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Trade, FDI, and the Organization of Firms

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Abstract

New developments in the world economy have triggered research designed to better understand the changes in trade and investment patterns, and the reorganization of production across national borders. Although traditional trade theory has much to offer in explaining parts of this puzzle, other parts required new approaches. Particularly acute has been the need to model alternative forms of involvement of business firms in foreign activities, because organizational change has been central in the transformation of the world economy. This paper reviews the literature that has emerged from these efforts.

The theoretical refinements have focused on the individual firm, studying its choices in response to its own characteristics, the nature of the industry in which it operates, and the opportunities afforded by foreign trade and investment. Important among these choices are organizational features, such as sourcing strategies. But the theory has gone beyond the individual firm, studying the implications of firm behavior for the structure of industries. It provides new explanations for trade structure and patterns of FDI, both within and across industries, and has identified new sources of comparative advantage.

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1 Introduction

International trade and foreign direct investment (FDI) have been among the fastest growing economic activities around the world. In 2003 world merchandise exports were close to 7.3 trillion dollars; world exports of commercial services were close to 1.8 trillion dollars; and world FDI inflows were close to 560 billion dollars.¹ However, between 1990 and 2001 sales by foreign affiliates of multinational corporations expanded much faster than exports of goods and nonfactor services.² A striking feature of this growth has been an unprecedented expansion of FDI in services; the inward stock of FDI in services increased from 950 billion dollars in 1990 to 4 trillion in 2002.³ In 2001-2002, services accounted for two-thirds of FDI inflows.

These remarkable figures mask equally remarkable changes in the nature of trade and FDI flows. The fast expansion of trade in services has been accompanied by fast-growing trade in intermediate inputs.⁴ Moreover, the growth of input trade has taken place both within and across the boundaries of the firm, i.e., as intrafirm and arm's-length trade.⁵ In the U.S. the latter has grown particularly fast. And many studies have documented the growth of international vertical specialization, as reflected in the flows of inputs across national borders for further processing and final assembly.⁶ These trends are closely related to the growing fragmentation of production, in which multinational corporations play a central role. Technological change, such as computer-aided design and computer-aided manufacturing, contributed to this process. And the same technological changes also contributed to growing outsourcing within and across national borders.⁷

In addition to these broad trends, new data sets enable researchers to uncover previously unobserved patterns of trade and FDI flows. Especially important is the finding that a systematic relationship exists between the characteristics of business firms and their participation in foreign trade and investment. Exporting firms are not a random sample of the population of firms in an industry, and neither are firms engaged in FDI. Only a small fraction of firms export, they are larger and more productive than firms that serve only the domestic market, and more firms export to larger markets.⁸ A small fraction of firms engage in FDI, and these firms are

¹FDI inflows reached a peak of 1.4 trillion dollars in 2000, but declined from 2000 to 2003; see UNCTAD (2004). According to UNCTAD (2002), foreign affiliates of multinational corporations accounted for 11% of world GDP and 35% of world trade in 2001. In the 1990s merchandise exports grew at an annual rate of 6.4% in real terms while merchandise production grew at an annual rate of 2.5% only (see WTO (2004)).

²According to UNCTAD (2002), by almost 7% per year.

³See UNCTAD (2004).

⁴See Yeats (2001).

⁵See Feenstra (1998) and Borgia and Zeile (2004). According to Borgia and Zeile (2004), exports of U.S. parent companies to their foreign affiliates for further processing have increased from 8.5% of total U.S. exports of goods in 1966 to 14.7% in 1999, and from 39.3% of total exports of goods by U.S. parents to their foreign affiliates in 1966 to 64.7% in 1999. These shares vary substantially across industries; they are particularly large in electronic and other electric equipment as well as in transportation equipment, and particularly small in petroleum manufacturing as well as in food and kindred products.

⁶See, for example, Campa and Goldberg (1997) for the U.S., U.K. and Canada; Strauss-Kahn (2003) for France; and Hummels, Rappoport and Yi (1998) and Hummels, Ishii and Yi (2001) for other OECD countries.

⁷See Abraham and Taylor (1996) and Bartel, Lach and Sichernman (2005) on outsourcing trends in the U.S.

⁸See Eaton, Kortum and Kramarz (2004). They report that only 17.4% of French firms in manufacturing industries export, and they export 21.6% of the aggregate manufacturing output. These numbers hide large

larger and more productive than exporting firms. A lot of within-industry heterogeneity exists, and the distribution of firms by size or productivity varies substantially across industries.⁹

Sourcing strategies of business firms have become more complex than ever before, and so have the integration strategies of multinational corporations.¹⁰ As a result, the traditional classification of FDI into vertical and horizontal forms has become less meaningful in practice. Large multinationals invest in low-cost countries to create export platforms from which they serve other countries around the world, and the large flows of FDI across industrial countries cannot be satisfactorily classified as horizontal FDI.¹¹

New theories have been developed to explain these changes. While the new theories do not replace comparative advantage explanations of intersectoral trade and FDI flows, nor do they replace imperfect competition explanations of intra-industry trade, they do bring to trade theory a new focus: the organizational choices of individual firms. By focusing on the characteristics of individual firms, the theory can address new questions: Which firms serve foreign markets? And how do they serve them, i.e., which choose to export and which choose to serve foreign markets via FDI? How do they choose to organize production, do they outsource or integrate? Under what circumstances do they outsource in a foreign country rather than at home? And if they choose integration, under what circumstances do they choose to integrate in a foreign country, via FDI, rather than to integrate at home?¹²

I discuss this literature in two sections. Section 2 examines insights from models of heterogeneous firms, in which the internalization decision, i.e., outsourcing versus integration, is put aside. This proves to be a useful simplification, because the resulting predictions go a long way toward explaining why firms sort into exclusive domestic producers, exporters, or foreign direct investors, and the structure of complex integration strategies. Naturally, these models cannot explain why some firms outsource while others integrate. This issue is taken up in Section 3, which examines the implications of the theory of incomplete contracts for internalization and offshoring decisions. The result is a trade theory with rich sourcing patterns.¹³

Various studies emphasize different tradeoffs in the decision to internalize or offshore, and no model integrates all considerations into a single framework. But the studies discussed in

variations across industries, however. In food and tobacco industries, for example, only 5.5% of the firms export, while in chemicals 55.4% of the firms export.

⁹See Bernard, Jensen and Schott (2005) for a portrait of U.S. firms.

¹⁰See UNCTAD (1998).

¹¹See Ekholm, Forslid and Markusen (2004) and Feinberg and Keane (2003).

¹²I attach traditional meanings to the terms "outsourcing" and "integration." That is, outsourcing means the acquisition of an intermediate input or service from an unaffiliated supplier, while integration means production of the intermediate input or service within the boundary of the firm. These choices are distinct from the choice of country in which to engage in these activities, because outsourcing can be carried out in the home country of the firm, or in any number of foreign countries, and similarly for integration.

¹³Some of the issues examined in Section 3 are discussed in Spencer (2005). I have chosen to focus on incomplete contracts, thereby not covering the work on managerial incentives, such as Grossman and Helpman (2004) and Marin and Verdier (2005). The reason for this choice is that there is a lot of common ground in the approaches reviewed in Section 3, while the papers on managerial incentives are highly idiosyncratic. I also do not review earlier work on incomplete contracts, such as Spencer and Qiu (2001) and Qiu and Spencer (2002), which have a narrow focus, such as Keiretsu-type organizations, and have no obvious implications for the broader issues discussed in the introduction.

Section 3 all build on a common assumption, namely that some inputs are highly specific to a final product and that their supply is not fully contractible. This assumption is enough to study (1) the role of matching between buyers and sellers of intermediate inputs, and the resulting "thick market" effect; (2) different degrees of contract incompleteness, which may vary across countries; (3) endogenous Ricardian-type comparative advantage, that arises when legal systems of different quality interact with sectoral differences in contract dependency; and (4) variations across industries in the intensity of inputs that suffer from agency problems.

The final part of Section 3 integrates within-industry heterogeneity with incomplete contracts. The resulting model yields joint predictions about internalization and offshoring. In particular, it predicts the relative prevalence of the four main organizational forms: integration at home, outsourcing at home, integration abroad, and outsourcing abroad.

While the main purpose of this article is to review the theoretical literature, I report empirical evidence wherever possible. The interplay between theory and empirics is particularly important here, because many of these theoretical studies have been motivated by evidence. As one would expect, the theoretical models deliver new empirical implications that can be confronted with data. I report empirical studies that do that, but other empirical implications have not yet been tested. Some will undoubtedly be tested in the near future, while others will have to wait, because they require data that are not yet available. These issues are discussed in the closing section of the paper.

2 Heterogeneous Productivity

In the 1980s trade theory introduced within-industry heterogeneity resulting from product differentiation and monopolistic competition. Heterogeneity in these studies was not designed, however, to explain asymmetries across firms in productivity or size. Not because it was not known at the time that firms differ along these dimensions, but rather because the aim was to explain large volumes of trade between countries with similar factor compositions and large volumes of intra-industry trade. For this purpose differences in productivity or size were not considered to be important. As a result, the models assumed (for the most part) symmetry across firms within an industry in terms of the available technology, which implied in turn similar productivity levels and similar participation in foreign trade. The monopolistic competition models implied that all firms export to all countries, unless there is pressure for the formation of multinational corporations.¹⁴

Detailed empirical studies of exporting firms have led to a recognition of the limitations of the symmetry assumption. As new firm-level data became available, it became clear that not all firms within an industry export, nor are exporting firms a random sample of the population

¹⁴See Helpman and Krugman (1985, Chapters 7 and 12). Differential incipient pressure on factor prices across countries can lead to the formation of multinational corporations despite the prevalence of factor price equalization. Under these circumstances some firms become multinationals while others do not. This produces asymmetries in the organizational forms of different firms in the same industry, and different trading patterns, but these firms do not differ in productivity or size.

of firms in an industry. This evidence accumulated in the 1990s and showed that only a small fraction of firms export and that exporters are larger and more productive than non-exporters.¹⁵ In view of these findings, Melitz (2003) developed a theoretical model of monopolistic competition with heterogeneous firms, that was designed to explain these features of the data. His model has become the cornerstone of a growing literature that examines the role of heterogeneity in international trade and foreign direct investment.¹⁶ The success of Melitz's model derives from the fact that, when combined with old and new approaches to trade theory, it yields rich predictions that can be confronted with data, and so far the model has performed admirably well.¹⁷

The main insights from Melitz's model are derived from an interaction between productivity differences across firms, the presence of variable trading costs, and similarity across firms in fixed costs of exporting. The fixed export costs are interpreted as distribution and servicing costs in foreign markets, and a firm has to bear them in every country to which it exports. As a result, the total fixed export costs are larger the more foreign countries the firm chooses to serve.¹⁸

To illustrate the nature of these interactions, consider an industry supplying a differentiated product, in which each of a continuum of firms manufactures a different brand. The demand function for firm j 's brand is $x(j) = Ap(j)^{-\varepsilon}$, where x is the quantity and p is the price, A is a measure of the demand level, and $\varepsilon \equiv 1/(1-\alpha)$ is the demand elasticity. The demand elasticity is assumed to be constant, with $0 < \alpha < 1$, which implies $\varepsilon > 1$.¹⁹ Although the demand level A is endogenous to the industry, it is treated as exogenous by producers, because every producer is of negligible size relative to the size of the industry.

Let $c/\theta(j)$ be the variable production cost per unit of output for firm j and let cf_D be its fixed cost, where c measures the cost of resources (e.g., the wage rate when there is only labor input); $\theta(j)$ is a measure of the firm's productivity; and f_D is a measure of fixed production costs in terms of resources. Then, if the firm chooses to sell the product, its profit-maximizing strategy is to charge $p(j) = c/\alpha\theta(j)$, which yields the operating profits $\pi(j) = \theta(j)^{\varepsilon-1}B - cf_D$, where $B \equiv (1-\alpha)A(c/\alpha)^{1-\varepsilon}$.

