of the findings on advertising in the outward equations, the poor performance of the advertising variable in the inward equations may indicate either that industry advertising intensities vary substantially among countries or that US advertising constitutes barriers to imports.

Summary

The results on the variables capturing firm-specific advantages are mixed. Both outward affiliate sales and exports are high in industries with high R&D, consistent with a model with firm-specific advantages. Moreover, the elasticity is higher for exports. In contrast, outward affiliate sales and exports respond in opposite directions to advertising intensity, suggesting that brand advantages require a local presence. On the other hand, inward affiliate sales are not explained by either US R&D intensities or advertising intensities, and, although imports are lower in industries where US advertising intensities are high as predicted, they are only weakly higher in industries with high R&D intensities. This can be taken as a contradiction of the internalization hypothesis. Alternatively, if advertising and R&D intensities differ across countries, the results may indicate that US firms have proprietary advantages in particular industries that constitute entry barriers for foreign firms; this would be consistent with specialisation associated with national agglomeration economies or technological differences.

VII. Conclusion

The proximity-concentration hypothesis appears robust in explaining the share of total sales accounted for by affiliate sales: this share is increasing in trade barriers and transport costs, and decreasing in investment barriers and production scale economies. Although strictly speaking, the proximity-concentration hypothesis does not apply to the levels of affiliate sales and exports, the estimated effects of trade and investment barriers on the levels are similar to their effects on the shares, even after controlling for simultaneity, and so is that of freight factors in the trade estimates. The estimated elasticity of affiliate sales with respect to tariff barriers ranges from 0.38 for gross inward sales to around 0.45 for outward sales and net inward sales, and the elasticity with respect to nontariff barriers is an additional 0.17. The results on FDI barriers are even more dramatic (although this may in part reflect collinearity with the trade openness index): the estimated elasticity of affiliate sales with respect to FDI barriers is -3.2 and that of exports is 1.6.[14] The elasticity of both imports and exports with respect to freight factors is -1. However, the role of freight factors is less robust in equations explaining the level of affiliate sales, with a negative response on the outward side and an insignificant response on the inward side, and the probability of observing any affiliate sales is positively related to the proximity of the market. This finding is consistent with recent empirical work documenting a tendency towards regional concentration in a variety of international transactions, as well as with managerial literature that focuses on familiarity as a primary explanatory factor for the establishment of overseas affiliates.

The complementarity between trade and affiliate sales arises in part because multinationals import intermediates from their home country, which cannot be distinguished in the data, but also because relative income levels and firm-specific advantages associated with intellectual property increase both multinational sales and trade, although to differing degrees. In contrast, affiliate sales and trade move in opposite directions in response to increases in advertising intensity, suggesting that advertising-intensive products require a local presence. These results are much stronger for outward flows than for inward flows, possibly indicating that the advertising and R&D intensities of industries vary across countries, so that the US intensities represent entry

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[14] The results are particularly dramatic for Japan: they suggest that if Japan were to increase its openness to FDI comparable to Canada, US affiliate sales would increase 65 percent, while exports would decline 32 percent. Although the direction of this result is in line with accounts such as Encarnation (1992), the magnitude is probably overstated.

barriers to inward affiliates.

The results also provide some insight into the determinants of trade. They suggest that for the US, exports are strongly increasing in proprietary advantages associated with intellectual property. They also confirm previous findings, at a greater degree of disaggregation and with more precise data, that proximity is an important determinant of trade flows in both directions, as are income and trade and investment barriers.

The findings that per capita income differentials reduce affiliate sales while either raising or having no effect on trade are largely consistent with tests on total volumes and intraindustry ratios of affiliate sales reported in a companion paper (Brainard, 1993). These tests clearly reject a pure factor proportions explanation of multinational activity. Total volumes of affiliate sales (net of trade) are strongly increasing in similarities in relative income shares, as would be predicted for trade in a model with identical factor proportions. Further, although intraindustry ratios of affiliate sales are lower on average than those for trade, they are still significant, and the variation in intraindustry ratios of affiliate sales is better explained by factor proportion similarities and relative incomes than is that of trade. Both findings are inconsistent with a pure factor proportions explanation of multinationals.

The companion paper also sheds some light on the results on transport costs. When affiliate production destined for export back to the home market is distinguished from that destined for local sale, it is clear that they differ in their response to transport costs: while production destined for export diminishes as freight factors rise, local sales are either unaffected or increase. This may explain the ambiguous results in the affiliate sales levels equations above and is consistent with a proximity explanation for local sales.

