FOREIGN TRADE AND INVESTMENT:
FIRM-LEVEL PERSPECTIVES

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ABSTRACT

This Economica Coase Lecture reviews research that has revolutionized the field of international trade
and foreign direct investment. It explains the motivation behind the development of new analytical
frameworks, the nature of these frameworks, and the empirical studies that sprouted from them.

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1 Background

The field of international trade is as old as economics itself. Adam Smith discussed it in *The Wealth of Nations* (published in 1776), as did many classical economists. Yet David Ricardo is credited with the development of the first *theory* of foreign trade, based on *sectoral* comparative advantage. It postulates that the relative productivity of sectors or industries varies across countries, and this variation determines trade flows: a country exports products from sectors in which it is relatively more productive. Despite the fact that Ricardo's analysis in chapter 7 of his *Principles of Political Economy, and Taxation* (published in 1817) was designed to illustrate why countries gain from trade (as part of his campaign to abolish the Corn Laws), his insights molded scholarly thinking about trade patterns for many years to come.

Although Ricardo's notion of comparative advantage dominated the intellectual discourse on trade issues until it was replaced by the Heckscher-Ohlin theory, it had proved to be too difficult for empirical analysis. In particular, it was hard to derive from it predictions that could be tested with data. As a result, initial attempts at empirical analysis—such as Mac-Dougall (1951, 1952) and Stern (1962)—were abandoned, and seriously renewed only in 2002 with the publication of Eaton and Kortum's stochastic approach to Ricardian comparative advantage. Unlike earlier articulations, their approach is well suited for quantitative explorations.

In 1919 Eli Heckscher published his famous paper "The Effect of Foreign Trade on the Distribution of Income," which became available to English-language readers in its full form only in 1991 (see Heckscher 1919). On top of providing an elegant and deep verbal analysis of the effects of trade on factor rewards, Heckscher's contribution laid the foundations for the factor proportions theory. In a doctoral dissertation, his former student Bertil Ohlin integrated these insights into a Walrasian equilibrium system (see Ohlin 1924), and further elaborated the theory in a pathbreaking book *Interregional and International Trade* (see Ohlin 1933). According to this view, countries that have access to the same technologies,

and therefore the same sectoral productivity levels, trade with each other as a result of differences in factor endowments: a country exports products that are relatively intensive in inputs with which it is relatively well endowed. Land-rich countries export land-intensive products, capital-rich countries export capital-intensive products, and labor-rich countries export labor-intensive products. Similarly to Ricardo, the Heckscher-Ohlin approach focuses on sectors. Some sectors, such as chemicals, are capital intensive; other sectors, such as agriculture, are land intensive; and still other sectors, such as clothing, are labor intensive.

Following its elaboration by Samuelson (1948), Jones (1965) and others, this theory dominated the thinking on trade issues for most of the 20th century. Nevertheless, many years passed before empirical studies that carefully built on the theory emerged. Leontief (1953) triggered a controversy that stimulated "tests" of the Heckscher-Ohlin theory, while Leamer (2004) provided the first comprehensive analysis of sectoral trade flows for a large number of countries, multiple sectors and multiple inputs, using insights from the theory. Yet only in 1987 did Bowen, Leamer and Sveikauskos develop proper tests of the theory, using measures of its three essential elements: sectoral trade flows, sectoral factor intensities, and factor endowments. These tests were based on Vanek's (1968) derivation of the theory's implications for the factor content of sectoral trade flows, and the news was not good: the data rejected the theory. More charitable evaluations of Eli Heckscher's and Bertil Ohlin's insights were later provided by Trefler (1995), while improvements and elaborations of Trefler's approach were further developed by Davis and Weinstein (2001). As a result, the belief that factor proportions are important in shaping world trade has been restored.