Figure 1 depicts these profits as a function of the productivity measure $\Theta \equiv \theta^{\varepsilon-1}$. The

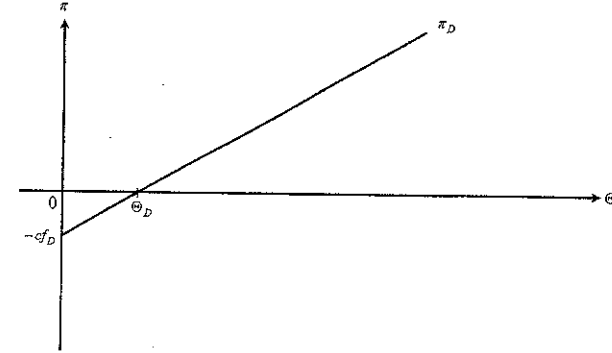


Figure 1: Producing and Nonproducing Firms

firm index j is dropped, because profits do not depend on the identity of the firm, only on its productivity level; firms with higher productivity have higher profits. The profit function in the figure is:

$$\pi_D(\Theta) = \Theta B - cf_D. \quad (1)$$

As is evident from the figure, firms with productivity levels below Θ_D choose not to produce, because for these firms variable profits do not cover their fixed cost, while firms with higher productivity supply their brands to the market. Given a productivity distribution $G(\Theta)$ we can calculate the fraction of firms that serve the domestic market as the fraction of firms with productivity above the cutoff Θ_D .

2.1 Export

Now interpret the profit function $\pi_D(\Theta)$ as applying to sales in the domestic market, so that A is the demand level in the domestic market. And assume that firms can sell their products in country ℓ as well, which has the demand function $x(j) = A^\ell p(j)^{-\varepsilon}$. That is, the demand elasticity is the same in the two markets, but the demand level is not necessarily the same at home as in country ℓ . In addition, there are melting iceberg trading costs for the shipment of every brand of the product from home to ℓ , such that $\tau > 1$ units have to be shipped for one unit to arrive, and there are fixed export costs cf_X .²⁰ The variable trading costs typically include transport costs, insurance, fees, duties, and other impediments that may stem from language barriers, differences in the legal systems, and the like.²¹ Under these circumstances a firm that chooses to sell in the domestic market, i.e., one with productivity $\Theta > \Theta_D$, can make *additional*

²⁰See Bernard and Jensen (2004) on the empirical importance of fixed export costs.

²¹See Anderson and van Wincoop (2004) for estimates of the size of these costs.

¹⁵See Clerides, Lach and Tybout (1998) for Colombia, Mexico and Morocco; Bernard and Jensen (1999) for the U.S.; Av, Chung and Roberts (2000) for Taiwan; Delgado, Farinas and Ruano (2002) for Spain; and Baldwin and Gu (2003) for Canada. Eaton, Kortum and Kramarz (2004) find that in the mid 1980s only 17.4% of French firms in manufacturing industries exported, that they exported only 21.6% of their output, and that both averages hide wide variations across industries. And Helpman, Melitz and Yeaple (2004) report that in a large 1996 sample of U.S. firms exporters had a 39% labor productivity advantage over non-exporters. A detailed account of the characteristics of U.S. firms that trade in goods is provided by Bernard, Jensen and Schott (2005).

¹⁶Melitz (2003) builds on the work of Hopenhayn (1992), who studied the entry and exit dynamics of firms in an industry.

¹⁷An alternative model of trade with heterogeneous firms is proposed by Bernard, Eaton, Jensen and Kortum (2003).

¹⁸Earlier studies, including Baldwin (1988), Baldwin and Krugman (1989), Dixit (1989) and Roberts and Tybout (1997), used sunk costs of exporting, yet only Roberts and Tybout touch upon some of the issues addressed by Melitz. Their model, which is designed to estimate the impact of sunk costs on export decisions, is not as useful, however, for dealing with the wide range of issues to which Melitz's model has been applied.

¹⁹As is well known, this form of demand function can be derived from a constant elasticity of substitution (CES) utility or production function. In this event $A = E/\int_{j \in J} p(j)^{1-\varepsilon} dj$, where E is total spending on these products and J is the set of available brands.

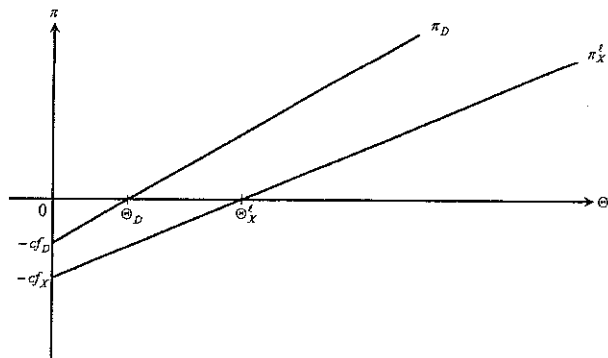


Figure 2: Exporting and Non-Exporting Firms

profits

$$\pi_X^\ell(\Theta) = \tau^{1-\varepsilon} \Theta B^\ell - cf_X \quad (2)$$

from export sales, where $B^\ell \equiv (1 - \alpha) A^\ell (c/\alpha)^{1-\varepsilon}$.

Figure 2 depicts both $\pi_D(\Theta)$ and $\pi_X^\ell(\Theta)$, for the case in which $A^\ell = A$ (thus $B^\ell = B$) and $\tau^{\varepsilon-1} f_X > f_D$. When the two demand levels are the same, π_D is steeper than π_X^ℓ as a result of the trading costs, and the assumption on the relative size of the fixed costs then ensures $\Theta_X^\ell > \Theta_D$. It follows that low-productivity firms, with $\Theta < \Theta_D$, still choose to close down, because they lose money from domestic sales as well as from exporting, while firms with productivity above Θ_D make money from serving the domestic market. Now, however, high-productivity firms, with $\Theta > \Theta_X^\ell$, also make money from exporting. Such firms choose, therefore, to serve the domestic market as well as the market in ℓ . Firms with intermediate productivity levels, between Θ_D and Θ_X^ℓ , attain the highest profits by serving the domestic market only, i.e., they choose not to export. The sorting pattern depicted in this figure implies that exporting firms are more productive than non-exporters and that they are bigger. The last implication follows from the fact that more-productive firms sell more in the domestic market and they sell in the foreign country as well. Evidently, this model's predictions are consistent with the data, in which exporters are larger and more productive than non-exporters.

Next observe that we can add as many profit functions from exporting as there are foreign countries ℓ . Assuming that the foreign countries differ only in market size, A^ℓ , would then imply a negative correlation between market size and the export cutoff Θ_X^ℓ . That is, the smaller the foreign country ℓ the larger its cutoff Θ_X^ℓ . For simplicity, suppose that $\min_\ell \Theta_X^\ell > \Theta_D$.²² In this event all exporting firms sell in the domestic market too, and there exist firms, with productivity

²²This should be true in big countries but may not be true in small countries. In any case, the analysis can be carried out without this assumption.

between Θ_D and $\min_\ell \Theta_X^\ell$, which serve the domestic market but do not export. All firms with productivity levels above $\min_\ell \Theta_X^\ell$ export. In this multicountry world, the positive correlation between productivity and export status is preserved. In addition, we obtain a new prediction which is consistent with the data: there exists a positive correlation between the size of an export market and the number of firms that export to it.²³ Naturally, this correlation may not hold when the trading cost τ is not the same with every foreign country. Nevertheless, it should still hold once we control for the cross-country variation in trading costs.

2.2 Turnover

I described a static version of Melitz's (2003) model. This is sufficient for the issues discussed above as well as for a number of other issues to be discussed below. Yet, the original formulation of the model is dynamic, shedding light on entry, exit and turnover of firms. In the dynamic version of the model, the fixed production and export costs f_D and f_X have to be borne every period. There also exists an entry cost f_E that is a capital cost; it has to be borne only once, at entry. Moreover, there is a constant probability of death δ_e of every firm, irrespective of its productivity. In this setting free entry requires the expected present value of profits to equal the entry cost. In a steady state firms constantly leave the industry, as a fraction δ_e die every period. At the same time there is a constant inflow of new firms, and a fraction of these firms — those whose productivity is above the cutoff Θ_D — remain in the industry. In the steady state equilibrium the inflow equals the outflow, so that the number of firms remains constant in every productivity category. As a result, the ratio of new entrants per period to the stock of active firms, a measure of turnover, equals $\delta_e / [1 - G(\Theta_D)]$, where $G(\cdot)$ is the cumulative distribution of Θ .²⁴ This setup can be used to study the determinants of turnover, which I illustrate in the next section with a discussion of trade liberalization.

2.3 Trade Liberalization

Consider multilateral trade liberalization, which leads to a proportional reduction of trading costs τ in all countries. On impact, this reduction in trading costs raises the profits of exporters, as a result of which the cutoff Θ_X^ℓ declines. As a result, a larger proportion of firms choose to export. But the presence of a larger number of exporters in a market reduces the demand facing every supplier, which cuts into the profits of exporters and non-exporters alike. After allowing the general equilibrium effects to work themselves out, the final outcome is a lower export cutoff Θ_X^ℓ (although not as low as one would predict from the impact effect) and a higher domestic cutoff Θ_D . It follows that trade liberalization leads to higher average productivity, since only the more-productive firms survive entry, and a larger turnover of firms. These are interesting implications, which illustrate important issues that this model can address, and which could not

²³See the evidence in Eaton, Kortum and Kramarz (2004) for French firms.

²⁴Let N be the stock of active firms and let n_E be the flow of new entrants per period. Then $[1 - G(\Theta_D)]n_E$ is the inflow of active firms and δN is the outflow. In steady state the two are equal. Therefore $n_E/N = \delta / [1 - G(\Theta_D)]$.

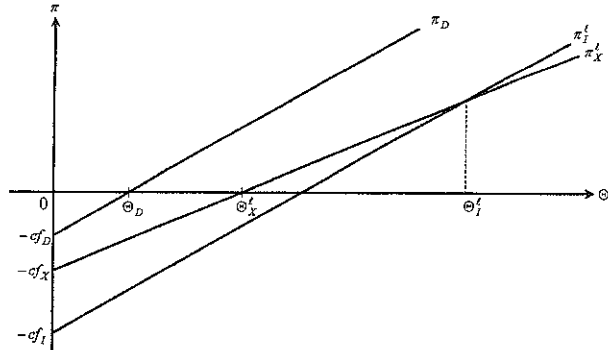


Figure 3: Multinationals, Exporting, and Non-Exporting Firms

be addressed by earlier models of international trade. Moreover, Trefler (2004) finds that both of these predictions are consistent with the impact of the Canada-U.S. Free Trade Agreement on Canadian industries.

2.4 Horizontal FDI

Melitz's (2003) model can be generalized to handle horizontal foreign direct investment. The traditional classification of FDI has been into *horizontal* and *vertical* FDI, where the former concerns subsidiaries that serve the local market in the host country while the latter concerns subsidiaries that add value to products that are not destined (necessarily) for the host country market (more on this in the next section).²⁵ Following Helpman, Melitz and Yeaple (2004), suppose that a home-country firm can build a (second) production facility in country ℓ , at cost cf_I , that will enable it to produce its brand of the product in country ℓ at unit cost c^ℓ/θ , where θ is the firm's productivity. Then if the firm exports to country ℓ , its profits from exporting are given by (2), while if it chooses to serve the foreign market via FDI, the firm's profits from FDI are

$$\pi_I^l(\theta) = \Theta B_I^l - cf_I, \quad (3)$$

where $B_I^l \equiv (1 - \alpha) A^\ell (c^\ell/\alpha)^{1-\epsilon}$. Comparing (2) with (3) we note that, as long as $f_I > f_X$ and $c^\ell < c\tau$, the firm faces a *proximity-concentration tradeoff*, for which Brainard (1997) provides empirical evidence. Namely, by choosing FDI instead of exporting the firm gives up concentration of production, which raises its fixed costs, but saves on variable unit costs by avoiding trade costs (and possibly on unit production costs). Figure 3 describes this tradeoff for the case in which $c^\ell = c$, $B_I^l = B^\ell$ (i.e., the demand level is the same in the two countries),

and $f_I > \tau^{\epsilon-1} f_X > f_D$. Under these circumstances $\Theta_I^l > \Theta_X^l > \Theta_D$. It follows that the most productive firms, with $\theta > \Theta_I^l$, serve the foreign market via subsidiary sales; lower productivity firms, with $\Theta_X^l < \theta < \Theta_I^l$, serve the foreign market via export; and still lower productivity firms, with $\Theta_D < \theta < \Theta_X^l$, serve only the domestic market. Evidently, this sorting pattern is consistent with the empirical evidence that multinational corporations are more productive than exporters who are not multinationals, and exporters who are not multinationals are more productive than firms who serve only the domestic market.²⁶