Table 1A: Affiliate Sales and Trade Flows
64 Tradeables Industries
27 Countries
1989, $ Millions

Total

	INWARD				OUTWARD			
	AFFIL SALES	AFFIL IMPORTS* /SALES	INTERNAL IMPORTS** /TOTAL IMPORTS	AFFIL SALES /TOTAL IMPORTS	AFFIL SALES	AFFIL EXPORTS* /SALES	INTERNAL EXPORT*** /TOTAL EXPORTS	AFFIL SALES /TOTAL EXPORTS
TOTAL	393213	0.11	0.07	1.04	541948	0.13	0.22	2.01

by Country

	INWARD				OUTWARD			
COUNTRY	AFFIL SALES	AFFIL IMPORTS* /SALES	INTERNAL IMPORTS** /TOTAL IMPORTS	AFFIL SALES /TOTAL IMPORTS	AFFIL SALES	AFFIL EXPORTS* /SALES	INTERNAL EXPORT*** /TOTAL EXPORTS	AFFIL SALES /TOTAL EXPORTS
arg	1	0.00	0.00	0.00	3332	0.08	0.22	3.36
aul	8548	0.04	0.02	2.36	21094	0.08	0.17	2.65
aus	693	0.21	0.11	0.63	1952	0.04	0.07	2.37
bel	5627	0.13	0.02	1.35	16529	0.09	0.15	2.00
bra	46	0.11	0.00	0.01	23134	0.06	0.26	5.02
can	56637	0.10	0.04	0.68	118338	0.28	0.49	2.09
col	1	0.00	0.00	0.00	2406	(d)	(d)	1.31
den	253	0.23	0.02	0.17	1303	0.03	0.03	1.33
fra	32108	0.13	0.18	2.67	40013	0.04	0.13	3.72
ger	44285	0.13	0.19	1.86	79678	0.04	0.19	4.94
hko	(d)	0.13	(d)	(d)	3543	0.13	0.07	0.59
ire	4243	0.00	0.00	2.85	9312	(d)	(d)	3.83
ita	4157	0.05	0.02	0.36	23438	0.04	0.13	3.38
jap	43738	0.23	0.10	0.47	22434	0.15	0.07	0.53
mex	1279	0.02	0.00	0.05	14325	0.51	0.26	0.61
net	43212	0.11	0.44	10.05	26392	0.08	0.17	2.38
nor	1192	0.16	0.06	0.61	4410	0.01	0.01	4.49
nze	3399	0.18	0.06	2.88	1252	0.03	0.04	1.20
phi	(d)	0.05	(d)	(d)	1707	0.13	0.10	0.81
sin	133	0.11	0.00	0.02	7579	0.21	(d)	1.06
sko	1037	0.11	0.01	0.05	1518	0.40	0.03	0.12
spa	197	0.18	0.00	0.06	18145	0.08	0.29	4.04
swe	9984	0.13	0.19	2.13	3406	0.05	0.06	1.17
swi	32672	0.07	0.52	8.75	2327	0.05	0.03	0.59
tai	(d)	0.01	(d)	(d)	4879	0.14	0.05	0.45
uki	97095	0.07	0.17	5.89	87516	0.05	0.21	4.52
ven	863	0.07	0.00	0.13	1986	0.19	0.09	0.68
Average		0.10	0.08	1.64		0.12	0.15	2.19

* Includes all US imports (exports) by (to) affiliates.
** Includes imports by affiliates only from foreign parent group.
*** Includes exports to affiliates only from affiliated parties in US.
(d) Suppressed.