The 1987 empirical challenge to the Heckscher-Ohlin theory was preceded by another empirical challenge that changed trade theory forever. In 1975, Herbert Grubel and Peter Lloyd published a book entitled *Intra-Industry Trade: The Theory and Measurement of International Trade in Differentiated Products*, in which they pointed out that the phenomenon of *intraindustry* trade is widespread, where intraindustry trade refers to the exchange of products within the same sectors. France, for example, exported chemical products to

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Germany and imported chemical products from Germany; France also exported clothing to Germany and imported clothing from Germany; and so on across most manufacturing industries. Grubel and Lloyd devised an index to measure the *share* of intraindustry trade, and reported that in most industrial countries this share exceeded one half. That is, the majority of trade in manufactures was intraindustry, while the dominant theory of the time—Heckscher-Ohlin—was about *intersectoral* trade flows, e.g., exports of chemical products in exchange for clothing. This finding has not changed over the years. In 2002 the OECD reported that the average share of intraindustry trade in 1996-2000 was 77.5% in France, 72% in Germany, and 68.5% in the United States. In Australia it was smaller, only 30%, yet large enough to shed doubt on the pure intersectoral view of foreign trade.

Another observation that triggered a rethinking of the intersectoral view of trade was that much of trade took place among countries at similar levels of development, and particularly among the rich countries. Both Ricardo and Heckscher and Ohlin emphasized cross-country differences as drivers of trade flows, while trade appeared to be predominately among countries that differed relatively little from each other. This too has not changed over time. In 2006 the WTO reported that out of close to 1.5 trillion dollars worth of manufacturing exports from North America in 2005, more than 800 billion were to North America and more than 200 billion were to Europe. At the same time European countries exported more than 4 trillion dollars worth of manufactures, more than 3 trillion dollars of which were to Europe and close to 400 billion to North America.

These observations, together with theoretical developments in the analysis of monopolistic competition, brought about a revolution in trade theory. New models of foreign trade were developed, with the explicit aim of incorporating intraindustry trade and large trade volumes among similar countries. Lancaster (1979, ch. 10) and Krugman (1979) were the first to develop such models, in which industries are populated by firms that produce differentiated products, each firm has its own variety, and firms sell their brands in both domestic and foreign markets. Because variety is desirable in every country, specialization in different

brands of the same good leads to intraindustry trade and to trade among countries that are similar to each other. These formal models used building blocks that were informally discussed in Balassa (1967), who studied the European Common Market and tried to provide a rationale for why much of the adjustment to the integration process took place *within* rather than across industries.

While the initial models of trade and monopolistic competition disregarded traditional forces of comparative advantage, subsequent research integrated the factor proportions view of intersectoral trade with the monopolistic competition view of intraindustry trade (see particularly Dixit and Norman 1980, Lancaster 1980, Helpman 1981 and Krugman 1981). The resulting theory is rich (see Helpman and Krugman 1985), it found many applications (including in endogenous growth theory; see Grossman and Helpman 1991), and it has ramifications that were empirically examined (see Helpman 2011, ch. 4, for a review). All in all it was a big success, yet a new challenge was quick to emerge.

2 Challenge and Response

Models of international trade under monopolistic competition, in contrast to neoclassical trade models, designated a central role to individual firms. Firms made decisions to enter an industry, invested in R&D in order to develop new products, acquired subsidiaries in foreign countries, and priced their products as profitably as they could. These decisions determined variety choice, trade patterns, trade volumes, shares of intraindustry trade, and the dynamic evolution of industries (see Helpman and Krugman 1985, and Grossman and Helpman 1991). Yet despite these tremendous advances, the theory retained a focus on sectoral outcomes. Within a sector, firms were treated symmetrically: they had the same technologies (even when they produced different brands), they employed the same composition of inputs, and they priced their products similarly. As a result, sectoral outcomes were a manifold of firm-level outcomes, with the exception of some studies of multinational corporations in which

domestic firms coexisted with multinationals in the same industry (e.g., Helpman 1984).

Led by Bernard and Jensen (1995, 1999), the examination of new data sets that became available in the 1990s posed a challenge to the symmetry assumption within sectors, with wide-reaching consequences. In models of monopolistic competition that were developed in the 1980s, the symmetry assumption was used for convenience, because heterogeneity within sectors was not essential for addressing the main questions for which those models were designed. What the new data sets revealed, however, was that the lens of a "representative firm" was more restrictive than previously appreciated. In particular, it turned out that in a typical industry only a small fraction of firms export and that these firms do not constitute a random sample. Exporters are larger and more productive than nonexporters, foreign markets are disproportionately served by large exporters, and exporters pay higher wages. In other words, there is a systematic relationship between the characteristics of firms and their engagement in foreign trade. According to the WTO (2008), 18% of U.S. firms in the manufacturing sector exported in 2002, 17.6% exported in France in 1986, and 20% exported in Japan in 2000. In U.S. manufacturing, the top 10% of firms by size contributed 96% of the exports in 2002, in France the top 10% contributed 84% of the exports in 2003, and in the U.K. the top 10% contributed 80% of the exports in 2003.