Helpman, Melitz and Yeaple (2004) also show that when the distribution of productivity θ is characterized by a Pareto distribution, the size distribution of firms also is Pareto, and the model then predicts more subsidiary sales relative to export sales in sectors with greater productivity (and therefore size) dispersion. This is a particularly interesting implication, because it suggests that heterogeneity can be a source of comparative advantage. The use of a Pareto distribution is compelling in this case, because the actual size distribution of firms is well approximated by such a distribution (see Axtell (2001)). Helpman, Melitz and Yeaple also show that the shape parameter of a Pareto distribution can be precisely estimated in almost every one of 52 sectors for which they have data, and these estimates exhibit large variations in the degree of dispersion across sectors. Using these measures of dispersion, as well as nonparametric measures, they estimate the impact of heterogeneity on the ratio of subsidiary sales to export sales of U.S. firms in a sample of 27 countries, and a broader sample of 38 countries, both in 1994. Their estimates are precise and consistent with the theory. Moreover, the estimates are large economically; they compare in size to the impact of freight, tariffs, and measures of fixed costs on the ratio of export to subsidiary sales, which have been routinely used in studies of the proximity-concentration tradeoff.²⁷

2.5 Complex Integration Strategies

Although horizontal FDI of the type described in the previous section is prevalent, the evidence points to growing importance of more complex integration strategies by multinational corporations. Feinberg and Keane (2003) find, for example, that among U.S. multinationals with affiliates in Canada, only 12 percent are of the purely horizontal type (i.e., they have negligible intrafirm flows of intermediate inputs) and only 19 percent are of the pure vertical type (i.e., they have negligible intrafirm flows of intermediate inputs in one direction only). The remaining 69 percent of the firms pursue more complex integration strategies.²⁸ Yeaple (2003) provides the first analysis of such complex strategies, identifying an important complementarity between the two types of FDI. In what follows I briefly discuss insights from Grossman, Helpman and Szeidl (2005b) who combine heterogeneity features from Melitz (2003) with the modelling of

²⁶Helpman, Melitz and Yeaple (2004) find that in 1996 U.S. firms that engaged in FDI had a 15% labor productivity advantage over exporters who did not engage in FDI, and the latter had a 39% labor productivity advantage over firms who engaged in neither export nor FDI. See also Head and Ries (2003) for evidence from Japan; Girma, Görg and Strobl (2004) for evidence from Ireland; and Girma, Kneller and Pisu (2005) for evidence from the U.K.

²⁷The comparability in size is of beta, or standardized, coefficients.

²⁸See also UNCTAD (1998), where the term "complex integration strategies" was coined.

²⁵According to the BEA data, the destination of sales of U.S. subsidiaries are distributed as follows: 65% in the host country markets, 11% in the U.S., and 24% in other countries (see Landefeld and Mataloni (2004)).

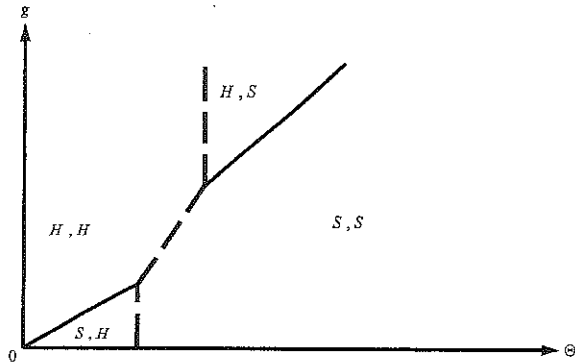


Figure 4: Optimal Integration Strategies

the two types of FDI from Yeaple (2003) in order to explore patterns of FDI in an environment that offers a rich choice of integration strategies.

The model has a simple structure. There are two symmetric countries in the North and one country in the South. Every Northern country has a population of firms who know how to produce varieties of a differentiated product. A typical firm has a production function $\theta F(m, a)$, where θ is (as before) a firm-specific productivity level and $F(\cdot)$ is a concave constant-returns-to-scale production function, common to all firms; m represents intermediate inputs and a represents assembly. That is, every final good is produced with a combination of intermediate inputs and assembly. The elasticity of substitution between m and a is smaller than one. And in this model there are no fixed manufacturing costs f_D nor fixed exporting costs f_X .

Intermediate inputs and assembly are produced from a bundle of primary inputs at cost c per unit, where c is higher in the North than in the South. As a result, there is a cost advantage to locating these activities in South, unless other costs enter the calculus. To introduce a tradeoff in location decision, it is assumed that no fixed costs are borne by a firm that locates both activities in the Northern country in which it is headquartered, but that such a firm has to bear a fixed cost g if it locates the production of intermediates in a different country and the fixed cost f if it locates assembly in a different country. The firm may also incur transport costs for either intermediate inputs or final goods. In combination, this cost structure induces a nontrivial decision problem in which the optimal integration strategy depends on these cost parameters as well as on the demand levels in the three countries. The demand function is $Ap(j)^{-\epsilon}$ (as before), and A is higher in a Northern country than in South.

First consider the case in which there are no transport costs. Then, given the fixed cost f of FDI in assembly, there are four integration strategies that may be chosen by a firm in equilibrium, depending on the fixed cost of FDI in intermediates g and the firm's productivity. They

are depicted in Figure 4. Region $\{S, H\}$ describes a strategy whereby the firm manufactures intermediates in South and assembles the final goods in the home country, i.e., the country in which the firm is headquartered. The other regions have similar interpretations; the first letter denotes the location of intermediate inputs while the second letter denotes the location of assembly. The fixed cost of FDI in intermediate inputs varies along the vertical axis while the productivity measure $\Theta \equiv \theta^{\epsilon-1}$ varies along the horizontal axis.

We see that for low fixed costs g the least-productive firms perform both activities at home, intermediate-productivity firms produce intermediates in South and assemble final goods at home, and high-productivity firms perform both activities in South. That is, the least productive firms do not engage in FDI; they produce intermediates and perform assembly in the home country and export the final product to the other Northern country and to South. Firms with intermediate productivity engage in partial FDI; they produce intermediate inputs in South, import them to the home country, assemble them there into a final product, and then export the final product to the other Northern country and to South. Finally, the most-productive firms engage in FDI to the greatest possible extent; they produce intermediate inputs in South and assemble there the final product. The final product is then exported to the two Northern countries, i.e., the South serves as an *export platform* to the rest of the world.²⁹

The figure also shows that for an intermediate range of FDI costs g there are only two optimal integration strategies; low productivity firms do everything at home while high productivity firms do everything in South. Finally, for high values of g low productivity firms do everything at home, the highest productivity firms do everything in South, and firms in between produce intermediates in the home country and assemble final goods in South.

It is also clear from the figure that, given a distribution of Θ , the fraction of firms that do both activities at home is rising with g while the fraction of firms that do both activities in South is declining with g . Moreover, as shown by the broken lines, the fraction of firms that assemble final goods in South declines with g . That is, FDI in intermediates and in assembly are complementary; as the fixed cost of FDI in intermediate goods increases, the fraction of firms assembling in South declines.³⁰

In the absence of trading costs horizontal FDI has no economic justification. And indeed, Figure 4 shows no instance in which a firm in one Northern country chooses to perform assembly in the other Northern country. At most there is vertical FDI (region $\{S, H\}$) and complex integration (region $\{S, S\}$). But horizontal FDI becomes a viable option when trade in final goods is costly. So consider a modified version of this model with melting iceberg transport costs of final goods (but still free trade in intermediate inputs). For low transport costs the equilibrium integration strategies are the same as in Figure 4. But for intermediate levels of such transport costs, and relatively low demand in South, the multinationals pursue different

²⁹ See also Ekholm, Forslid and Markusen (2004) on export-platform FDI.

³⁰ This is what Grossman, Helpman and Szeidl (2005b) call unit-cost complementarity, which has its origin in Yeaple (2003). It arises from the fact that when intermediates are produced in South at lower unit cost, it becomes more attractive to assemble final goods there because the larger final good sales make it easier to cover the fixed cost of FDI in assembly.

integration strategies for high values of g . The least-productive firms perform both activities in the home country while the most productive firms perform both activities in South. However, firms with productivity between these extremes produce intermediate inputs in the home country, but choose different strategies for serving foreign markets, depending on how productive they are within this range; the less-productive firms choose subsidiary sales in the other Northern country and export to South, while the more-productive firms choose subsidiary sales in both foreign countries. As a result, all these firms engage in horizontal FDI, except that the more-productive firms do not export at all; they serve every market with local subsidiary sales. In this case too there is complementarity between the two forms of FDI; as g increases, a smaller fraction of firms engage in subsidiary sales in foreign countries.³¹ As Grossman, Helpman and Szeidl (2005b) show, this type of complementarity is robust, in the sense that it holds also for high transport costs of final goods and for high transport costs of intermediate inputs.³²

2.6 Variable Markups

The constant-elasticity demand function that was used above has been the workhorse of monopolistic competition studies in economics, including international trade. It is a convenient tool in many applications, and it is easily derived from either CES preferences or a CES production function. It has one particularly undesirable feature, however: it implies that markups depend neither on cost nor on demand levels.³³ As a result, the distribution of prices is a scaled version of the distribution of marginal costs, with no impact of market size or the number of competitors on the shape of the price distribution. Yet empirical evidence on regional markets in the U.S. suggests that higher demand, as measured by market density, reduces markups and price dispersion.³⁴ Moreover, with this type of demand, free entry implies that total spending on the industry's products has no effect on firm size, because higher spending raises the demand level A but entry of new firms then reduces this demand level, so that at the end of the process A does not change.³⁵ This too is inconsistent with the evidence; market size actually is positively

³¹The composition of FDI in assembly is now driven by an additional source of complementarity, what Grossman, Helpman and Szeidl (2005b) call source-of-components complementarity, which stems from the fact that, for moderate transport costs of final goods, a Northern market is cheaper to serve from assembly lines in South if and only if intermediate inputs are also produced in South.

³²When transport costs of final goods are high and the demand level in South is not very high, firms do not assemble final goods in South for export to North; they either export from the home country or they serve foreign markets through subsidiary sales.

³³A firm with marginal cost c/θ that faces the demand function $x(j) = Ap(j)^{-\epsilon}$, where $\epsilon = 1/(1-\alpha) > 0$, maximizes profits by charging price $p(j) = c/\alpha\theta$. Under these circumstances the ratio of price to marginal cost — which is a measure of the markup — equals $1/\alpha$, and it does not depend on marginal cost. Moreover, it does not depend on the demand level A .

³⁴See Syverson (2005) for a study of ready-mixed concrete plants.

³⁵For simplicity, consider a closed economy, with no export opportunities. Using the optimal pricing strategy $p(j) = c/\alpha\theta$, a firm with productivity θ earns operating profits that equal either $\Theta B - cf_D$ or zero, whichever is larger, where $B = (1-\alpha)A(c/\alpha)^{1-\epsilon}$ (see (1)). Then free entry implies that the expected present value of these operating profits equals the entry cost. This free entry condition depends on the cutoff Θ_D and on the demand level A . Together with the equation for the cutoff, i.e., $\Theta_D B = cf_D$, the two equations uniquely determine the cutoff Θ_D and the value of A . It follows that larger spending on these products is precisely offset by a larger number of entrants (brands) so that A is not affected.

correlated with firm size.³⁶ In order to accommodate these features of the data, it is necessary to find an alternative specification of demand, in which markups are endogenous. The theory will be more consistent with the evidence when the model implies that a larger market size reduces a firm's markup, because in this case the firm also raises sales at constant cost and productivity.

Although comparable evidence on variation across countries does not exist, it is quite likely that markups, prices and firm size vary across countries in similar fashion. To address these issues, Melitz and Ottaviano (2005) combine supply-side features from Melitz (2003) with demand side features from Ottaviano, Tabuchi and Thisse (2002) to construct a model of international trade with variable markups, in which market size affects average prices, price dispersion, and firm size. The model yields interesting predictions concerning trade and the impact of trade liberalization on productivity and price distributions.

Ottaviano, Tabuchi and Thisse (2002) use the following quadratic, quasilinear utility function:

$$u = x_0 + \zeta \int_{j \in J} x(j) dj - \frac{1}{2} \gamma \int_{j \in J} x(j)^2 dj - \frac{1}{2} \eta \left[\int_{j \in J} x(j) dj \right]^2,$$

where x_0 is consumption of an outside good that yields constant marginal utility, J is the set of brands available in the market, and ζ and η are positive parameters. When $\gamma = 0$ all brands are perfect substitutes, and the brands are less substitutable for each other the larger is γ .³⁷ Let $\gamma > 0$. Then, assuming that the consumer has enough income to justify positive consumption of the outside good, his demand for brand j is:

$$x(j) = \frac{1}{\gamma} \left[\frac{\zeta \gamma + \eta N \bar{p}}{\gamma + \eta N} - p(j) \right], \quad (4)$$

where N is the number of products he consumes and \bar{p} is the average price of these products.³⁸ This is a linear demand function in which the demand level is increasing in the average price \bar{p} and declining in the number of products N .³⁹ That is, as the competitive pressure intensifies, either because prices of competing products decline or the number of competing products increases, the manufacturer of brand j faces lower demand. In an economy populated by Q such consumers, aggregate demand for the brand equals $Qx(j)$. Facing production unit cost c/θ , this manufacturer maximizes profits by charging price

$$p(j) = \frac{1}{2} \left(\frac{\zeta \gamma + \eta N \bar{p}}{\gamma + \eta N} + \frac{c}{\theta} \right). \quad (5)$$

³⁶See Campbell and Hopenhayn (2005) for evidence on retail trade industries across U.S. cities.