Table 1B: Affiliate Sales and Trade Flows, by Industry

27 Countries, 1989, $ Millions

BEA	INWARD AFFIL SALES	INWARD AFFIL IMPORTS* /SALES	INTERNAL INWARD IMPORTS** /TOTAL IMPORTS	INWARD SALES /TOTAL IMPORTS	OUTWARD AFFIL SALES	OUTWARD AFFIL EXPORTS* /SALES	INTERNAL OUTWARD EXPORT*** /TOTAL EXPORTS	OUTWARD SALES /TOTAL EXPORTS
10	1046	0.00	0.00	0.28	314	0.10	0.00	0.02
20	639	0.01	0.00	0.53	103	0.08	0.01	0.14
80	10	0.00	0.00	0.05	(d)	(d)	(d)	(d)
90	271	0.00	0.00	0.10	(d)	(d)	(d)	(d)
101	651	0.09	0.11	1.30	(d)	(d)	0.00	(d)
102	3717	0.02	0.22	16.03	797	0.08	0.01	1.09
107	121	0.08	0.03	0.33	65	0.00	0.00	0.17
120	1339	0.01	0.09	14.27	605	0.04	0.01	0.16
133	824	0.00	0.00	0.05	19937	0.01	0.16	42.49
140	2517	0.02	0.05	3.51	(d)	(d)	(d)	(d)
201	1150	0.03	0.01	0.48	925	0.03	0.01	0.23
202	6259	0.01	0.10	9.20	2427	0.01	0.04	6.95
203	(d)	(d)	(d)	(d)	4660	0.02	0.03	3.35
204	(d)	(d)	(d)	(d)	11576	0.08	0.42	6.65
205	3579	0.01	0.10	10.94	2602	0.02	0.39	35.06
208	5766	0.12	0.10	1.65	8899	0.02	0.06	10.97
209	13929	0.03	0.09	5.03	17463	0.04	0.18	5.91
210	(d)	(d)	(d)	(d)	10017	(d)	(d)	3.54
220	3567	0.13	0.05	0.70	1977	0.11	0.08	0.90
230	1709	0.09	0.01	0.12	3063	0.08	0.11	2.20
240	1018	0.05	0.00	0.20	1086	(d)	(d)	0.20
250	491	0.12	0.01	0.10	1500	0.14	0.20	1.73
262	2180	0.18	0.03	0.22	5910	0.02	0.01	1.07
265	5293	0.06	0.11	3.98	11492	0.10	0.50	8.73
271	1608	0.00	0.02	47.95	91	0.00	0.00	0.23
272	6905	0.01	0.04	6.51	2702	0.03	0.07	2.39
275	4825	0.01	0.03	7.94	960	0.02	0.02	0.99
281	59709	0.09	0.28	4.96	40056	0.11	0.19	2.02
283	16505	0.09	0.46	5.36	21610	0.08	0.40	5.48
284	12853	0.02	0.12	11.80	17344	0.02	0.24	13.41
287	335	0.05	0.00	0.22	1756	0.16	0.09	0.68
289	1893	0.09	0.20	2.75	10130	0.09	0.41	5.11
291	44539	0.11	0.10	5.24	26992	0.00	0.02	7.84
299	703	0.00	0.00	5.45	246	0.17	0.07	0.46
305	7554	0.09	0.09	1.48	7899	0.09	0.35	4.62
308	4390	0.10	0.12	1.34	6032	0.08	0.16	2.25
310	(d)	(d)	(d)	(d)	183	0.03	0.00	0.19
321	3927	0.07	0.10	2.47	3083	0.12	0.29	2.87
329	12283	0.04	0.06	3.44	4313	(d)	(d)	3.36
331	9168	0.07	0.04	0.93	1193	0.06	0.03	0.47
335	13939	0.16	0.15	1.15	3705	0.17	0.07	0.44
341	8980	0.06	0.10	7.70	4159	0.06	0.11	2.59
342	643	0.20	0.02	0.19	2593	0.07	0.12	1.65
343	2160	0.04	0.08	2.56	1953	0.11	0.14	1.92
349	10971	0.08	0.12	2.00	6049	0.06	0.08	1.58
351	(d)	(d)	(d)	(d)	2534	0.20	0.13	0.83
352	842	0.13	0.02	0.35	(d)	(d)	(d)	(d)
353	10849	0.14	0.19	2.10	8892	(d)	(d)	1.70
354	1411	0.18	0.04	0.24	2075	(d)	(d)	0.64
355	5100	0.11	0.07	0.94	3577	0.10	0.08	0.88
356	3184	0.29	0.15	0.57	3470	0.12	0.08	0.75
357	7216	0.22	0.05	0.33	65716	0.12	0.34	2.94
358	2131	0.04	0.04	0.99	4321	0.10	0.12	1.60
359	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)
363	(d)	(d)	(d)	(d)	6977	(d)	(d)	5.63
366	14744	0.34	0.14	0.77	5947	(d)	(d)	0.92
367	6878	0.21	0.06	0.42	15833	0.28	0.30	1.10
369	(d)	(d)	(d)	(d)	7385	0.14	0.10	0.83
371	12242	0.44	0.07	0.16	110558	0.26	1.07	4.87
379	3674	0.17	0.05	0.30	3494	0.12	0.01	0.13
381	4022	0.10	0.05	0.71	4423	0.21	0.09	0.55
384	2704	0.11	0.07	0.73	6652	0.17	0.21	1.41
386	388	0.24	0.01	0.07	10627	0.16	0.54	3.48
390	2919	0.18	0.02	0.22	3321	0.08	0.05	0.75
average	6144	0.10	0.08	5.18	8468	0.09	0.15	3.54

Variable Definitions

OUT	Total outward affiliate sales
OUTSH	Share of outward affiliate sales in total outward sales
NOUT	Outward affiliate sales net of exports to affiliates from US
EX	Total exports
EXSH	Share of exports in total outward sales, EX/(EX+OUT)
NEX	Exports net of exports to US-owned affiliates abroad
NEX2	Exports net of exports to US-owned affiliates abroad and exports from US affiliates to foreign parent
IN	Total inward affiliate sales
INSH	Share of inward affiliate sales in total inward sales
NIN	Inward affiliate sales net of imports by US affiliates from foreign parents
IM	Total imports
IMSH	Share of imports in total inward sales, IM/(IM+IN)
NIM	Imports net of imports by US affiliates from foreign parent
NIM2	Imports net of imports by US affiliates from foreign parent and imports from US-owned affiliates abroad
FF	Freight factor: transport cost as percent of value
FAT	Foreign average tariff
TOPN	Survey measure of openness to trade
FOPN	Survey measure of openness to FDI
USAT	US average tariff
NTB	US Nontariff Barrier coverage ratio
EXR	Depreciation of dollar vis-a-vis foreign currency, 1985-9
TAXR	Average effective corporate tax rate
PCY	Per capita income
GDP	
PSCL	Number of production workers in median plant
ADVT	Advertising expenditure as percent of sales
RD	R&D expenditure as percent of sales
DIST	Weighted land and sea distance between economic centers

Table 2: Correlations

Inward
(obs=1731)

	in	im	nin	nim
im	0.2023			
nin	0.9945	0.1380		
nim	0.1660	0.9958	0.1082	
nim2	0.1468	0.9842	0.0958	0.9956

Outward
(obs=1731)

	out	ex	nout	nex	nex2
ex	0.6392				
nout	0.9397	0.4553			
nex	0.1803	0.6884	0.2102		
nex2	0.1704	0.6845	0.1984	0.9969	