Similarly to Balassa (1967), studies of the new data sets found substantial reallocations *within* sectors in response to trade liberalization. Two of the responses are particularly striking. On one hand, some of the least productive firms leave their industries (see Clerides, Lach and Tybout 1998 for Colombia, Mexico and Morocco; Bernard and Jensen 1999 for the U.S.; and Aw, Chung and Roberts 2000 for Taiwan). On the other hand, market shares are reallocated from less to more productive firms (see Pavcnik 2002 for Chile; Trefler 2004 for Canada; and Bernard, Jensen and Schott 2006 for the U.S.). Evidently, international trade and firm heterogeneity are intimately related. What drives this relationship? And what are its consequences?

Melitz (2003) started a revolution in trade theory by designing an analytical framework

with heterogeneous firms (an extension of the basic one-sector model of monopolistic competition) that is consistent with most of the empirical regularities outlined above. Although Bernard, Eaton, Jensen and Kortum (2003) also proposed a model with the same aim in mind, the Melitz model proved to be more durable and more useful for addressing a host of issues (to be discussed below).

In the Melitz model firms produce varieties of a differentiated product. Unlike Krugman (1979) and Lancaster (1979), however, a firm that enters an industry does not know the total factor productivity (TFP) of its technology. Instead, similarly to Hopenhayn (1992), it knows the distribution from which its productivity draw will be realized. After sinking the entry cost, a firm learns its productivity level. Since it has to bear a fixed cost of operation, a firm stays in business only if its operating profits are high enough to cover this fixed cost. Entry proceeds until expected profits cover the entry cost, so that ex-ante all entrants break even.

In an open economy a firm can derive profits from domestic and foreign sales, but it faces variable and destination-specific fixed costs of exporting. As a result, a firm exports only if operating profits in a destination market are large enough to cover the fixed cost of exporting. In equilibrium some firms remain in the industry, serving only the domestic market, while other firms sell at home and abroad. The model provides a characterization of firms that sort into each one of these organizational forms: that is, firms that stay in the industry after sinking the entry cost, and, among those who stay, firms that export. Since firms vary by realized TFP only, the result is that the least productive firms do not stay in business, while the most productive firms export. Firms with intermediate productivity serve only the domestic market, while exporters serve the domestic market too.

A remarkable property of this analytical framework is that it replicates the pattern of response to trade liberalization observed in the data. That is, a multilateral reduction in trade costs drives some of the least productive firms out of the industry and leads to a reallocation of market shares from less to more productive firms (exporters), consistent

with the evidence. By weeding out the least productive firms and raising the weight of high-productivity firms in the industry, trade liberalization raises the sector's *average* productivity.

Can these productivity gains be substantial? The answer is that they can be and they were in Canada after the implementation of its free trade agreement with the United State in 1989. Trefler (2004) and Lileeva and Trefler (2010) provide estimates that are summarized in Melitz and Trefler (2012). According to these estimates, market share reallocations raised manufacturing productivity by 4.1%, while exit of the least productive plants raised productivity by an additional 4.3%. In other words, the efficiency of Canadian manufacturing improved by 8.4% on account of these adjustments. An additional gain of 4.9% was realized through productivity-enhancing investments (a mechanism that also played an important role in Argentina after the formation of MERCOSUR in 1991, a free trade agreement between Argentina, Brazil, Paraguay, Uruguay, and Venezuela; see Bustos 2011). In Canada, 3.5% out of the 4.9% was attained as a result of productivity-enhancing investments by new exporters, i.e., firms that did not export prior to the free trade agreement but started to export after its implementation. And 1.4% was attained as a result of investments of existing exporters. Bustos (2011) showed analytically that in the Melitz model the incentive to invest in better technologies is largest among the most productive *non*exporters, who find it profitable to become exporters in the aftermath of trade liberalization.