³⁷This utility function represents preferences over two goods: a homogeneous outside good x_0 and a differentiated product with consumption $x(j)$ of brand j . It can be generalized to many goods.

³⁸The consumer chooses to purchase all products with

$$p(j) \leq \frac{\zeta \gamma + \eta N \bar{p}}{\gamma + \eta N},$$

and in an equilibrium with these types of consumers the set J consists only of such products.

³⁹Note that the inequality in the previous footnote together with (4) imply $\bar{p} \leq \zeta$.

Under these circumstances, the markup — defined as the ratio of price to marginal cost — is increasing in the average price and declining in the number of products. Moreover, the markup is increasing in γ , implying that it is higher the less substitutable are brands for each other.

In this model firms with very low productivity do not produce even if they bear no fixed production costs f_D , because demand drops to zero at a finite price.⁴⁰ It is then possible to solve the entire model of a closed economy by adding a free entry condition, with or without a positive fixed cost f_D . The solution for θ_D then implies that the cutoff for positive production is declining in γ and in Q . That is, less-productive firms survive entry the less substitutable the products are for each other and the larger the market size is. It follows that in sectors with less substitutability there is more productivity and size dispersion and average productivity is lower.⁴¹

Melitz and Ottaviano (2005) assume that countries differ only in their numbers of consumers Q , that there are neither fixed production nor fixed export costs, but that there are variable trade costs $\tau > 0$. The trade costs introduce a degree of market segmentation that produces cross-country variation in the number of consumed products that is positively correlated with market size, as measured by the number of consumers. Moreover, average productivity is higher in larger markets, because low-productivity firms find it harder to compete in larger markets. This is similar to the result in Melitz (2003), but for different reasons. In Melitz (2003) trade raises the profits of high-productivity firms — which export — and these exporters raise the demand for domestic inputs. As a result, domestic producers who do not export are hit by competition from foreign exporters on the one hand and by higher input prices on the other, which forces the least productive of them to leave the business. As a result the cutoff θ_D increases, and so does average productivity. In contrast, in Melitz and Ottaviano (2005), trade does not change input prices, but it reduces markups as a result of the increase in competitive pressure from foreign exporters, and this raises the cutoff θ_D and average productivity. The implication is that not only do consumers in larger markets have access to more products, they also pay lower prices.⁴²

⁴⁰With $f_D = 0$, demand is not negative for

$$p(j) \leq \frac{\zeta\gamma + \eta N\bar{p}}{\gamma + \eta N}.$$

Together with (5) it implies

$$\frac{c}{\theta} \leq \frac{\zeta\gamma + \eta N\bar{p}}{\gamma + \eta N}.$$

Therefore the cutoff productivity level θ_D satisfies

$$\theta_D = c \frac{\gamma + \eta N}{\zeta\gamma + \eta N\bar{p}}.$$

⁴¹Syverson (2004) provides evidence of these effects for a cross section of U.S. manufacturing industries.

⁴²The differences between Melitz (2003) and Melitz and Ottaviano (2005) stem from two sources: they use different shapes of demand functions (constant elasticity in one case and linear in the other) and they make different assumptions about the outside good (no outside good with constant marginal utility in one case and the presence of such a good in the other). The absence of an outside good in Melitz (2003) generates impacts on input costs that are absent in Melitz and Ottaviano (2005), but this is distinct from the impacts of the shapes of the demand functions for final goods, which are isoelastic in one case and linear in the other. In the isoelastic

Multilateral liberalization raises the number of products in all markets, which raises competition and cuts into markups. Only more-productive firms survive this pressure, resulting in higher productivity and lower prices. Evidently, this sort of trade liberalization is beneficial to all countries concerned. In contrast, when only a subset of countries liberalize trade amongst themselves, the impact on the liberalizing countries differs markedly from the impact on the excluded countries. In the former countries average productivity rises, markups and prices decline, and the number of products increases. The opposite takes place in the excluded countries. Under these circumstances the liberalizing countries gain while the other countries lose.

2.7 Factor Proportions

Although Melitz (2003) places the firm at the center of analysis, his approach has implications for trade flows at the sectoral level. This is apparent from the fact that sectoral average productivity levels are endogenous, and they depend on the determinants of the sectoral cutoffs, θ_D (or Θ_D). These endogenous productivity levels generate Ricardian-type comparative advantage that affects the sectoral patterns of trade flows.

Bernard, Redding and Schott (2005) have extended the Melitz (2003) model to accommodate variable factor proportions, producing a richer model of trade in differentiated products than the standard Helpman and Krugman (1985) version. They consider a two-sector two-factor world with constant expenditure shares on each sector's output, CES preferences for varieties in every sector, and Cobb-Douglas production functions for activities that generate either fixed or variable costs. And they achieve great simplicity by assuming that the Cobb-Douglas production functions have the same exponents in all activities within a given sector, while they vary across sectors. In a world with no trading frictions, i.e., neither fixed nor variable costs of exporting, the analysis proceeds along the now familiar lines of the integrated equilibrium approach, with results similar to Helpman-Krugman. The sectoral cutoffs θ_D are not affected by trade, and therefore neither are sectoral productivity levels. The intersectoral pattern of trade is of the Heckscher-Ohlin type: every country is a net exporter of goods that use relatively more intensively the input with which the country is better endowed.⁴³

Next they introduce melting iceberg variable trade costs and fixed export costs, where the sectoral fixed export cost, arising from a Cobb-Douglas production function, has the same factor intensity as the other sectoral activities. These costs segment markets across countries. Now trade has an influence on the cutoffs θ_D ; they rise in every country and every industry. This means that trade raises average productivity everywhere in the world. Importantly, however, in every country it raises average productivity proportionately more in the comparatively advantaged industry, i.e., the sector that is relatively intensive in the input with which the country case the demand level has no effect on the cutoff, because any shift in demand is offset by entry (see footnote 26), in contrast to the case of linear demand. And while the markup is constant in the isoelastic case, it responds to demand and entry in the linear case.

⁴³This result does not hold in a world in which different activities within a sector have different factor proportions.

is relatively well endowed. Under the circumstances, the Heckscher-Ohlin-type comparative advantage, which emanates from factor composition, also produces Ricardian comparative advantage; and the two forms of comparative advantage are positively correlated. This is an important result, because the empirical evidence suggests that it is necessary to control for TFP differences across countries in order to estimate the impact of factor proportions on trade flows.⁴⁴ In addition, trade increases firm size, and relatively more so in sectors having comparative advantage. Finally, trade raises the rate of gross job destruction and gross job creation, thereby raising turnover. But net job creation rises in comparatively advantaged industries and declines in the other sectors. These are very interesting predictions that will undoubtedly influence empirical analysis.

2.8 Gravity Equation of Trade Flows

The gravity equation is a major tool for the empirical analysis of trade flows. It has been used to study the impact on trade flows of international borders, currency unions, membership in the WTO, and other variables. And it has been used outside trade for instrumental variable estimation of the impact of variables such as social infrastructure or political institutions on measures of economic success.⁴⁵ In all these applications the standard procedure is to estimate a gravity equation of bilateral trade flows on a sample of countries that export to each other. This selected sample of countries represents, however, only about half of the country pairs in large samples of countries; in the majority of the other half of country pairs, the countries do not trade with each other; and in the remaining pairs, one country exports to the other but not vice versa.⁴⁶ These facts raise two questions: First, what accounts for the absence of trade among so many pairs of countries? And second, to what extent are estimates of trade flows that disregard the nontrading countries reliable?

Helpman, Melitz and Rubinstein (2004) show that a modified version of Melitz (2003) can account for the lack of trade between potential trade partners and that the modified theoretical framework provides guidance for an estimation procedure that exploits the information contained in the zero trade flows. In particular, they argue that lack of trade is not random, but rather arises from economic conditions, and that therefore we should simultaneously explain which countries trade bilaterally and, amongst those that do, how much is traded. The model suggests that the standard estimation procedure introduces two types of biases: a sample-selection bias and an omitted-variable bias. The sample-selection bias problem is well known and it can be corrected with standard methods. The omitted-variable problem is novel, however. It stems from the fact that, in addition to the intensive margin of trade, i.e., the response of a firm's export to changing conditions, there is an extensive margin, which consists of the response of the *number* of exporting firms to changing conditions. Helpman, Melitz and Rubinstein propose a method for the joint estimation of the impact of economic variables on

the intensive and extensive margins of trade, and they show that the extensive margin is an important determinant of trade flows.

The main ingredient of the modified model is a cumulative distribution function of productivity θ that has finite support $[\theta_L, \theta_H]$, where θ_L is the lowest productivity level and $\theta_H < \infty$ is the highest. It is evident from Figure 2 that if $\Theta_H \equiv (\theta_H)^{\varepsilon-1}$ falls between the domestic cutoff Θ_D and the export cutoff Θ_X^ℓ , then home firms produce for the home market but none of them finds it profitable to export to country ℓ . Moreover, Θ_H can be below the export cutoff of some countries and above the export cutoff of other countries, so that domestic firms may find it profitable to export to some countries but not to others. The export cutoff Θ_X^ℓ is smaller the larger the market in ℓ is and the lower the fixed export or trading costs with ℓ are. The variables that affect the cross-country variation in Θ_X^ℓ therefore explain to which foreign countries the home country should export.

Using the firms' optimal pricing and sales strategies together with the free-entry condition, the model implies two equations for every export flow, say from country i to country j . One equation describes a latent variable that is positive if and only if i exports to j , while the other equation describes the volume of exports from i to j conditional on the latent variable being positive. The second equation has the fraction of firms that export from i to j as an explanatory variable on its right-hand side. This variable is endogenous, however, and not observable. For this reason an important component of the estimation procedure is to develop an estimate of this fraction for every pair of countries. Helpman, Melitz and Rubinstein (2004) show how to do it with the aid of the latent variable equation. In this way they can separately identify the impact of various variables on the intensive and extensive margins of trade.

3 Incomplete Contracts

My discussion of trade and FDI has so far focused mostly on final products.⁴⁷ Importantly, none of the studies reviewed in the previous section, where firms make FDI choices, explicitly analyzes the internalization decision. That is, it is *assumed* that foreign operations are organized in foreign affiliates, be it for the purpose of manufacturing final products designated for the foreign market, manufacturing components in a foreign country to be assembled at home or in a foreign country, or assembling final goods to be sold in the home or foreign market. Yet the choice of whether to manufacture components inhouse or acquire them from an unaffiliated firm is a key decision about organizational form, as is the decision of whether to source such components at home or in a foreign country. The same applies to assembly, which is just another activity in the chain of tasks that need to be performed in order to deliver a product to a final user. A better understanding of these choices is needed in order to explain the trends in trade and FDI and their relation to the evolving organization of production and distribution.

Two facts stand out, which triggered a major research effort into the international organi-

⁴⁷The only exception being the discussion of the interrelationship between FDI in components and FDI in assembly in Section 2.5.

⁴⁴See Treffer (1995) and Davis and Weinstein (2001).

⁴⁵See the discussion in Helpman, Melitz and Rubinstein (2004).

⁴⁶See Helpman, Melitz and Rubinstein (2004).

zation of production. First, with the advent of computer-aided design, computer-aided manufacturing, and institutional changes in labor markets, outsourcing has increased at a rapid rate.⁴⁸ This is true about both domestic and international outsourcing, where rising domestic outsourcing means an increase in the purchase of intermediate goods and services from domestic unaffiliated firms, and rising foreign outsourcing means an increase in the purchase of intermediate goods and services from foreign unaffiliated firms. These trends have been widespread across different sectors and different inputs.⁴⁹ Second, the sourcing of inputs from foreign countries has increased at a rapid pace, both via arm's-length trade (outsourcing) and via intrafirm trade (FDI), a phenomenon known as offshoring.⁵⁰ In order to understand these trends, we need to understand the two-dimensional decision problem of business firms: whether to outsource or insource (i.e., integrate), and whether to offshore or not.⁵¹ This yields four possibilities: insourcing at home, outsourcing at home, insourcing abroad (FDI), and outsourcing abroad. The first two organizational forms do not involve foreign trade, while the latter two do: intrafirm trade in the case of FDI and arm's-length trade in the case of outsourcing.⁵² An analysis along these lines helps to understand why some companies, such as Dell, source inputs abroad primarily via FDI, while other companies, such as Nike, source them abroad primarily via outsourcing.