Inward
(obs=1423)

	nin	nim	ff	usat	ntb	pcy	pscl	advtg
nim	0.1062							
ff	-0.0257	-0.0499						
usat	0.0117	-0.0243	-0.0181					
ntb	-0.0123	0.0553	0.0151	0.0518				
pcy	0.1427	0.0890	-0.0649	0.0157	-0.0043			
pscl	0.0066	0.2357	-0.0809	0.2338	0.0213	0.0050		
advtg	0.0026	-0.0649	0.0117	0.3836	-0.1270	0.0052	-0.0294	
rd	0.0074	0.0704	-0.1398	-0.0859	-0.1670	-0.0018	0.4471	-0.0383

Outward
(obs=1157)

	nout	nex	ff	fat	pcy	pscl	advtg	rd	topn
nex	0.2248								
ff	-0.0433	-0.0972							
fat	-0.0073	0.0077	-0.0209						
pcy	0.0488	0.0486	-0.0231	-0.5733					
pscl	0.2903	0.2494	-0.0776	0.0875	-0.0022				
advtg	0.0080	-0.1477	0.0087	0.1567	-0.0007	-0.0190			
rd	0.0950	0.3955	-0.1305	-0.0762	-0.0031	0.4441	-0.0391		
topn	-0.0121	-0.0752	0.0075	-0.3299	0.0043	0.0023	-0.0012	0.0040	
fopn	0.0550	-0.1039	0.0143	-0.2392	-0.1459	-0.0013	-0.0045	0.0029	0.7063

Table 3: Proximity/Concentration and Outward Shares

$$OUTSH_i^j = \alpha_0+\alpha_1 FF_i^j+\alpha_2 FAT^j+\alpha_3 PCY_i+\alpha_4 EXR_i+\alpha_5 TAX_i+\alpha_6 TOPN_i+\alpha_7 FOPN_i+\alpha_8 PSCL^j+\mu_i^j$$

$$EXSH_i^j = \beta_0+\beta_1 FF_i^j+\beta_2 FAT^j+\beta_3 PCY_i+\beta_4 EXR_i+\beta_5 TAX_i+\beta_6 TOPN_i+\beta_7 FOPN_i+\beta_8 PSCL^j+\epsilon_i^j$$

A. Ordinary Least Squares

DEP VAR	outsh	exsh	outsh	exsh
ff	0.1650	-0.1993	0.2202	-0.2753
	3.53	-4.50	4.97	-6.08
fat	0.2132	-0.2360	0.1793	-0.2860
	4.01	-5.24	3.66	-6.16
pcy	0.8944	-0.0739	0.7359	-0.0068
	6.04	-0.57	5.61	-0.06
exr	-0.3154	-0.0379	-0.2549	-0.0636
	-4.13	-0.56	-3.79	-1.01
tax	0.9114	-1.4131	0.9499	-1.6619
	2.58	-4.46	3.08	-5.63
topn	-0.1274	2.0715	-0.3338	2.3528
	-0.30	5.31	-0.91	6.44
fopn	2.2074	-2.7208	2.1405	-3.1672
	6.28	-8.66	6.93	-10.79
pscl			-0.1473	-0.0275
			-4.23	-0.80
const	-20.0987	7.7073	-16.7281	8.7950
	-10.19	4.89	-9.58	5.86
Observ.	826	1186	782	1059
Adj. R-sq	0.1413	0.1089	0.1960	0.1771

B. Seemingly Unrelated Regressions

DEP VAR	outsh	exsh	outsh	exsh
ff	0.1656	-0.4699	0.2123	-0.4881
	3.55	-8.86	4.81	-9.86
fat	0.2119	-0.3136	0.1629	-0.4226
	3.81	-4.96	3.10	-7.16
pcy	0.8949	-0.2348	0.7602	-0.2147
	6.07	-1.40	5.81	-1.46
exr	-0.3166	0.0143	-0.2685	-0.0394
	-4.14	0.16	-3.98	-0.52
tax	0.9038	-1.4903	0.8868	-1.6313
	2.56	-3.70	2.86	-4.70
topn	-0.1162	1.4495	-0.2735	1.9558
	-0.28	3.03	-0.73	4.69
fopn	2.2002	-2.4568	2.0570	-2.9500
	6.27	-6.15	6.64	-8.50
pscl			-0.1510	-0.0374
			-4.37	-0.97
const	-7.7175	6.4031	-6.0239	7.6182
	-4.15	3.02	-3.67	4.14
Observ.	824	824	771	771
R-sq.	0.1468	0.1710	0.2018	0.2667

Table 3: Proximity/Concentration and Outward Shares

$$OUTD_i^j = \delta_0 + \delta_1 FF_i^j + \delta_2 FAT^j + \delta_3 PCY_i + \delta_4 EXR_i + \delta_5 TAX_i + \delta_6 TOPN_i + \delta_7 FOPN_i + \delta_8 PSCL^j + \delta_9 GDP_i + \delta_{10} RD^j + \delta_{11} DIST_i + \mu_i^j$$

$$OUTSH_i^j = \alpha_0 + \alpha_1 FF_i^j + \alpha_2 FAT^j + \alpha_3 PCY_i + \alpha_4 EXR_i + \alpha_5 TAX_i + \alpha_6 TOPN_i + \alpha_7 FOPN_i + \alpha_8 PSCL^j + \mu_i^j$$