The extent to which productivity gains from exit of the least productive firms and market share reallocations towards more productive firms shape *welfare* gains from trade liberalization has been the subject of a recent controversy. Arkolakis, Costinot and Rodríguez-Clare (2012) have argued that one can disregard these productivity changes. To justify this claim they show that in a class of models—which includes the basic Melitz model with Pareto distributed productivity—the percentage increase in welfare as a result of changes in variable trade costs equals the percentage decline in the share of a country's spending on its own goods raised to a positive power that equals the elasticity of trade with respect to variable trade costs. According to this view, all we need are estimates of the trade elasticity and the

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percentage decline (rise) in the share of spending on own goods in order to gauge welfare changes, because the same formula applies to economies with or without firm heterogeneity. For this reason details of the within-industry reallocations that change productivity are not relevant for welfare analysis. Finally, an extension of the argument to many sectors brings out the need to also assess the response of intersectoral resource allocation to trade liberalization, and whether inputs move into sectors with large or small declines in the share of spending on own goods and sectors with large or small elasticities of substitution.

While the analysis of Arkolakis, Costinot and Rodríguez-Clare is elegant and useful, their interpretation of the welfare formula is quite misleading. The reason is that the response of the share of spending on own goods to trade liberalization depends on whether the economy is of the Melitz type or whether firms within the sectors are all alike. This is particularly relevant for attempts to quantify welfare changes by means of calibration, where the choice of parameters has to place alternative economic environments on the same footing. For example, if one calibrates two models—one model with and the other without firm heterogeneity—to data of a country that is already engaged in foreign trade, then to match the same data the required parameters will differ across models. Under these circumstances, comparisons across models are not very instructive. Melitz and Redding (2013a) provide a detailed discussion of the shortcomings of this type of analysis. They show, for example, that if one calibrates these two models—one with firm heterogeneity and the other without it—to generate the same outcomes in autarky, including the same average productivity within the sector, then the opening of trade always yields higher welfare gains in the environment with firm heterogeneity, in which average productivity rises with trade, than in the environment with symmetric firms, in which productivity does not change.

A particularly interesting quantitative analysis that sheds light on these issues is provided by Balistreri, Hillberry and Rutherford (2011). They use a computable general equilibrium model of the world economy, consisting of 12 countries (some of which are regions), to assess the impact of a halving of tariffs on manufactures. Since tariffs on manufactures are low,

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this entails a reduction of about 5% in variable trade costs. In carrying out the analysis, Balistreri, Hillberry and Rutherford consider two alternative versions of the manufacturing sector: in one version firms are symmetric, in the other they are heterogeneous. But in both cases the average productivity of manufactures is the same. What they find is that the unweighted mean of the welfare gain from cutting tariffs by half is about four times higher (in percentage terms) when firms are heterogeneous. Evidently, economic structure makes a big difference for policy analysis.

Bernard, Redding and Schott (2007) point out an important implication of an extended version of the Melitz model. They construct a two-country, two-sector, two-factor version, in line with the Heckscher-Ohlin view of factor proportions. Allowing for heterogeneity in both sectors, they show that trade raises productivity in each of them. However, productivity rises relatively more in the sector with comparative advantage; namely, in the sector that uses relatively intensively the input with which the country is well endowed. Under the circumstances trade raises productivity relatively more in the labor-intensive sector in the country that has relatively more workers, and it raises productivity relatively more in the capital-intensive sector in the country that has relatively more capital. Since the former country exports labor-intensive products on net and the latter exports capital-intensive products on net (while both countries export varieties of both types of goods), it follows that productivity rises proportionately more in the export sector. The implication is that factor proportions induce (endogenously) Ricardian-type comparative advantage, leading to a structure of trade that combines Ricardian and Heckscher-Ohlin forces.