3.1 Matching without Market Segmentation

A simple approach, which places matching between buyers and sellers of intermediate inputs at the heart of the analysis, has been developed by McLaren (2000) and Grossman and Helpman (2002). In this approach potential buyers of an intermediate input find it more attractive to outsource, the "thicker" is the market for the input, in the sense that there exist more sellers to serve the buyers' needs. And similarly, sellers of an intermediate input find it more attractive to operate the larger is the number of potential buyers. Although there can be more than one reason for this type of market externality, both papers use an endogenous probability of

⁴⁸I use "outsourcing" to mean the acquisition of an input or service from an unaffiliated company. This is the standard terminology used in industrial organization. A narrower definition is used in some of the literature, e.g., Amiti and Wei (2005). A notable example of a very narrow definition is Bhagwati, Panagariya and Srinivasan (2005), who restrict the term to outsourcing of services from foreign unaffiliated companies. I find it preferable to use the traditional definition.

⁴⁹See Bardi and Tracey (1991), Gardner (1991), Helper (1991), Bamford (1994), Abraham and Taylor (1996) and Bartel, Luch and Sichernan (2005) for evidence on the growth of outsourcing in various industries. *The Economist* (1991) provides an early overview.

⁵⁰Feenstra and Hanson (1996) find more than a doubling of the share of imports in total purchases of intermediates from 1972 to 1990 in the U.S. (from 5.0% to 11.6%), while Campa and Goldberg (1997) find similar trends in Canada and the U.K. And Hummels, Ishii and Yi (2001) and Yeats (2001) find that foreign trade in components has grown faster than foreign trade in final goods. Finally, Hanson, Mataloni and Slaughter (2004) find that intrafirm trade within U.S. multinationals has grown very fast, although somewhat less than international outsourcing by U.S. firms.

⁵¹Two additional decisions, which are equally important but received only scant attention, concern the types of inputs that should be acquired by means of each one of these organizational forms, and if an input is to be sourced abroad, to which country it should be offshored.

⁵²The segmentation of production across different countries has become so large, that it prompted the WTO to describe in its 1998 annual report the detailed acquisition of inputs by U.S. car manufacturers in different countries, concluding that only 37% of a car's value was generated in the U.S. Tempest (1996) describes an equally global sourcing strategy of Mattel in the manufacturing of Barbie dolls (see Feenstra (1998)).

successful matching between buyers and sellers as the main driving force of this process. In this type of environment, international trade in a world of integrated markets and no trading costs can change the incentives to integrate. Under the circumstances, trade (or 'globalization,' using McLaren's terminology) affects the tradeoff between outsourcing and integration. In particular, in the presence of economies of scale to matching, trade encourages outsourcing, and so does the removal of impediments to trade. Since Grossman and Helpman's (2002) analysis is closer in form to what we have seen in the previous section and what we shall see below, and they also show how to deal with these issues in general equilibrium, I will use their framework to illustrate this approach.

Consider an industry supplying a differentiated product, in which the demand for variety j is, as before, $x(j) = Ap(j)^{-\epsilon}$, where $\epsilon = 1/(1-\alpha) > 1$ (i.e., $0 < \alpha < 1$). The demand level A is endogenous and common to all brands. Now assume that in order to produce brand j the manufacturer of the final good needs to acquire an input that is highly specific to the brand. In the extreme case to be considered, it has to be tailor-made for brand j , and once it has been tailor-made for j it cannot be used for any other brand, nor can it be put to any other use. For simplicity, assume that one unit of the intermediate input is needed per unit of final good and that no other inputs are required once the technology for brand j has been developed and the final good producer has set up shop.

First consider a closed economy, in which the producer of brand j has two organizational options: she can produce the intermediate good inhouse or outsource it. If she produces the intermediate inhouse, she needs $1/\theta > 1$ units of labor for every unit of the tailor-made intermediate input, where θ is a measure of productivity, common to all firms. In addition, she has to bear a fixed labor cost f_V , which includes her entry cost (the entry cost covers the acquisition of the technology, the cost of setting up shop, and the like). Making the wage rate the numeraire, her optimal pricing strategy after entry is $p(j) = 1/\alpha\theta$, which generates the profit level $\pi_V(A)$, an increasing function of the demand level A .⁵³ It follows that integration is viable in a free entry equilibrium if and only if the demand level is A_V , such that the integrated firm breaks even; that is $\pi_V(A_V) = 0$. Obviously, the demand level cannot be higher than A_V , because this would induce entry of additional integrated final good producers, and if it is lower than A_V no final good producer would choose to integrate.

Next consider a final good producer who chooses to outsource. For this she needs to be matched with a supplier of the intermediate input, because inputs with her specialized needs are not readily available in the market. It is assumed that once she is matched with a supplier, they cannot sign a contract for the delivery of the brand-specific intermediate input.⁵⁴ In this event there exists a holdup problem; the supplier can choose how much of the input to produce, but

⁵³This profit level depends on the demand level A as follows:

$$\pi_V(A) = (1-\alpha)A(\alpha\theta)^{\alpha/(1-\alpha)} - f_V.$$

⁵⁴This assumption borrows from the literature of incomplete contracts; see in particular Grossman and Hart (1996) and Hart and Moore (1990).

then he has to bargain with the final good producer for payment. A specialized supplier of inputs can produce them with one unit of labor per unit output, which gives him a cost advantage over the integrated firm (which needs $1/\theta > 1$ units of labor per unit output). In the ensuing Nash bargaining the final good producer gets a fraction β of the surplus. Under the circumstances the unaffiliated supplier of the input maximizes profits by producing $A(1-\beta)^{1/(1-\alpha)}\alpha^{1/(1-\alpha)}$ units, which then sell for a price $p(j) = 1/\alpha(1-\beta)$.⁵⁵ Evidently, the distribution of the bargaining power between the two parties affects pricing and production. It also affects payoffs. At the bargaining stage the payoff of the final good producer is $\beta A(1-\beta)^{\alpha/(1-\alpha)}\alpha^{\alpha/(1-\alpha)}$ while the payoff of the intermediate good producer is $(1-\beta)A(1-\beta)^{\alpha/(1-\alpha)}\alpha^{\alpha/(1-\alpha)}$. Using these payoffs it is possible to calculate the expected profits of a final good entrant who plans to outsource and the expected profits of an intermediate good producer. These expected profits depend on the probabilities of being matched and on entry costs, in addition to the payoffs at the bargaining stage.

Let $\mu(N, M)$ be the matching function, which describes the number of matches that take place in a market with N outsourcing final good producers and M producers of intermediate inputs. This function is increasing in both arguments. Then the probability of a final good producer being matched is $\mu(N, M)/N$ and the probability of an intermediate good producer being matched is $\mu(N, M)/M$. When the matching function exhibits constant returns to scale, the former probability is $\mu(1, M/N)$ and the latter probability is $\mu(N/M, 1)$. Together with the entry and operating fixed costs of final and intermediate good producers, f_N and f_M , respectively, it is then possible to calculate the expected profits (before entry) of a final good producer who plans to outsource her input and the expected profits (before entry) of an intermediate good producer. These expected profits are functions of the demand level A and the ratio of entrants M/N , that is, $\pi_N(A, M/N)$ and $\pi_M(A, M/N)$.⁵⁶ Both expected profits are rising in A , but the final good producer's profits $\pi_N(A, M/N)$ are rising in M/N while the intermediate good producer's profits $\pi_M(A, M/N)$ are declining in M/N . Hence, there is complementarity between entry of intermediate good producers and entry of outsourcing-oriented final good producers. Other things equal, an increase in M raises the expected profits of final good producers while an increase in N raises the expected profits of intermediate good producers. It follows that more entry of one type encourage more entry of the other type.

⁵⁵The intermediate good producer can supply $y(j)$ units of the intermediate input, which will generate an output of $x(j) = y(j)$ units of the final good. Selling this output generates revenue $p(j)y(j)$, which — using the demand function $x(j) = Ap(j)^{-1/(1-\alpha)}$ — yields a revenue of $y(j)^\alpha A^{1-\alpha}$. Since he gets only a fraction $1-\beta$ of this revenue in the bargaining stage, he chooses $y(j)$ to maximize the profits

$$(1-\beta)y(j)^\alpha A^{1-\alpha} - y(j).$$

The solution to this problem yields the supply of the tailor-made input and the price of the final good in the text.

⁵⁶The resulting profit functions are

$$\begin{aligned}\pi_N(A, M/N) &= \mu(1, M/N)\beta A(1-\beta)^{\alpha/(1-\alpha)}\alpha^{\alpha/(1-\alpha)} - f_N, \\ \pi_M(A, M/N) &= (1-\alpha)\mu(N/M, 1)(1-\beta)A(1-\beta)^{\alpha/(1-\alpha)}\alpha^{\alpha/(1-\alpha)} - f_M.\end{aligned}$$

Viability of outsourcing in the resulting equilibrium requires zero expected profits for both final and intermediate good producers; that is, $\pi_N(A, M/N) = 0$ and $\pi_M(A, M/N) = 0$. The two free entry conditions are satisfied for unique values of the demand level and the ratio of entrants, say A_O and $r_O = M_O/N_O$.

Grossman and Helpman (2002) show that an integrated equilibrium always exists, but that it is not stable unless $A_V < A_O$. Namely, stability requires the demand level that ensures zero profits of integrated firms to be lower than the demand level that ensures zero profits of outsourcing final good producers and their suppliers of parts. The reason that an integrated equilibrium always exists is that, in the absence of suppliers of intermediate inputs, the final good producers' optimal strategy is to enter as integrated manufacturers; and in the absence of outsourcing final good producers the optimal strategy of intermediate good producers is not to enter. This is one consequence of the above-discussed entry complementarity. And Grossman and Helpman also show that there is no mixed equilibrium in which some final good producers insource while others outsource.⁵⁷ Finally, they show that a unique stable equilibrium exists, in which final good producers integrate when $A_V < A_O$ and outsource when $A_V > A_O$. It follows that structural features determine whether integration or outsourcing prevails.

The analysis so far has focused on the equilibrium organizational form, which does not depend on the size of the economy. Together with a resource constraint, our equilibrium conditions determine the number of entrants. The main implication is that the number of entrants rises proportionately with the size of the economy. Namely, if, say, the labor force doubles, so does the number of entrants in an integrated equilibrium, as well as in an outsourcing equilibrium. Under these circumstances the opening of trade between two countries that differ only in size, where markets are fully integrated and there are no impediments to trade, does not change the equilibrium organizational form and the number of entrants in the world economy. This is a direct consequence of the assumption that the matching function exhibits constant returns to scale.

In the absence of constant returns to scale in matching, the probabilities of a match, $\mu(N, M)/N$ and $\mu(N, M)/M$, depend not only on the ratio of entrants M/N but also on the absolute number of entrants. As a result, there is feedback from country size to organizational form. When $\mu(N, M)$ exhibits increasing returns to scale two stable equilibria can coexist: one with integration, the other with outsourcing. Moreover, in this case outsourcing is more likely the larger is the country. This implies that opening trade between two countries that differ only in size makes outsourcing more likely. In particular, it is possible to have a situation in which every country in isolation is too small to support an outsourcing equilibrium, yet by opening to trade, the integrated world sustains an outsourcing equilibrium (see also McLaren (2000)). If the outsourcing equilibrium is unique, it implies that trade changes the organization of production from integration to outsourcing. More generally, increasing returns to matching imply that market integration encourages outsourcing through the thick-market effect.⁵⁸

⁵⁷An exception is a special case in which the parameters of the economy are such that $A_V = A_O$.

⁵⁸The above described model is special in many ways. It clarifies, however, the role of market thickness in the link between trade and the organization of production. One of its stark implications is that all firms choose

One drawback of this approach is that, in an outsourcing equilibrium, international trade in intermediate inputs results from the random matches of buyers and sellers from different countries. Although the volume of trade in intermediate inputs is well determined in both directions, it is not related to a deliberate effort of final good producers in one country to seek out suppliers of parts in a different country. In other words, in this model, offshoring is not a strategic choice of business firms. The approach described in the next section makes explicit the offshoring decision and introduces a role for different degrees of contract incompleteness.

3.2 Matching in Segmented Markets

Grossman and Helpman (2003, 2005) develop a different variant of organizational choice under incomplete contracts, in which technological proximity between final good producers and suppliers of intermediate inputs plays a key role. In this model firms choose in which country to search for an outsourcing partner, and countries may differ in their degrees of contract incompleteness. These modifications introduce separate roles for variations across countries in market thickness, legal systems, and other institutional features, in determining the sourcing strategies of business firms.