C. Generalised Tobit

DEP VAR	outd	outsh	outd	outsh
ff	0.0324	0.1237	0.1216	0.1951
	0.50	2.46	1.38	3.33
fat	0.0816	0.2276	0.1049	0.1662
	1.59	3.42	1.71	2.12
gdp	0.4267		0.4785	
	8.89		8.54	
pcy	0.0515	0.9092	0.0437	0.7612
	0.33	6.25	0.26	4.99
exr	-0.1329	-0.3165	-0.1786	-0.2687
	-1.63	-4.19	-2.02	-3.84
tax	-0.1474	0.9400	-0.1776	0.9271
	-0.38	2.00	-0.42	2.20
topn	0.2752	-0.2633	0.8844	-0.3563
	0.54	-0.54	1.55	-0.84
fopn	1.1895	2.3398	0.9438	2.1855
	3.09	5.35	2.23	5.60
pscl			-0.1775	-0.1539
			-3.68	-4.42
const	0.0899	-8.0021	1.4338	-6.4582
	0.03	-3.63	0.37	-3.00
rd	0.4438		0.5453	
	10.01		10.10	
dist	-0.5602		-0.6970	
	-3.24		-3.59	
sigma		1.2039		1.0357
		63.79		56.58
rho		0.1815		0.1218
		1.47		0.84
Observ.	1126		1046	
Log Like.	-1816.6		-1572.5	
% Pos. Ob	71.94%		73.71%	

Table 4: Proximity/Concentration and Outward Levels

$$NOUT_i^j = \alpha_o+\alpha_1 FF_i^j+\alpha_2 FAT_i^j+\alpha_3 GDP_i+\alpha_4 PCY_i+\alpha_5 EXR_i+\alpha_6 TAX_i+\alpha_7 TOPN_i+\alpha_8 FOPN_i+\mu_i^j$$

$$NEX_i^j = \beta_o+\beta_1 FF_i^j+\beta_2 FAT_i^j+\beta_3 GDP_i+\beta_4 PCY_i+\beta_5 EXR_i+\beta_6 TAX_i+\beta_7 TOPN_i+\beta_8 FOPN_i+\epsilon_i^j$$

REGRESS	OLS	2SLS	OLS	2SLS
DEP VAR	nout	out	nex	ex
ff	-0.4024	-0.1991	-0.9287	-0.9949
	-5.42	-2.23	-17.54	-16.31
fat	0.4490	0.4334	-0.0638	-0.1761
	5.34	4.98	-1.19	-2.56
gdp	0.6710	0.4925	0.9657	0.7148
	9.13	5.77	18.99	11.42
pcy	0.9343	1.1857	-0.4804	-0.2614
	3.94	4.99	-3.08	-1.38
exr	-0.2699	-0.3867	0.0978	-0.0169
	-2.15	-3.07	1.17	-0.17
tax	0.7913	0.8710	-1.6680	-2.0599
	1.39	1.49	-4.30	-4.55
topn	-0.2552	-0.1844	2.1840	2.3264
	-0.35	-0.25	4.12	4.00
fopn	3.2336	3.5645	-1.6066	-2.3185
	5.61	6.06	-4.06	-4.94
const	-27.1645	-29.8107	-3.2374	2.2943
	-7.62	-8.40	-1.48	0.78
ex		0.2622		
		5.31		
out				0.1729
				4.79
Observ.	815	757	1131	823
Adj. R-sq	0.2226	0.2901	0.4230	0.4407

Table 5: Proximity/Concentration and Inward Shares

$$INSH_i^j = \phi_0 + \phi_1 FF_i^j + \phi_2 USAT_i^j + \phi_3 NTB_i + \phi_4 PCY_i + \phi_5 EXR_i + \phi_6 TAX_i + \phi_7 PSCL^j + \mu_i^j$$

$$IMSH_i^j = \gamma_0 + \gamma_1 FF_i^j + \gamma_2 USAT_i^j + \gamma_3 NTB_i + \gamma_4 PCY_i + \gamma_5 EXR_i + \gamma_6 TAX_i + \gamma_7 PSCL^j + \epsilon_i^j$$

A. Ordinary Least Squares

DEP VAR	insh	imsh	insh	imsh	insh	imsh
ff	0.4567	-0.1022	0.4528	-0.0968	0.4440	-0.0810
	6.75	-3.55	6.81	-3.30	6.20	-2.46
usat	0.2181	0.0150	0.0384	-0.0413	0.0295	0.0236
	2.76	0.47	0.35	-0.92	0.29	0.59
pcy	0.6286	-0.2412	0.6869	-0.2424	0.6336	-0.2465
	4.12	-7.17	4.64	-7.13	3.99	-6.93
exr	0.1520	-0.0206	0.1026	-0.0179	-0.0548	-0.0191
	1.59	-1.10	1.14	-0.95	-0.49	-0.97
tax	1.3405	-0.4137	1.5224	-0.4454	1.2944	-0.4071
	3.67	-3.70	4.30	-3.95	3.65	-3.46
ntb			-0.0077	0.0036		
			-0.17	0.20		
pscl					-0.1862	0.0922
					-3.11	3.62
const	-11.8125	2.9694	-12.5006	3.1704	-9.3942	2.5318
	-8.04	6.94	-8.66	7.24	-6.26	5.41
Observ.	585	1590	533	1420	513	1412
Adj. R-sq	0.1736	0.0756	0.1982	0.0824	0.1746	0.0862