Firm heterogeneity has also been used by Helpman, Melitz and Rubinstein (2008) to devise an estimation method that achieves three objectives: (i) accounts for the lack of trade among many country pairs; (ii) enables separate estimation of the intensive and extensive margins of trade; and (iii) corrects for selection bias. To achieve these aims, Helpman, Melitz and Rubinstein construct a many-country version of the Melitz model, allowing for a variety of asymmetries across countries, such as differences in fixed and variable trade costs. They

use this analytical model to derive a generalized gravity equation for trade flows, as well as an equation for trade participation. Since trade participation depends on the fixed cost of exporting, while the volume of exports—conditional on exporting—does not, the system provides a natural way to correct for selection bias in estimating trade flows. This bias emanates from the fact that only the most productive firms select into exporting. Moreover, the participation equation can be used to identify the extensive margin of trade, which results from variation in the number of firms that choose to export. Finally, this equation accounts in a natural way for the lack of exports from a country to some potential trade partners for which the fixed trade cost may be too high to make such exports profitable. Many of the issues discussed in this section are further elaborated in Melitz and Redding (2013b).

3 Unemployment and Inequality

Labor market frictions are widespread. They differ across countries as a result of differences in hiring and firing practices, the effectiveness of labor markets, and government policies such as unemployment insurance. As a result, rates of unemployment vary across countries and in a trading world they are interdependent. In particular, a country's rate of unemployment depends on the labor market frictions of its trade partners in addition to its own labor market frictions. Because such frictions make room for rent-sharing between employers and employees, they also impact wages and inequality of earnings.

3.1 Unemployment

Past research on trade and unemployment focused on minimum wage constraints as frictions in the labor market (see Brecher 1974 and Davis 1998), although other frictions—such as efficiency wages (see Copeland 1989) and search and matching (see Davidson, Martin and Matusz 1999)—were also analyzed. Apart from these frictions, those studies employed neoclassical frameworks to examine the impact of trade on unemployment. More recently,

trade and unemployment have been jointly studied for economies with firm heterogeneity and monopolistic competition.

Helpman and Itskhoki (2010) developed a framework in which there is a traditional homogeneous sector and a sector that produces varieties of a differentiated product. The former sector is competitive in the product market, the latter engages in monopolistic competition. In both sectors there is search and matching in the labor market.

In the general equilibrium of a two-country world, Helpman and Itskhoki show how differences in labor market frictions generate comparative advantage. In particular, the country that has lower labor market frictions in the differentiated sector relative to the homogeneous sector exports differentiated products on net. A sufficient statistic for these frictions is the resulting cost of hiring, which can differ across sectors and countries. They also show that both countries gain from trade, independently of the impact of trade on unemployment.

Tracing the impact of trade on unemployment reveals complicated patterns. Trade may, for example, increase or reduce the level of unemployment. And moreover, reductions of variable trade costs can impact unemployment in a nonmonotonic fashion. Particularly important is the finding that a reduction in one country's labor market frictions in the differentiated sector raises its welfare but hurts the trade partner. On the other hand, there exist coordinated reductions in labor market frictions in both countries that benefit both.

Due to multiple distortions, multiple policies are needed to raise welfare substantially or to attain *constrained* Pareto efficiency. For example, using unemployment insurance as a single policy tool is beneficial in some circumstances but harmful in others (see Helpman, Itskhoki and Redding 2011). And when unemployment insurance is beneficial, there exists an optimal level that maximizes welfare.

Unemployment insurance may or may not be part of a policy package that achieves constrained Pareto efficiency. To be sure, some intervention in the labor market is needed to secure the Hosios (1990) condition (for the relationship between the elasticities of the match-

ing function and the relative bargaining power of workers), which has to be satisfied in a constrained Pareto-efficient equilibrium. Yet this cannot always be achieved with unemployment insurance, because in some circumstances a tax rather than a subsidy to hiring costs is required. Other policies to achieve this efficiency include subsidizing the output of differentiated products (to correct for markup pricing) and subsidizing equally (in percentage terms) the fixed costs of operating and exporting. As a rule, optimal policies do not discriminate between exporting and domestic activities.

3.2 Inequality

Research concerning the impact of trade on wage inequality was traditionally focused on the relative wages of workers with different skills or workers employed in different sectors and occupations. Much of this work resorted to differences in factor intensities across sectors to transmit international prices into factor rewards. As a result, when the college wage premium almost doubled in the United Sates between the late 1970s and the early 1990s, scholars first examined whether this development could be explained by globalization, and in particular by the increased participation of less developed countries in world trade (see Helpman 2004, ch. 6, for a summary of this literature and for references). The tentative answer was that trade can explain a fraction of the increased gap in relative wages, but that most of it was due to skill-biased technical change. This conclusion was strengthened by studies that showed rising relative wages of skilled workers across the board, in developed and less developing countries alike (see also Goldberg and Pavcnik 2007).