To understand the basic mechanism of outsourcing in Grossman and Helpman (2003, 2005), consider a simplified version of a closed economy in which integration is not an option. An industry supplies a differentiated product with an isoelastic demand function for every brand $x(j) = Ap(j)^{-\varepsilon}$, $\varepsilon = 1/(1-\alpha) > 1$. A unit of $x(j)$ is produced with one unit of a tailor-made intermediate input that has no other uses, and it takes one unit of labor to manufacture one unit of the intermediate input by specialized suppliers of parts.

There are N final good producers, each one specializing in a different brand, and M producers of intermediate inputs. Unlike the previous model, however, in which N and M were finite numbers, now M is a finite number while N is a mass. In this formulation each supplier serves many downstream firms. The producers are all located on the circumference of a circle of length one. This circumference represents a technology space; a point in this space represents the expertise of an intermediate good producer or the expertise needed by a final good producer for her intermediate input. The finite number of intermediate good producers is symmetrically spaced at distance $1/M$ from each other, while the mass N of final good producers is uniformly distributed with density N at each point on the circumference. I will shortly discuss how these firms found themselves spaced in this way. For now, take these locations as given.

A final good producer cannot manufacture her final product without outsourcing its tailor-made input to a supplier of inputs. The cost of manufacturing an intermediate input has two parts: a variable cost of one unit of labor per unit output plus a fixed cost of customization

the same organizational form. To avoid this outcome, one can introduce heterogeneity. Thus, for example, one could divide explicitly the fixed costs into entry and operating fixed costs. By paying the fixed entry cost a final good producer would find out its productivity θ , drawn from a known distribution, as in Melitz (2003). After that the final good producer would decide whether to outsource, integrate, or leave the industry. Under these circumstances outsourcing could coexist with integration, whereby low-productivity firms outsource while high-productivity firms integrate.

to the special needs of the final good producer. The cost of customization is proportional to the distance d in technology space between the seller and buyer of the input, say wvd , where w is the wage rate and v is a cost parameter. That is, it is more costly to customize the input when the seller and buyer are far away from each other than when they are close to each other. Under the circumstances every final good producer chooses to source her input from the closest supplier, with the distance d varying between zero and $1/2M$.

It is assumed that the investment in customization has to be made by the producer of the intermediate input, and that this investment is not contractible.⁵⁹ Moreover, once a final good producer and an intermediate input supplier form a relationship, the final good producer is bound to acquire her input from this partner.

After the investment in customization, the two parties sign an *order contract*, which stipulates the production of intermediates, assembly of final goods, and the distribution of profits from sales. At this stage both parties seek to maximize joint profits, so they price the final good according to $p(j) = w/\alpha$.⁶⁰ This generates a profit π_O that is distributed according to the Nash bargaining weights, which are taken to be $1/2$ for each party.⁶¹ The profit π_O determines the incentive of the intermediate good producer to customize the input. If $\pi_O/2 \geq wvd$, the intermediate good producer is willing to customize the product, otherwise he is not, because the expected payoff does not cover investment costs.⁶²

In view of these considerations, we can calculate the aggregate post-entry profits of an intermediate input producer as the integral between $d = 0$ and $d = \pi_O/2wv$ of the flow of profits $N(\frac{1}{2}\pi_O - wvd)$, call it Π_M . And we can calculate the post-entry profits of a final good producer who finds herself at distance d from the nearest producer of intermediate inputs, call it $\Pi_N(d)$. Then the expected value of $\Pi_N(d)$, where the expectation is taken over the distance d , determines the expected pre-entry profits of a final good producer, call it Π_N . To calculate this expectation, assume that when a final good producer enters the industry she is equally likely to be located at any point on the circumference of the circle. And indeed, ex post, the final good producers are uniformly distributed in this technology space. As for the intermediate good producers, they can each choose their location in the technology space. But in the Nash equilibrium of the entry game they choose equal distances from each other. Moreover, entry of intermediate input producers proceeds until the expected profits Π_M equal the entry cost wf_M , and entry of final good producers proceeds until the expected profits Π_N equal the entry cost wf_N . These conditions together with the resource constraint then determine the equilibrium number of entrants, M and N .

Note that in this model too there is complementarity between entry of the final good and the intermediate input producers; the more entry there is of one type the more profitable is entry of the other type. This is the thick market effect.

⁵⁹We will introduce partial contractibility shortly.

⁶⁰More generally, they choose $p(j) = c/\alpha$, where c is marginal cost.

⁶¹It is not difficult to allow more general weights β and $1-\beta$.

⁶²It follows that if $1/M > \pi_O/2wv$, then there exist final good producers who cannot find suppliers for their specialized intermediate inputs, and they exit the industry. This is similar to the presence of an exit cutoff in the models discussed in Section 2. The discussion below proceeds under the assumption that this is indeed the case.

To introduce trade, Grossman and Helpman (2005) consider a two-country (North and South) world, in which final good producers enter only in North and intermediate input producers enter in both the North and the South. As in the closed economy described above, final good producers have to outsource intermediate inputs. But now they have to pay a fee for finding the location of input suppliers in the technology space, and this fee is separate for each country. Therefore, when the search costs for component suppliers are large enough, a final good producer searches in one country only, either in North or in South. This generates segmentation of input markets across countries, and introduces a deliberate decision of where to search for a supplier. This decision involves two considerations, in addition to search costs. First, wages differ across countries, making it attractive to search in the low-wage South, where higher profits can be shared. Second, the number of suppliers of parts differs across countries, making it attractive to search in the country with a larger number of suppliers, where the probability of finding a good match is higher. It follows that if search costs are the same in North and South, the outsourcing of intermediate inputs in both countries can take place only if the number of suppliers is smaller in South.

Grossman and Helpman (2005) characterize a general equilibrium of a trading world of this type and analyze its determinants. They find multiple equilibria. The positive feedback that produces multiple equilibria is the following. As more input suppliers enter a particular country, the country becomes more attractive to final good producers searching for suppliers of parts, because the suppliers are more closely packed there in technology space, making it more likely for a final good producer to find a supplier who will undertake the requisite investment in customization. Moreover, the larger the number of final good producers searching in a country, the more attractive it is for intermediate input suppliers to set up shop there. For this reason there can be one equilibrium with intermediate inputs produced in both countries, and another equilibrium with intermediate inputs produced only in North.⁶³

Focusing on an equilibrium with suppliers of parts in both countries, Grossman and Helpman (2005) show that in a world with a larger South there are more suppliers of intermediate inputs in South and fewer in North; the volume of outsourcing is larger in South and smaller in North; the volume of trade is higher relative to income; and the wage is lower in North relative to South. That is, unlike in a neoclassical world, here growth in labor of one type does not reduce its relative factor reward. In addition, uniform improvements across countries in the customization technology have no effect on the numbers of input suppliers, the volumes of outsourcing, the relative wage, or the volume of trade relative to income. But improvements in customization that are biased toward South increase the entry of parts suppliers in South, reduce their entry in North, and shift outsourcing from North to South. Moreover, such improvements in technology raise the relative wage of South and the volume of trade relative to income.

One may argue that computer-aided manufacturing and computer-aided design have reduced

⁶³In a two-country world the positive feedback is limited by a relative wage response, which stems from the fact that expanding economic activity in a country raises the demand for its labor, which raises in turn its wage relative to the wage in the other country. This general equilibrium effect limits to some extent the concentration of economic activity in one country only, despite the presence of a thick market effect.

the cost of customization. If so, then this analysis suggests that the observed patterns of outsourcing and trade expansion cannot be explained by this technological improvement alone, unless we have reason to believe that it has been particularly effective in reducing customization costs in South.

To discuss the impact of different degrees of contract incompleteness, Grossman and Helpman (2005) extend the model at the customization stage. Instead of assuming that the investment in customization is not contractible, they assume that a fraction of this investment is contractible, and that the supplier of an intermediate input and its potential buyer negotiate an *investment contract*, which specifies an upfront payment for the contractible part of the investment. As a result, there exists a range of distances d in which customization did not take place before (in the absence of contractibility), but takes place now, and this range is larger the larger the fraction of contractible investment is. It follows that contractibility enlarges the set of active matches.

This generalization has a number of implications. First, starting with no contractibility, the introduction of a positive fraction of contractible customization costs in North increases the number of suppliers of parts in North, reduces their number in South, and raises the relative wage of North. As a result, the volume of outsourcing rises in North, declines in South, and trade relative to income shrinks. Second, an improvement in contracting institutions in South, which raises the contractible fraction of customization costs there, may not expand outsourcing in South. When a significant fraction of customization costs are contractible in North but not in South, initial improvements in contractibility in South raise outsourcing there (and also in North), raise South's relative wage, and raise the trade volume relative to income. But once the fraction of contractible costs crosses a threshold, further improvements in contractibility in South reduce outsourcing there, further raise outsourcing in North, reduce the relative wage of South, and diminish the ratio of trade to income. In other words, the response to better contracting institutions in South is not monotonic, and it depends on how far the South's institutions lag behind those of North.

The analysis has so far dealt with outsourcing, where the choice is between the acquisition of intermediate inputs at home (in North) or abroad (in South). Grossman and Helpman (2003) discuss a variant of the same model in which a final good producer can either outsource or integrate, but this tradeoff is analyzed at the expense of abandoning the endogeneity of wages and the tradeoff between locating the activity in North or South. In particular, they assume that the production of intermediates takes place in South, so that intermediates are offshored, and a firm has to decide only whether to produce its intermediates in a subsidiary or acquire them at arm's-length from an unaffiliated supplier. And they assume constant wages in every country.

The tradeoff is the following. As in Grossman and Helpman (2002), an integrated firm has a cost disadvantage in producing intermediates. Therefore, while a specialized supplier of parts needs only one unit of labor per unit of intermediate input, a final good producer needs $1/\theta > 1$ units of labor per unit of intermediate input, where θ is common to all firms. But, the final

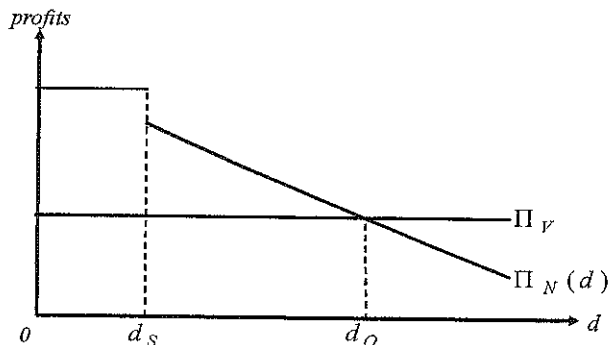


Figure 5: Choice of integration versus outsourcing depends on technological distance from input supplier

good producer has a cost advantage in customization; his customization costs are zero while a specialized supplier of parts bears customization costs wvd , which are (as before) proportional to the distance in technology space between him and the producer of the final good. As a result, a final good producer who chooses integration makes profits Π_V , which can be calculated in the usual way.

A final good producer who chooses outsourcing seeks out the closest supplier of parts in technology space, and negotiates with him an investment contract (to be followed by an order contract after customization takes place). The largest distance d that makes such a relationship viable depends on the degree of contract incompleteness: the larger the contractible fraction of the investment in customization, the larger this distance. It follows that the profits of an outsourcing final good producer depend on how far she is from the closest supplier of parts, $\Pi_N(d)$.

Figure 5 depicts the profits Π_V and $\Pi_N(d)$ as functions of the distance d . Naturally, Π_V is flat, because it does not depend on this distance. But $\Pi_N(d)$ is flat up to d_S , and declines gradually after a downward drop at d_S . The flat part results from the fact that up to distance d_S half of the profits from the order contract exceed the customization costs, in which case no investment contract is signed and the supplier of parts invests in customization. Just slightly above d_S , however, the customization costs wvd exceed half the profits from the order contract, in which case the supplier of parts does not invest in customization unless an investment contract is signed, and the equilibrium investment contract allocates the customization costs equally between the supplier and the buyer of intermediate inputs. The larger the distance between the two parties the larger the contribution of the final good producer to the customization costs

and the smaller her profits.

Under these circumstances there exists a critical distance d_O , which satisfies $\Pi_N(d_O) = \Pi_V$, such that all final good producers with $d < d_O$ prefer to outsource and all final good producers with $d > d_O$ prefer to integrate (or exit if $\Pi_N(d) < 0$). Since d is random before entry, we can use the uniform distribution of location on the circumference of the circle together with the number of intermediate good producers to calculate the expected profits of a final good producer who enters the industry. Entry proceeds until these expected profits, net of entry cost, equal zero. We can similarly calculate the free entry condition for intermediate good producers.