B. Seemingly Unrelated Regressions

DEP VAR	insh	imsh	insh	imsh	insh	imsh
const	-3.1253	-2.1079	-3.0103	-2.0266	-0.6366	-3.5687
	-1.69	-1.22	-1.67	-1.20	-0.33	-1.82
ff	0.4570	-0.5023	0.4529	-0.4958	0.4440	-0.5407
	6.79	-8.02	6.86	-8.00	6.24	-7.45
usat	0.2166	0.0115	0.0375	0.0361	0.0271	0.1507
	2.76	0.16	0.34	0.35	0.27	1.46
pcy	0.6284	-0.0589	0.6868	-0.1012	0.6335	-0.0454
	4.13	-0.42	4.67	-0.73	4.02	-0.28
exr	0.1519	-0.1748	0.1025	-0.1416	-0.0548	-0.0874
	1.60	-1.97	1.14	-1.68	-0.50	-0.78
tax	1.3406	-0.0598	1.5225	-0.2286	1.2941	-0.0032
	3.69	-0.18	4.33	-0.69	3.67	-0.01
ntb			-0.0075	0.0535		
			-0.17	1.28		
pscl					-0.1862	0.0965
					-3.13	1.59
Observ.	585	585	533	533	513	513
R-sq.	0.1806	0.1151	0.2072	0.1239	0.1843	0.1324

Table 5: Proximity/Concentration and Inward Shares

$$IMD_i^j = \eta_0 + \eta_1 FF_i^j + \eta_2 USAT_i^j + \eta_3 NTB_i + \eta_4 PCY_i + \eta_5 EXR_i + \eta_6 TAX_i + \eta_7 PSCL^j + \eta_8 GDP_i + \eta_9 RD^j + \eta_{10} DIST_i + \mu_i^j$$

$$INSH_i^j = \phi_0 + \phi_1 FF_i^j + \phi_2 USAT_i^j + \phi_3 NTB_i + \phi_4 PCY_i + \phi_5 EXR_i + \phi_6 TAX_i + \phi_7 PSCL^j + \mu_i^j$$

C. Generalised Tobit

DEP VAR	ind	insh	ind	insh	ind	insh
ff	-0.0676	0.4468	-0.0627	0.4474	-0.1812	0.4073
	-1.23	5.89	-1.09	6.32	-2.71	4.94
usat	-0.0554	0.1332	0.1318	-0.1273	0.0632	0.0363
	-1.16	1.88	1.84	-1.09	1.07	0.36
ntb			0.0402	-0.0249		
			1.24	-0.49		
gdp	0.4528		0.4864		0.4749	
	12.02		11.96		11.76	
pcy	0.4244	0.7431	0.4307	0.7946	0.4629	0.7704
	6.35	4.86	6.13	5.08	6.40	4.16
exr	0.0523	0.1369	0.0532	0.0859	0.1015	-0.0625
	1.49	1.76	1.48	1.19	2.06	-0.65
tax	0.3154	1.3279	0.2874	1.5579	0.3768	1.3835
	1.52	3.86	1.30	4.34	1.75	3.78
rd	0.0946		0.1284		0.1753	
	2.44		3.06		3.94	
dist	-0.4574		-0.5010		-0.3104	
	-4.15		-4.09		-2.59	
pscl					-0.2213	-0.2038
					-5.14	-3.16
const	2.0021	-2.5112	2.0591	-2.3561	1.3504	-0.5507
	1.17	-1.55	1.12	-1.48	0.75	-0.30
sigma		1.4384		1.3487		1.3383
		39.92		41.49		7.03
rho		0.0977		0.0929		0.1640
		0.75		0.66		5.05
Observ.	1514		1366		1412	
Log Like.	-1721		-1522		-1500	
% Pos. Ob	37.38%		38.07%		36.33%	

Table 6: Proximity/Concentration and Inward Levels

$$NIN_i^j = \phi_0 + \phi_1 FF_i^j + \phi_2 USAT_i^j + \phi_3 NTB_i + \phi_4 GDP_i + \phi_5 PCY_i + \phi_6 EXR_i + \phi_7 TAX_i + \mu_i^j$$

$$NIM_i^j = \gamma_0 + \gamma_1 FF_i^j + \gamma_2 USAT_i^j + \gamma_3 NTB_i + \gamma_4 GDP_i + \gamma_5 PCY_i + \gamma_6 EXR_i + \gamma_7 TAX_i + \epsilon_i^j$$