While wage inequality across skill groups has increased to some extent, changes in the return to observed skills—such as education—account for a small fraction of the rise in *overall* wage inequality. The majority of the rise in wage inequality was due to the rise in *residual* wage inequality, which represents differences in the wages of workers with similar characteristics. In addition, wage dispersion across firms and plants has been identified as an important source of wage variation (see Helpman, Itskhoki, Muendler and Redding 2013).

To illustrate, in 1994 residual wage inequality accounted for 59% of the overall inequality of wages in Brazilian manufacturing, with 89% of this variation due to differences in wages within sector-occupation cells (see Helpman, Itskhoki, Muendler and Redding 2013, Table 4). In Sweden residual wage inequality accounted for 70% of the overall wage inequality in manufacturing in 2001, with 83% of the variation due to wage differences within sector-occupation cells (see Akerman, Helpman, Itskhoki, Muendler and Redding 2013, Table 3). Evidently, residual wage inequality is large in both these countries, which differ greatly from each other in other dimensions. Moreover, in each of them the contribution of worker observable characteristics to wage inequality is smaller than the contribution within sectors of firm-specific components of wage variation (although the latter is significantly smaller in Sweden than in Brazil).

Helpman, Itskhoki and Redding (2010) developed a theoretical model in which residual wage inequality is affected by foreign trade. In their model heterogeneous firms select into exporting on the basis of total factor productivity. Workers search for jobs and firms post vacancies. But while workers are ex-ante identical, a worker's match with a job generates a random productivity outcome. This outcome is not observable, yet firms can invest in screening to identify workers with a productivity level above an endogenously chosen threshold. Since screening is costly, involving a fixed cost that rises with the threshold's level, more productive firms screen to a higher productivity cutoff and therefore employ a better composition of workers. As a result, wage bargaining leads to higher wages being paid by more productive firms. Under the circumstances more productive firms are larger, employ better workers, pay higher wages, and the most productive among them export, all in line with the evidence.

A major implication of this model is that lowering trade costs raises residual wage inequality when trade costs are high and reduces residual wage inequality when trade costs are low. In other words, the relationship between trade frictions and wage inequality has an inverted-U shape.

Adding heterogeneity to screening costs and fixed export costs, Helpman, Itskhoki, Muendler and Redding (2013) show how this analytical framework can be used to derive an econometric model that consists of three equations: for employment, wages, and selection into exporting. Assuming a joint log normal distribution of the three sources of firm heterogeneity yields a likelihood function. Using this likelihood function, they estimate the econometric model on a large matched employer-employee data set from Brazilian manufacturing. The estimated model generates first and second moments of the distribution of employment and wages (where the latter consists of firm-specific components) that closely approximate moments in the data. In addition, the estimated model generates an inverted-U-shaped relationship between trade frictions and wage inequality, as predicted by the theory.

In this framework trade affects residual wage inequality. To gauge how large these effects might be, Helpman, Itskhoki, Muendler and Redding examine counterfactual scenarios. They find, for example, that in 1994 Brazilian wage inequality due to firm-specific components—where wage inequality is measured by the standard deviation of log wages—was about 7.6% higher than it would have been in autarky. This is roughly the largest gap in inequality that trade can generate when fixed export costs vary between zero and infinity.

4   Multinational Corporations

By refocusing the analysis from sectors to firms, recent research has also improved our understanding of the role of multinational corporations (MNCs) in global supply chains. These companies are very large and they play dominant roles in production, employment and foreign trade. To illustrate, according to the most recent benchmark survey of the U.S. Bureau of Economic Analysis (BEA), in 2009 the combined value added of U.S. parents of multinationals and their majority-owned affiliates exceeded 3.5 trillion dollars and they employed close to 40 million workers (see Barefoot and Mataloni 2011). MNC-associated U.S. exports of goods were 578 billion dollars, close to 55% of total U.S. exports of goods.