Grossman and Helpman (2003) analyze the prevalence of outsourcing using two measures: the fraction of final good producers who choose to outsource, and the market share of outsourcing firms. They find that outsourcing is more prevalent in larger markets, and that the thick market effect is responsible for the positive correlation between market size and the fraction of outsourcing firms and their market share. They also find that better contracting institutions in South, which render larger fractions of the customization costs contractible, increase the prevalence of outsourcing.

Analyzing the tradeoff between outsourcing at home or abroad and the tradeoff between outsourcing or integration, provides useful insights but it gives only a partial view of organizational choices. A complete analysis requires simultaneously allowing firms to choose between outsourcing and integration in every country, thereby admitting an interaction between the offshoring decision and the internalization decision. No such analysis exists for the class of models discussed in this section. It exists, however, for a different class of models to be discussed below.

3.3 Ricardian Comparative Advantage

Differences across countries in legal systems and institutions that impact the enforcement of contracts, and thereby the degree of contract incompleteness, affect patterns of comparative advantage as reflected in relative productivity levels. Nunn (2005) develops a simple model of Ricardian comparative advantage along these lines, in which the relative requirement of contract-dependent inputs varies across sectors. In his model better contracting institutions reduce costs in sectors with a larger need for contract-dependent inputs relatively more than in sectors with less need for contract-dependent inputs.⁶⁴

More importantly, Nunn (2005) provides a detailed empirical analysis of the impact of the degree of contract incompleteness on international trade flows.⁶⁵ As the main representative of the degree of contract incompleteness, he uses a measure of the rule of law, which consists of a weighted average of a number of variables that gauge the effectiveness of the judiciary, its predictability, and its enforcement of contracts.⁶⁶ He finds that the results do not change much

⁶⁴In the theoretical model the quality of contract enforcing institutions is parametrized by the probability that a court enforces a contract.

⁶⁵Levchenko (2004) makes related arguments, but I focus on Nunn (2005) because he provides the more convincing empirical evidence.

⁶⁶These variables are estimated from subjective perceptions; see Kaufmann, Kraay and Mastruzzi (2003).

when this variable is replaced with other, more objective measures of the efficacy of courts.⁶⁷ To compute an index of contract dependence for every final good sector, Nunn uses U.S. input-output tables to compute the proportion of intermediate inputs used in every final good, and he classifies intermediates into those that are traded on an organized exchange, those that have a reference price, and those that have none of these.⁶⁸ He *assumes* that a good is more contract dependent the larger is the fraction of its intermediate inputs that have no organized exchange nor a reference price, or alternatively, the larger is the fraction of its intermediate inputs that have no organized exchange only. The main empirical finding is that countries with better legal systems export relatively more in sectors that are more intensive in contract-dependent inputs. This finding is robust to controls of other determinants of trade flows, alternative specifications of the estimated equation, and alternative estimation methods. Moreover, not only has the quality of the legal systems a statistically significant impact on trade flows, it also has a large economic impact. In particular, its impact, as measured by the beta coefficient, is of similar magnitude to that of human capital and physical capital combined. In other words, contracting institutions are an important source of comparative advantage.

Acemoglu, Antràs and Helpman (2005) propose a model in which Ricardian comparative advantage emerges from the interaction of contract incompleteness with the deliberate choice of technology by final good producers. In their model, a final good producer can choose how to divide the production process, so as to have many or few tasks or intermediate inputs. Each task (or intermediate input) has to be contracted for. The supplier of the task, who can be a worker in the firm or an outside supplier, has to execute a set of activities in order to perform the task. A subset of these activities are contractible, while the others are not. The fraction of noncontractible activities provides a measure of contract incompleteness.

On the one hand, more sophisticated technologies — that involve more tasks in the production process — are more costly to acquire, and they may involve larger organizational costs (because, for example, the final good producer has to bargain with a larger number of suppliers or workers). On the other hand, more sophisticated technologies are more productive. Using this tradeoff a final good producer makes an optimal technology choice, and this choice depends on technological features of the industry and the degree of contract incompleteness. Acemoglu, Antràs and Helpman (2005) find that better contracting institutions lead to the choice of more sophisticated technologies, and that the impact of contracting institutions on technology choice is relatively larger in sectors with lower elasticities of substitution across tasks (intermediate inputs), because low substitutability makes the sector more contract dependent. As a result, countries with better contracting institutions have a relative productivity advantage, and therefore comparative advantage, in sectors with less substitutable inputs.

Costinot (2005) proposes a different model, in which contracting institutions interact with

⁶⁷These objective measure are from Djankov, La Porta, Lopez-de-Silanes and Shleifer (2003), and they are available for a smaller sample of countries.

⁶⁸The classification of inputs into those that have an organized exchange, those that have a reference price, and those that have no organized exchange and no reference price is from Rauch (1999).

technological features to create Ricardian comparative advantage. In his model every industry is characterized by a set of tasks that have to be performed, and these sets are exogenous. Industries are ordered by the complexity of their technology, which is measured by the number of tasks in their set. Workers are assigned to tasks. A worker has to spend a fixed amount of time to learn a particular task. As a result, there are increasing returns to scale in the performance of tasks. But a worker can shirk, and not perform his task. In the event of shirking no output is produced, because every task is essential. The degree of contract incompleteness is measured by the probability that a worker shirks, which is exogenous and independent across workers.

When a team of workers produces a product, it is efficient to assign every worker the same number of tasks. Given the size of the team, it is then possible to compute expected output per worker. The resulting optimal team size, which maximizes output per worker, is larger in more complex industries and in countries with better legal institutions, in which contracts are enforced with higher probabilities. In a competitive economy, better institutions raise output per worker proportionately more in more complex industries. As a result, a country with better contract-enforcing institutions gains a comparative advantage in more complex industries.

3.4 Input Intensity

In this section I introduce an additional source of variation across sectors that affects the internalization decision: input intensity. Unlike differences in factor intensity that play a key role in the factor proportions trade theory, however, what matters here is how intensive production is in the inputs that have to be provided directly by the final good producer (with no agency problems) as opposed to inputs that require the cooperation of a supplier, be it a division of the firm or an unaffiliated firm. This measure of factor intensity determines the relative importance of the two types of inputs, which impacts the power of the incentives that a final good producer wants to give the supplier. In particular, the more intensive the production process is in inputs that are not provided by the final good producer, the more powerful incentives she wants to give the supplier of parts. Yet her most desired incentives are bounded, so that she never wants to give the supplier as strong as possible or as weak as possible incentives. Under the circumstances, her choice of organizational form must consider its effect on the incentives of suppliers.

To understand the role played by this new element, consider an industry of a differentiated product in which the demand function is, as before, $x(j) = Ap(j)^{-\varepsilon}$, $\varepsilon = 1/(1 - \alpha) > 0$. Now, however, the production of brand j requires two customized inputs, headquarter services $h(j)$ and components $m(j)$, which are combined via a Cobb-Douglas production function:

$$x(j) = \theta \left[\frac{h_j(i)}{\eta} \right]^\eta \left[\frac{m(i)}{1 - \eta} \right]^{1-\eta}, \quad 0 < \eta < 1, \quad (6)$$

where θ represents productivity, which for the time being is the same for all firms in the industry, while η measures factor intensity. The larger η is the more intensive the sector is in headquarter

services (but η does not vary across firms in the industry).⁶⁹ The critical assumption is that h has to be supplied by the final good producer, while m requires the cooperation of an additional party, which can take place either inside or outside the firm, but in either case this party controls the supply of m . In this event the internalization decision is only about the intermediate input m , not about h . In a simple version of the model there is only labor and both h and m are produced with a fixed amount of labor per unit output. More generally, there can be many primary inputs, and h and m may be produced with different factor proportions.

Using the demand function $x(j) = Ap(j)^{-\epsilon}$ and the production function (6), we can calculate revenue as a function of the inputs h and m , say $R[h(j), m(j)]$. The assumption is that the final good producer bears directly the cost of headquarter services and decides the level of h , while the choice of the intermediate input m is made by its supplier, who may be working for the final good producer or be independent. Great simplification is attained by assuming that the final good producer can obtain as many suppliers as she wants by offering a reward structure consisting of an upfront payment and a share of the profits at the bargaining stage, such that a supplier's total net income (net of input cost) equals his opportunity cost, normalized to zero. At the bargaining stage the distribution of revenue $R[h(j), m(j)]$ depends on the bargaining weights, which are β for the final good producer and $1 - \beta$ for the intermediate good producer, and on organizational form, which determines every party's outside option.

Consider outsourcing. Under this organizational form the outside options at the bargaining stage are zero for both parties, because one party owns h and the other owns m , and both inputs have been customized for product j (so they have no value outside the relationship). As a result, the final good producer receives the fraction β of the revenue while the supplier receives the fraction $1 - \beta$.

Next consider integration. Now both h and m belong to the final good producer, because the supplier is her employee. But, following Grossman and Hart (1986), assume that if the bargaining fails and the supplier does not cooperate, then the final good producer cannot deploy the inputs as effectively as she can if the supplier cooperates. In particular, without the cooperation of the supplier she is able to produce only a fraction δ of the output in (6). Under the circumstances the outside option of the supplier at the bargaining stage is zero, while the outside option of the final good producer is fraction δ^α of the revenue $R[h(j), m(j)]$. As a result, in the bargaining stage the final good producer receives a fraction $\beta_V = \delta^\alpha + \beta(1 - \delta^\alpha)$ of the revenue $R[h(j), m(j)]$, and the supplier receives a fraction $1 - \beta_V$.

An important tradeoff in the choice of organizational form is derived from a comparison of the distribution shares of revenue, $R[h(j), m(j)]$, that the final good producer prefers, with the shares that arise under outsourcing and integration. Let β^* be the final good producer's most preferred share, which maximizes her profits. First note that it cannot be zero, because if it were zero she would have no incentive to provide headquarter services, and in the absence of h , revenue equals zero. Second, note that it cannot be one, because if it were one the supplier would have no incentive to provide components, and in the absence of m , revenue would equal

⁶⁹My exposition follows Antràs (2003) and Antràs and Helpman (2004).

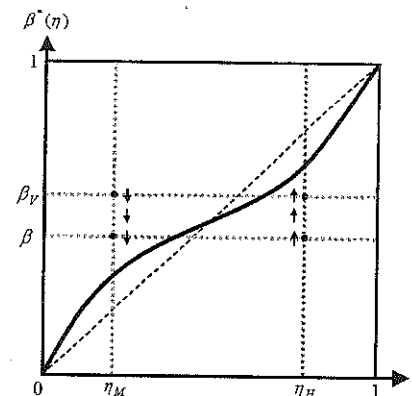


Figure 6: Optimal Bargaining Share

zero. Evidently, β^* is strictly positive and strictly smaller than one. Moreover, it is an increasing function of the intensity of headquarter services, as measured by η . The shape of the relationship is depicted in Figure 6.

The figure also shows the distribution of revenue shares under outsourcing and integration, β and β_V , respectively; they are above the optimal share β^* when an industry is component-intensive, so that η is small (such as η_M), and they are below β^* when an industry is headquarter-intensive, so that η is large (such as η_H). The arrows show the direction of rising profits; that is, profits rise when the final good producer's share shifts vertically toward β^* . In particular, there exists a cutoff η_c such that the final good producer has higher profits from outsourcing when η is below the cutoff and higher profits from integration when η is above it. It follows that, based on the power of incentives consideration alone, final good producers prefer outsourcing in component-intensive industries and integration in headquarter-intensive industries. However, the final verdict on whether to outsource or integrate does not depend on these considerations alone, because there may also be cost differences in running firms with different organizational forms.⁷⁰

Antràs (2003) uses a variant of this model, in which the power of incentives dominates the

⁷⁰Feenstra and Hanson (2005) estimate a related model of the firm from Chinese export-processing data. A plant that processes imported inputs for sales to a foreign firm can be owned either by a foreign firm or by a Chinese entity. Similarly, imported inputs for further processing can be owned by a foreign firm or by the processing plant. In the latter case the inputs are controlled by the plant's manager. The organizational form, which consists of the ownership of the plant and the ownership of the imported inputs, is determined according to the property rights approach, as in the model described in the text. Feenstra and Hanson find that the prevalence of alternative organizational forms varies across Chinese regions in accordance with the model's prediction. This is a good case study, because 55.6% of Chinese exports during the sample period, 1997 to 2002, are of this nature (i.e., export-processing), and the distribution of export-processing exports into the four organizational forms has a nonnegligible fraction in every regime.

integration decision, in order to explain the impact of differences in capital intensity on the share of intrafirm trade. He assumes that there are two inputs, capital and labor, that h is capital-intensive and m labor-intensive, and that h and m are not tradeable across borders. The last assumption implies that every final good producer has to deploy h and m in the same country. Moreover, these inputs are combined with the help of production function (6) to manufacture an intermediate input that can be freely shipped across borders, from which the final good is produced in the destination country with one unit of the input per unit output. The final goods are not traded internationally. In addition, there are fixed entry costs. Finally, consumers spend fixed budget shares on goods in every sector and they have CES preferences across brands.