A. Net, Ordinary Least Squares

B. Gross, Two-Stage Least Squares

REGRESS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
DEP VAR	nin	in	nin	in	nim	im	nim	im
ff	-0.0856	0.1670	-0.1699	0.1160	-1.0101	-1.0598	-1.0305	-1.0966
	-0.81	1.38	-1.61	0.92	-16.95	-13.73	-17.90	-14.80
usat	0.4757	0.3847	0.4793	0.3043	0.1152	0.2100	0.5444	0.1677
	3.84	3.16	2.73	1.76	1.75	1.97	6.20	1.27
ntb			0.1705	0.1256			0.1886	0.2395
			2.39	1.75			5.27	4.99
gdp	0.4898	0.3719	0.5228	0.3999	0.9158	0.7757	0.9301	0.7659
	5.49	3.75	5.88	3.95	17.81	12.05	18.91	12.24
pcy	0.3949	0.3262	0.4846	0.3709	-0.0160	-0.7594	-0.0168	-0.7970
	1.56	1.30	1.96	1.52	-0.21	-4.04	-0.23	-4.42
exr	0.4135	0.4564	0.3777	0.4185	0.0092	0.2827	0.0440	0.3257
	2.75	3.08	2.63	2.94	0.24	2.22	1.19	2.72
tax	0.7887	1.2467	1.1041	1.6126	-1.1348	-0.6929	-1.3993	-0.4850
	1.38	2.20	1.96	2.90	-4.89	-1.70	-6.32	-1.24
const	-8.1360	-9.0194	-11.6709	-11.7487	-6.5597	-0.8458	-7.3924	-2.2235
	-3.24	-3.69	-4.64	-4.80	-6.14	-0.47	-7.17	-1.24
in						0.1418		0.1335
						3.91		3.68
im		0.2543		0.2553				
		4.39		4.02				
Observ.	584	541	532	495	1559	513	1394	480
Adj. R-sq	0.1539	0.2238	0.1905	0.2579	0.3341	0.4313	0.4133	0.4803

Table 7: Internalisation and Outward and Inward Levels

A. Outward Sales and Exports

$$NOUT_i^j = \alpha_0+\alpha_1 FF_i^j+\alpha_2 FAT_i^j+\alpha_3 GDP_i+\alpha_4 PCY_i+\alpha_5 EXR_i+\alpha_6 TAX_i+\alpha_7 TOPN_i+\alpha_8 FOPN_i+\alpha_9 ADVT+\alpha_{10} RD+\mu_i^j$$

$$NEX_i^j = \beta_0+\beta_1 FF_i^j+\beta_2 FAT_i^j+\beta_3 GDP_i+\beta_4 PCY_i+\beta_5 EXR_i+\beta_6 TAX_i+\beta_7 TOPN_i+\beta_8 FOPN_i+\beta_9 ADVT+\beta_{10} RD+\epsilon_i^j$$

B. Inward Sales and Exports

$$NIN_i^j = \phi_0+\phi_1 FF_i^j+\phi_2 USAT_i^j+\phi_3 NTB_i+\phi_4 GDP_i+\phi_5 PCY_i+\phi_6 EXR_i+\phi_7 TAX_i+\phi_8 ADVT^j+\phi_9 RD^j+\mu_i^j$$

$$NIM_i^j = \gamma_0+\gamma_1 FF_i^j+\gamma_2 USAT_i^j+\gamma_3 NTB_i+\gamma_4 GDP_i+\gamma_5 PCY_i+\gamma_6 EXR_i+\gamma_7 TAX_i+\gamma_8 ADVT^j+\gamma_9 RD^j+\epsilon_i^j$$

REGRESS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
DEP VAR	nout	out	nex	ex	nin	in	nim	im
ff	-0.2645	-0.1397	-0.6518	-0.7511	-0.1544	0.0160	-0.9961	-1.0215
	-3.33	-1.58	-11.68	-11.95	-1.35	0.13	-15.20	-12.35
fat	0.3447	0.2941	-0.0382	-0.0638				
	4.08	3.41	-0.71	-0.95				
usat					0.3398	0.2622	0.2717	0.4844
					2.23	1.72	3.36	4.31
gdp	0.7674	0.5929	1.0099	0.7923	0.4955	0.4195	0.9281	0.8068
	10.83	6.96	21.25	13.07	5.71	4.26	18.24	13.01
pcy	0.7695	0.9850	-0.5792	-0.2091	0.4529	0.3580	0.0315	-0.8092
	3.40	4.36	-3.97	-1.19	1.85	1.47	0.41	-4.44
exr	-0.3439	-0.4495	0.0492	-0.0837	0.4129	0.4597	0.0087	0.3313
	-2.87	-3.76	0.63	-0.90	2.85	3.21	0.23	2.69
tax	0.8331	0.7930	-1.4988	-1.6692	0.5231	0.9293	-1.1238	-0.6747
	1.54	1.43	-4.14	-3.94	0.92	1.64	-4.90	-1.72
topn	0.4038	0.3139	2.8252	2.9715				
	0.57	0.43	5.68	5.42				
fopn	2.8810	3.2946	-1.9630	-2.3599				
	5.24	5.87	-5.30	-5.40				
advt	0.3145	0.3959	-0.0986	-0.0871	-0.0299	-0.0291	-0.2632	-0.3533
	6.01	7.37	-2.76	-2.06	-0.35	-0.34	-5.16	-5.58
rd	0.2228	0.1058	0.5140	0.5140	-0.0905	-0.1238	0.0364	0.1373
	3.39	1.50	12.12	9.92	-0.97	-1.36	0.73	2.13
const	-25.5063	-27.3416	-2.0094	-0.6362	-8.3200	-9.3718	-8.4548	-2.2422
	-7.49	-8.07	-0.97	-0.23	-3.24	-3.70	-7.57	-1.23
ex		0.2486						
		4.86						
im						0.1959		
						3.35		
in								0.1125
								3.19
out				0.1402				
				4.06				
Observ.	810	752	1084	818	565	523	1483	510
Adj. R-sq	0.2760	0.3442	0.5047	0.5095	0.1600	0.2201	0.3609	0.4793