Of these exports, 209 billion were intrafirm (i.e., intra-MNC). At the same time, MNC-associated imports were 703 billion dollars, accounting for 45% of U.S. imports, of which 222 billion were intrafirm. In the manufacturing sector, foreign affiliates of these companies sold large fractions of output in the host countries, but they also exported some of it to the U.S. and to other countries. In 2009 host-country sales amounted to 55% of total sales, 11% were to the U.S., and 34% were to other foreign countries.

Affiliates of foreign multinationals are important enterprises in the economies of many countries. Because they are bigger than domestic firms, their shares in employment, sales and exports far exceed their relative number. According to the OECD (2010), in 2006-2007 the share of foreign affiliates in manufacturing employment exceeded 40% in Ireland, the Slovak Republic, the Czech Republic, Estonia and Luxembourg. But even in countries with low employment shares, such as the U.S., Switzerland and Israel, these shares were in excess of 10%. Moreover, foreign affiliates in Poland, Sweden, Finland, Israel and Estonia exported more than half of their turnover (a measure of revenue). And in countries with low export propensities, this share remained significant: 10.5% in the U.S., 25.3% in Japan, 36.3% in Italy, and 38.2% in France. Antràs and Yeaple (2013) provide more evidence on the sway of multinational corporations in the world economy.

Dunning (1977) developed the "OLI" approach to multinational corporations, arguing that in order to acquire foreign subsidiaries firms need three types of advantages: in Ownership, Location, and Internalization. This informal approach was later replaced with more detailed modelling of MNCs, including their decisions to engage in horizontal FDI, vertical FDI, and complex integration strategies. In this classification, horizontal FDI concerns situations in which a firm acquires a foreign subsidiary in order to serve the host country market; vertical FDI concerns situations in which a firm acquires a foreign subsidiary in order to produce intermediate inputs for its own use; and complex integration strategies concern situations in which decisions to serve a foreign market via subsidiary sales are reliant on vertical FDI (possibly in a different country) that imparts cheap inputs. The latter may involve

platform FDI, where these inputs are exported to multiple subsidiaries, the parent firm, or at arm's-length to nonaffiliated parties. As pointed out above, U.S. manufacturing subsidiaries tend to sell a substantial share of their output in the host country's market, but they also export to other countries and to the U.S. (see Yeaple 2003; Grossman, Helpman and Szeidl 2006; Ekholm, Forslid and Markusen 2007; and Helpman 2011, ch. 6, for a discussion of these issues).

Pure horizontal FDI is considered to arise from a tradeoff between proximity and concentration. A firm that serves a foreign market with exports bears export costs, but saves the cost of acquiring a subsidiary abroad. On the other side, a firm that serves a foreign market with subsidiary sales bears the cost of the subsidiary, but saves on export costs. Hence the proximity-concentration tradeoff (see Markusen 1984). Brainard (1997) provides evidence in support of this tradeoff.

Helpman, Melitz and Yeaple (2004) introduced firm heterogeneity into the proximity-concentration tradeoff framework. They show that, in line with the evidence, this model implies that among firms that stay in an industry the least productive serve only the domestic market, the most productive serve foreign markets via subsidiary sales, and firms with intermediate productivity levels serve foreign markets with exports. In 1996, the labor productivity of U.S. multinationals was about 15% larger than the labor productivity of exporters, which was in turn about 40% larger than the labor productivity of purely domestic firms. But this pecking order was also found in other countries: in Japan (see Head and Ries 2003, and Tomiura 2007), Ireland (see Girma, Görg and Strobl 2004), and the U.K. (see Girma, Kneller and Pisu 2005). Moreover, Helpman, Melitz and Yeaple show analytically that in this case the ratio of exports to subsidiary sales depends not only on the tradeoff between proximity and concentration, but also on the degree of firm heterogeneity. Using U.S. firm-level data they confirm the model's predictions: exports relative to subsidiary sales are higher in sectors with lower trade costs and higher fixed costs of FDI, and they are lower in sectors with more productivity dispersion. Furthermore, all these effects are

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quantitatively of comparable size. Evidently, firm heterogeneity is a significant source of comparative advantage. These findings are further confirmed by Yeaple (2009) with a more detailed analysis.