In a two-country two-sector version of this model, trade structure can be derived from the integrated equilibrium, similarly to Helpman and Krugman's (1985) analysis of trade in differentiated products. Assuming that the capital-intensive sector has η above the cutoff η_c and the labor-intensive sector has η below this cutoff implies that firms are integrated in the capital-intensive sector and firms outsource in the labor-intensive sector. As a result, there is intra-firm trade in the tradeable intermediate inputs in the capital-intensive sector and arm's-length trade in tradeable intermediate inputs in the labor-intensive sector. This implies a positive correlation between capital intensity and the share of intrafirm trade. A multicountry version of this model also implies a positive correlation between the share of intrafirm imports and the capital abundance of the exporting country. Antràs (2003) provides evidence supporting these predictions. In U.S. data, intrafirm imports as a fraction of total imports are positively correlated with the capital intensity across 23 manufacturing industries, and intrafirm imports as a fraction of total imports are positively correlated with capital abundance across 28 exporting countries.

Antràs (2005) applies a one-factor variant of this model to product cycles. The two countries are North and South. He assumes that headquarter services are produced in North, and that final goods are also produced in North. But in addition to whether to integrate or outsource, a final good producer has to decide in which country to source the component m . Integration or outsourcing in North imply no trade in components, integration in South implies intrafirm trade, and outsourcing in South implies arm's-length trade. Contracts are complete in North but incomplete in South. That is, the two countries differ in the degree of contract incompleteness.

The main result is that there exist two cutoff values of the factor intensity measure, η_1 and $\eta_2 > \eta_1$ (η_1 is the critical value η_c below which firms prefer to outsource). When headquarter intensity is above the upper threshold, final good producers source m in North (the model is silent on whether they outsource or integrate there). For values between η_1 and η_2 , final good producers invest in subsidiaries in South and source m from their affiliates in South. And when headquarter intensity is below the lower cutoff, final good producers outsource in South. Interpreting η as a feature of technology that changes over time — so that it is high for a new product and it declines over time as experience in production is gained — these results imply a product cycle of the Vernon (1966) type: all parts of the value chain of a new product are produced in North, over time the production of components is shifted to subsidiaries in South,

and as the product matures the components are outsourced to Southern manufacturers.

3.5 Heterogeneity

The previously-discussed factor intensity approach can be combined with the productivity heterogeneity approach from Section 2 to generate equilibria in which all four organizational forms — insourcing at home, outsourcing at home, insourcing abroad, and outsourcing abroad — coexist in an industry. This generalization enables us to analyze what determines the relative prevalence of different organizational forms, and how they vary across industries by sectoral characteristics.

Following Antràs and Helpman (2004), assume that the production function (6) applies to a typical industry, but that the productivity level θ varies across firms. As in Melitz (2003), an entrant into the industry obtains a productivity draw θ after sinking the entry cost. After entry, and knowing her productivity, the final good producer has to decide on her organizational form.

There are two countries, North and South, with the wage rate in North — which is normalized to one — exceeding the wage rate in South. Labor is the only primary input. All final good producers are located in North, where they also produce headquarter services h . The intermediate inputs m can be produced either in North or South with the same labor input per unit output. This makes the variable costs of m lower in South. But there are different fixed costs of sourcing in North and South, and these fixed costs also differ for outsourcing and integration. In particular, Antràs and Helpman (2004) focus on the case $f_V^S > f_O^S > f_V^N > f_O^N$, where f_V^S is the fixed cost of integration in South (FDI), f_O^S is the fixed cost of outsourcing in South, f_V^N is the fixed cost of integration in North, and f_O^N is the fixed cost of outsourcing in North, all measured in terms of Northern labor.⁷¹

Under these circumstances outsourcing dominates integration in component-intensive industries, because (i) outsourcing has lower fixed cost; and (ii) for low values of η outsourcing provides better incentives to suppliers of intermediate input m (see Figure 6). It follows that in component-intensive industries all firms outsource, and the only remaining tradeoff is between domestic and foreign outsourcing. In the offshoring decision, the tradeoff is between lower variable cost in South and lower fixed cost in North. This tradeoff is depicted in Figure 7, where π_O^S represents profits from outsourcing in South and π_O^N represents profits from outsourcing in North as a function of the productivity measure $\Theta \equiv \theta^{\varepsilon-1}$. The profit line π_O^S is steeper because variable costs are lower in South. Evidently, firms with productivity below Θ_D exit the industry, high-productivity firms — with Θ above Θ_M — import components from unaffiliated producers in South, and firms with productivity between Θ_D and Θ_M acquire components from unaffiliated firms in North. That is, among the active firms low-productivity firms outsource at home and high-productivity firms outsource abroad.

A similar analysis of a headquarter-intensive sector shows that all four organizational forms can coexist. The tradeoff between outsourcing and integration in North is depicted in Figure

⁷¹They also provide a brief discussion of the implications of other orderings of fixed costs. See also Grossman, Helpman and Szeidl (2005a).

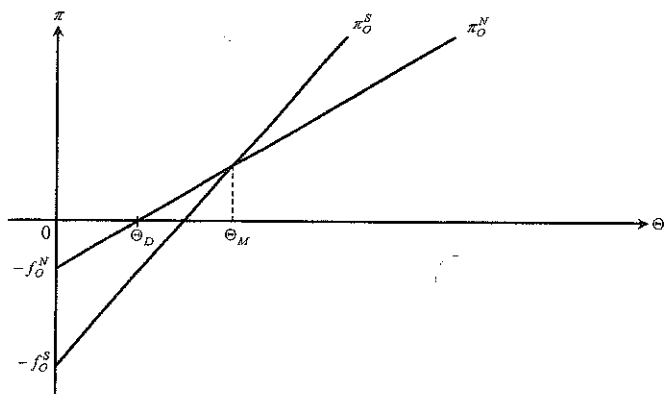


Figure 7: Importing and nonimporting firms in a component-intensive sector

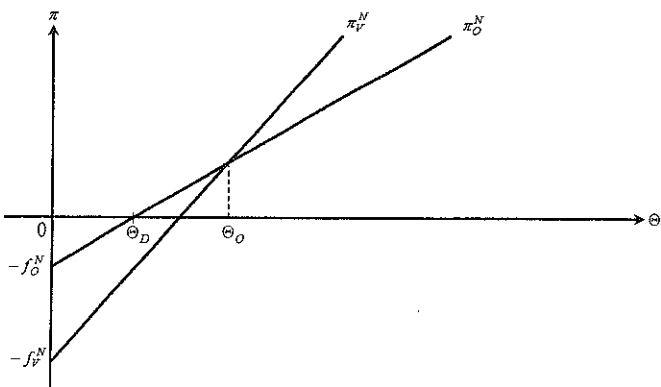


Figure 8: Insourcing and outsourcing firms in North in a headquarter-intensive sector

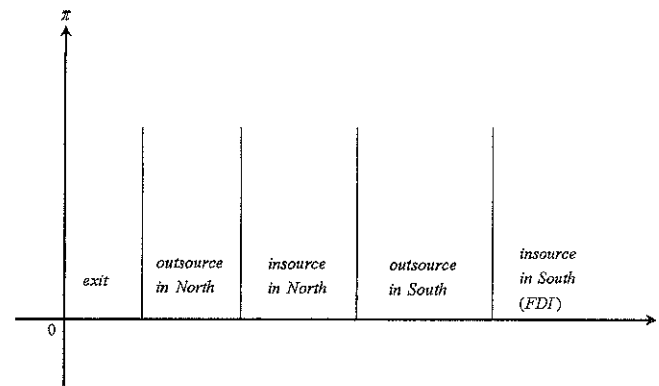


Figure 9: Sorting pattern in a headquarter-intensive sector

8, where π_V^N represents the profits of an integrated producer and π_O^N represents the profits of an outsourcing producer. The profit line π_V^N is steeper because integration in a headquarter-intensive sector provides better incentives to suppliers of parts (see Figure 6). In this case low-productivity firms — with Θ below Θ_D — exit the industry; high-productivity firms — with Θ above Θ_O — integrate; and firms with intermediate productivity levels outsource. Combining this analysis with a similar analysis of the tradeoff between outsourcing and integration in South, and accounting for the fact that offshoring has an advantage in terms of variable cost but a disadvantage in terms of fixed cost, we obtain the sorting pattern depicted in Figure 9. That is, the least-productive firms exit the industry, while the most-productive firms use FDI to produce intermediate inputs in South. In between, the less-productive firms outsource in North, the more-productive firms outsource in South, and firms with intermediate productivity levels integrate in North.

Three interesting results emerge from a comparative statics analysis. First, offshoring declines with headquarter intensity η . Second, more productivity dispersion leads to more offshoring;⁷² in component-intensive sectors it leads to more outsourcing in South while in headquarter-intensive sectors it leads to more integration plus outsourcing in South. In addition, in headquarter intensive sectors, where there is both outsourcing and integration, more productivity dispersion leads to more integration and less outsourcing. These predictions apply to variations across industries; e.g., the model predicts more offshoring in sectors with higher component intensity and sectors with more productivity dispersion. Third, an improvement in the competitive advantage of South, be it as a result of declining relative wages or declining protection in North, raises offshoring in all sectors; and in headquarter-intensive sectors,

⁷²Productivity dispersion is measured by the shape parameter of the Pareto distribution.

outsourcing of components from foreign suppliers rises proportionately more than purchases of intermediate inputs from foreign affiliates.⁷³

4 Concluding Remarks

New developments in the world economy have called for new developments in the theory of international trade and foreign directed investment, designed to better understand the shifts in trade and investment patterns and the reorganization of production across national borders. Although traditional trade theory has much to offer in explaining parts of this puzzle, such as the international fragmentation of production,⁷⁴ the theory had to be generalized in order to provide a better understanding of the new trends. Particularly acute has been the need to model different forms and degrees of involvement of business firms in foreign activities, because organizational change has been a central element in the transformation of the world economy. As a result, theoretical refinements have focused on the individual firm, studying its choices in response to its own characteristics, the nature of the industry in which it operates, and the opportunities afforded by foreign trade and investment. Important among these choices are organizational features, such as sourcing strategies.

But the theory went beyond the individual firm, studying the implications of firm behavior for the structure of an industry, and, by implication, structural differences across industries. These variations deliver new explanations for trade structure and patterns of FDI, both within and across industries. For example, they identify new sources of comparative advantage, such as the degree of heterogeneity within industries and the quality of contracting institutions.

Heterogeneity plays a key role in this literature in two ways. First, heterogeneity arises in productivity due to the efficiency differences in different firms' technologies. This is treated as exogenous; some firms are luckier than others.⁷⁵ Second, there is heterogeneity in organizational form. The two are related, however, because differences in productivity induce different choices for the organization of production and distribution. In this theory, trade and FDI patterns are jointly determined with organizational structures, such as sourcing and integration strategies.

Some implications of these models have been tested empirically. Examples include the sorting patterns of firms into exporters and foreign direct investors. Other implications have not been tested. These include patterns of sorting into outsourcing at home, integration at home, outsourcing abroad, and integration abroad, because this cannot be done with the available data sets. More generally, hypotheses that require detailed firm-level data about trade in different types of products, such as intermediate inputs versus final goods, and whether this trade takes

⁷³Grossman, Helpman and Szeidl (2005a) use a variant of this model to examine the complementarity between outsourcing and offshoring. In their model, the fraction of offshoring firms is larger the smaller the fixed cost of outsourcing. This is the sense in which offshoring is complementary to outsourcing; as the fixed cost of outsourcing changes, it generates a positive correlation between the fraction of firms that outsource and the fraction of firms that offshore.

⁷⁴See Jones (2000).

⁷⁵The empirical literature supports the view that causality goes from productivity to, say, exports, rather than the other way around; see, for example, Bernard and Jensen (1999) and Clerides, Lach and Tybout (1998).

place within the boundary of the firm or at arm's-length, cannot be examined. The theoretical models point out, however, what additional data need to be collected in order to improve the empirical analysis. Since this is still a lively area of research, we can expect to see much more theoretical and empirical work on these topics.

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