Table 8: Internalisation and Outward and Inward Shares

A. Outward

$$OUTSH_i^j = \alpha_0 + \alpha_1 FF_i^j + \alpha_2 FAT^j + \alpha_3 PCY_i + \alpha_4 EXR_i + \alpha_5 TAX_i + \alpha_6 TOPN_i + \alpha_7 FOPN_i + \alpha_8 PSCL^j + \alpha_9 ADVT^j + \mu_i^j$$

$$EXSH_i^j = \beta_0 + \beta_1 FF_i^j + \beta_2 FAT^j + \beta_3 PCY_i + \beta_4 EXR_i + \beta_5 TAX_i + \beta_6 TOPN_i + \beta_7 FOPN_i + \beta_8 PSCL^j + \beta_9 ADVT^j + \epsilon_i^j$$

B. Inward

$$INSH_i^j = \phi_0 + \phi_1 FF_i^j + \phi_2 USAT_i^j + \phi_3 NTB_i + \phi_4 PCY_i + \phi_5 EXR_i + \phi_6 TAX_i + \phi_7 PSCL^j + \phi_8 ADVT^j + \mu_i^j$$

$$IMSH_i^j = \gamma_0 + \gamma_1 FF_i^j + \gamma_2 USAT_i^j + \gamma_3 NTB_i + \gamma_4 PCY_i + \gamma_5 EXR_i + \gamma_6 TAX_i + \gamma_7 PSCL^j + \gamma_8 ADVT^j + e_i^j$$

Seemingly Unrelated Regressions

DEP VAR	outsh	exsh	insh	imsh
ff	0.1803	-0.4534	0.4438	-0.5439
	4.25	-9.51	6.24	-7.52
fat	0.0742	-0.3262		
	1.44	-5.64		
usat			0.0324	0.2230
			0.30	2.05
pcy	0.7007	-0.1500	0.6329	-0.0540
	5.59	-1.06	4.01	-0.34
exr	-0.2872	-0.0191	-0.0544	-0.0814
	-4.44	-0.26	-0.49	-0.73
tax	0.8228	-1.5618	1.2947	0.0040
	2.77	-4.69	3.68	0.01
topn	-0.2370	1.9161		
	-0.67	4.79		
fopn	2.0246	-2.9148		
	6.83	-8.76		
advt	0.2867	-0.3117	-0.0086	-0.1150
	8.44	-8.16	-0.15	-1.96
pscl	-0.1445	-0.0446	-0.1876	0.0777
	-4.37	-1.20	-3.12	1.27
const	-4.6511	6.1261	-0.6838	-4.2027
	-2.95	3.46	-0.35	-2.12
Observ.	771	771	513	513
R-sq.	0.2694	0.3250	0.1843	0.1389

Appendix: BEA Industry Definitions

010	Crops
020	Livestock, animal specialties
080	Forestry
090	Fishing, hunting, trapping
101	Iron ore
102	Copper, lead, zinc, gold, silver
107	Other metallic ores
120	Coal
133	Crude petrol extraction, natural gas
140	Nonmetallic minerals, except fuels
201	Meat products
202	Dairy products
203	Preserved fruits and vegetables
204	Grain mill products
205	Bakery products
208	Beverages
209	Other food and kindred
210	Tobacco products
220	Textile mill products
230	Apparel and other textile products
240	Lumber and wood products
250	Furniture and fixtures
262	Pulp, paper, board mill products
265	Other paper and allied products
271	Newspapers
272	Miscellaneous publishing
275	Commercial printing and services
281	Industrial chemicals and synthetics
283	Drugs
284	Soap, cleaners, toilet goods
287	Agricultural chemicals
289	Chemical products, nec
291	Integrated petroleum refining and extraction
299	Petroleum and coal products, nec
305	Rubber products
308	Miscellaneous plastics products
310	Leather and leather products
321	Glass products
329	Stone, clay, concrete, gypsum, other nonmetallic mineral products
331	Primary metal products, ferrous
335	Primary metal products, nonferrous
341	Metal cans, forgings, stampings
342	Cutlery, hardware, screw products
343	Heating equipment, plumbing fixtures, structural metal products
349	Metal services; ordnance; fabricated metal products, nec
351	Engines, turbines
352	Farm and garden machinery
353	Construction, mining, and materials handling machinery
354	Metalworking machinery
355	Special industrial machinery
356	General industrial machinery
357	Computer and office equipment
358	Refrigeration and service industry machinery
359	Industrial and commercial machinery, nec
363	Household appliances
366	Household audio, video, communications equipment
367	Electronic components and accessories
369	Electrical machinery, nec
371	Motor vehicles and equipment
379	Aircraft, motorcycles, bikes, spacecraft, railroad
381	Measuring, scientific, optical instruments
384	Medical and ophthalmic instruments and supplies
386	Photographic equipment and supplies
390	Miscellaneous manufacturing

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