Pure vertical FDI lowers the cost of producing intermediate inputs, mostly due to low wages in the host country (see Helpman 1984). Availability of sites with low manufacturing costs encourages vertical FDI, but only in situations in which the cost of fragmentation of production is not too high. Developments in computer-aided design and computer-aided manufacturing, as well as other IT technologies, have substantially reduced the cost of fragmentation since 1980, leading to rapid expansion of cross-country vertical links, both at arm's-length and via integration (see Antràs and Yeaple 2013). These developments raised again the question posed by Coase (1937): What are the boundaries of the firm? Except that in this context the relevant boundaries include multinationality. To understand the complex supply chains that have emerged in the decades since 1980, it is necessary to understand the tradeoffs between outsourcing and integration on one hand, and between domestic and offshore sourcing on the other.

Although a number of alternative approaches to the organization of firms have been examined in the literature (e.g., Grossman and Helpman 2004, Marin and Verdier 2012), the theory of incomplete contracts—as developed by Grossman and Hart (1986) and Hart and Moore (1990)—has yielded the most durable insights about the endogenous choice concerning the make-or-buy decision (in the older literature on multinationals this choice was exogenous). In a seminal paper, Antràs (2003) developed a model of international trade in which incomplete contracts govern the tradeoff between outsourcing and integration. Because incomplete contracts lead to underinvestment by the final good producer and the supplier of intermediate inputs, his model predicts that final good producers choose integration in headquarter-intensive sectors (in which underinvestment in headquarters is particularly important) and outsourcing in component-intensive sectors (in which underinvestment in components is particularly important). Since integration includes FDI, the model predicts

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intrafirm foreign trade in headquarter-intensive sectors and arms'-length trade in component-intensive sectors. Assuming that capital intensity is synonymous with headquarter intensity, he finds in U.S. data a positive correlation across sectors between the fraction of intrafirm trade and headquarter intensity. He also finds a positive correlation between an exporting country's capital abundance and its share of intrafirm exports to the U.S., in line with the model's prediction.

Antràs and Helpman (2004) introduced firm heterogeneity into a trade model with incomplete contracts. In this framework firms sort into alternative organizational forms based on total factor productivity. Among the firms that stay in an industry, the most productive offshore while the least productive serve the home market only. Among the domestic firms the most productive integrate while the least productive outsource. And similarly, among firms that serve foreign markets the most productive integrate (i.e., acquire subsidiaries to produce intermediate inputs) while the least productive outsource (i.e., purchase intermediates from nonaffiliated foreign companies). This pecking order is based on the assumption that fixed costs of operating abroad are higher than fixed costs of operating at home and fixed costs of integration are higher than fixed costs of outsourcing. Firm-level evidence from Japan, France and Spain is consistent with the prediction that multinationals are more productive than firms that outsource intermediate inputs offshore (see Tomiura 2007; Corcos, Irac, Mion and Verdier 2013; and Kohler and Smolka 2012; respectively). But the evidence from Spain is inconsistent with the prediction that the latter-type firms are more productive than domestic integrated companies.

The model also predicts that the share of intrafirm trade should be larger in sectors with higher headquarter intensity and larger productivity dispersion. For the former prediction there is evidence from the U.S., using capital intensity, R&D intensity, and specialized equipment intensity as proxies for headquarter intensity (see Yeaple 2006, Nunn and Trefler 2008, and Nunn and Trefler 2013). For the latter prediction there is also evidence from the U.S., using a variety of measures of productivity dispersion (see Yeaple 2006, Nunn and Trefler

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2008, and Nunn and Trefler 2013). Additional tests of predictions from Antràs and Helpman (2004, 2008) concerning variation in contractibility across sectors and countries are discussed in Antràs and Yeaple (2013).

5 Concluding Comments

The field of international trade has undergone two major revolutions in the last three decades: first by integrating product differentiation and monopolistic competition into its mainstream, second by expanding the integrated framework to accommodate firm heterogeneity. As a result, the focus has shifted from a sectoral view of trade and foreign direct investment to a firm-based perspective. This has greatly enriched the analytical framework, making it both more suitable for addressing a host of questions that became paramount for understanding globalization and also more suitable for empirical analysis with the newly available rich data sets. We now have better tools for studying the complex web of trade flows and foreign direct investment, including the boundaries of international firms and global supply chains. And we have better tools for studying the impact of international trade on unemployment and inequality, two facets of globalization that have raised many concerns.

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